

# Inclusion of Latino-oriented local businesses in popular online maps: An empirical study in the Inland Northwest of the United States

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## Abstract

*Entrepreneurship in the Latino community is transforming the business landscapes of small and medium-sized cities throughout agricultural regions of the United States. These new businesses offer their owners and employees an alternative to farm or industrial work, while creating jobs, revitalizing often-vacant parts of town, and offering a sense of place and familiarity to recent immigrants and their families. This study examines to what degree popular online maps are likewise transforming to include these Latino-oriented local businesses. We visited strategically-selected commercial areas of four cities with relatively high Latino populations in the Inland Northwest region, recorded all operational businesses, then compared this inventory with businesses symbolized on Google Maps, Apple Maps, Bing Maps, and OpenStreetMap. We also studied the activity history of contributors who added Latino-oriented local businesses to OpenStreetMap. We found that Latino-oriented local businesses appeared in significantly fewer map platforms than other businesses. Additionally, national chain businesses appeared in significantly more map platforms than local businesses, and areas with relatively high Latino populations saw significantly less mapping of businesses than other areas. OpenStreetMap had low inclusion of Latino-oriented local businesses. We offer possibilities for future research and ways to improve the rate of mapping of these businesses. We also describe how all field notes from this project were added to OpenStreetMap following the study.*

*Keywords: online maps; entrepreneurship; Latino communities; placemaking; OpenStreetMap*

## Introduction

During the past several decades, the commercial landscapes of many small and medium-sized cities in agricultural regions of the United States (US) are being transformed by Latino entrepreneurs through new forms of ethnic “placemaking” (Sandoval & Herrera, 2019). Such transitions involve the establishment of local businesses that offer products and services of interest to the growing Latino populations in these towns. Often these establishments are operated by immigrants and take root in previously vacant storefronts near the downtown core (Figure 1). Although the businesses want to expand, they often find themselves in vulnerable positions due to difficulties with accessing capital, competing with larger retailers, and facing racially-charged resistance from some who are uncomfortable seeing changes in the commercial and residential landscapes of their towns (Trabalzi & Sandoval, 2010; Sandoval & Herrera, 2019).

Along with the traditional means of word-of-mouth and print media advertising, Internet searches are an increasingly popular way that local businesses come into public

knowledge (Rainie et al., 2011). Internet search companies frequently use maps and geographic databases to enhance search results, often even embedding a map next to other returned information such as photos and text. Google Maps is one of the more ubiquitous examples of these online mapping platforms, offering place lookup, navigation help, and links to related information, such as a business's opening hours, customer reviews, and so forth. Other organizations, both commercial and non-profit, have built similar digital map platforms that enhance placemaking power through their ability to influence people's knowledge and decisions about available businesses.

Up-to-date representations of Latino commercial landscapes on popular online map and search platforms could provide visibility and a potential flow of customers to many fledgling entrepreneurs; however, the level of success of online maps at representing Latino-oriented local businesses is not well understood. Currently, the most widely used online maps are driven by commercial interests and data collection processes that have historically favored larger businesses (Dalton & Thatcher, 2019).

The purpose of this study is to learn more about how small businesses serving the US Latino community are represented on digital maps; namely, to what degree they are present in the map and how that presence varies across technology platforms and geography. We focus on the Inland Northwest region of the country, which encompasses parts of Washington, Idaho, and Oregon states. This is a mostly rural and agricultural area with a smattering of small and medium-sized cities and a burgeoning Latino presence. The study area consists of four of these cities that have relatively high Latino populations.



Figure 1: Local businesses specializing in Latino-oriented products and services in downtown Pasco, Washington

This study investigates Google Maps, Apple Maps, Bing Maps (operated by Microsoft), and OpenStreetMap (OSM) so that differences between commercial and crowdsourced maps can be explored. The first three are digital maps made by some of the world's wealthiest technology companies to support search, advertising, and software development enterprises. OSM is a crowdsourced geographic database that is operated in a not-for-profit fashion.

Including every operational business at any given time is an impossible task for any mapping platform; therefore, we are particularly interested in understanding how the current commercial landscape compares to what is visible in online map platforms. We approach this study using the following questions:

- To what extent do Latino-oriented local businesses appear on the maps when compared with other businesses in general?
- To what extent do Latino-oriented local businesses appear on the maps when compared with other local businesses?
- To what extent is the Latino population level of the surrounding neighborhood related to the appearance of businesses on the maps?
- To what extent do national chain businesses appear on the maps when compared with local businesses?
- Who is adding Latino-oriented local businesses to OSM, and what can we learn about them through publicly available profile and edit history information?

The study addresses the above questions through the following procedure:

1. Conduct inventories of businesses in sampled neighborhoods with a mix of relatively high and low Latino populations.
2. Classify businesses in order to determine those that are Latino-oriented, as well as those that are local in character (not national chains).
3. Examine the digital map platforms to identify which of these businesses are present in each map.
4. Analyze and compare the distributions of the Latino-oriented local businesses that are included or omitted from the maps, in relation to such factors as the demographics of the neighborhood and the size of the business chain.
5. Review the list of users adding Latino-oriented local businesses to OSM, along with their public profile pages and contribution histories, to form an understanding of who is adding these institutions to the map.

In this study, we use the term “Latino-oriented businesses” to refer to establishments that sell goods and services appealing specifically to Latino residents, or market themselves in ways that evoke feelings of nostalgia, connectedness, or accessibility among Latino customers through language, design characteristics, advertising imagery, and so forth. Usually, these businesses are owned and operated by Latinos, although this study does not directly interrogate race, ownership, or business structure.

We begin by reviewing literature about the Latino entrepreneurship experience in the US, especially some of the unique challenges faced by these businesses and the potential benefits of appearing in online maps. We subsequently describe the research methods and their accompanying results. We then offer discussion about the implications of these findings and how they might contribute to future studies. The paper concludes with a section summarizing key findings and describing how we contributed the research field notes to OSM at the conclusion of the study.

### **Latino-oriented local businesses and their inclusion in online maps**

In the US, Latinos are starting businesses at a faster rate than other ethnic groups (García-Pabón & Klima, 2017; Mills et al., 2018; Amarante, 2018). These businesses most commonly offer services such as food, landscaping, hairdressing, auto repair, construction, and childcare (Grey, 2006; Zarrugh, 2007; Hidalgo & Luis, 2013). For recent immigrants especially, entrepreneurship offers a safer and more stable alternative than the agricultural or industrial work they may have started with when they first arrived in the country, thereby providing a possible route out of poverty (Delgado, 2011, p. 64–92; Amarante, 2020).

Beyond potentially benefitting their owners, Latino small businesses often help the surrounding community by creating job opportunities and tax revenues (Zarrugh, 2007; García-Pabón & Klima, 2017; Amarante, 2018). They fill commercial store frontage in downtowns and strip malls that would otherwise be vacant (Amarante, 2018; Sandoval & Herrera, 2019). They also boost the economy in more distant places through increased remittances and the opportunity for export of Latin American goods (Sandoval, 2012; Hidalgo & Luis, 2013).

### **The placemaking function of Latino-oriented businesses in the Inland Northwest**

Businesses catering to a Latino clientele offer social benefits in addition to economic ones. These establishments can often stir feelings of nostalgia and cultural connectedness in customers who are adapting to new surroundings (Oberle, 2006; Delgado, 2011; Hidalgo & Luis, 2013). More than just a place to buy goods, Latino *tiendas* often function as de facto community centers where people meet, visit, and exchange information in the Spanish language, as well as engage in trans-local activities such as wiring money to loved ones, buying products connected with their home country, or even boarding a bus to visit family abroad (Sandoval & Herrera 2019; Smith & Mannon 2020).

