

Shifting Gears

Framing Bike-sharing Trends in Sun Belt Cities



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EXECUTIVE SUMMARY

While bike-sharing is typically framed as a means of transportation for weekday commuters, a new analysis of the programs in Austin, Denver, Fort Worth, and Houston indicates that users frequently turn to bike-sharing for recreational purposes in these cities. This finding is critical to our understanding of bike-share programs, which are poised to proliferate and expand in the Sun Belt and elsewhere in the coming years.

As planners, policymakers, and program operators throughout the country develop bike-share systems, they can benefit from a richer understanding of how people use bike-share programs in lower-density, automobile-oriented urban environments. However, despite the rise of bike-sharing systems, comparative studies of bike-sharing activity are lacking, particularly for cities in the southern and western United States. To shed light on the role that bike-share systems inhabit in these areas, this study examines bike-sharing trips in Austin, Denver, Fort Worth, and Houston, comparing and visualizing the type and volume of trips in the four cities.

What Is Bike-share?

A growing part of the transportation systems and recreational landscapes of many cities, bike-share systems place rentable bikes at a network of kiosks across a city. Each kiosk consists of several bicycle docks and a pay station. At most hours of the day, users can check out bikes after purchasing a daily pass or a longer-term membership. After riding, users can return their bikes to any kiosk in the network, including the one where they began their rides. The flexibility of these systems allows riders to make trips for a variety of purposes—to commute to work, travel to a restaurant, exercise, run errands, or simply take a relaxing spin. Riders can engage in these pursuits without owning or maintaining a personal bicycle, waiting for transit, or driving a car.

Classifying Bike-share Activity

To differentiate between the many types of rides that bike-share users make, this study groups trips into four categories.

- Weekday two-location trips
- Weekend two-location trips
- Weekday round trips
- Weekend round trips

Two-location trips begin and end at different rental kiosks, while round trips begin and end at the same kiosk. The simple classification scheme provides a better picture of how people use bike-share systems and the individual kiosks within them.

KEY OBSERVATIONS

- In Denver and Austin, more than half of users' trips are weekday two-location trips. Trips of this type are often commuting trips that replace peak-hour trips made by other transportation modes.
- In Fort Worth and Houston, only around one third of trips are weekday two-location trips. The remaining two-thirds of the trips in these cities are round trips or weekend trips, suggesting that these programs cater primarily to recreational users.
- The Austin system generates more two-location trips per kiosk than any of the other three systems in a standard week in January through May.
- The Houston system generates more than twice as many round trips per kiosk than any of the other three systems in a standard week in January through May.
- The overwhelming majority of kiosks in the four cities generate more two-location trips than round trips.
- Round trip activity is concentrated at a handful of kiosks in parks and along trails in the four cities. Many of these kiosks rank among the most heavily-used stations in all four systems.

INTRODUCTION

Urban bike-share programs are on the rise throughout the United States. These programs consist of networks of kiosks—also called docking stations—located throughout a city. Each kiosk functions as an unmanned bike rental facility where prospective users can purchase memberships ranging from 24-hour passes to annual plans. Once registered, members can check out and return bikes at any combination of kiosks in the system. Pricing structures incentivize shorter rides: trips under 30 minutes are typically free beyond the initial use fee. Exact rates vary from system to system, and in some cities—including Houston—the first hour is free.

The flexibility of these systems allows members to travel for a variety of purposes. Members can check out bikes for their weekday commutes, use a bike for an afternoon spin, or circulate through parks on evenings and weekends.

Because bike-share provides a convenient means of transportation, recreation, and exercise, these programs appeal to many urban leaders seeking to build mobile, vibrant, and healthy places. Since 2010, metropolitan areas across the country have introduced bike-sharing programs in their urban cores. Programs currently exist in New York, Chicago, Houston, Philadelphia, Phoenix, San Antonio, San Diego, and San Jose—all cities home to over a million people—as well as dozens of smaller cities. Los Angeles and Atlanta, the two largest U.S. metropolitan areas without bike-share, plan to roll out programs in 2016.

Despite the growing importance of bike-share in rapidly growing metropolitan areas in the southern and western United States, we lack a strong understanding of the role that these systems play in Sun Belt cities. Recent discussions of bike-share focus on programs in dense, transit-oriented cities and increasingly frame bike-share as a novel form of public transportation.¹ New York's Citi Bike, Chicago's Divvy, Washington D.C.'s Capital Bike-share, and Boston's Hubway have garnered a great deal of attention because of their size, popularity, and growing role in weekday commutes. However, because most bike-share research continues to focus on systems in older cities, it remains unclear how individuals make use of bike-share programs in younger, more car-centric urban environments.

Bike-sharing programs are likely to take on different roles in Sun Belt cities because the urban fabric and transportation systems in these cities differ substantially from their Northeastern and Midwestern counterparts. Whereas legacy transit networks and dense development guided urban growth in older, northern cities, Sun Belt metros developed almost exclusively around the automobile. While Sun Belt cities have invested heavily in developing walkable, bikeable, transit oriented urban cores in recent decades, these cities remain far less dense and more car-dependent than cities like Washington, D.C. and Chicago. Given the significant physical and infrastructural differences, there is reason to believe that residents of Sun Belt cities might utilize bike-sharing programs differently than Chicagoans or District residents, even if the programs in their cities one day grow as large as Divvy or Capital Bikeshare.

This study, the first of several to be released by the Kinder Institute in the coming months, seeks to advance the understanding of the dynamics already at play in Sun Belt bike-share systems. Subsequent studies will examine kiosk characteristics and network dynamics more thoroughly.

¹Josh Cohen, "Seattle DOT Takes Over Bike-Share, Plans Major Expansion," *Next City*, October 6, 2015, <https://nextcity.org/daily/entry/seattle-dot-runs-bike-share-pronto-plans-major-expansion>.

Lindsay Lazarski, "How smaller cities should think differently about bike share," *Keystone Crossroads*, April 28, 2015, <http://crossroads.newsworks.org/index.php/local/keystone-crossroads/81227-how-smaller-cities-should-think-differently-about-bike-share>.

Susan Shaheen, Elliot Martin, Adam Cohen and Rachel Finson. *Public Bikes Sharing in North America: Early Operator and User Understanding*. Mineta Transportation Institute, 2012. Accessed November 1, 2015. <http://transweb.sjsu.edu/PDFs/research/1029-public-bikes-sharing-understanding-early-operators-users.pdf>

Toole Design Group and the Pedestrian and Bicycle Information Center. *Bike Sharing in the United States: State of the Practice and Guide to Implementation*. U.S. Department of Transportation, 2012. Accessed November 1, 2015.

The Case Studies

This report examines and compares the range of bike-sharing activity occurring in Austin, Denver, Fort Worth, and Houston. The Kinder Institute initially partnered with Houston Bike Share as a part of Rice University's involvement with the MetroLab Network, in which local and regional governments collaborate with university researchers to develop strategies for improving metropolitan infrastructure and services. To facilitate a richer understanding of bike-share activity throughout the Sun Belt, the Kinder Institute acquired comparable datasets from the the bike-share organizations in Austin, Denver, and Fort Worth in addition to Houston.

While the bike-sharing organizations in the four cities all contract with the same vendor—BCycle—the four programs are at different stages of development.

- *Denver's bike-share program* is the oldest, largest, and most utilized of the four systems. After a temporary program debuted during the 2008 Democratic National Convention in the city, the program formally launched in April 2010 with 40 stations. By the spring of 2014, the period considered for Denver in this report, the program had expanded to 83 kiosks. The bulk of the stations are found in and around the central business district, Union Station, and the Colorado State Capitol; others are located near light rail stations, creeks, and parks in the surrounding neighborhoods, as well as by the University of Denver.
- *Houston's bike-share program* began operation in May 2012 with only three stations. Thought the program was initially framed as a way for people to travel quickly within the downtown area, it gradually expanded into adjacent neighborhoods. Operators added stations around the light rail line running through the city's rapidly developing (and densifying) downtown, Midtown, and Museum District areas, and also placed stations in and around parks, community centers, and other amenities slightly further from downtown. By the spring of 2015—the period considered for Houston in this report—the system had 29 kiosks, fewer than any of the other three systems. The pricing structure of the Houston program also differs from the norm. While most bike-share programs charge members incremental usage fees for trips over 30 minutes, the Houston program allows its members to ride for a full hour at no additional charge.
- *Fort Worth's bike-share program* opened in April 2013. In the spring of 2015, the system encompassed 34 stations. Several stations are located in Fort Worth's downtown; another handful are around Trinity Park and the cultural district to the west. On the outskirts of downtown, there are several kiosks near the T & P Station and the Intermodal Transportation Center, two heavy rail stations served by the commuter line that connects downtown Fort Worth with downtown Dallas by way of the DFW airport. A few docking stations are also located along "restaurant row" in the neighborhood just south of downtown, and two kiosks flank the campus of Texas Christian University.
- *Austin's bike-share program* is the youngest of the four systems; it rolled out in December 2013. In the spring of 2015 the system consisted of 46 stations. The city's system is oriented around its major downtown activity nodes including the University of Texas, the Texas State Capitol and government complex, and the downtown entertainment area anchored by East and West Sixth Street and Rainey Street. It also stretches to include the popular shopping and dining area on South Congress Boulevard. Finally, Austin's system links into the popular hike-and-bike trail alongside Ladybird Lake, connects to the performing arts center, and ties into the popular Zilker Park.

Using trip data from the bike-share organizations in the four cities, this report examines the bike-sharing activity that occurs in each city during a standard week. All analysis and numbers presented in this report reflect the activity in the each city's composite week—a representative week comprised of the average Sunday in the period considered for each city, the average (non-holiday) Monday in the period considered, the average Tuesday, and so on. This study considers Austin and Houston trips made between January 3, 2015 and May 31, 2015; Fort Worth trips made between January 3, 2015 and May 10, 2015; and Denver trips made between January 4, 2014 and May

31, 2014. Additional information about the datasets and the construction of the composite weeks can be found in the methodology section of the appendix.

Figure 1: Size, Age, and Activity of Four Sun Belt Bike-share Systems

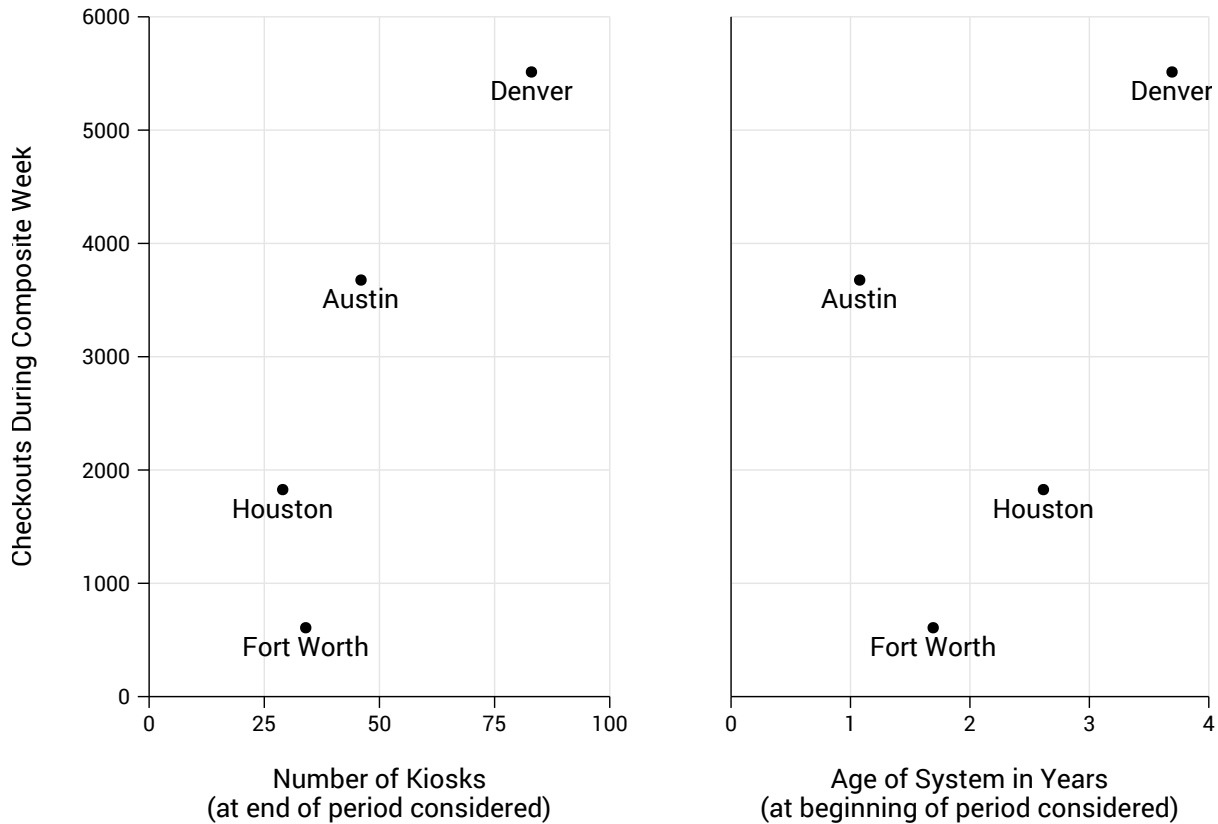


Figure 1 shows the number of trips observed during standard weeks in each of the four systems, with respect to their size and age. While activity generally appears to increase with system size and age, Houston generates more trips than Fort Worth, even though its network is comprised of fewer kiosks. Likewise, Austin's system is already generating far more checkouts per week than either Fort Worth or Houston despite its more recent founding.

Classifying Bike-share Activity

To evaluate how bike-share members use the four Sun Belt systems, this study classifies bike-sharing trips in two ways. The study distinguishes between weekday and weekend trips and between two-location trips and round trips. While two-location trips begin and end at different kiosks, round trips begin and end at the same kiosk. These two distinctions create four types of trips, which correspond with different purposes and activities:

- *Weekday two-location trips* are the most likely to be work-related and the least likely to be recreational. Because many trips of this type are made by commuters, these trips are the most likely to replace peak-hour trips made by other modes of transportation.
- *Weekday round trips* can occur for both work-related and recreational purposes. Just as some users make these trips to grab lunch and return to work, others make them to ride through a park for fun or exercise.
- *Two-location weekend trips* are less likely to be work-related and more likely to be recreational. These trips often take riders to, from, and between urban amenities and attractions, replacing weekend travel that might otherwise be made via other modes of transportation.
- *Weekend round trips* are the most likely to be made purely for recreation or exercise. These trips are the least likely to supplant transit and automobile trips.

BIKE-SHARING ACTIVITY IN FOUR SUN BELT CITIES

How does bike-sharing activity vary across systems?

Comparing the composition of trips in each system reveals stark differences in bike-sharing activity between Denver and Austin on one hand and Houston and Fort Worth on the other.

- *Denver and Austin*, the systems with the most total activity, also have the most commuter-oriented systems. In both cities, the majority of trips are weekday two-location trips, and less than 15 percent of trips are round trips.
- *Houston and Fort Worth* experience much higher percentages of round trips and weekend trips, which are presumably more recreational. In these two Texas cities, no particular type of trip accounts for more than a third of all bike-sharing activity.

Comparing the volume of the four trip types in each system reveals additional differences between the four systems.

- *Denver and Austin* kiosks witness a greater volume—in addition to a greater percentage—of checkouts for two-location trips during the standard week.
- *Austin* generates the greatest of two-location trips per kiosk; the city's edge over Denver stems from its larger volume of weekend two-location trips.
- *Houston* generates more than twice as many round trips per kiosk as any of the other three cities. Its round trips are split evenly between weekdays and weekends.

