Hidden Style in the City: An Analysis of Geolocated Airbnb Rental Images in Ten Major Cities

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ABSTRACT

In this article, we analyze geolocated Airbnb rental images in ten major cities. Airbnb is a hallmark institution in the sharing economy, allowing anyone with a bed and shelter to act like a micro-hotel, i.e. a bed-and-breakfast for other travelers. Travelers often spend less on Airbnb rentals than hotels and get a residential experience in a new place.

Since hosts advertise their rentals on Airbnb, the site has a wealth of residential interior images from all over the world: from rural Africa to downtown Manhattan. As part of an ongoing project, we have downloaded over 200,000 images posted on Airbnb to ask: how do people decorate their homes in different locales? Do they use certain colors, or have a certain ornate or simple style?

Here, we test ten major metropolitan areas using image rating responses from Mechanical Turk as well as automated image color predominance routines to investigate geographical differences in interior styles. We find overarching indicators of globalization and a lack of local culture in the case of color, but that different neighborhoods within cities have different levels or ornateness when decorating their properties. The results of this research can also help to identify the kinds of interiors that are more pleasant in the eyes of customers.

CCS Concepts

• Social and professional topics → User characteristics → Geographic characteristics. • Social and professional topics → User characteristics → Cultural characteristics • Applied computing → Art and humanities → Architecture (buildings)

Keywords

Decoration; Image Classification; Interiors; Crowdsourcing; Color; Airbnb

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1. INTRODUCTION

1.1 Airbnb

The increasing use of Internet and mobile applications have yielded a sharing economy where consumers exchange goods via digital platforms. In this model, companies provide a web infrastructure venue where producers and consumers share their goods and services in exchange for value (e.g. Uber, Airbnb, TaskRabbit, etc.). The companies' goal is to connect owners of unused resources to those who need those for a lower rate compared to the traditional market.

Airbnb, founded in San Francisco, CA in 2008, has successfully used this business model for peer-to-peer housing short-term (vacation) rental services. By 2014, it expanded to 192 countries and 34,000 unique locales with more than two million listings worldwide [1], a figure expected to grow in the future [2].

Owners advertise their accommodations by providing a brief description of their home, amenities, location, price, and—crucially--photos, mostly of the interior spaces. As per the sharing economy, Airbnb's success depends on social capital. Both the host and the guest create user profiles through Airbnb and previous guests or hosts leave feedback and ratings for their counterparts.

The lucrative renting business has invited opportunities for both consumers and researchers. Airbnb curates a new 'servicescape' [3] that, unlike hotels, is formed by individuals' personal tastes and ideas; the interiors reflect the owner's identity to some extent—a factor that exposes the traveler to more individualized (and geographical/cultural) décor than he or she would incur at a typical hotel. This also allows the owner to put the result of his or her own agency and decisions for sale. Second, the inventory of Airbnb's various individualistic interior spaces is ripe for investigating, specifically for teasing out the preferences of customers as they choose from locations with similar utility, but different style.

Accordingly, this research looks at the geographic distribution of different interior spaces with different spatial characteristics—from the point of view of the decorator host more than the guest. In other words, we ask: Where and to what extent do individuals decorate their homes beyond the necessities of bed, table, sink, etc.? Which colors, patterns and elements do they use? Questions for further inquiry are on the client-side: how much more is a client willing to

pay for a thoughtfully-decorated, embellished or ornate booking vs. one with minimalistic, neutral utility?

1.2 Interiors as a Means of Self-Expression

The Airbnb business model has created a new land-use type of dueling residential and commercial. Residential interiors are personalized like regular homes to reflect the individual's taste and identity and become a venue of self-expression for the host. However, this décor is intended to have a commercial, i.e. sales, function as well so that the home can be marketed and advertised to attract customers.

Meanwhile, domestic interiors are reflective of different attributes of places such as culture, social values, climate, economy and etc. In countries where public events of self-expression are not encouraged, interior decorating seems like a relatively-safe way to express of one's own creativity, decisions and choices. What kinds of places foster self-expression in the home?

Decorating, is said to have roots in human's need of variety and self-expression [4-6] as the interior space is part of a person's possessions and an indicator of social and economic status [7]. Before the industrial age, mostly the privileged class had the opportunity of self-expression in their domestic interior spaces [6]. After mass manufacturing, other classes could more-easily enhance their own living conditions by decorating their living spaces with more affordable materials and products, feeding the IKEAfication of living spaces.