With these benefits in mind, Sandoval & Herrera (2019) portray entrepreneurship in the Latino community as a form of placemaking that reflects an ethnic resilience in its transformation of the commercial landscape. In a broad sense, the term “placemaking” has been used across the social sciences to refer to human activities and processes that give special

meanings to a location (Zambonelli, 2013). These meanings can change over time as people act upon the landscape in different ways. Although trained planners and other experts sometimes implement formal placemaking projects, ordinary residents and entrepreneurs also carry out urban placemaking activities and processes as they (re)appropriate and use spaces such as commercial storefronts (Strydom et al., 2018). In this way, business activities in immigrant communities are a vital form of placemaking. They often aim at underserved markets using relatively low startup costs and low economies of scale (Lara, 2018, p. 3–4). The presence of Latino-oriented businesses is an indication that enough Latino residents to constitute a customer base have been settling in the community (Griffith, 2006). These businesses both attest to and support Latino lives and livelihoods while transforming places.

In the Inland Northwest study region of Idaho, eastern Washington, and eastern Oregon (Figure 2), Latinos have played a steady role in the region's agriculture and ranching industries for over a hundred years (Gamboa, 2000; Jones & Hodges, 2003; Guzman, 2006; Mendoza & Stephen, 2008). The 1980s and 1990s saw accelerated growth and community development within the Latino population; however, improvements to the quality of life were slower to be realized (Slone, 2006). Latino laborers made consistently less money than non-Latino white workers, who could access greater training and education.

Local Hispanic commissions often vocalized these labor concerns. Despite a chronic lack of funding, these organizations provided symbols of voice and hope for struggling Latino communities. Cyclical labor shortage and surplus patterns rocked the region for nearly a decade, exacerbated by a farmhand housing crisis in 1989 (Slone, 2006). Only by the 2000s did the tide turn, as many Latinos began opening restaurants and shops, as well as purchasing farms of their own (Jones & Hodges, 2003; Guzman, 2006). Cultural and community events such as eastern Oregon's *Fiesta Mexicana* and Caldwell, Idaho's annual Cinco de Mayo celebration reflect the community's impact on the region (Jones & Hodges, 2003; Mendoza & Stephen, 2008). Spanish-language media has taken deep root across the Inland Northwest, providing outlets for television and radio advertising (Mendoza & Stephen, 2008).

### **Challenges faced by Latino-oriented small businesses**

Despite their important placemaking role and the goods and services they provide to their communities, Latino-oriented small businesses often find themselves in a fragile position. Just starting a business is a challenge, due to lack of access to capital. Many Latino entrepreneurs resort to personal savings, credit cards, cash advances, and borrowing from informal lenders because they either do not qualify for bank loans, they do not believe they will qualify, or because banks discriminate against them (Grey, 2006; Lara, 2018, p. 75, 87; Mills et al., 2018). Small businesses selling goods are threatened by larger retailers and "big box" stores, whose low prices often lure away low-income shoppers in the community (Zarrugh, 2007; Smith & Mannon, 2020).

According to Pisani & Morales (2020), approximately one-third of Latino-owned businesses in the US operate without the required government licenses. Reasons for doing this include the desire to avoid regulation, taxes, bureaucracy, and encounters with immigration enforcement (see Amarante, 2020 for a discussion of the thorny legal terrain faced by undocumented small business owners). At the same time, others would like to comply if they could get help with legal and financial procedures, especially in the Spanish language. Although unlicensed businesses operating in the so-called “informal economy” contribute to the overall economic health and viability of a place, they do sometimes encounter challenges ensuring sufficient benefits and workplace protections for their workers (Delgado, 2011).

Attempts by Latino entrepreneurs to create a sense of place have sometimes been contested by established non-Latino residents who see large ads and placards in Spanish appearing in storefronts and feel that their own culture will lose representation. For this reason, Latino revitalization is sometimes portrayed as “blight” (Trabalzi & Sandoval, 2010; Sandoval & Herrera, 2019), a common epithet that has been used historically to justify the removal or relocation of undesirable “others”.

### **The importance of appearing in online maps**

One way to counter the idea that Latino-oriented businesses constitute blight is by ensuring that they are included in online maps and place-based searches, thereby bringing these businesses into the picture as map users navigate and build understanding of places. Inclusion in maps and related searches could provide local businesses with a much-needed boost in clientele. In their interviews of Latino entrepreneurs, Smith and Mannon (2020) found that the main reason people gave for starting a business was to provide a better life for their children and earn a living, rather than to get wealthy or wield power in the community; however, a sizable minority were not reaching any of those objectives, and some were thinking of going out of business. Most of the Latino entrepreneurs interviewed by García-Pabón & Klima (2017) stated that they needed new customers. Although US residents still use some traditional sources such as word of mouth and newspapers to learn about local businesses, Internet searches are the most common way (Rainie et al., 2011). Some unlicensed or undocumented service providers may still prefer to operate with a low public profile to avoid legal troubles (Grey 2006), but the available literature suggests that most Latino small business owners want media publicity beyond simple word of mouth. For example, those who visited with Kim et al. (2014) mentioned running radio commercials, launching web pages, and conducting online sales to expand their reach.

Digital maps influence the set of entities that potential business customers can know about and act upon (Crampton, 2001; Zook & Graham, 2007a; Zook & Graham, 2007b). Tech giants such as Google, Apple, and Microsoft make maps to support their search and advertising services. They are locked in a race to comprehensively represent places on their map platforms, while simultaneously wielding power to shape what those places look like on the ground. These

companies are especially interested in depicting businesses in their map platforms, since businesses have fixed street addresses that are easy to capture, and represent potential sources for advertising revenue (Dalton & Thatcher, 2019).

Online map users can become aware of businesses through searches or simply browsing around the map. In these situations, search result rankings and the visual presence and prominence of data points can affect the map user's knowledge and actions (Zook & Graham, 2007a). The device's awareness of the user location can spatially filter search results or zoom the map to the user's coordinates. In this way, data and code work together to steer the flow of material goods (Graham et al., 2013); yet maps made by tech companies use proprietary data and code whose origins are often not known. The set of businesses included on each map is incomplete, constantly changing, and distinct from other maps.

Because each company is trying to assemble the most complete database possible, online map platforms frequently provide avenues whereby small businesses can request to get themselves included on the map. This is usually accomplished by the business owner filling out a web form and completing a process to prove the business exists at the submitted address. For example, at the time of this writing, in order for a business to get itself into Google Maps, the owner must create a Google Business profile, add or claim the business, and then verify ownership. Google offers an option to complete this process in Spanish and many other languages, a benefit for immigrant entrepreneurs. Many business owners add themselves in order to attract customers; others would like to add themselves but aren't aware of how to do so. Those who do make it onto the map must still take care that future data updates do not remove their locations (Dalton, 2015).

In addition to the tech companies mentioned, OSM also holds power to influence the ways that people perceive and interact with places. OSM's free and open nature has led companies such as Lyft, Facebook, Mapbox, and others to use the data in their maps and apps (Veselovsky et al., 2022). OSM potentially allows for a unique degree of local influence, since it is built in a crowdsourced fashion by volunteers and operated by a not-for-profit organization; however, in practice OSM has a history of uneven development and a shortage of local editors, especially in small cities (Quinn, 2017). Business owners sometimes add their franchises directly into OSM, and are welcome to do so if they keep the advertising verbiage to a minimum (Quinn & Bull, 2019).