Figure 2: Weekly Trip Composition in Four Sun Belt Cities

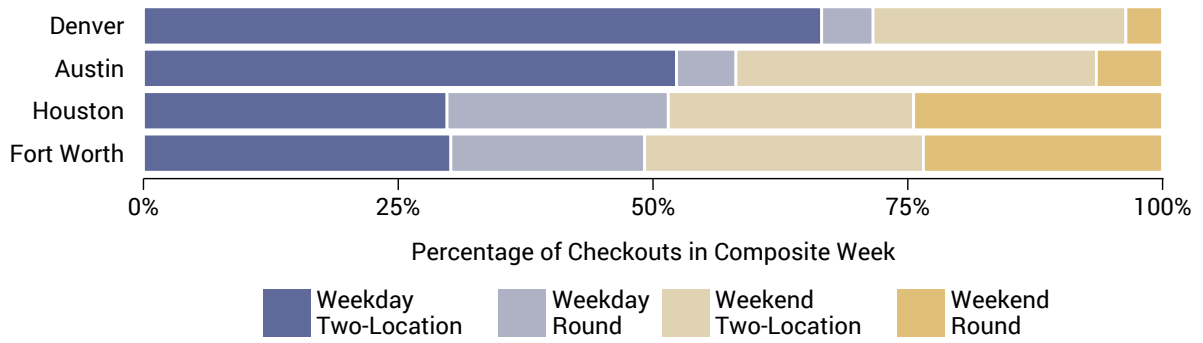


Figure 2 displays the composition of trips during a standard week in each city. While the majority of trips in Austin and Denver are two-location weekday trips, only about a third of trips in Fort Worth and Houston belong to this category.

Figure 3: Weekly Two-location Trips per Kiosk in Four Sun Belt Cities

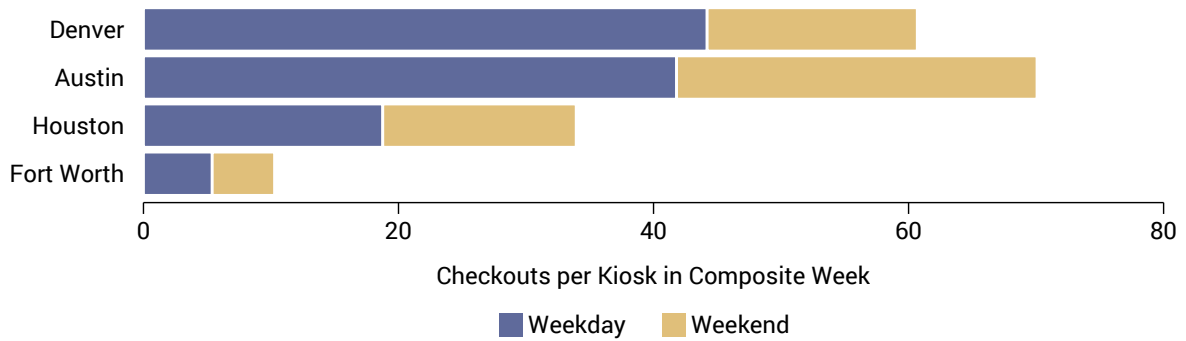


Figure 3 displays the volume of two-location trips in a standard week in the four cities. Austin generates more two-location trips per kiosk than any of the other cities. Its edge over Denver stems from its larger volume of weekend two-location trips.

Figure 4: Weekly Round Trips per Kiosk in Four Sun Belt Cities

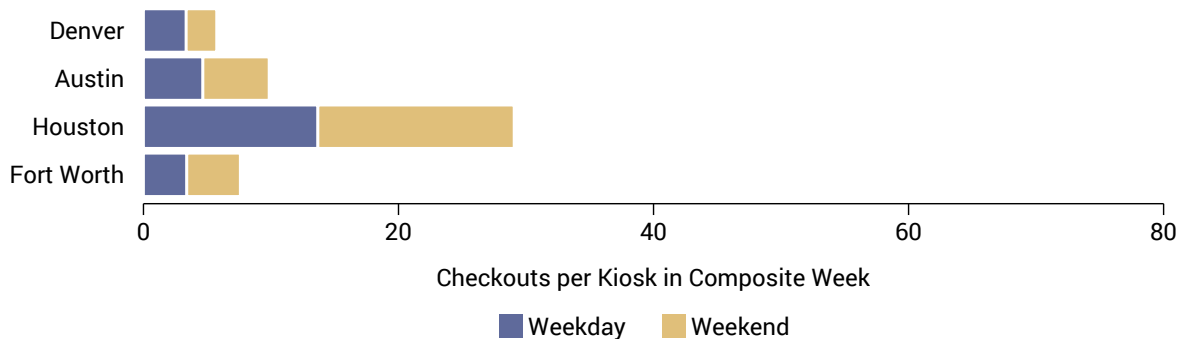


Figure 4 displays the volume of round trips in a standard week in the four cities. Houston experiences more than twice as many round trips per kiosk as any of the other three cities. Its round trips are split evenly between weekdays and weekends.

How does bike-sharing activity vary across kiosks?

The classification scheme also provides a way to describe and understand the use of individual kiosks within a system. Four system maps—Figures 5-8—illustrate the type and volume of activity at individual kiosks within each network. These maps show the four systems at the same scale, allowing the reader to visually compare the size and station density of the bike-sharing networks. (Larger, labeled maps and figures showing the percentage and volume of each trip type at each kiosk can be found in the appendix.) The size of each station's circle is proportional to the total volume of bike-sharing activity at the kiosk in the composite week; the size scale is also consistent across the four maps. The color of each station represents the percentage of checkouts that result in two-location trips. Stations that generate far more two-location than round trips are shown in dark blue; at least 84 percent of the trips that begin at these stations are two-location trips. Stations that generate mostly round trips, in contrast, are shown in bright yellow.

Figure 5: Map of Weekly Bike-sharing Activity in Austin

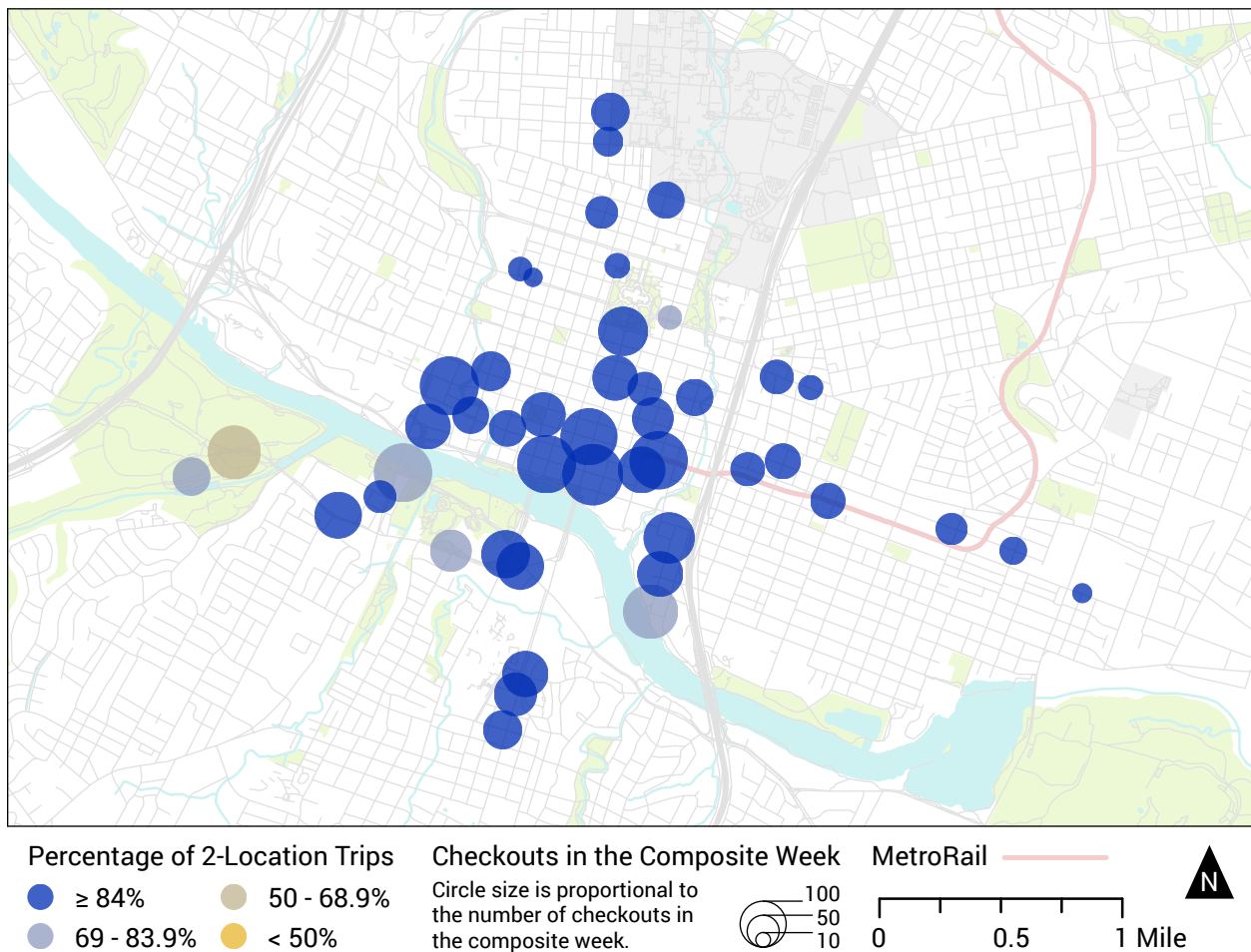
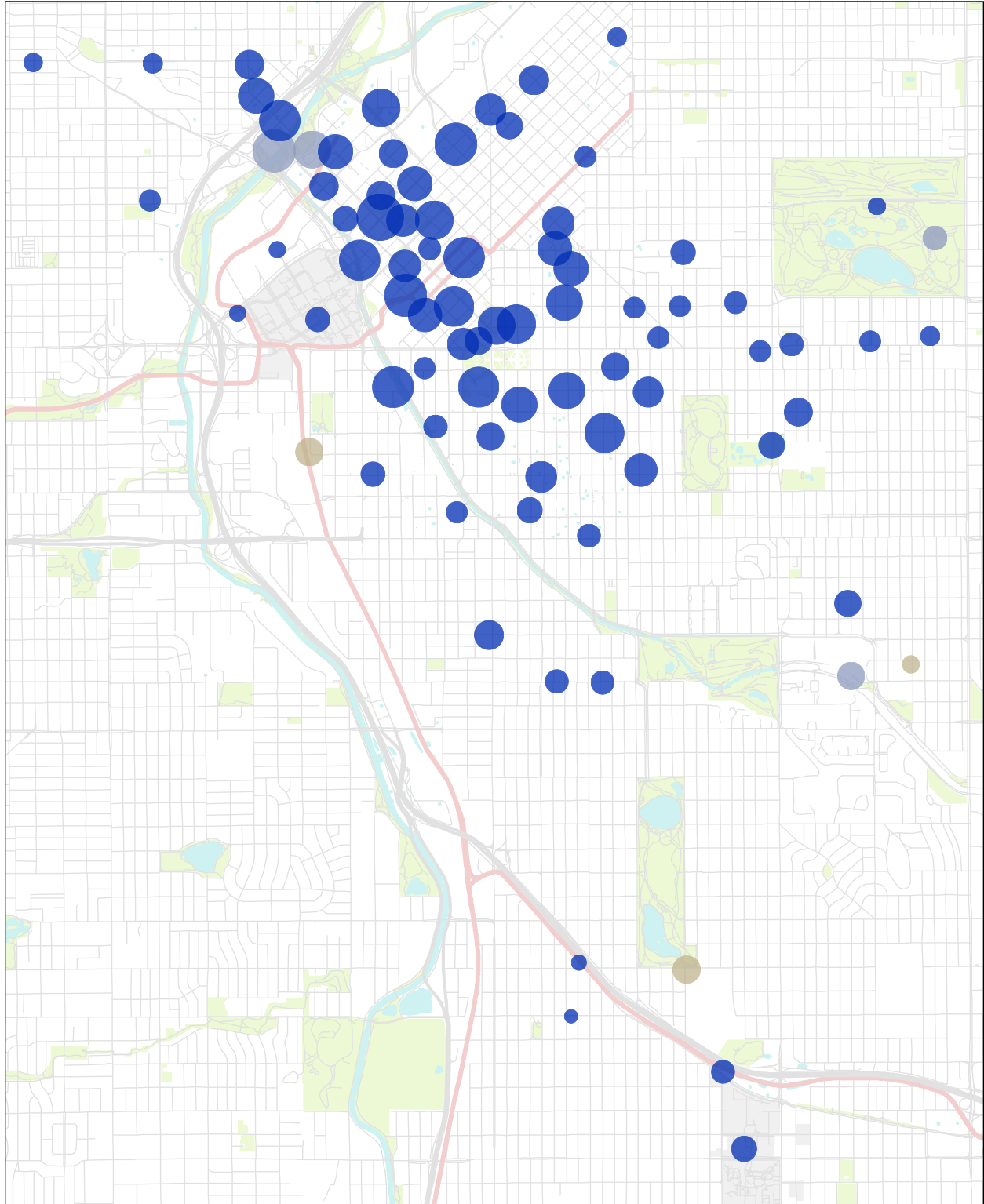


Figure 6: Map of Weekly Bike-sharing Activity in Denver

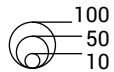


Percentage of 2-Location Trips

- $\geq 84\%$
- 69 - 83.9%
- 50 - 68.9%
- $< 50\%$

Checkouts in the Composite Week

Circle size is proportional to the number of checkouts in the composite week.