Accordingly, the host designs his or her interior using some elastic combination of utility, personal style and expression, what is believed to be a competitive, appealing theme. It takes time to decorate one's home and furnish it beyond the necessary items but interior decorating with color, collage, repurposed materials and furnishings can be a relatively low-cost way to express oneself. In the U.S., for instance, free materials and do it yourself (DIY) projects abound. Given that economic and political hurdles to augmenting a home with one's own creative view can be overcome, geolocated Airbnb photos allow researchers to examine the spatial environments, i.e. neighborhoods, cities, countries where human creativity in "nesting" is more abundant.

There is also a cultural component associated with interior spaces that reflects the place. Cultural artifacts facilitate and enrich interactions, while conveying attitudes, values and affiliations [8]. In one study of residential spaces of Italian and French houses [9] the French valued ornamentation and Italians functional objects in their living rooms.

Airbnb has revealed many domestic interior spaces throughout the world that have not been available before. Airbnb locations are a largely unanalyzed cultural indicator and means of self-expression for different cities worldwide.

1.3 Interiors as a Marking Tool

Airbnb's new technology-driven, sharing-economy business model requires new strategies for attracting customers. From a commercial standpoint, we can attempt to find the kinds of interiors that are more attractive from the customers' perspective. Finding attractive interior design factors can potentially inform hosts on styles they can use to attract more customers.

Environmental psychology and marketing research suggests that design factors can be used as a marketing tool [5, 10, 11, 13], though these studies tend to focus on hotels [14]. More recent studies also indicate that stylish spaces and comfortable rooms are among the most important criteria for selecting hotels for both business trips and vacations [15]. Consumers focus on the qualities that interior spaces infer, relying on their intuition and feelings of places, often derived from detailed visual features over objective features [18-20]. Factors that relate to the consumer feelings about a space (e.g. lighting, style, and color) most affect their judgments [21].

Hotels typically use images on their websites to portray their (luxurious) lodging services and distinctiveness to potential customers [16]. However, few studies have investigated the extent to which a hotel's interior spaces affect the costumers' choice (given similar price, location and amenities). We have not found research on this topic using Airbnb, which is a newer means of facilitating travel lodging.

1.4 Evaluating Decoration in Domestic Interiors

An ornament can be defined as something that has not function and is aimed to enhance the enjoyment of a product [7]. Yet, the distinction between ornament and function is disputed, particularly among architects. In a previous study on the physical details associated with interior spaces, consumer perception was categorized into (a) holistic design factors (overall planning and architectural style features) (b) primary elements (i.e. walls, windows, ceiling, etc.); and (c) secondary elements (colors, furniture, art.) [17]. Furthermore, objects in domestic interior spaces are categorized by function. In one prominent example, four broad categories of objects in a domestic interior are constructed [18] and defined as:

- Appliances such as microwaves, which are intended to aid with certain functions
- Furniture that is intended to enhance comfort
- Objects of interaction such as a television or stereo
- Objects that convey no function and are decorative, such as paintings.

Within this framework, we choose to concentrate on the 4th category: objects that convey no function and are decorative, but with participation from furniture-type objects that also have function, but are chosen for style.

2. DATA AND METHOD

For this pilot study, we choose U.S. cities Chicago, Los Angeles, New York, Pittsburgh, San Francisco, Washington DC, Russian cities St. Petersburg and Moscow, and Asian cities Singapore and Tokyo. In sum, we downloaded 500,000 images from the Airbnb website. We are currently expanding these pilot cities to as many locations as possible, including developing and developed nations, different climates, city sizes and continents.

2.1 Categorization & Classification of Images

We first classified images into different room types on Mechanical Turk [22]: bedroom, bathroom, kitchen, living room, office, other interior room, non-interior images, and images of objects (Table 1). Non-room photos include pictures of exteriors, the city, maps, and images of objects include appliances, pets, people, etc. In the results, we comment geographic differences in popularity of room images.