Latino-oriented local businesses are important to include on all these maps, as they bring both economic and social benefits to their communities, while contributing to a sense of place for those who are getting established in new cities and towns. It is reasonable to believe that the appearance of a business on an online mapping platform could bring economic benefits to that business in most situations. Given the volatile status of many Latino-owned small businesses, it is especially important to understand how thoroughly they are being included in popular online maps.

## Methods

Using field surveys, we made a list of operational businesses along approximately 28 kilometers of strategically sampled streets in four cities, and then examined a variety of digital map platforms to determine which businesses appeared in which platforms. The data capture was performed in April 2022 using the methods below.

### Description of the study area

We wanted to study cities in the Inland Northwest that were large enough to have a thriving Latino business community as well as a reasonable number of potential contributors to OSM. At the same time, we were interested in learning how maps portrayed smaller-sized cities that might not be the most lucrative or interesting to online map producers. Ultimately, we chose Wenatchee, Yakima, and Pasco in the state of Washington, and Caldwell in the state of Idaho (Figure 2) because in the 2019 American Community Survey, these are the only cities in the Inland Northwest with a total population over 30,000 where at least 30% percent of the population is estimated to identify as Hispanic or Latino. Wenatchee and Yakima are geographically isolated enough to have their own Metropolitan Statistical Areas (MSAs); however, Pasco is part of the larger Kennewick–Richland MSA and Caldwell is part of the Boise MSA.

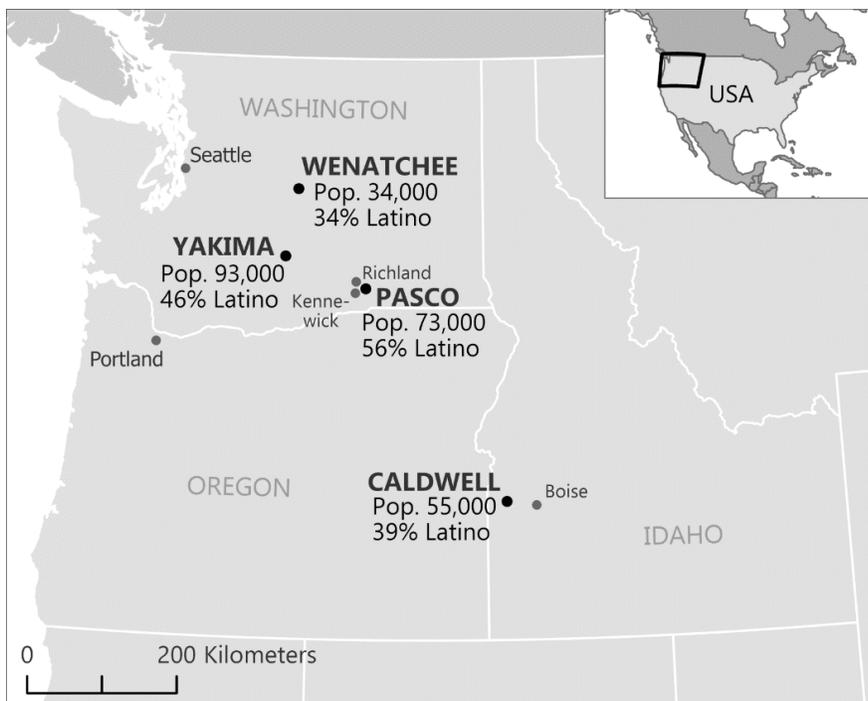


Figure 2: Locations of study cities and neighboring metropolitan areas. Data from 2019 American Community Survey 5-year estimates.

Each of the four cities contributes greatly to its regional economy. The economic history of Wenatchee and Yakima is rooted in agrarianism, bolstered by favorable tree fruit growing conditions (Gloria, 2022; Meseck, 2022). These areas underpin the apple industry in Washington, the leading state in domestic production of the fruit (Kershner, 2021). Today, farm work remains a foundational component of both cities' economies (Gloria, 2022; Meseck, 2022). In addition, Wenatchee is known for hydroelectric energy production from Columbia River dams, which services customers statewide (Gloria, 2022).

Pasco and Caldwell, on the other hand, lead in various manufacturing-related sectors (Port of Pasco, 2017). Agricultural processing and industrial transportation also play key roles in the local economies. Much of this activity stems from a rich history of agrarian entrepreneurship, thereby introducing many foodstuff products for regionwide trade. While Pasco today continues to diversify and expand this traditional workforce, Caldwell has developed into a hub for tourism in recreational, historical, and luxury agribusiness sectors such as viticulture (Port of Pasco, 2017; Destination Caldwell, 2022).

### **Selecting streets to sample for an inventory of businesses**

Rather than studying a list of businesses from an existing directory, we took our own inventory through field visits. We wanted to ensure that we captured the most recent information about all businesses in operation at the time of study. This is because business directories could be out of date (especially following the COVID-19 pandemic) and could also omit smaller or unlicensed businesses. For practical reasons, the in-person survey ruled out an exhaustive census of thousands of businesses; however, we felt that a careful sampling could provide enough businesses to discern meaningful trends, while allowing us additional time to study multiple cities.

We considered the geography of each city to strategically select sample streets on which to perform the business inventory. First, we consulted the percent Latino population for each city using American Community Survey 2019 data and classified each block group in the city into two categories: those above the city's overall Latino percentage (which we will call "high-Latino areas") and those below it. Within the boundaries of each city, we selected 4–5 kilometers of commercially-zoned street frontage in high Latino areas, and 2–3 kilometers of commercially-zoned street frontage in other areas. This resulted in a total of 18.4 km of frontage in high-Latino areas and 9.5 km of frontage elsewhere, a total of 27.9 km. The sampled street segments were chosen strategically based on local knowledge of the authors and examination of satellite images and commercial street-level imagery for areas likely to have a high density of businesses; however, these images were not used in the actual business inventory, and no business names or types were recorded at this stage. A map of the selected street segments is included in the appendix.

The reason more kilometers of sample streets were selected in high-Latino areas was because the commercial zones in the four study cities tend to be in these areas. The purpose of the study was not to compare the density of businesses across the study areas, but rather to capture trends in how the map platforms were representing the businesses; therefore, it was acceptable to have different amounts of sampled commercial frontage across cities and demographic categories.

Distances were calculated on each side of the street, so that sampling both sides of a 1-kilometer stretch would equal 2 kilometers of frontage. There were some cases where only one side of a street was sampled, either because the other side was in a block group with a different demographic category, or because the other side did not appear likely to contain businesses. We avoided sampling along the boundaries of block groups, except when it was difficult to identify the desired amount of street frontage from the center of block groups. Indeed, block group boundaries often lie along commercial thoroughfares.

### **Conducting the in-person business inventory**

We walked all the sampled streets and made notes about the businesses along them. Only businesses with an exterior sign or a name on the door were counted. Along with the name of the business, we recorded any decoration, signage, or marketed products that might indicate it as a business oriented toward members of the Latino community. We only physically entered the business in cases when it would help with determining the function and marketing approach of the business.

Places of worship, government offices, universities, and other nonprofit organizations were considered out of scope for this study and not recorded, although they are valuable for placemaking and might warrant studies of their own. Businesses on street corners or between parallel one-way streets were recorded if they had a street address or an automobile entrance along the sampled street. To capture the streetscape at the point in time we surveyed it in a way that would allow further verification and note-taking, we recorded our own street-level imagery of all the sample areas by driving along the road with a GoPro camera mounted in a vehicle. The ability to review this footage was occasionally useful during the classification and OSM mapping processes described later in this paper.