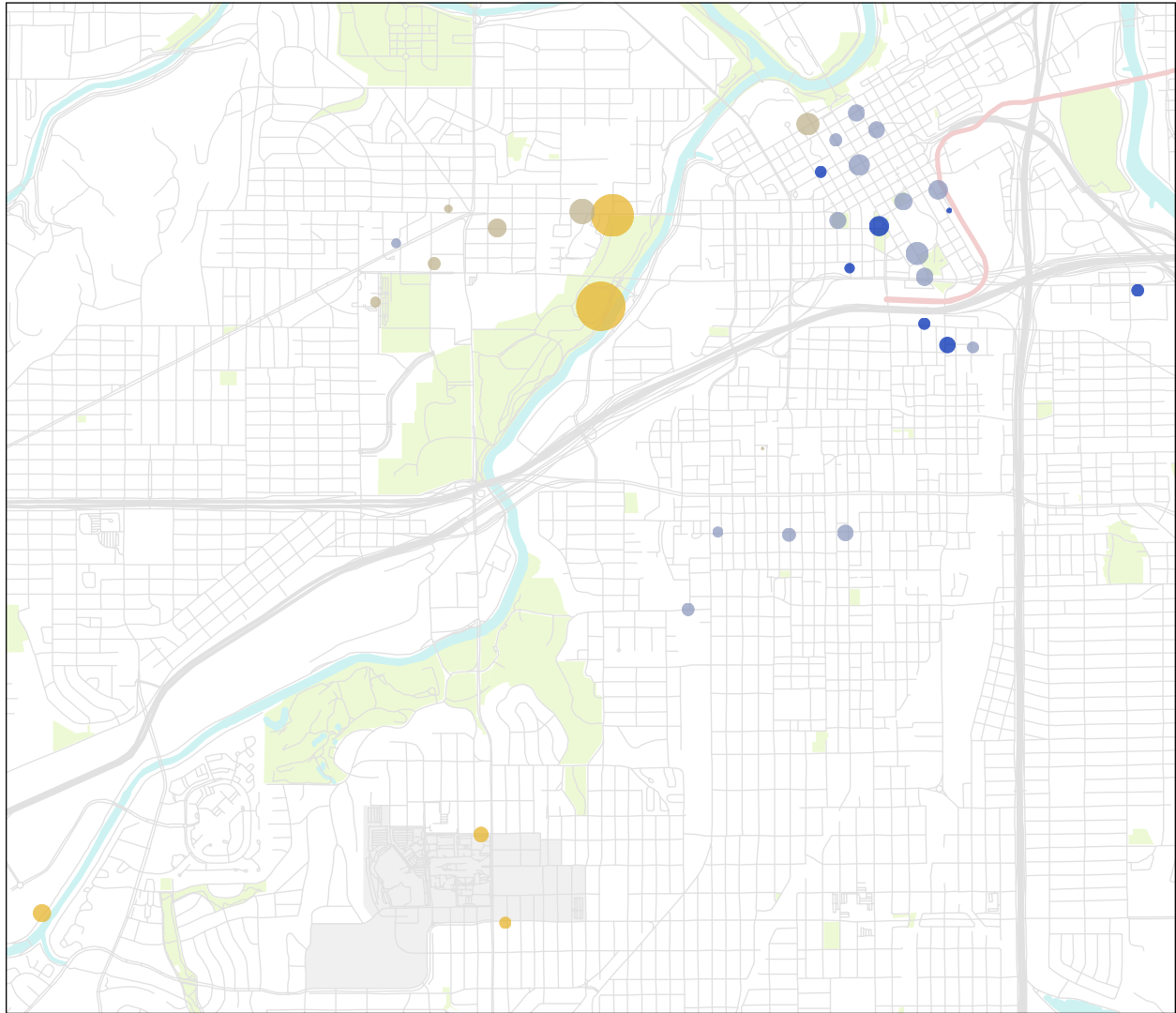


Light Rail



0 0.5 1 Mile

Figure 7: Map of Weekly Bike-sharing Activity in Fort Worth



Percentage of 2-Location Trips

- ≥ 84%
- 69 - 83.9%
- 50 - 68.9%
- < 50%

Checkouts in the Composite Week

Circle size is proportional to the number of checkouts in the composite week.

- 100
- 50
- 10

Trinity Rail —

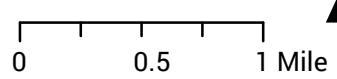
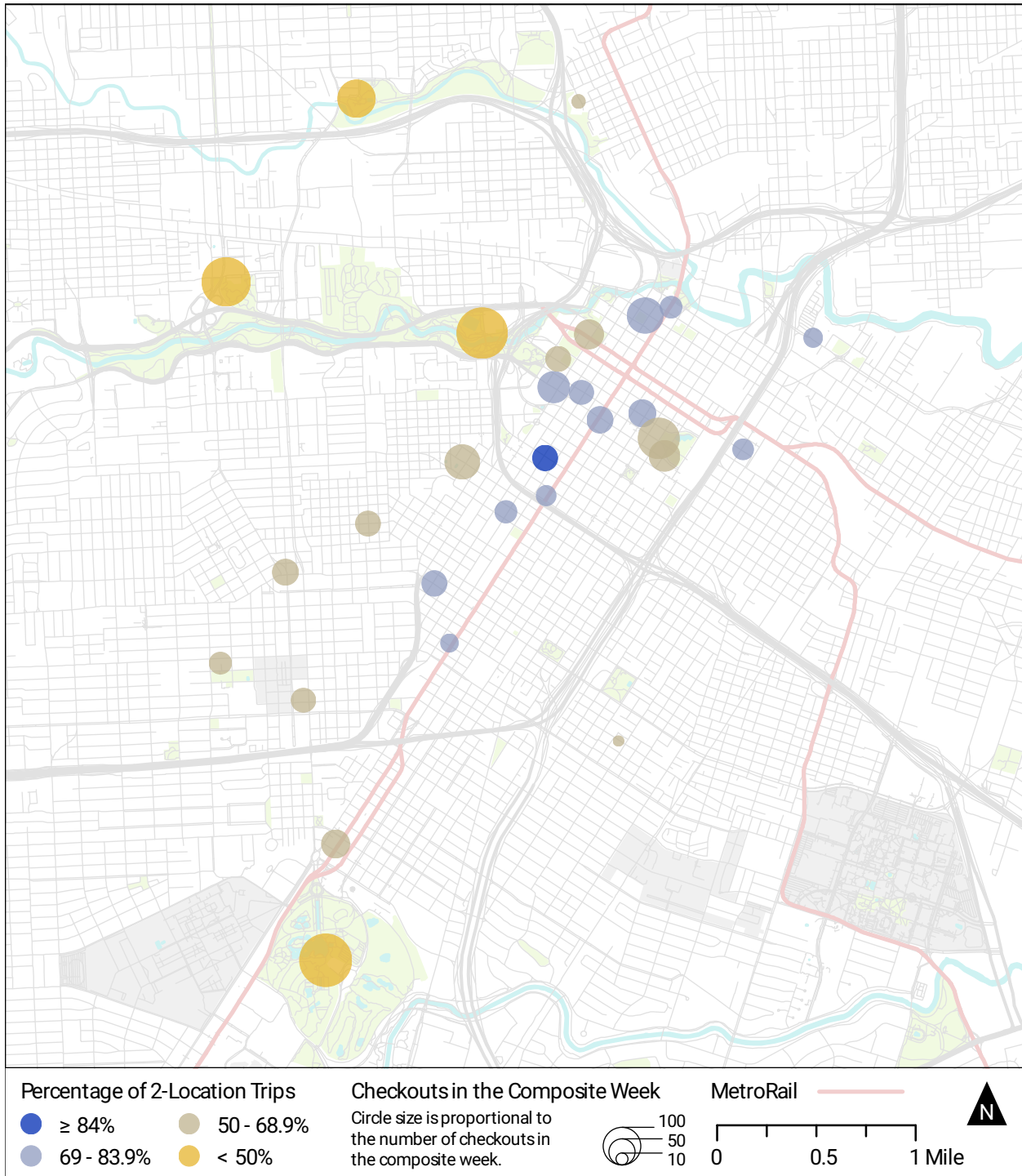


Figure 8: Map of Weekly Bike-sharing Activity in Houston



Examining the activity at individual kiosks reveals that the overwhelming majority of docking stations generate more two-location trips than round trips. In Denver and Austin, every bike-share kiosk generates more two-location trips than round trips. Moreover, the vast majority of kiosks in these two cities generate more than five times as many two-location trips as round trips. While most of the kiosks in Fort Worth and Houston also generate more two-location trips than round trips, kiosks that generate such a high proportion of two-location activity are rare in these cities.

- *Austin.* Every kiosk generates more two-location trips than round trips. At 40 of 46 kiosks, checkouts result in two-location trips more than 84 percent of the time.
- *Denver.* Every kiosk generates more two-location trips than round trips. At 76 of 83 kiosks, checkouts result in two-location trips more than 84 percent of the time.
- *Fort Worth.* All but five of 34 kiosks generate more two-location trips than round trips. At seven kiosks, checkouts result in two-location trips at least 84 percent of the time.
- *Houston.* All but four of 29 kiosks produce more two-location trips than round trips. Only one kiosk—the Tellepsen YMCA station downtown—generates checkouts for two-location trips more than 84 percent of the time.

Round trip activity is concentrated at a small number of kiosks across the four systems. Of the almost 200 bike-sharing kiosks across the four systems, only nine generate more round trips than two-location trips.

- *Austin.* At six of the system's 46 kiosks, checkouts result in round trips more frequently than elsewhere in the network. Checkouts from these stations result in round trips at least 16 percent of the time, and these six kiosks account for just under a third (32 percent) of all round trips in Austin.
- *Denver.* At seven of the network's 83 kiosks, checkouts result in round trips more frequently than elsewhere in the system. These seven kiosks, the only ones in the city at which checkouts result in round trips at least 16 percent of the time, generate a quarter (25 percent) of all round trips in Denver.
- *Fort Worth.* Five of 34 kiosks generate more round trips than two location trips. This group accounts for more than three-fifths (63 percent) of the round trips in the city.
- *Houston.* Four of 29 kiosks generate more round trips than two-location trips. These four kiosks account for slightly more than half (55 percent) of the round trips in Houston.

Many of the round-trip oriented kiosks are located in and around parks, trails, and waterways. Moreover, many of these kiosks—and especially those in the Texas cities—account for more trips than the kiosks that see more two-location trips.

- *Austin.* The six most round-trip oriented kiosks are all within a block of a park along a creek, river, or lake. Three of these six kiosks—those at Lamar Bridge, Zilker Park, and the intersection of Rainey Street and Cummings Street—are in the top fifth of Austin stations in terms of total checkouts.
- *Denver.* The seven most round trip-oriented kiosks are all within three blocks of a park, trail, or waterway. In contrast to the other networks, these kiosks do not stand out for their popularity. Only two of the seven stations—those outside REI and at 16th Street and Little Raven Street—fall in the top quintile of Denver kiosks in terms of checkouts.

- *Fort Worth.* Three of the five most round-trip oriented kiosks are located in parks or near trails along the Trinity River, and the other two are at the periphery of the Texas Christian University campus. The two kiosks in Trinity Park are the two most popular stations in the Fort Worth network and account for more than a third of all bike-sharing checkouts in the city.
- *Houston.* The four most round-trip oriented kiosks are in parks connected to city's bayou network. These four kiosks rank among the five most productive kiosks in Houston in terms of checkouts, and two of these stations—the Hermann Park and Sabine Bridge kiosks—are the most popular across all four systems.

The popularity of the round trip oriented kiosks stands in direct contrast to trends observed at the system level. While the systems with a larger percentage of round trips (Houston and Fort Worth) see less ridership per kiosk and overall, the kiosks that generate a large fraction of round trips are among the most productive across the four systems.

DRAWING CROSS-CITY COMPARISONS

Many challenges arise when comparing bike-sharing systems across cities. Because the four cities and the bike-sharing programs within them differ from one another in many respects, it is unclear whether the four bike-share systems experience different levels and types of activity because of differences in network configuration, contextual factors, or sheer size.

The number of kiosks in each network presumably accounts—at least partially—for the greater volumes of two-location trips per kiosk observed in Denver and Austin. Because the Denver and Austin programs are bigger than the programs in Houston and Fort Worth, bicyclists have more options regarding where to return their bikes. In Denver, a bike-share user can complete a two-location trip to 82 other kiosks. In Houston the number drops to only 28. Because Denver has almost three times as many kiosks as Houston, the average Denver kiosk presumably connects people with more destinations of interest than the average Houston kiosk.

Infrastructure and perceptions of safety may also contribute to the stark differences in two-location trips between Austin and Denver on one hand, and Fort Worth and Houston on the other. Denver and Austin ranked higher than Houston and Fort Worth on the Bike Score index², a metric designed to measure how conducive places are for cycling. While rankings are computed for cities in their entirety, rather than for the specific areas in which bike-sharing systems operate, the rankings suggest that bicycling is easier and safer in Austin and Denver. Accordingly, existing and prospective bike-share users in Austin and Denver may have fewer qualms about cycling along city streets—a required component of most two-location trips—than their counterparts in Houston and Fort Worth.

Neither the number of kiosks nor the perceived bikeability fully account for the different levels of two-location trips observed at the average kiosk in each city. Austin has fewer bike-share kiosks and received a lower Bike Score than Denver, yet its bike-sharing kiosks produce more two-location trips. Austin's edge over Denver in ridership per kiosk may be a function of the weather in the two cities. This report only considers trips made between January and May, and winter bike rides are presumably more comfortable in Austin than in Denver.

It is likewise challenging to attribute Houston's large number of round trips to a single factor. The Houston network may generate more round trips per kiosk because the network has fewer stations clustered together than other systems. For instance, Houston has only one kiosk in Hermann Park, while Denver operates two in City Park. The numbers of bike-sharing kiosks notwithstanding, these green spaces offer strikingly similar programming and amenities. Presumably, the trips that begin and end in Hermann Park closely resemble those that begin and end in City Park. However, these trips can be classified differently. Because Houston's Hermann Park Lake

²Rachel Musiker. *Bike Score 2015 Supplemental Data: Full Ranking and New Cities*, Redfin Research Center, 2015. Accessed November 1, 2015. <https://www.redfin.com/research/reports/special-reports/2015/bike-score-2015-supplemental-data-full-ranking-and-new-cities.html#.Vjzxo7erTIU>

Plaza station is the only kiosk within the park, all trips that begin and end in the park are necessarily round trips. Trips between the two kiosks in City Park, however, are classified as two-location trips.

At the same time, Houston's bike-sharing program may generate more round-trip activity because of the city's efforts to provide residents and visitors with infrastructure for active recreation. Elected officials, residents, and philanthropists have displayed an impressive commitment to developing Houston's system of parks and trails in recent years, committing to building one of the largest urban trail systems in the United States. Houston BCycle has directly tied itself to this expanding network by placing several kiosks in and around reinvigorated urban greenspace.

CONCLUSION

Sun Belt cities have produced a diverse set of bike-share programs. Just as the programs in Chicago and New York operate differently based on a number of factors from cost to kiosk location, so too do Sun Belt bike-share systems possess unique characteristics. Often we assume that cities with similar climates, built environments, or political bents will likewise share common approaches to infrastructure, transportation, or investment in parks. This approach leads to the creation of one-size fits all policy choices that ignore localized differentiations and on-the-ground realities.

In the coming years, bike-sharing programs around the country will proliferate and expand. Los Angeles and Atlanta - the two largest U.S. metros without bike-share - plan to roll out programs in 2016. Likewise, the bike-sharing organization in Houston will use funds from the Houston-Galveston Area Council to more than triple the size of the network in the next 18 to 24 months. And Seattle's Department of Transportation is applying for federal grants to expand its bike-share system. Given the pressing need for alternative modes of transportation in some automobile-oriented cities, these developments hold great promise.

As cities design and implement larger bike-share programs, they will naturally look to existing programs for inspiration. Planners will closely examine the systems they deem successful, find design strategies that appear to underpin these systems' success, and implement these strategies in their own cities. This practice is well-intentioned: planners should learn as much as they can from cities confronting similar challenges and pursuing similar goals.

But if the design strategies we implement depend upon the systems we deem successful, we should reconsider how we define and quantify success. With bike-share, as with many other programs, it is tempting to focus on those systems with the largest numbers. However, Sun Belt cities should pause before they model their new and expanding bike-share systems after more established programs in the Northeast and Midwest that generate the most total activity today. We cannot say whether the impressive levels of bike-sharing activity in New York and Chicago stem from effective design decisions, the sheer size of the networks, or the dense, transit-oriented fabric of the cities they inhabit. Moreover, cities like Houston and Fort Worth have created systems with high levels of recreational use. In the Sun Belt, pursuing the bike-share model forwarded by Chicago or Washington D.C. may not necessarily build on this strength. While bike-share operators in Sun Belt cities should learn from systems in other cities, they should also not ignore their existing strengths.

Moving forward, planners and operators of bike-share systems must take contextual factors and system size into account when evaluating bike-sharing programs in different cities. It will not be easy, by any means, to control for the wide array of factors that might influence transportation choices in urban areas. But by understanding their own systems' strengths and identifying systems in comparable environments that perform well for their size, planners and operators of growing bike-sharing networks can begin to tease out the practices in network configuration, kiosk placement, and system design that will serve their cities most effectively.