Table 1. Image Classification Responses by Room Type

Room Type	*Responses*	*Percent*
JUST OBJECT (food, pet...)	4586	9.4
NOT an INDOOR house photo	9391	19.3
Bathroom	5420	11.1
Bedroom	8885	18.3
Dining Room	1987	4.1
Kitchen	7410	15.2
Living Room	6838	14.1
Office	527	1.1
Other Indoor Room	3607	7.4
Sum	48651	100

We then focused on living rooms as the main areas where décor and personal choices are most often found, that is, where decorative energy gets manifested. We combined images tagged as living room from the first classification exercise, for each rental. As a result, for example, listing 1001's living room may have three images associated with it, and are combined into one image with three panels.

Mechanical Turk workers are given the following directions. They access the image through the URL described in each individual set of directions.

"Rate 1 - 5 (low to high decoration). A room rated "5" has a lot of COLOR, ELABORATE OBJECTS, ART, SELF-EXPRESSION, ORNAMENTS. A room rated "1" is very plain. See a "5" and a "1" here: http://tinyurl.com/cat-guide3 IGNORE images that are not of rooms (like a picture of pets, people, coffee maker, towels, etc.)"

Three anonymous, rotating workers then classified composite image of the living room in each rental. We then averaged these three scores and assigned this value to the living room in this locale. Rentals with a standard deviation of more than two ordinal units were deleted, as this indicates a discrepancy in the results.

2.2 Color Analysis

For each of the 50,000 categorized images, the top three prominent RGB color values of the image are found using Leifer's method for finding dominant colors in images [23]. These RGB colors are then converted to corresponding color text using [24] and analyzed for potential color dominance in each locale and in rooms of the home.

2.3 Geographical Analysis

Each downloaded image is accompanied by a longitude / latitude value of the approximate location of the rental. We map these data in the Tableau and ArcGIS environments. We detect hot spots using the Getis-Ord Gi* statistic within the ArcGIS environment to determine whether specific neighborhoods within a city exhibit similar colors or austere/ornate qualities.

3. RESULTS

3.1 Ratings by City

In sum, workers gave the following counts of ratings 1 (n = 687), 2 (n= 1934), 3 (n=2064), 4 (n=1152), 5 (n=407) and NA (n = 35) averaging 2.785, with a preference for lower scores. In summary, ratings were found for 2095 different rentals. 14 records have a standard deviation of two or greater, and we removed these listings.

The scores for each city (Table 2) show the variation in ornateness ratings per city. Chicago, on average, had the highest rating score at 3.273 (Table 1) and Tokyo had the lowest score (2.49) and also had the lowest standard deviation, indicating general agreement among rating participants. Moscow has the highest average standard deviation (0.788), indicating that raters disagreed often about how to rate rentals in Moscow. Washington D.C. and San Francisco had exhibited the next highest scores at 2.929 and 2.967, respectively, indicating that U.S> cities were decorated with more ornate styles, by descriptive statistics alone. This may be an effe4ct of consumer culture and/or disposable income.

Fig. 1. Graphical guide for classification workers to rate rooms from 1-5.

Table 2. Cities and Ornateness

City	*Number of Living Room Listings*	*Average Score*	*Standard Deviation*
Chicago, IL, USA	230	3.273	0.730
Los Angeles, CA, USA	227	2.848	0.688
Moscow, Russia	229	2.670	0.788
New York, NY, USA	240	2.848	0.704
Pittsburgh, PA, USA	235	2.779	0.687
San Francisco, CA, USA	215	2.967	0.714
Singapore, Singapore	187	2.604	0.710
St. Petersburg, Russia	235	2.629	0.772
Tokyo, Japan	199	2.497	0.592
Washington DC, USA	242	2.929	0.766

3.2 Ratings within Neighborhoods

The study of neighborhoods shows some interesting results regarding the juxtaposition of the elaborated and plain interior space. Overall, our analysis shows that the extent of ornamentation is not necessarily correlated with the nightly price for all cities. For example, in San Francisco the results show the Airbnb units with simpler interior spaces are located in regions where rental units are more expensive (Figure 2), as indicated by hotspots in part of the city. Left to right, the cities in figure 2 are San Francisco, Tokyo and New York. Bluer areas indicate lower values. On the bottom row, the same hotspot technique is used for the rating values of the rentals. In San Francisco, cheaper areas do not necessarily have low ratings, in fact there is more of an inverse correlation between price and décor, meaning that other factors (such as location) may play a role in the upscaling of the price of a non-decorative home.