## Classifying the businesses

Using the information from the street inventory, we then identified the businesses that were likely to be oriented toward the local Latino community in terms of their products, services, or retail environment. The academic literature offered many characteristics for us to consider in this classification. These include the presence of Spanish-language signage, large ads and placards, bright colored facades, names and images from Latin America that provoke nostalgic feelings, and the selling of trans-local services such as money wiring (Oberle, 2006; Sandoval & Herrera, 2019; Smith & Mannon, 2020). We also invited feedback on our methods from students in our university's chapter of the Association of Latino Professionals for America (ALPFA) who had grown up in the study area and had much experience patronizing these kinds of businesses.

For the purposes of this study, we classified a business as Latino-oriented if it had one or more of the following characteristics:

- Name of the business entirely or partially in Spanish (including people's names or surnames)
- Prominent signage on the exterior of the business in Spanish (more than just "Se habla español", or "Spanish spoken here")
- Prominent display or sale of products, brands, services, or fashions of interest to Latino residents in the Inland Northwest (such as the trans-local services mentioned above)

Many of the businesses we classified as Latino-oriented contained more than one of these characteristics. Note that the identity or ethnicity of the owner was not asked; the focus of the classification was on the function of the business in the community and the making of place. We also classified the size of the business enterprise. If the business had franchises outside of the states of Washington, Oregon, or Idaho, it was classified as a "national chain". All other businesses were marked as "local". Internet searches were used when necessary to confirm the accuracy of this classification. Finally, we noted whether the census block group containing the business had a higher percentage of Latino residents than the city as a whole, or whether it had a lower percentage. This allowed us to tally and compare results between areas that had relatively high percentages of Latino residents (relative to the local population) versus those that did not.

## Conducting the digital map business inventory

Within three days of the in-person business inventory for each city, we also performed a digital map inventory. We examined the sampled streets in Google Maps, Apple Maps, and Bing Maps at all zoom levels of the vector-based map view (in other words, not the satellite view), and recorded the names of all businesses appearing along those streets. For this exercise, Google

Maps and Bing Maps were viewed in a web browser and Apple Maps was viewed in the Maps app on the iPhone.

As part of the inventory process, we used the QuickOSM QGIS plugin to download the current OSM data in the city. Any OSM point or polygon feature representing a named business along the sample streets was recorded. Historical versions of OSM features were not examined at this phase of the research. Note that we recorded businesses directly from the OSM database and not the default rendering of the map on OpenStreetMap.org. This is because institutions often download and use OSM source data to build their own maps. Although we have observed slight differences between the businesses in the OSM database and the ones shown on OpenStreetMap.org, the maps are similar enough that we feel that either source could have been used for this exercise without substantially affecting the results.

### **Comparing the in-person inventory with the digital map inventory**

For each business observed in the in-person inventory, we recorded whether it was found in each of the four digital maps. This allowed us to tally and compare the representation of businesses in the different map platforms.

We also created a variable summing how many maps included each business, with the minimum value being 0 (the business did not appear in any maps) and the maximum being 4 (the business appeared in all the maps studied). We used Welch two sample t-tests to compare the mean of this “map sum” variable across several different binary variables (such as whether a business was part of a national chain or not). We followed up on this analysis by performing a series of Pearson’s chi-square tests (with Yates’ continuity correction) to study the relationship between the appearance of businesses in each mapping platform and the presence of the binary variable in question. In the presentation of the results below, we use an alpha of 0.05 to determine significance. Although additional statistical procedures such as logistic regression or principal component analysis might provide interesting insights about the individual effects of the business characteristics on the presence or absence of businesses on the maps, we felt that the tests described above were acceptable for addressing the research questions within the focus and scope of this paper.

### **Investigating OSM editors**

To learn a bit more about the crowdsourced mapping happening in the study area, we investigated the edit history of the Latino-oriented local businesses that we observed in OSM, along with the user activity of the people who edited these businesses. The information was straightforward to obtain from searches on [openstreetmap.org](https://openstreetmap.org), the OSM user pages, and Pascal Neis’s “How Did You Contribute” heatmap (<https://yosmhm.neis-one.org/#>). We looked

at the different versions of the features, the number of edits per contributor, the dates the edits were made, and any public OSM profile information we could get about each contributor.

## Results

When data from all cities were considered together, a total of 614 businesses were recorded. Google Maps had the largest percentage of these appearing on the map, with 67.1%. This was followed by Apple Maps (53.1%), Bing Maps (38.6%) and OSM (18.6%) (Figure 3). When the data were examined individually by city, the platforms still followed this order (Table 1).

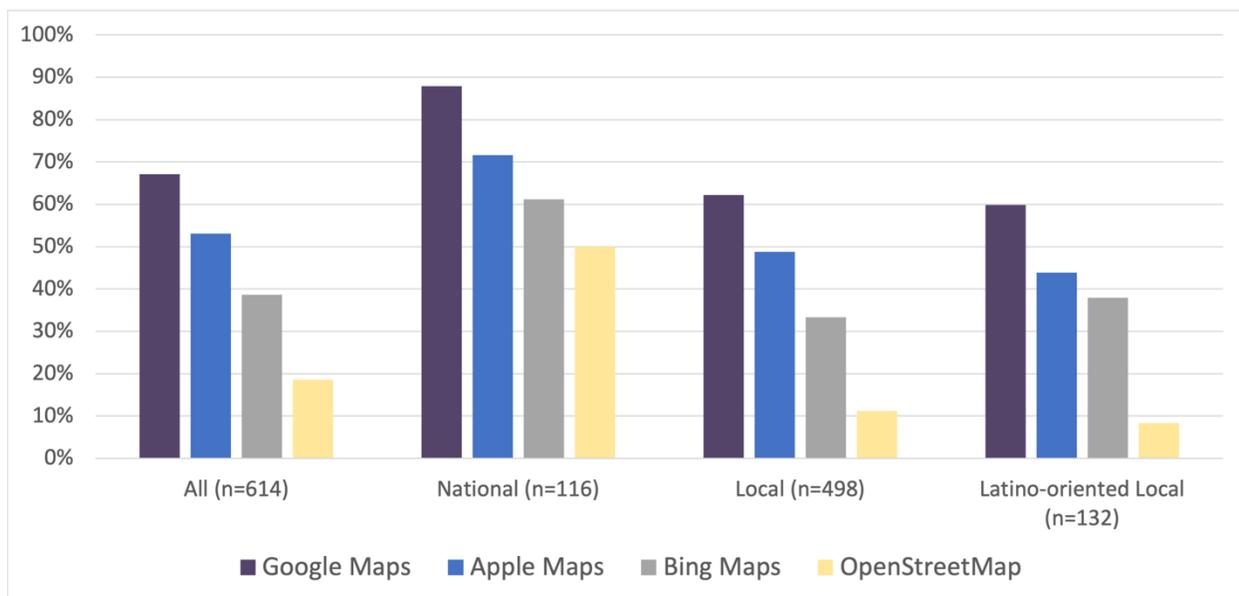


Figure 3: Percentage of businesses appearing in each online map platform, based on business type

Table 1: Percentages of operational businesses appearing in each mapping platform, by city

Online map platform	Total (n=614)	Caldwell (n=120)	Pasco (n=172)	Wenatchee (n=154)	Yakima (n=168)
Google Maps	67.1%	70%	65.7%	68.2%	65.5%
Apple Maps	53.1%	55%	45.9%	57.8%	54.8%
Bing Maps	38.6%	38.3%	35.5%	41%	39.9%
OpenStreetMap	18.6%	9.2%	17.4%	29.2%	16.7%

Popular digital maps may appear rife with data points, thereby conveying the idea that they contain nearly all businesses; however, the reality for each of the platforms we studied was that approximately one-third or more of currently operating businesses in the sampled areas were missing. This absence needs to be acknowledged and kept in mind when reading, using, or interpreting these maps. Figure 4 offers a visual representation of the businesses present and missing in the four maps along the North 1st Street segment in the city of Yakima (see appendix for more location context). Similar patterns existed for the other sampled segments.