APPENDIX

Methodology

The bike-share organizations in Austin, Houston, and Fort Worth provided records of all trips that took place between January and May of 2015. The datasets specify the date, the kiosk from which the bike was checked out, the kiosk to which the bike was returned, and the checkout and return times of each bike-sharing trip that took place during the period. Trip data from 2015 were not available for Denver, so data from January through May of 2014 were used instead.

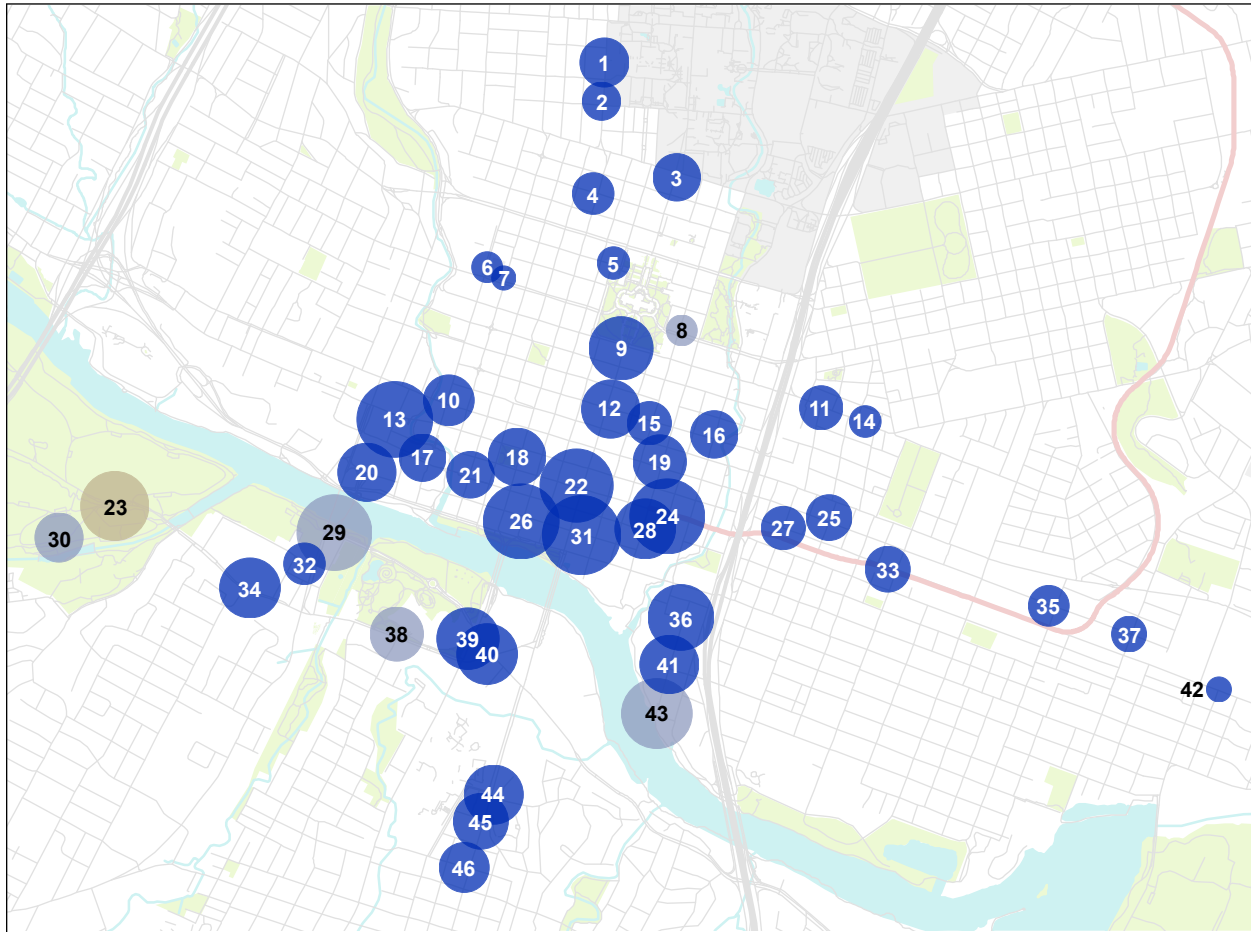
In the Austin, Houston, and Denver systems, bike-sharing trips from the full five-month period were included in analysis. A slightly shorter time period was adopted for Fort Worth. While the number and configuration of bike-share kiosks remained relatively consistent over the five-month period in the Houston, Austin, and Denver systems, Fort Worth introduced eight new kiosks midway through May. Because the change occurred so late in the five-month period, and it significantly altered the configuration of the network, this report includes only the trips that occurred before the roll-out of the new stations.

Two types of trips were tossed out of each dataset. First, all trips with a duration of less than two minutes were excluded from analysis. Records of these extremely short trips were suppressed in the data provided by Houston Bike Share, so they were ignored in the other cities as well. Second, trips completed on federally recognized holidays were thrown out. This report relies heavily on the distinction between weekday and weekend trips; holiday trips do not fit neatly into this classification scheme. Trips completed before the first weekend January were likewise excluded, as many workers take the first few weekdays of the year as vacation.

Because certain dates were excluded from analysis, different days of the week were represented unevenly in the trimmed dataset. For instance, the cleaned dataset from Houston contained trip data from 21 Sundays but from only 18 Mondays. To adjust for the discrepancy, trips that occurred on underrepresented days of the week factored more heavily into weekly ridership estimates. This study constructed a representative composite week by aggregating day-specific ridership averages. Simply put, the composite week consists of the average Sunday, the average Monday, the average Tuesday, and so on.

The trips to and from new stations also factored more heavily into the composite week. The systems remained relatively consistent over the time periods considered, but each system introduced one or two new stations over the course of the period. To develop consistent estimates for the weekly ridership at the new stations, the observed trips to and from these kiosks were weighted by the ratio of the total number of original-kiosk trips and the number of original-kiosk trips completed after the new kiosk was introduced. The exact weights were specific to the day of the week. In effect, this methodology estimated the trips that the new kiosks would have generated and attracted, had they been active for the full time period.

Figure 9: Labelled Map of Weekly Bike-sharing Activity in Austin

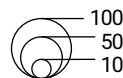


Percentage of 2-Location Trips

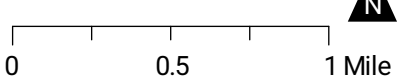
- ≥ 84%
- 69 - 83.9%
- 50 - 68.9%
- < 50%

Checkouts in the Composite Week

Circle size is proportional to the number of checkouts in the composite week.



MetroRail



17th & Guadalupe	4	Convention Center -	16
2nd & Congress	31	3rd & Trinity	18
3rd & West	17	Convention Center -	29
4th & Congress	22	4th at MetroRail	44
5th & Bowie	13	Davis & Rainey	46
5th & San Marcos	27	E. 11th & San Marcos	45
8th & Congress	12	E. 11th at Victory Grill	15
ACC - Rio Grande & 12th	7	E. 6th & Pedernales	37
ACC - West & 12th	6	E. 6th & Robert Martinez	35
Barton Springs & Kinney	34	Guadalupe & 21st	2
Barton Springs		Long Center	39
& Riverside	40	Nueces & 3rd	21
Barton Springs Pool	30	Palmer Auditorium	38
Bullock Museum	3	Pflugler Bridge	20
Capital Metro HQ	42	Plaza Saltillo	33
Capitol Station	9	Rainey & Cummings	43
City Hall	26	Rainey & River	41
		Red River & 8th	16
		Republic Square	18
		Riverside & S. Lamar	29
		S. Congress & Academy	44
		S. Congress & Elizabeth	46
		S. Congress & James	45
		San Jacinto & 8th	15
		State Capitol -	
		14th & Colorado	5
		State Capitol -	
		San Jacinto & 12th	8
		Toomey & S. Lamar	32
		Trinity & 6th	19
		UT West Mall	1
		Waller & 6th	25
		West & 6th	10
		Zilker Park	23