In Tokyo and New York City, on the other hand, the hotspot analysis results for daily price and ornateness level correlate positively. In both cases, however, the differentials between the prices are much stronger than the differentials between the ratings. This may be an artifact of the range of each scale (Airbnb rentals range between $15 to $5000—although the latter is an extreme—but typically up to $300), whereas the rating system is 1-5, which does not allow for anomalies. Still, the hot and cold spots work within their respective ranges.

We interpret this result, in part, that regardless of wealth, a home can be decorated in an appealing way, and, self-expression may not be a luxury for the uber-wealthy.

In other cities (e.g. Washington DC, Los Angeles, Moscow, Singapore) no significant correlation is found between elaborate and expensive Airbnb units. This may be explained by the different cultural contexts of each neighborhood, and although there may be less disposable income and lower housing prices, it seems as though ornamentation is a significant personal and family value. For instance, in Washington, D.C. although there are major differences between impoverished and wealthy areas, there were no statistically significant results that divided the city into ornate and non-ornate areas.

However, some neighborhoods are more segregated in terms of their ornateness. In Tokyo, the western end has many more 4's and 5's in their rating system than the eastern end (Figure 2).

3.3 Color Popularity

The most popular color taken from the images was "dark slate grey" for nearly all of the cities (Figure. 3). We find the following anomalies. San Francisco favors colors described by [24] as misty rose and linen more than other cities. Singaporean rentals tend towards light blue, and Tokyo towards dark salmon more than other cities (Figure. 4). In Tokyo, black predominates in 24 instances, while in Pittsburgh, black is used as part of the majority of the room in 72 instances.

3.4 Color Popularity

Each rental is accompanied by a title to attract the consumer. This is shorter than the following long description of the rental. An exploratory analysis of frequent terms in this title showed that for each U.S. city, the most common adjective in the rental description was: "private", followed by "cozy", while Chicago uses sunny next and Los Angeles uses the beach and then cozy in its descriptions. Four U.S. cities advertise "spacious" locations prominently, and San Francisco stands out by adding the term garden to its descriptions. Singapore advertisements use cozy/cosy as the most popular descriptor followed by central, private and new. Tokyo's most common descriptor is Wi-Fi, followed by free and cozy. Both also use private many times. Finally, Russian cities value cozy and the term 'view' as their most prominent descriptors.

4. CONCLUSIONS

This report is part of an ongoing project whose goal is to learn about how citizens of certain geographic locales choose to decorate the average household. We find that the color schemes detected carry much grey and neutral colors, when perhaps it is a variety of color within each room that best reflects an individual's self-expressive and artistic proclivities. We are currently examining methods using computer vision and feature detection to study the decoration preferences in more depth.

Also, from an economics standpoint, our future goal is to create a hedonic model of Airbnb rentals by price (by locale and number of rooms) and popularity (helpfully, Airbnb tells visitors whether the rental is a "rare find") to isolate the added value of a high décor variable.

Airbnb gives people—for the first time –an instantaneous view into other peoples' homes in many different locations and reflective of many different cultures. Humans have been curious about how the average person in other places/cultures decorated in the past, but today we can know. It connects the average person to the average person with less curation. The media invites us into homes via documentaries, photos of palaces and historic homes, journalistic exposes, and sensationalistic shows. Reality TV has brought us into more peoples' homes, but Airbnb expands this vista hundredfold.

Our results show an effect of globalization: ubiquitous household goods and décor have blurred local cultural arts and craft, design.

This may also blur the effect of place and geography, while society loses their collective influence of locality. As a result, the notion of a 'people' from a place, becomes rarer, and choices of foods, clothing, household décor and lifestyles reflect no longer reflect local climate, government, religion, and smaller circles of influence and apprenticeship, but instead belong to a global culture.