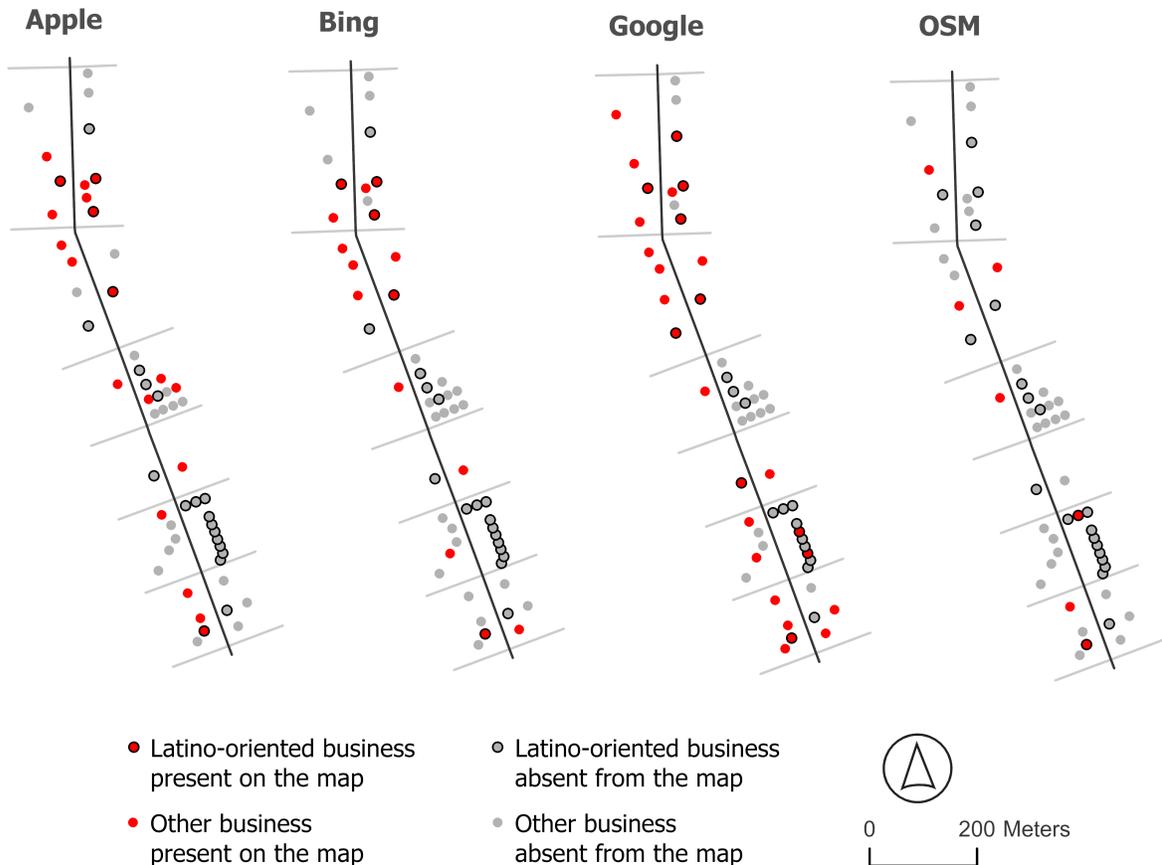


Figure 4: Maps of the North 1st Street segment in Yakima, showing which businesses were visible in each map platform.

Figure 5 depicts the same street segment, this time with graduated symbols representing how many maps each business appeared in. This figure demonstrates how some businesses were consistently missing from the map, and others were consistently present. Many fell somewhere in the middle. Further study needs to be done to determine how a business’s size, type, longevity, and other variables correspond with the prevalence of the business in online maps.

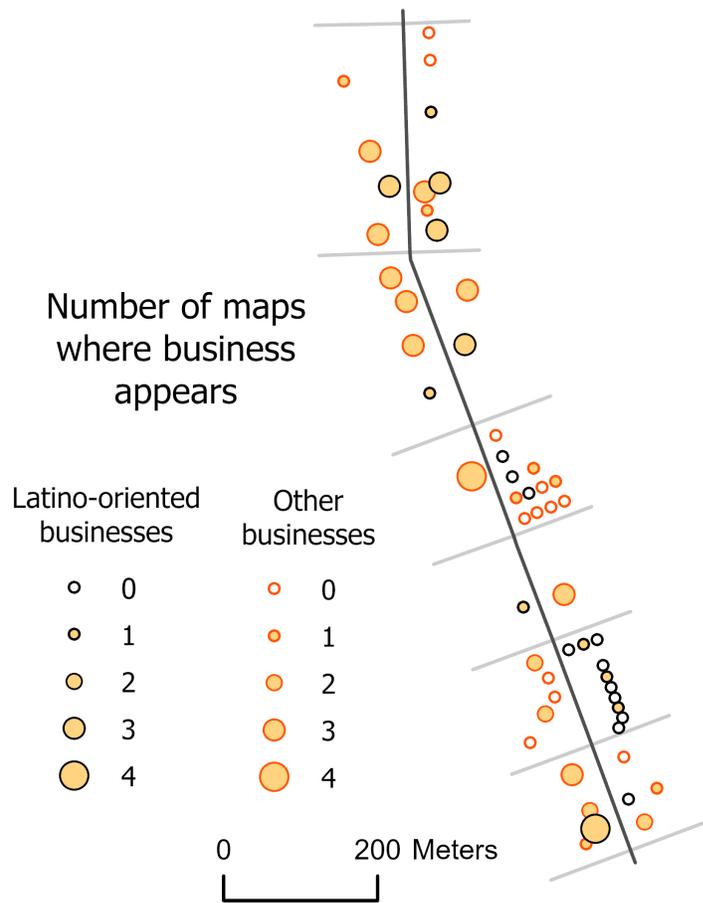


Figure 5: Map of North 1st Street segment in Yakima showing the number of online maps in which each business appears.

Overall, the mean number of maps that a business appeared on was 1.77. Slightly under a quarter of the businesses appeared on no map at all (23.6%). Only 11.4% of businesses appeared on all four maps, although this low figure is partially due to the low number of businesses in OSM. An additional 18.2% of businesses appeared in the three commercial maps (Apple Maps, Bing Maps, Google Maps) without appearing in OSM.

The following section describes how the gathered data and the associated statistical analyses helped to address each research question. Results of all chi-square tests, including p-values, are shown in the appendix.

**To what extent do Latino-oriented local businesses appear on the maps when compared with other businesses in general?**

Overall, 132 businesses (21.5%) were classified as both local and Latino-oriented. Out of these, Google Maps showed 59.8%, Apple Maps followed with 43.9%, Bing Maps had 37.9%, and OpenStreetMap had 8.3% (Figure 3).

Latino-oriented local businesses appeared in significantly fewer map platforms ( $M = 1.50, SD = 1.32$ ) than other businesses ( $M = 1.85, SD = 1.34$ ),  $t(210.71) = -2.69, p = .008$ . When the platforms were examined separately, Latino-oriented local businesses were significantly less likely than other businesses to appear in Apple Maps and OSM. A significant difference could not be shown for Google Maps and Bing Maps (see appendix).

**To what extent do Latino-oriented local businesses appear on the maps when compared with other local businesses?**

There was no significant difference in the number of map platforms where Latino-oriented local businesses appeared ( $M = 1.50, SD = 1.32$ ) when compared with other local businesses ( $M = 1.58, SD = 1.23$ ),  $t(219.22) = -0.58, p = 0.56$ . Likewise, no significant relationship was observed between these two categories of businesses and presence on any of the four map platforms.