Figure 10: Weekly Trip Composition at Austin Kiosks

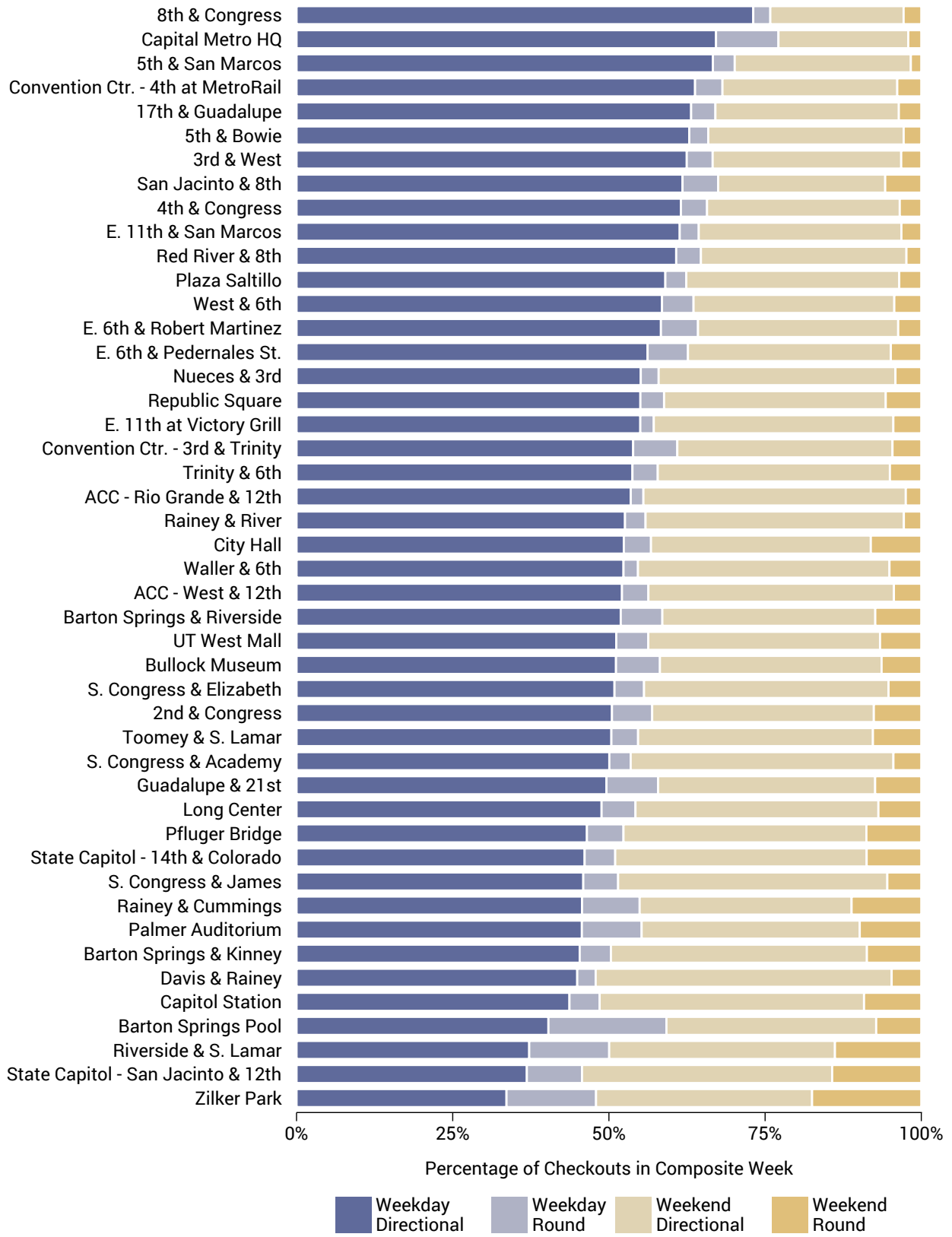


Figure 11: Weekly Two-location Trips at Austin Kiosks

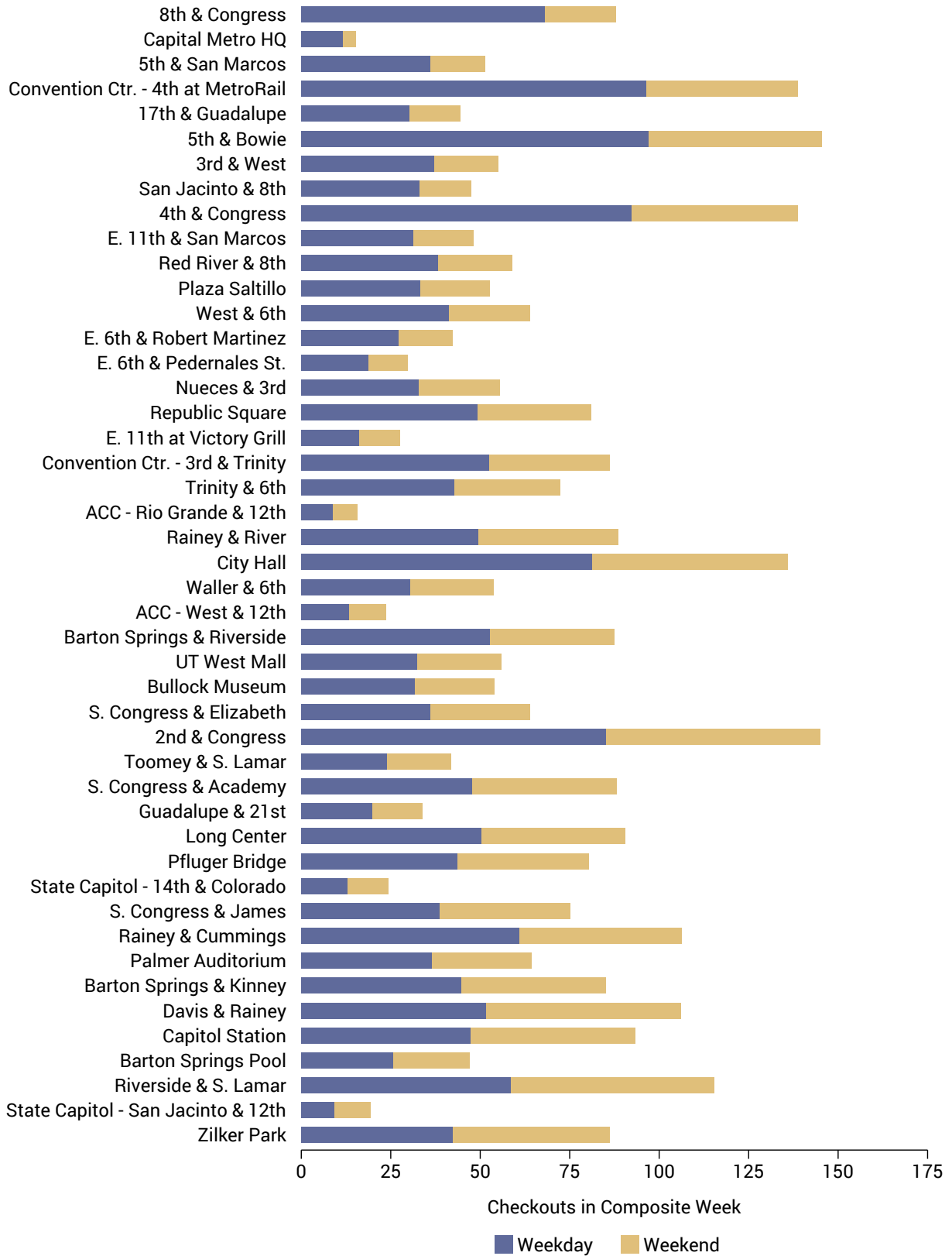


Figure 12: Weekly Round Trips at Austin Kiosks

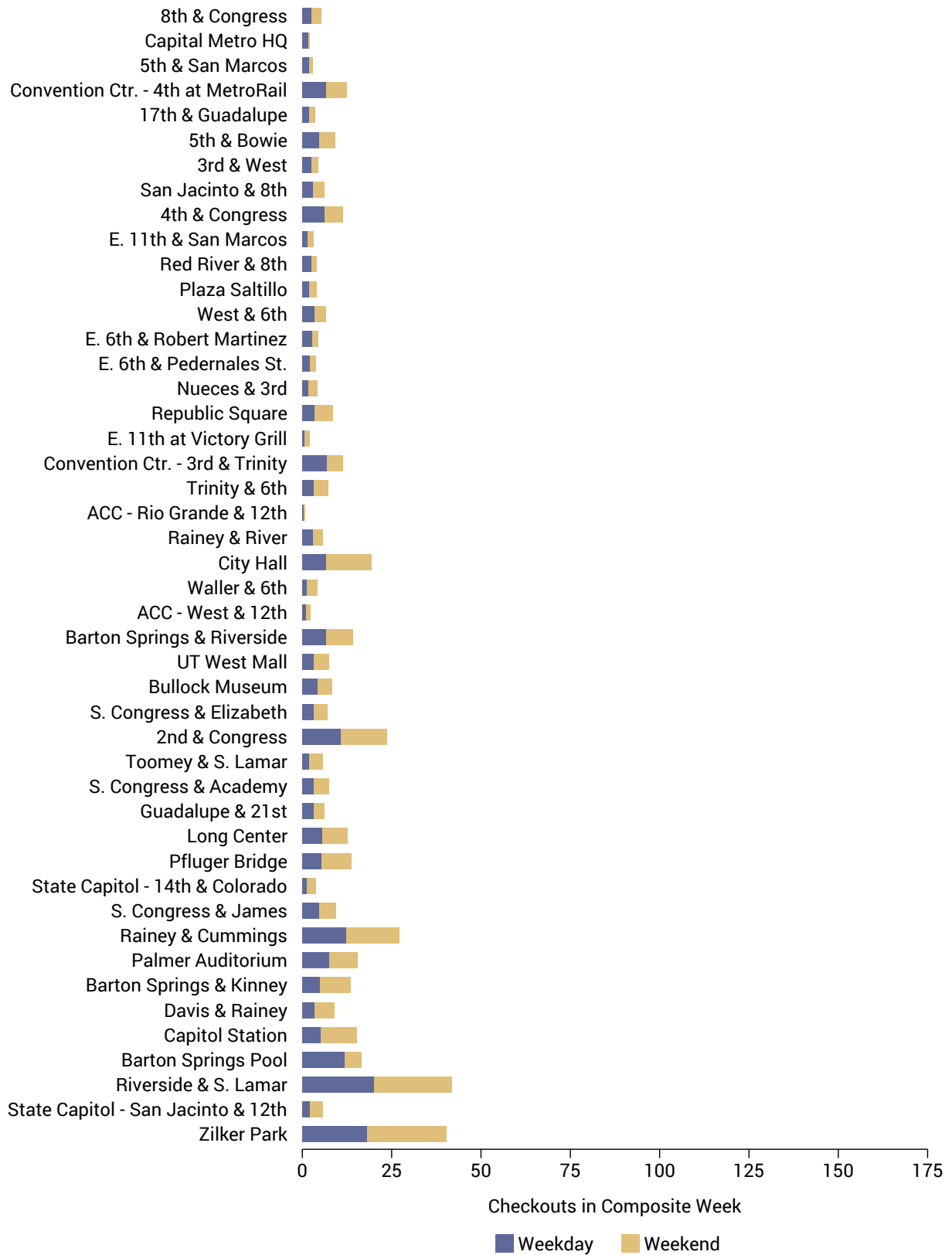
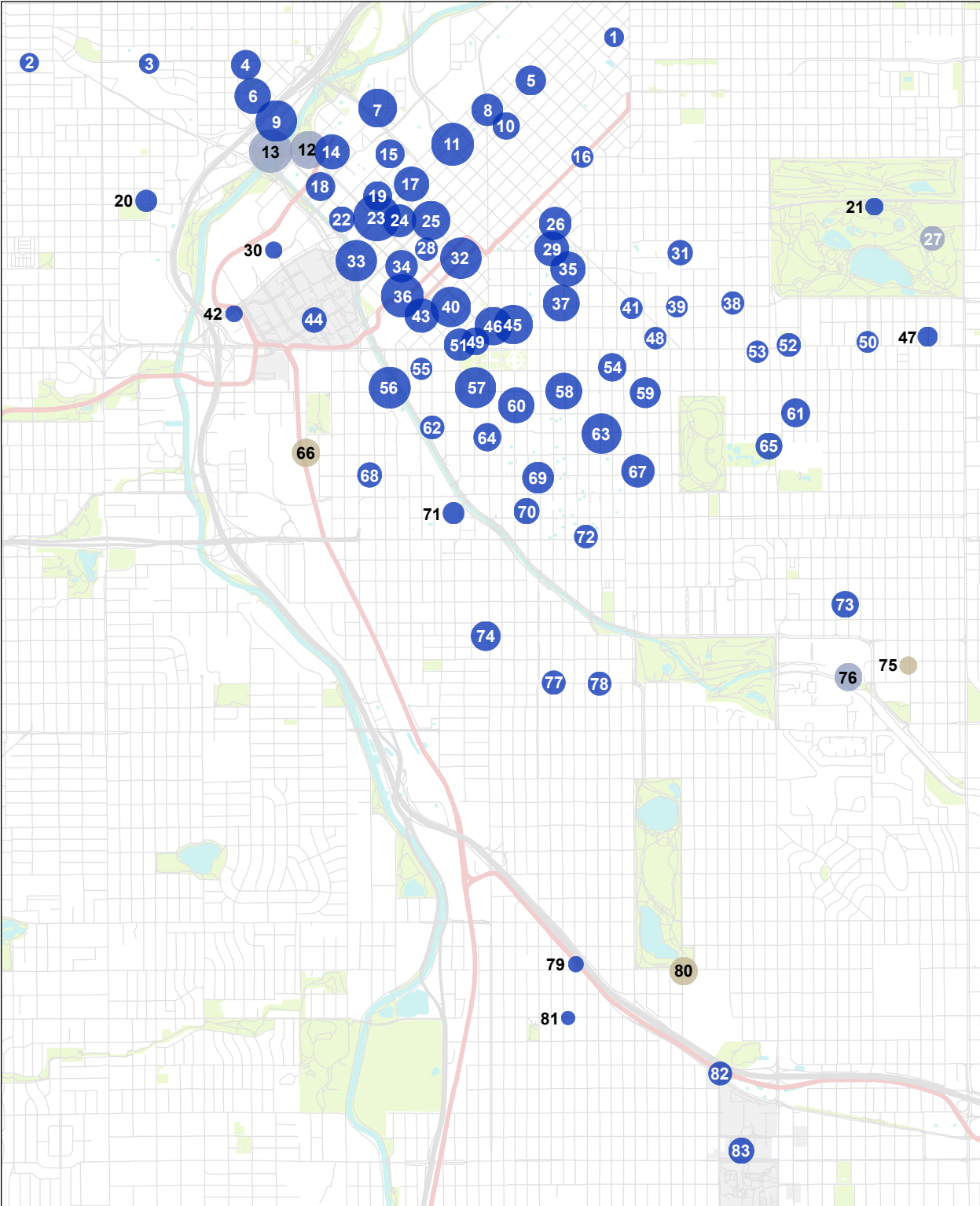


Figure 13: Labelled Map of Weekly Bike-sharing Activity in Denver

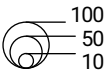


Percentage of 2-Location Trips

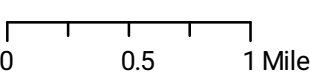
- ≥ 84%
- 69 - 83.9%
- 50 - 68.9%
- < 50%

Checkouts in the Composite Week

Circle size is proportional to the number of checkouts in the composite week.



Light Rail —



10th & Osage	66	17th & Franklin	39	9th & Santa Fe	68
11th & Broadway	64	17th & Larimer	24	Bayaud & Emerson	78
11th & Delaware	62	17th & Pearl	37	Bayaud & Pennsylvania	77
11th & Emerson	63	17th & Race	38	Broadway & Walnut	8
12th & Columbine	61	17th & Tejon	4	Butchel & High	82
12th & Sherman	60	18th & Arapahoe	25	Cherry Creek Mall	76
1350 Larimer	33	18th & California	32	Colfax & Columbine	52
13th & Marion	59	19th & Market	17	Colfax & Garfield	47
13th & Pearl	58	19th & Pearl	35	Colfax & Gaylord	53
13th & Speer	56	19th & Wynkoop	15	Colfax & Steele	50
1450 Wazee	22	1st & Broadway	74	Denver Botanic Gardens	65
14th & Elati	55	2045 Franklin	31	Denver Health	71
14th & Ogden	54	20th & Chestnut	7	Denver Public Library	57
14th & Stout	36	22nd & Market	11	Denver Zoo	21
14th & Welton	43	22nd & Pennsylvania	29	DU Driscoll Center	83
1550 Glenarm	40	23rd & Clay	20	Ellsworth & Madison	75
1551 Lafayette	48	25th & Lawrence	10	Five Points	16
15th & Cleveland	49	28th & Larimer	5	Florida & South Pearl	81
15th & Curtis	34	32nd & Clay	3	Louisiana & Franklin	80
15th & Delgany	18	32nd & Julian	2	Louisiana/Pearl Stn.	79
16th & Boulder	6	33rd & Arapahoe	1	Market St. Stn.	23
16th & Broadway	46	3rd & Milwaukee	73	Museum of	
16th & Little Raven	12	4th & Walnut	42	Nature & Science	27
16th & Platte	9	6th & Clarkson	72	Park & Tremont	26
16th & Sherman	45	7th & Grant	70	Pepsi Center	30
17th & Black	19	9th & Curtis	44	REI	13
17th & Curtis	28	9th & Downing	67	Union Stn. at 17th	14
17th & Downing	41	9th & Logan	69	Webb Building	51