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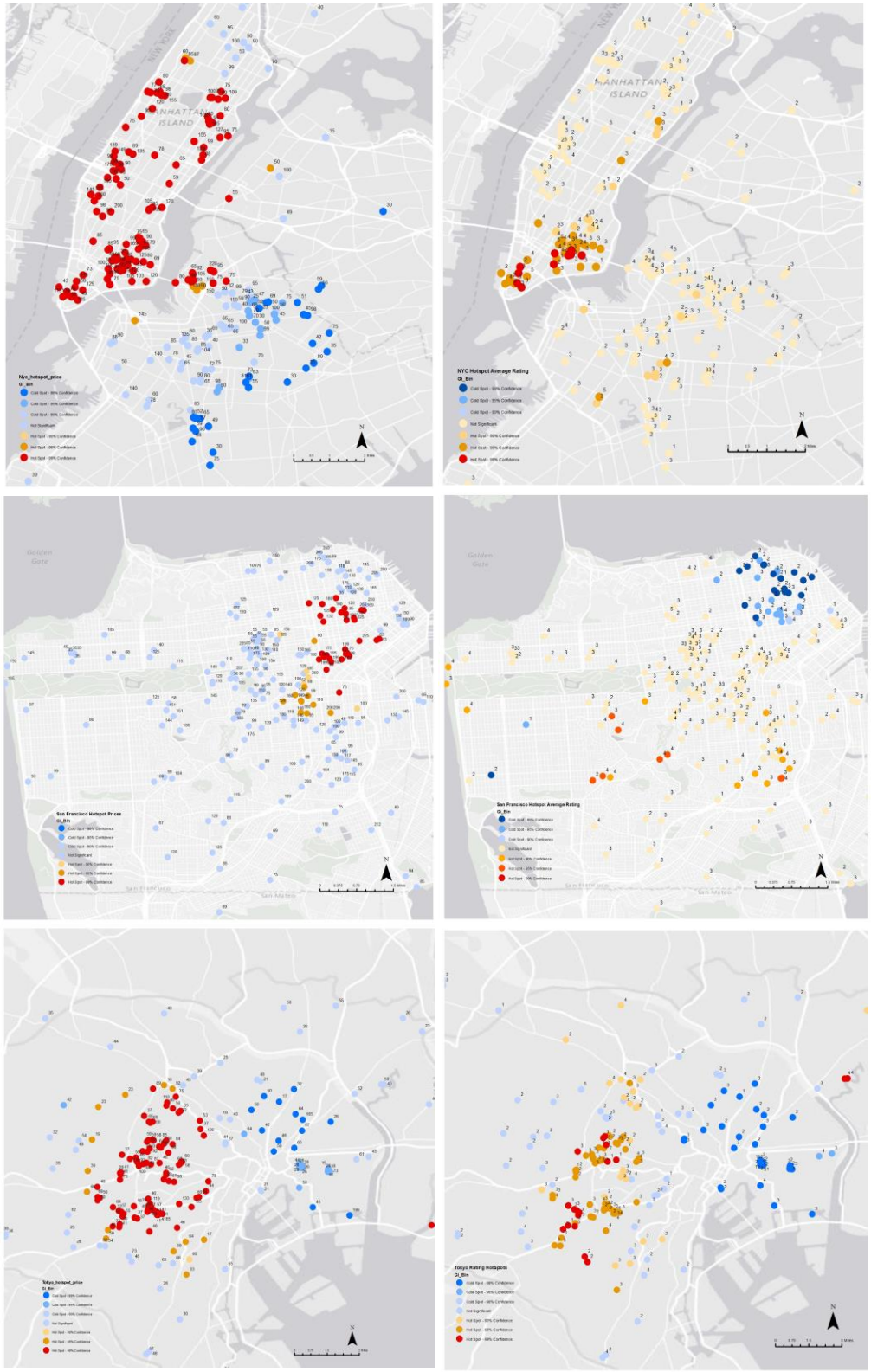

Figure. 2. Cities San Francisco, Tokyo and New York exhibit the greatest variation in neighborhood pricing and ornateness ratings, although the boundaries for high and low prices and ornateness are not always overlayed. The left column hot spots indicate rentals' price, and right column, the hotspots of rentals' ornateness. Color red denotes the statistically significant clusters of high values and color blue denotes that of low values in all cases.