**To what extent is the Latino population level of the surrounding neighborhood related to the appearance of businesses on the maps?**

Out of all businesses inventoried, 383 (62.4%) were located in high-Latino areas as defined in the methods section of this paper (recall that this higher proportion was by design). Google Maps displayed 64.5% of these businesses, followed by Apple Maps (50.1%), Bing Maps (34.7%), and OSM (12.5%). In other areas, Google Maps managed to show 71.4% of businesses, while Apple Maps showed 58%, Bing Maps showed 45%, and OSM showed 28.6% (Figure 6).

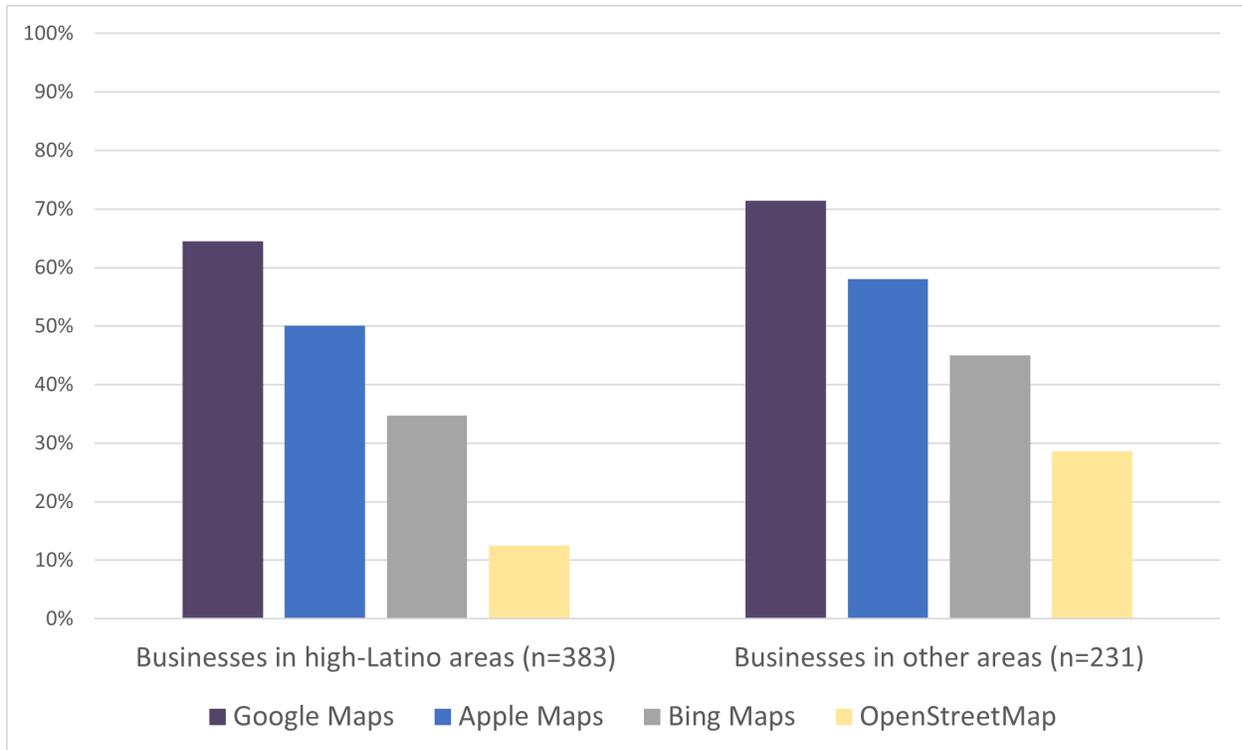


Figure 6: Percentage of businesses appearing in different digital mapping platforms, based on demographics of the containing census block.

Businesses in high-Latino areas appeared in significantly fewer map platforms ( $M = 1.62$ ,  $SD = 1.30$ ) than businesses in other areas ( $M = 2.03$ ,  $SD = 1.36$ ),  $t(467.42) = -3.69$ ,  $p < .001$ . Businesses in high-Latino areas were significantly less likely to appear in Bing Maps and OSM than were businesses in other areas. Google Maps and Apple Maps also had low  $p$ -values for this test but did not meet the significance threshold (see appendix). Out of the 132 Latino-oriented local businesses recorded in this study, 119 (90.2%) were in high-Latino areas. Although this statistic may seem unsurprising, it highlights the potential collateral effects of the lower rates of mapping we observed in high-Latino areas.

### To what extent do national chain businesses appear on the maps when compared with local businesses?

We classified 116 (18.9%) of the businesses as being part of national chains; the remainder were considered “local businesses” for this exercise. Figure 3 shows the percentages of local and national chain businesses appearing in the four map platforms. These platforms perform in the same order as in the other analyses above, with Google having the highest percentage, followed by Apple Maps, Bing Maps, and OSM.

National chain businesses appeared in significantly more map platforms ( $M = 2.71$ ,  $SD = 1.29$ ) than local businesses ( $M = 1.56$ ,  $SD = 1.26$ ),  $t(169.81) = 8.72$ ,  $p < .001$ . For all four map

platforms, national chain businesses were significantly more likely to appear on the map than local businesses. A related statistic of note is that in high-Latino areas, local businesses were found at a significantly greater rate than national chains  $X^2(1, N = 614) = 32.67, p < .001$ .

**Who is adding Latino-oriented local businesses to OSM, and what can we learn about them through publicly available profile and edit history information?**

Out of the 11 Latino-oriented local businesses appearing in OSM, five were in Pasco, four were in Wenatchee, two were in Yakima, and none were in Caldwell. These business features were added or modified by a total of eight unique users over 15 different changesets (edit sessions), spanning a time frame from 2010 to 2022. The majority of these changesets were made in 2019 or later (Figure 7). Three contributors were novices with 10 or fewer total changesets in the OSM project, while the rest of the contributors were much more active, with at least 800 changesets each (Table 2).

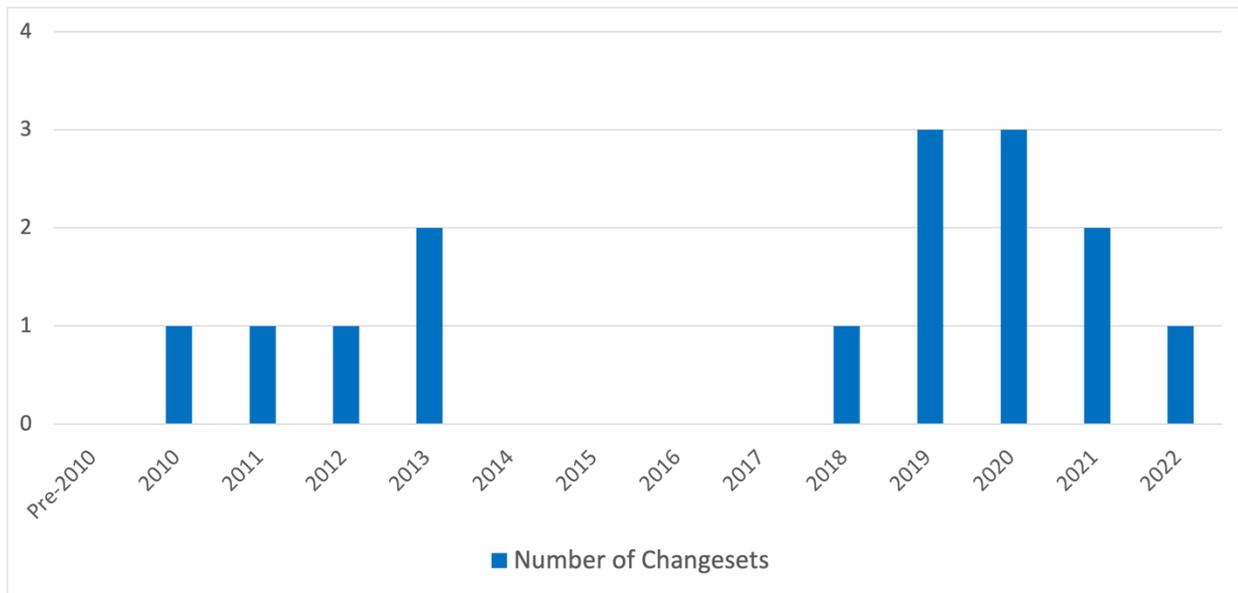


Figure 7. Timeline of OSM changesets affecting Latino-oriented local businesses in the sampled locations

Table 2. Activity levels of the eight OSM editors who added or modified Latino-oriented local businesses in the sampled locations. Changeset totals were recorded in May 2022.