Figure 14: Weekly Trip Composition at Denver Kiosks

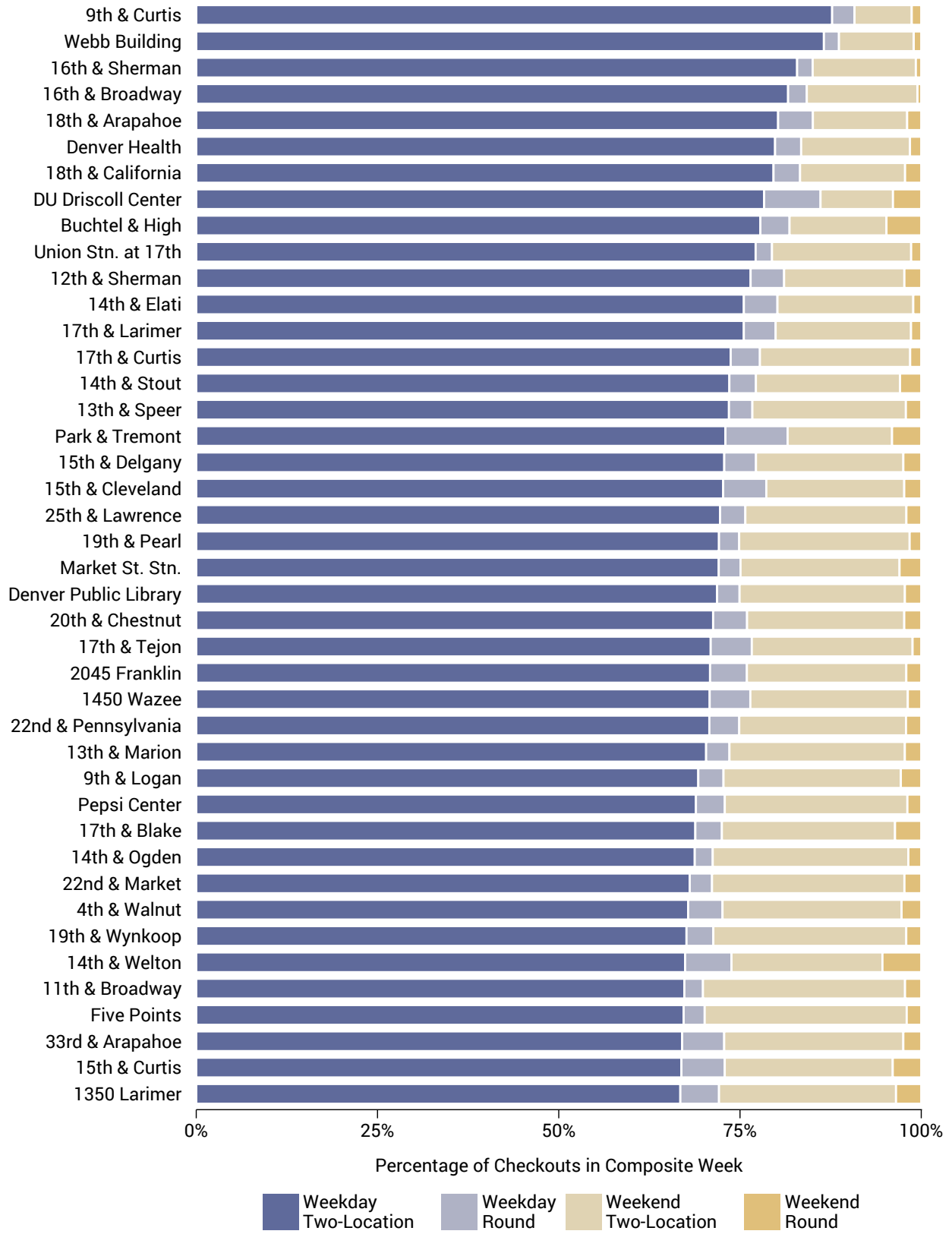


Figure 14, cont'd: Trip Composition By Kiosk - Denver

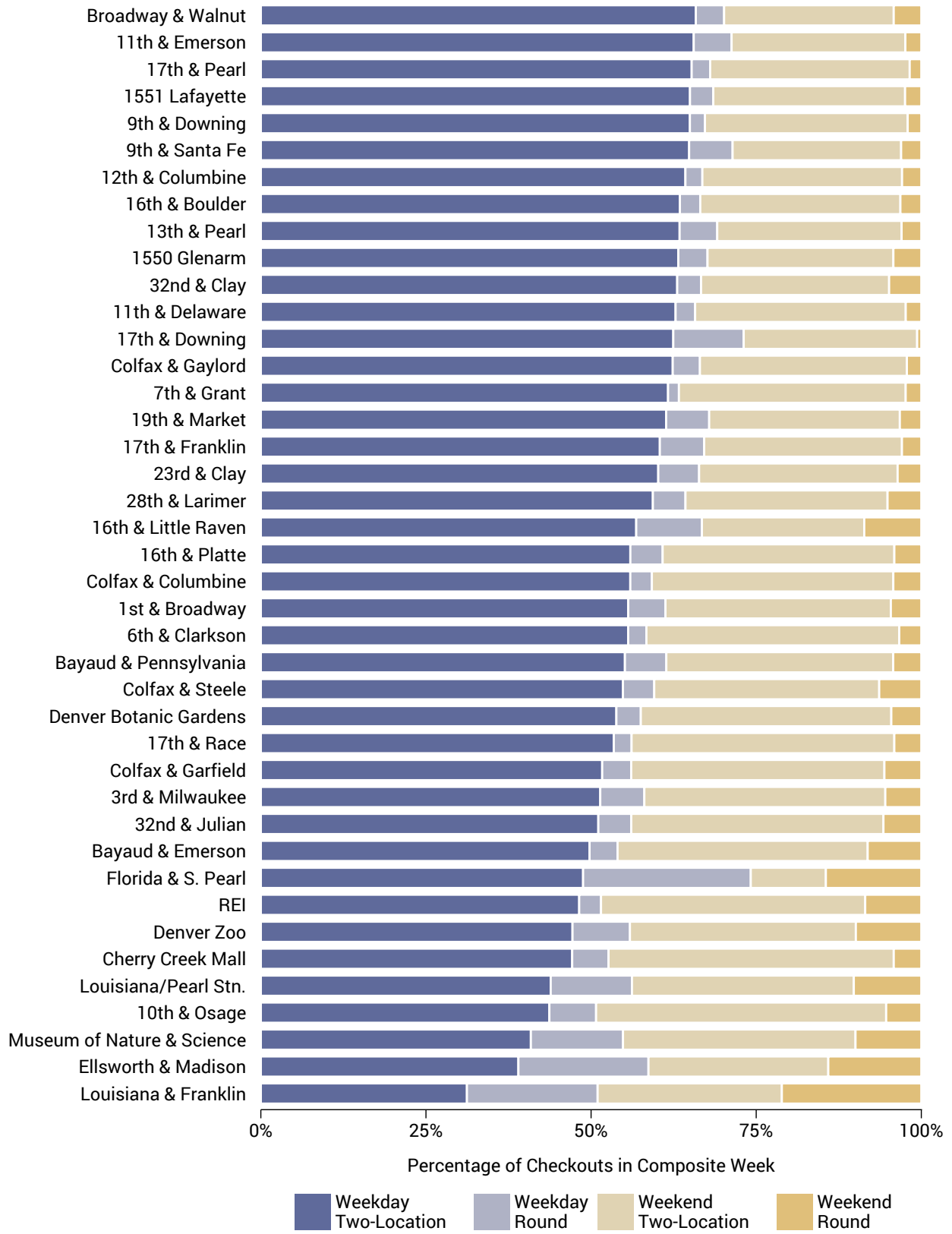


Figure 15: Weekly Two Location Trips at Denver Kiosks

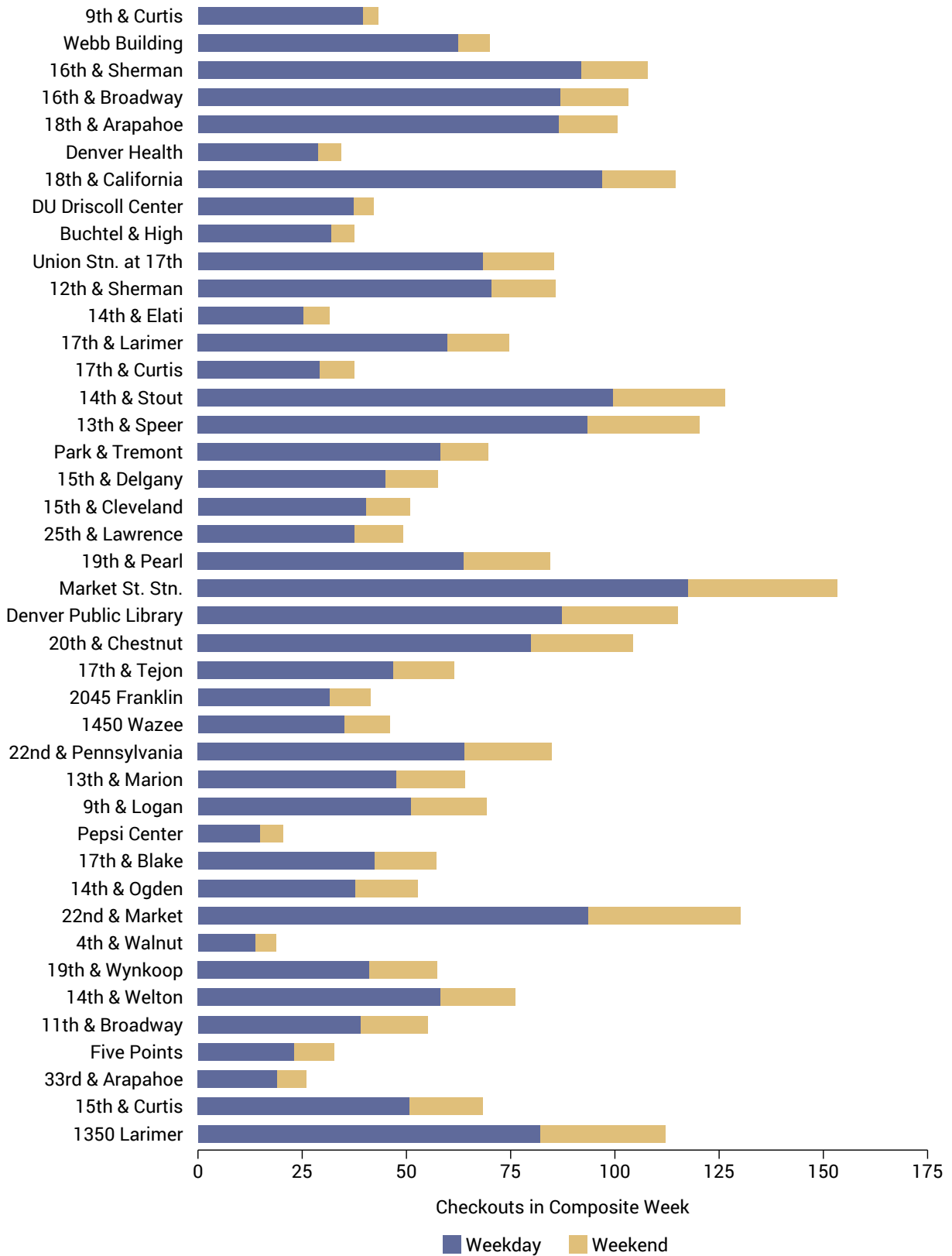


Figure 16: Figure 15, cont'd: Two Location Trips at Denver Kiosks

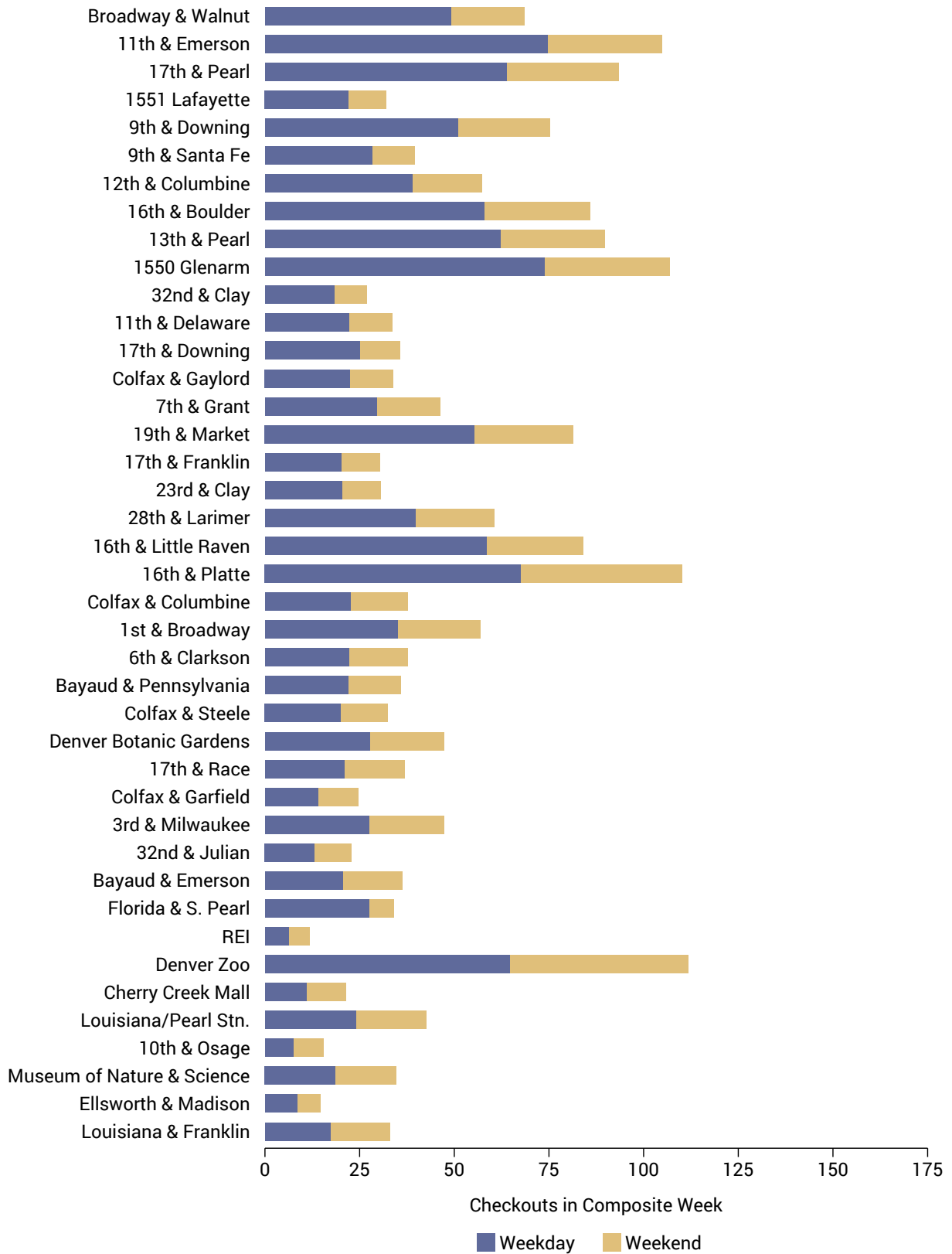


Figure 17: Weekly Round Trips at Denver Kiosks

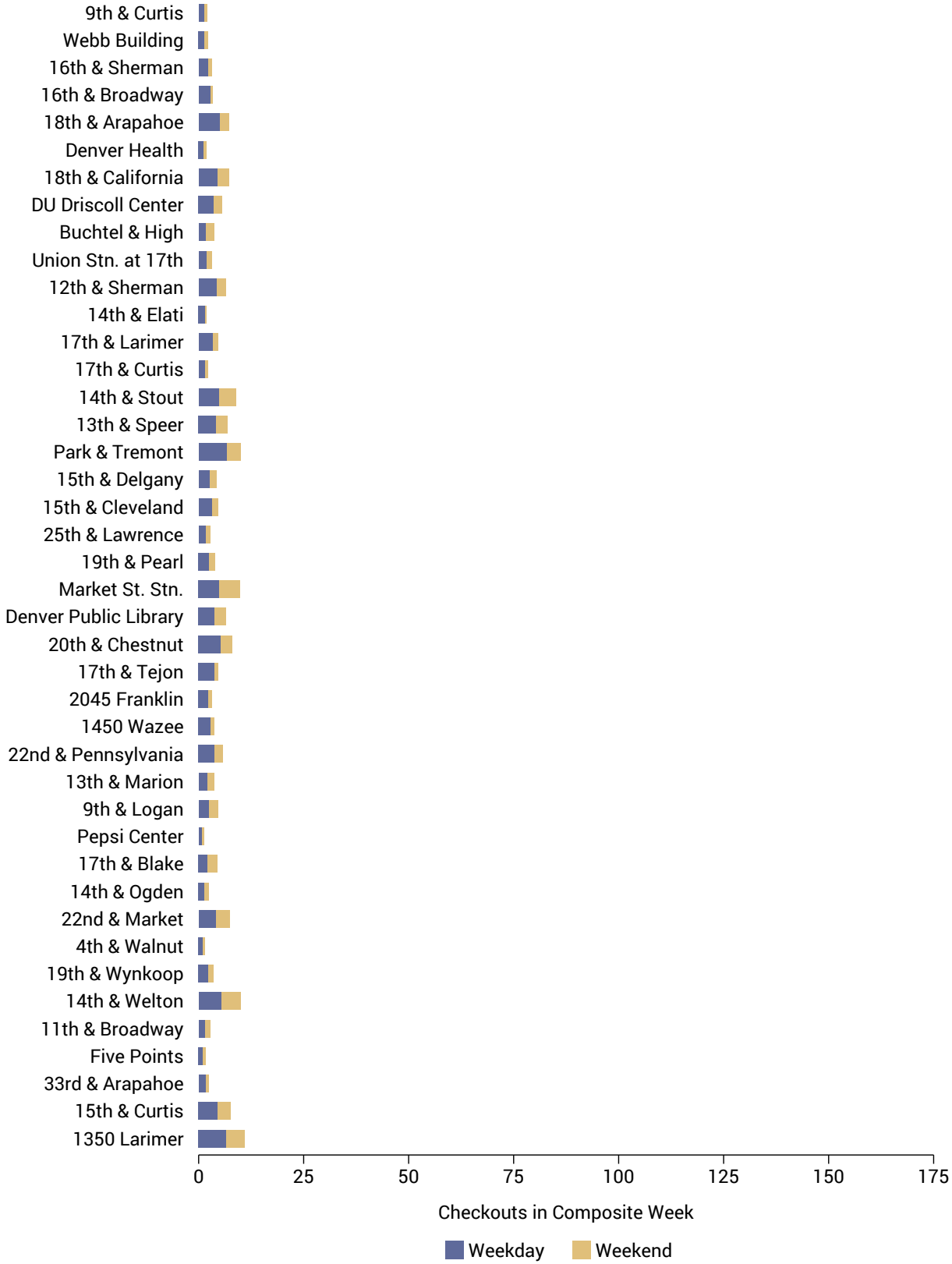


Figure 18: Figure 17, cont'd: Weekly Round Trips at Denver Kiosks

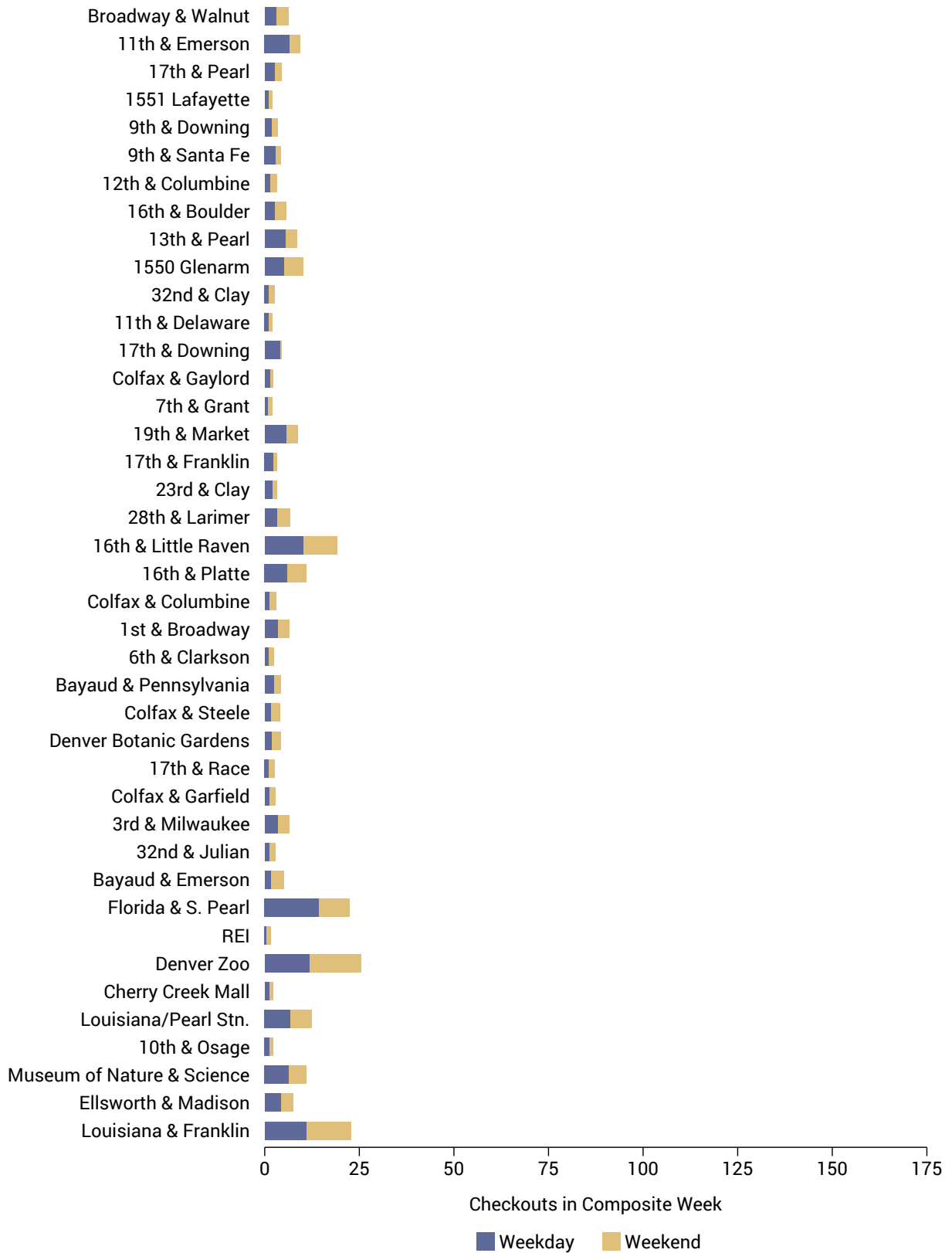
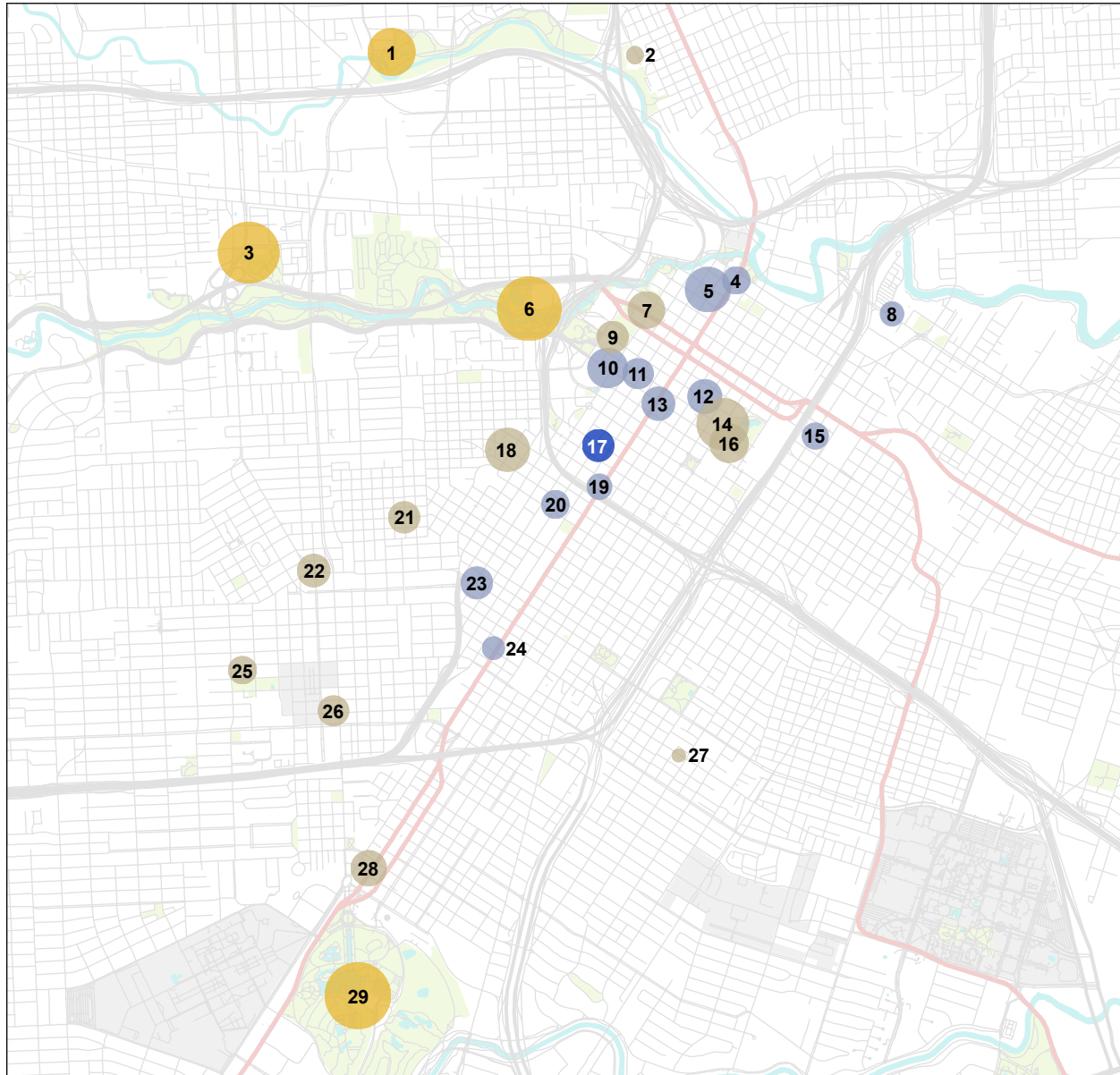


Figure 19: Labelled Map of Weekly Bike-sharing Activity in Houston

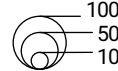


Percentage of 2-Location Trips

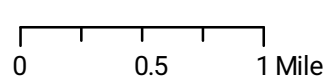
- ≥ 84%
- 69 - 83.9%
- 50 - 68.9%
- < 50%

Checkouts in the Composite Week

Circle size is proportional to the number of checkouts in the composite week.



MetroRail



1919 Runnels	8	Lamar & Milam	11	Sabine Bridge	6
City Hall	9	Main & Dallas	13	Smith & Capitol	7
Dallas & Smith	10	Market Square	5	Spotts Park	3
Elgin & Smith	23	McKinney & Caroline	12	Stude Park	1
Ensemble/HCC Station	24	Menil Collection	25	Taft & Fairview	21
Freed Library	26	METRO Transit Center	19	Tellepsen YMCA	17
Hermann Park	29	Milam & Webster	20	U. of H. - Downtown	4
L. Castillo Cmty. Ctr.	2	Museum of Fine Arts	28	West Gray & Baldwin	18
La Branch & Lamar	14	Project Row Houses	27	Westheimer & Waugh	22
Lamar & Crawford	16	Rusk & St. Emanuel	15		