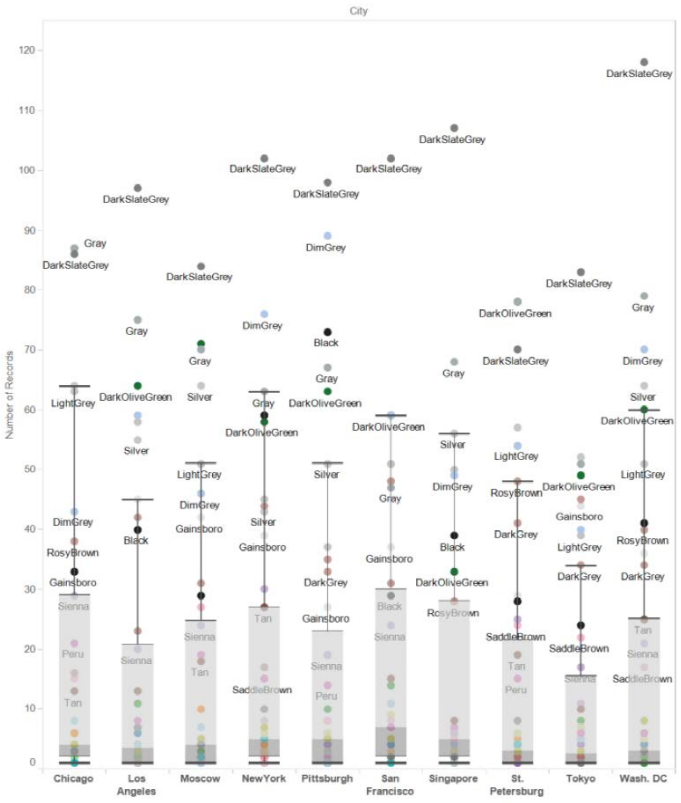

Figure. 3. Dominant colors for different cities show a preponderance of dark slate gray, gray, dim gray, black, and dark olive green. Colors are described using the python script found in [24].

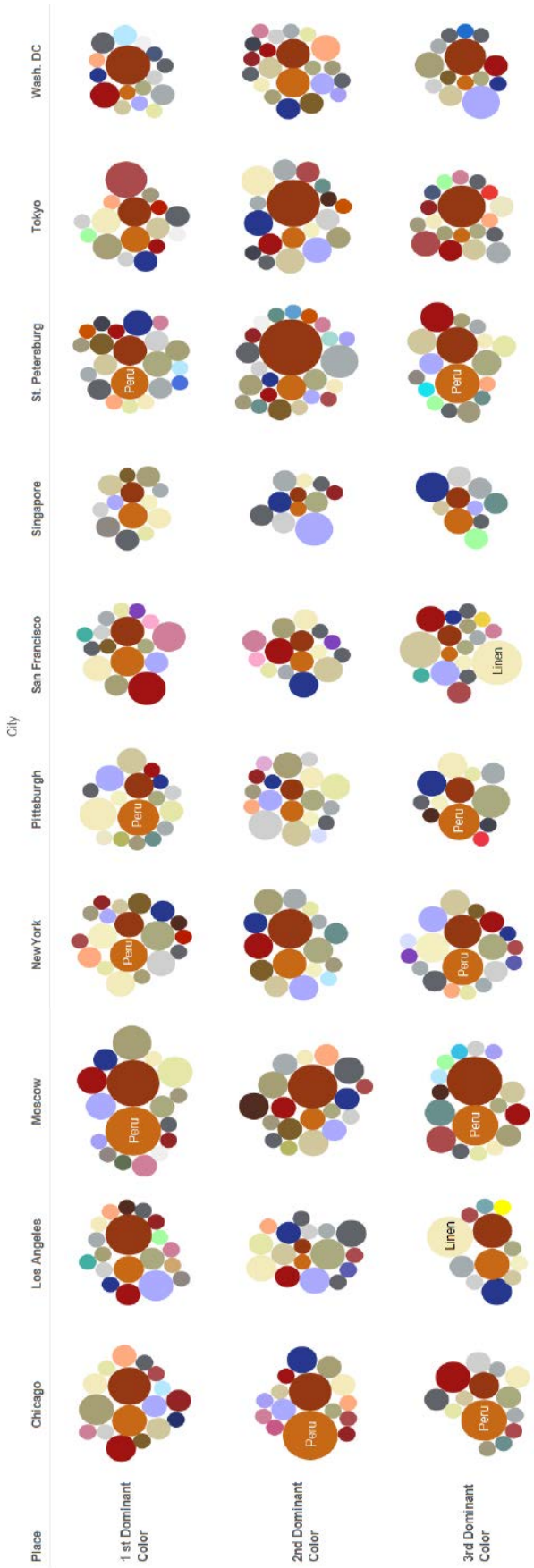

Figure. 4. Non-grey prominent colors in 10 cities.