Changesets editor made in all of OSM	Number of editors
0 - 10	3
11 - 100	0
101 - 1000	1
1001 - 10000	3
More than 10000	1

## Discussion and possibilities for future research

In the areas where we collected data, the local business landscape in general is under-represented in popular online maps, a situation which affects Latino-oriented businesses and communities. This under-mapping of the local business landscape exists despite there being avenues for businesses to add themselves onto maps. Here we discuss some possibilities for future research on the challenges and opportunities faced by local businesses, especially those with an ethnic character, that are trying to find a place on the map.

### Defunct businesses on digital maps

None of the four cities was imposing visible COVID-19-related visitation restrictions on businesses at the time we performed the study; however, as we walked the streets, we observed many recently closed businesses that may have been rendered unprofitable by the pandemic or its aftermath of economic volatility. In some cases, old signage lingered and merchandise was visible in dark disarray through the store windows.

In many cases, these defunct businesses were still displayed on the digital maps we studied. In fact, all four platforms are littered with old and nonfunctioning businesses, some of which to the knowledge of the authors have been closed for many years. It may be easier for data collection algorithms and processes to detect new businesses than to identify and remove old ones. Within a few weeks of doing our inventories, we noticed that Google Maps had already added many of the businesses we recorded as missing; however, much fewer missing businesses had been removed.

We encourage further study about the quantity and effects of defunct businesses on digital maps. Are they getting in the way of new businesses that are trying to climb to the top of search rankings or stand out in a crowd of other points of interest? Do they pose any detrimental effects to the operators of new businesses who have taken over those spaces? Are

digital maps destined to pile up more and more nonfunctioning storefronts to the point where the maps lose user trust, or are there reliable processes in place that will eventually remove these sites?

### **Differences in visibility and search ranking**

The digital mapping platforms studied contain too many businesses to show at a state or even city-wide scale. The businesses appear as the map user zooms in, following algorithms that are little-known except for in the case of OSM. In the commercially-produced maps, businesses can pay to give their location more prominence. For example, in Google Maps, some businesses have purchased the right to show logos and a different-shaped marker.

Our study zoomed in to the largest scale of the maps in order to record all visible businesses; this was because we wanted to get a feel for what was in the underlying databases, not because we feel that most users will zoom in to browse the map at these deep levels. Additional studies could investigate the first zoom level at which each business appears, comparing this variable against other characteristics to see which kinds of businesses are likely getting the most attention of people visually exploring the map.

We also based our study entirely on the presence of a visible marker, and did not test whether there are some businesses without markers that show up only on search; nor did we evaluate ranking algorithms for search results. The code behind these processes holds great potential to affect people's choices, yet it is often protected by trade secrets and is little understood. Our study design could be expanded in the future to include text searches for all businesses recorded on the ground and evaluate the results each platform gives when there is no visible point on the map.

### **Agency and crowdsourced mapping**

Finally, we encourage further study and comparison of the means available for entrepreneurs and allies to add Latino-oriented local businesses to digital maps. Rather than passively waiting to be mapped, what are the ways that business owners can exercise agency to put themselves on the map, or opt out if they so choose? All four mapping platforms studied here offer web forms or editing mechanisms for proprietors to add their own businesses. How user-friendly are each of these mechanisms, and in what ways could they be made more accessible to people from a variety of cultural contexts?

While talking with a leader of a business advocacy group in one of the study cities, we learned that she has helped various business owners add their locations into online maps. Such assistance may be a relatively simple thing that these groups can do in order to have a big

impact on the visibility and viability of small businesses. Surveys of business owners could also reveal how many entrepreneurs are aware of how to get themselves onto digital maps.

Due to its crowdsourced nature, the mapping platform with the greatest potential for immediate addition and maintenance of business locations is OSM; however, in our study, this platform consistently had the lowest percentage of businesses across all categories. In larger cities and in other areas of the world, it may be that OSM surpasses the amount of data in commercially produced maps, but this is far from the case in the relatively small US cities that we studied. This follows a pattern observed by Quinn (2017) wherein small cities in OSM were often mapped by an unpredictable mix of passers-by, commercial interests, and bots, rather than a crowd of active mappers with an intimate local knowledge. Even though the number of corporate editors pumping data into OSM has recently quintupled, these organizations are usually focused on adding roads and buildings, rather than points of interest such as businesses (Anderson et al., 2019; Veselovsky et al., 2022).

Although there was not any obvious corporate influence on the OSM points we researched, we did notice that two of the eight contributors who had added Latino-oriented local businesses to OSM happened to be students who took geography courses from one of the authors of this paper several years ago at a rural regional university in the study area. The edits were performed as part of an assignment that required learning OSM and making some updates to the data based on the student's own local experiences. The assignment did not dictate which types of features should be added, nor did it discuss any of the major themes in this paper; the students happened to choose these local businesses from their own knowledge of the areas. Such educational exercises and other similar events that bring new mappers into OSM, such as mapping parties (Hristova et al., 2013), may be catalysts for the inclusion of local businesses that might escape the attention of data uploads, corporate mappers, or nonlocal power users. The teaching of OSM and open geospatial technologies at rural schools may also contribute to the filling in of blank spots on the map.

## **Conclusion**

Although digital maps may be filled with points of interest and return many search results, we found that none of the platforms we studied approached full coverage of all businesses operating on the ground. We found that Latino-oriented local businesses were being mapped less than other businesses, and that under-mapping was an issue for local businesses in general. Businesses in high-Latino areas were also under-mapped compared to businesses in other areas; however, this could be because businesses in high-Latino areas tended to be more local in character. Not all mapping platforms showed a significant difference in this regard.

Large national chain businesses constitute a major source of competition for local businesses. In addition to greater budgets and name recognition, the national chains have a visibility advantage in the digital maps as well. They show up more often than local businesses,

and are often able to promote their many retail outlets with special markers, logo graphics, and name-dropping in the text of turn-by-turn directions.

In this study, Google Maps showed the highest percentage of businesses, followed by Apple Maps and Bing Maps in that order. OSM did not have a strong presence in these cities. The people who did add Latino-oriented local businesses to OSM had either a very small number of changesets or a large amount of experience. At least two of the contributors were mapping as part of an educational exercise.

Although these four map platforms are gathering data at a fast rate, they need to improve at removing out-of-date information. Further studies also need to be conducted on the effects of scale-dependent drawing and search ranking algorithms on the visibility of businesses in these platforms. Local business advocacy groups, especially those associated with the Latino community, could provide training and demonstrations for business owners about how to take advantage of the many avenues that exist for putting themselves on the map. Digital map makers could also try to be aware of ethnic communities that may be under-mapped, and commit additional resources to making sure that recent data has been gathered in their neighborhoods. In the United States, the demographic data and free GIS software that could inform those efforts are widely available.