Figure 20: Weekly Trip Composition at Houston Kiosks

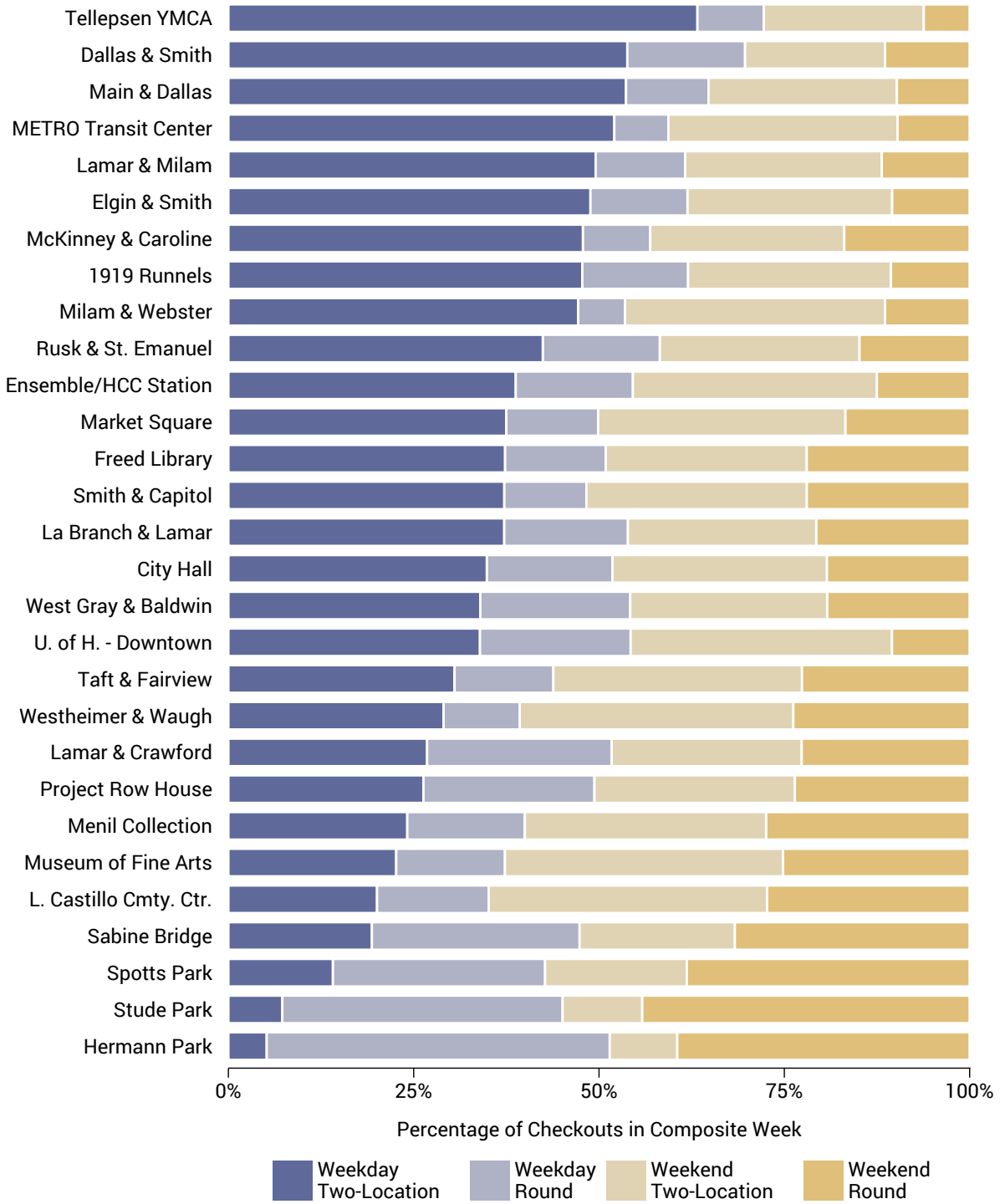


Figure 21: Weekly Two-Location Trips at Houston Kiosks

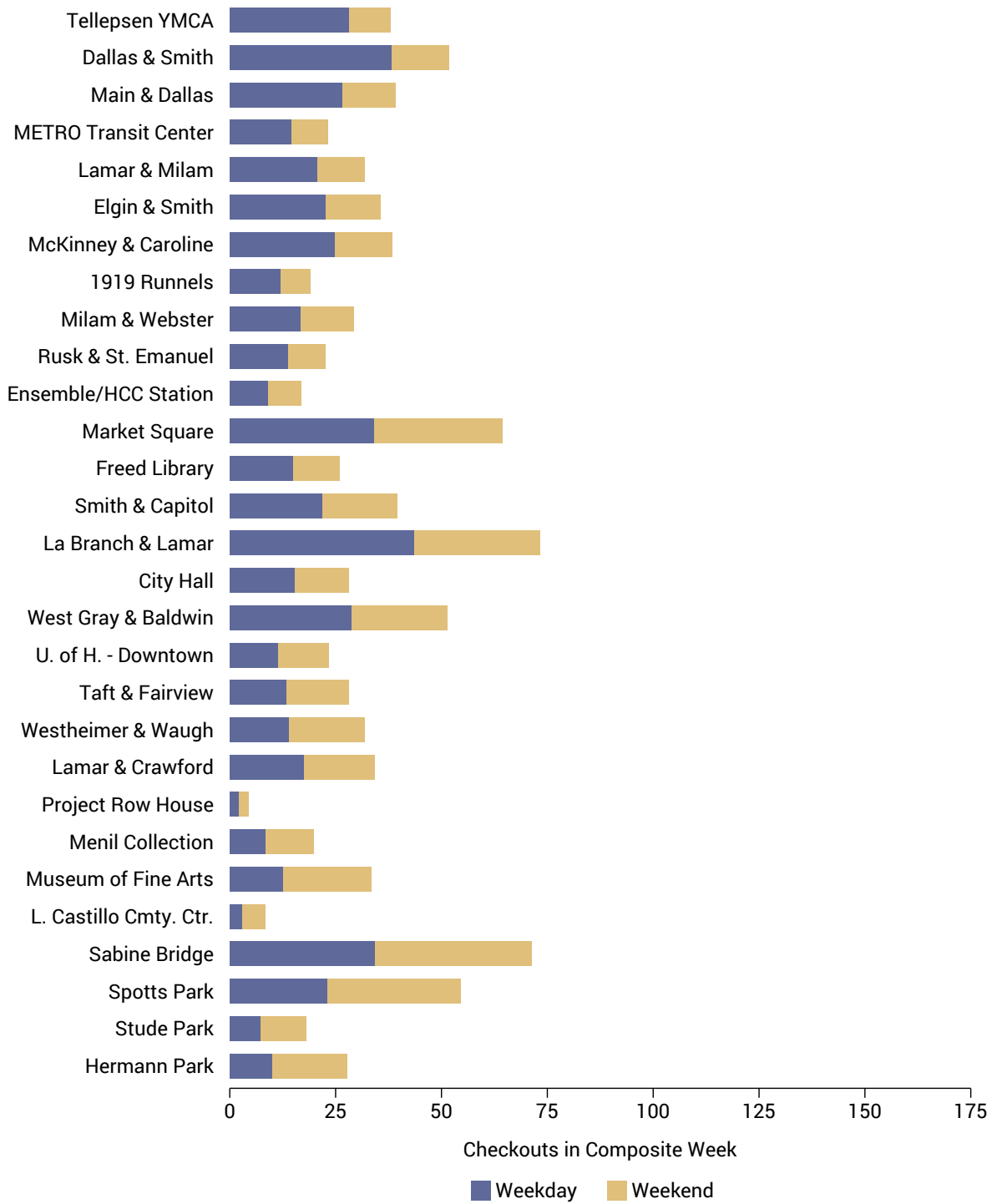


Figure 22: Weekly Round Trips at Houston Kiosks

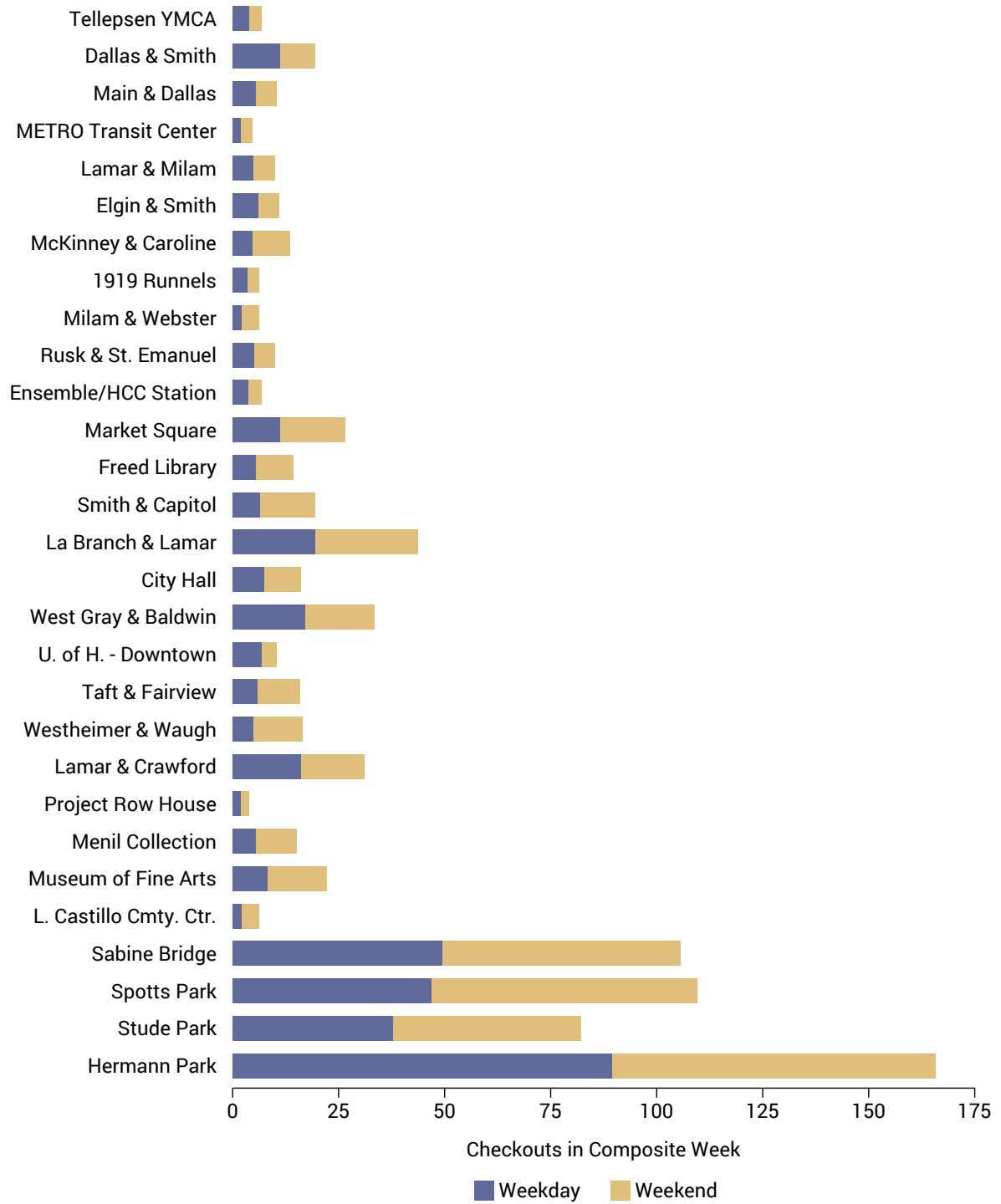
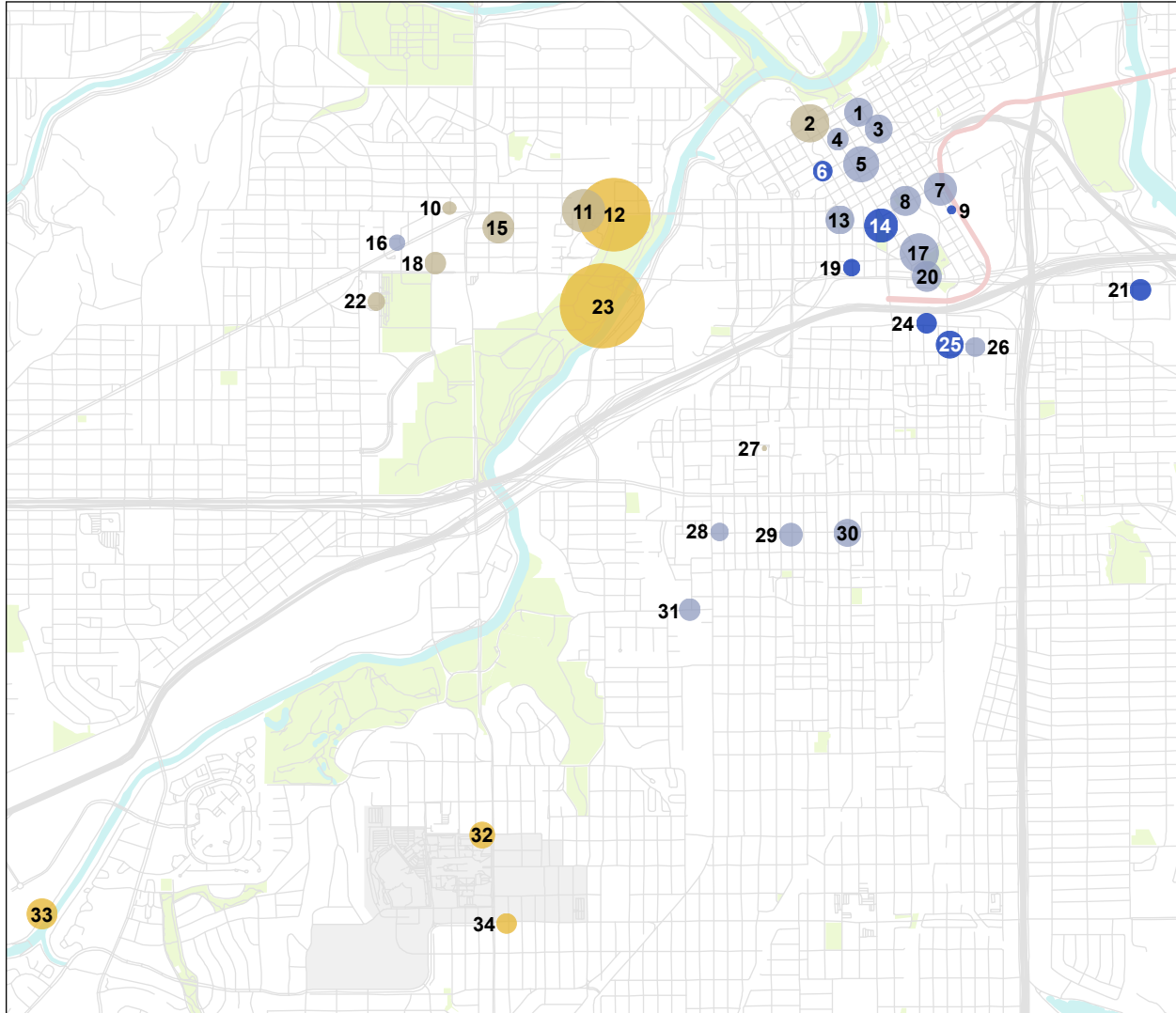


Figure 23: Labelled Map of Weekly Bike-sharing Activity in Fort Worth



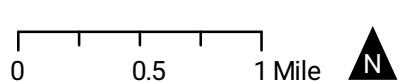
Percentage of 2-Location Trips

- ≥ 84%
- 69 - 83.9%
- 50 - 68.9%
- < 50%

Checkouts in the Composite Week

- Circle size is proportional to the number of checkouts in the composite week.
- 10
 - 50
 - 100

Trinity Rail



2597 W. 7th St.	11	ITC South	9	TCU	32
Art Museums	18	Magnolia & Henderson	29	The T Offices	21
Belknap & Taylor	2	Magnolia & Hurley	28	The Trailhead	
Burnett Park	13	Magnolia & Lipscomb	30	at Clearfork	33
Central Library	6	Museum Place	10	Trinity Park North	23
City Hall	14	Omni Hotel Fort Worth	17	Texas Health - Harris	
City Place	4	Park Place & Enderly	31	Methodist Hospital	27
Convention Center	8	S. Main & Daggett	25	UNT Health Science Ctr.	16
Ft. Worth Bike Sharing	26	Sundance Square North	3	W. 7th	15
Gendy & Lansford	22	Sundance Square South	5	W. 7th St. & Stayton	12
Higginbotham	19	T & P North	20	W. Berry & University	34
ITC North	7	T & P South	24	Weatherford & Main	1

Figure 24: Weekly Trip Composition at Fort Worth Kiosks

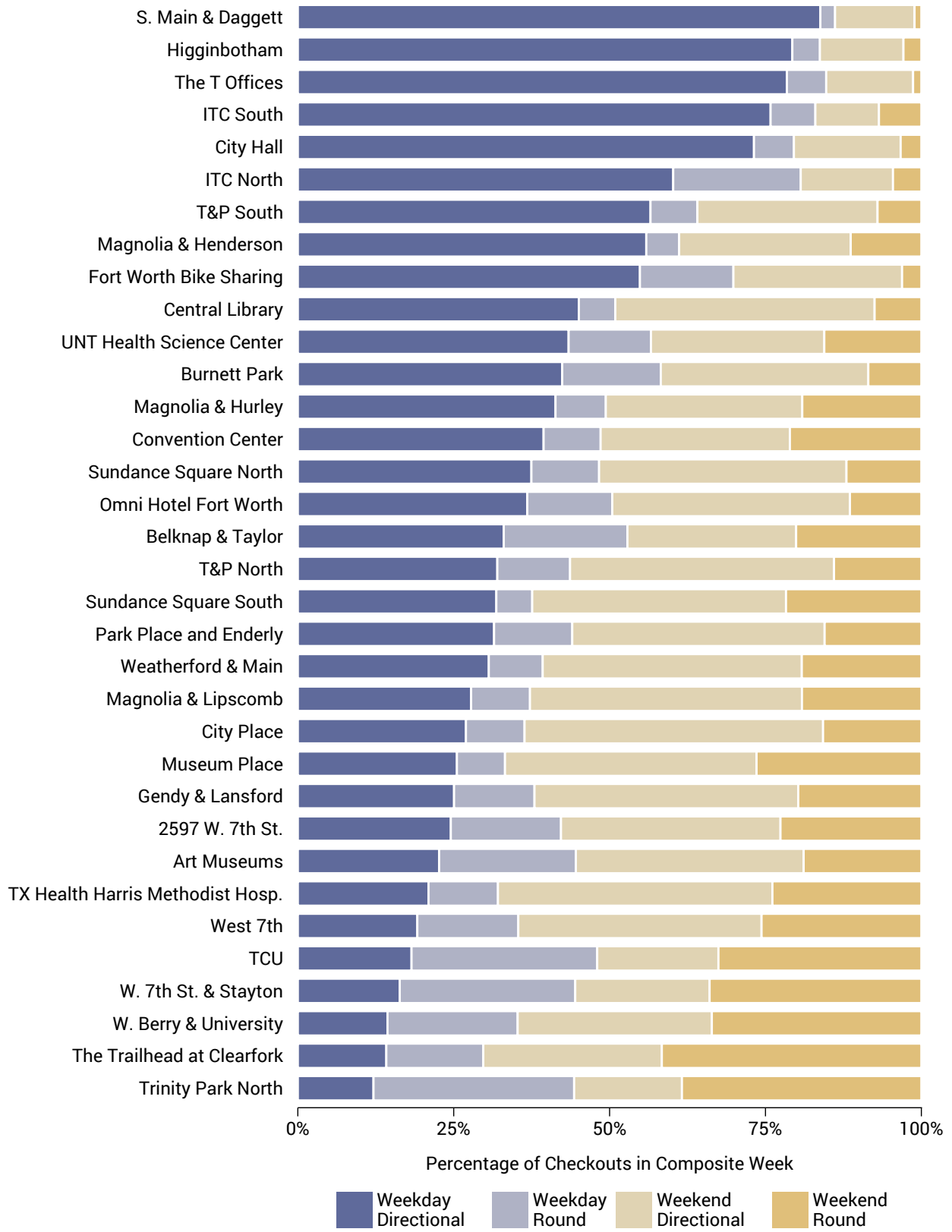


Figure 25: Weekly Two-Location Trips at Fort Worth Kiosks

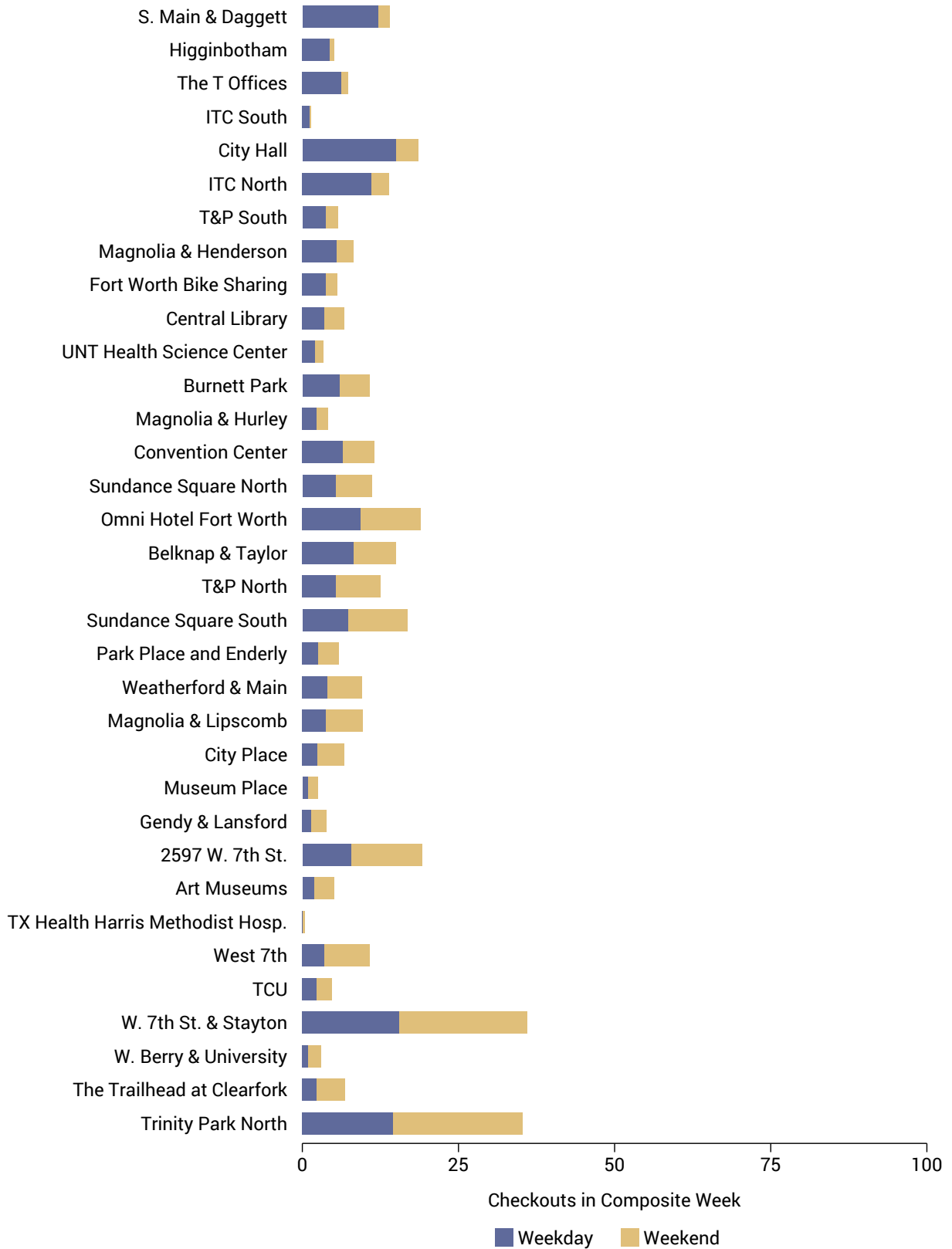


Figure 26: Weekly Round Trips at Fort Worth Kiosks