### **Afterword: Adding the data to OSM**

At the conclusion of the study, we used our research notes and GoPro camera footage to supervise the addition of the inventoried businesses into OSM. Much of this editing work was performed by a geography student familiar with OSM and several of the study cities, using changeset comments and hashtags designed to be transparent to the OSM user community. During the mapping, we regularly monitored our user accounts for messages from other mappers in case people in the communities had questions or feedback about the edits; however, we received no correspondence.

This OSM mapping was intended as a service to the communities where the research was conducted. We felt the data was of more value sitting in the map than locked up in our computer files; nevertheless, we are aware that such a mapping effort could bring a mix of drawbacks and benefits. Possible drawbacks include the possibility that the local OSM community might not have the mappers to keep the new data up to date, the creation of a “patchwork” effect from mapping only sampled areas rather than the entire city, the potential that some information changed between the time of the field inventories and the mapping, and the inability to repeat the study to see how community mapping of these places changed in the future. There is also the possibility a business would prefer to operate by word of mouth only and remain off the map; however, from the literature we studied, this case seems rare. This project only inventoried businesses with street signage or names on the door, so all of the mapped points already had some sort of public exposure.

Possible benefits of the mapping include new visibility and publicity for these businesses in any app where OSM data is used. The edits also improve the utility of the OSM project, especially because these four cities are under-mapped compared to larger ones in this region. This OSM mapping also provides a pattern that future researchers might follow in order to incorporate service mapping components into their projects.

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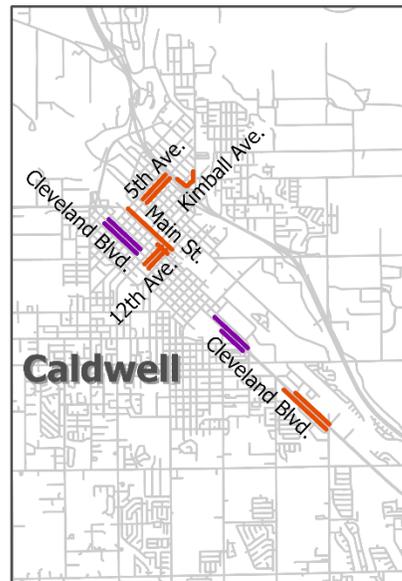
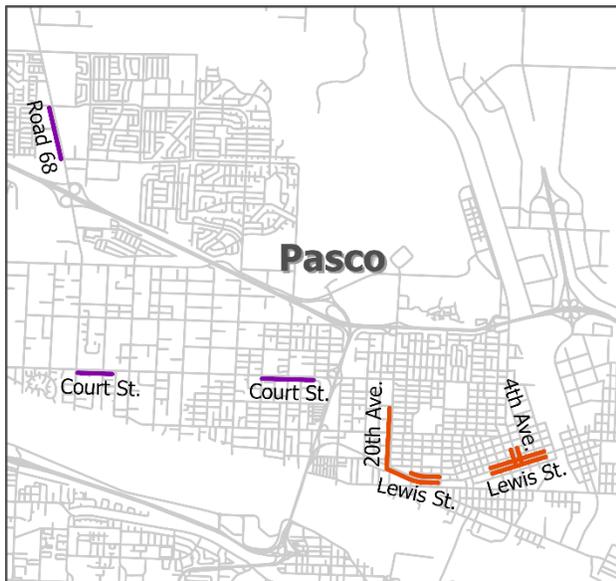
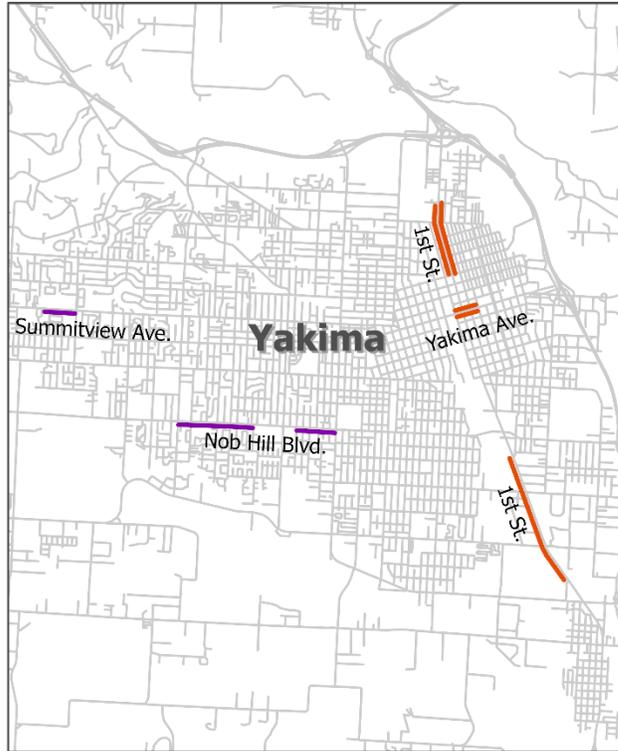
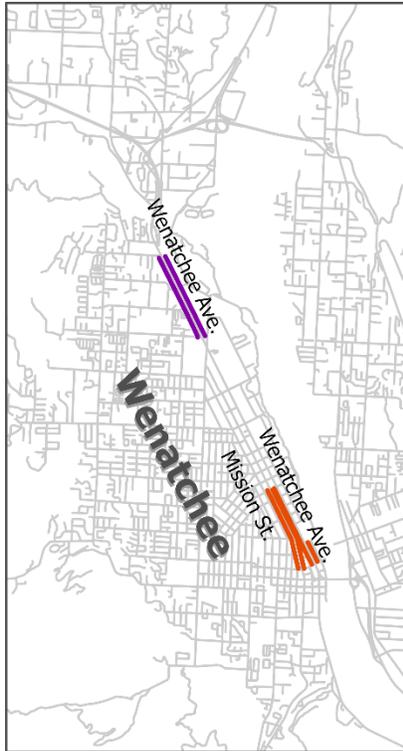
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## Appendix

The following map shows the street segments where the business inventories were taken in each of the four cities.



0 5 Kilometers

- Sampled streets in areas with high percentage of Latino residents
- Sampled streets in other areas

The table on the following page shows the results of the chi-square tests comparing different binary variables among the four map platforms. For readability, it has been placed in the appendix so that it can be of larger size.

	Apple Maps				Bing Maps				Google Maps				OSM			
	Present	Missing	X <sup>2</sup>	p	Present	Missing	X <sup>2</sup>	p	Present	Missing	X <sup>2</sup>	p	Present	Missing	X <sup>2</sup>	p
Latino-oriented local	58	74	5.20	<b>.023</b>	50	82	.008	.928	79	53	3.60	.058	11	121	10.8	<b>.001</b>
All other	268	214			187	295			333	149			103	379		
Latino-oriented local	58	74	1.44	.230	50	82	1.40	.236	79	53	.31	.576	11	121	1.15	.283
Other local	185	181			116	250			231	135			45	321		
High Latino areas	192	191	3.28	.070	133	250	6.02	<b>.014</b>	247	136	2.84	.092	48	335	23.47	<b>&lt;.001</b>
Other areas	134	97			104	127			165	66			66	165		
National chain	83	33	18.66	<b>&lt;.001</b>	71	45	29.68	<b>&lt;.001</b>	102	14	26.96	<b>&lt;.001</b>	58	58	90.92	<b>&lt;.001</b>
Local	243	255			166	332			310	188			56	442		