

THE ATLANTA STREETCAR: an analysis of its development and growth as it relates to the Core Cognitive Structure of the City

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Abstract

As shown previously by the work of Haynie & Peponis at the 7th Space Syntax Symposium in 2009, the spatial structure of the city of Atlanta has shifted significantly as the city grew. It emerged from a pattern of colliding grids, which bridged the railroads, and an analysis of these early maps illustrated a centrally located area of dense street connectivity distinct from the spaces that are more easily accessible in terms of direction changes – where direction changes describe cognitive rather than metric accessibility. As the city grew and additional clusters of higher local density emerged, each isolated from the other, a multi-centered city was established with ever increasing fragmentation of the Directional Reach structure. Eventually then, the city is forced to negotiate the dispersed pattern of cognitive integration and metric density through a symbolically, culturally supported patchwork of dispersed areas of interest.

In this paper, the evolution of the Atlanta Streetcar, significant as the first major means of local public transportation for the city, is tracked and compared to those original maps of Haynie & Peponis. To track the development of the Atlanta Streetcar, a series of historic maps are selected – a summary of 1871 to 1881, a summary of 1882 to 1892, 1895, 1900, 1912, 1924, and 1933. These maps outline the various routes for the different companies managing the streetcar systems at particular points in time. Similarly, the area of focus is contained within a four-mile radius centered on downtown. The intent of the study is to reveal where and when the routes of the streetcar intersected the areas of highest metric and directional reach. The aim is to better understand the underlying influences of one upon the other and to explore whether public transportation routes reflect the cognitive, syntactic structure of the city.

The findings reveal that the early growth of the streetcar followed the shifting core cognitive structure of the city more often than the emerging metric densities. Thus, it can be argued that perhaps one becomes a “lagging indicator” of sorts for the other, particularly when the adaptation of the structure was left to its natural economic tendencies and not directed by outside political influences. This dependency is further verified by the shared location of the most profitable streetcar line in the system and the most consistently identified street within the core cognitive structure. Ironically, as the city began to noticeably and significantly fragment, the measured success of the streetcar began to collapse as well.

Carson has argued in his 1981 book, The Trolley Titans, that the demise of the streetcar resulted from a multitude of factors – the cost of the infrastructure and associated maintenance, the lack of flexibility in setting routes, fixed fares, labor disputes, and the introduction of the jitney bus and motor coach as competition. Preston has argued in his 1979 book, Automobile Age Atlanta: The making of a southern metropolis, that the collapse of the streetcar can be attributed to the accessibility and affordable of the individual automobile. The results here suggest that perhaps the true demise lies in the streetcars' ineffectiveness to align with the core cognitive structure of the city coupled with the decentralized, fragmented, and ever shifting structure of the city.

INTRODUCTION

In 2009, Haynie and Peponis explored how urban centers in the City of Atlanta maintained their intelligible connecting structure while the urban system changed as a function of growth. Street structure was described in terms of the density measures *metric reach* and *directional reach*. Metric reach captures the density of connectivity by measuring the available length accessible to a particular segment while moving outward in every direction from the midpoint of that segment for a set distance independent from changes of direction. Directional Reach measures the cognitive distances entailed by measuring the available street length accessible while moving outward in every direction from the midpoint of a segment for a set number of changes in direction, with every change in direction measured against a parametric threshold (Peponis, Bafna, & Zhang, 2008). An analysis of the earliest street map illustrated a centrally located area of metric density isolated from a split directional reach core. As the city grew, additional clusters of higher local densities emerged, each isolated from the other; and interestingly, the directional reach core cognitive structure shifted with the city growth and eventually dispersed. As a result, a multi-centered city was established with ever increasing fragmentation (Haynie, Dawn & Peponis, 2009).

In this paper, the evolution of the Atlanta Streetcar, significant as the first major means of public transportation within the city, is tracked and compared to those original maps of Haynie & Peponis. Points of connection and intersection between the street network and the street railroad lines are considered in not only the maps highlighting the emerging density clusters and directional reach cores, but with new data which documents streetcar ridership and the profitability of the various lines as well. The intent of the work here is to reveal where and when the routes of the streetcar system intersected the areas of highest metric density as well as when these routes overlapped the directional reach core cognitive structure, particularly as both shifted with the city growth. The aim is to better understand the underlying influences of one upon the other and to suggest alternatives to the traditional notions of dependency between metric density and public transportation.

A BRIEF HISTORY OF ATLANTA AND ITS STREET RAILWAY SYSTEM

Interestingly, the city of Atlanta has always been focused on transportation and embracing all that was new and emerging within it. In 1837, the Georgia General Assembly approved the construction of the Western & Atlantic Railroad and designated the area now known as Atlanta as its terminus. By 1846, two other

railroads, the Georgia Railroad, coming from Augusta, and the Macon & Western Railroad, coming from Macon, were in Atlanta as well. With the construction of the railroads, landowners began to subdivide their land in relation to it to accommodate the newly arriving residents and resources (Carson, 1981; Russell, 1988). The lack of a comprehensive plan for the development of the city coupled with its expansive growth resulted in a cluster of colliding street grids bridging the newly constructed railroads.

In 1866, Richard Peters and George Adair, both in real estate, acknowledged the direct relationship between transportation and the value of land, and they recognized the emerging local problems in transportation resulting from Atlanta's growth. Together, they chartered the Atlanta Street Railway Company to create a local transportation system using the streetcar; and by 1871, a local public transportation system was introduced to the city – the horse/mule car. The first line ran from Whitehall Street, south down Mitchell Street, down Forsyth Street, along Peters Street, and ended at the Barracks. See Figure 1. With the steam railroads, telegraph, and central gas service established, the streetcar was Atlanta's next public utility (Carson, 1981).

After much competition, wrought with the associated legal and political battles between rivals seeking to secure the majority market share, the street railroads were eventually consolidated and secured to their electric power source. In 1902, the city government created, through their Consolidated Ordinance, the Atlanta Railway & Power Co. to unify the street railroad system. The newly formed company was charged with standardization, modernization and the management of appropriate resources, coordination and consolidation - particularly between the various companies and their duplicative lines, negotiation between public and private interests; and lastly and perhaps more importantly, they were charged with evaluating which lines would be abandoned as well as planning for which ones would be built (Carson, 1981).

Over the next several decades, many issues would plague the success of the Atlanta street railroad system – a race riot in 1906, labor disputes in 1916, consistent clashes with the city over paving costs and associated street maintenance, inflation and a loss of service population during World War I, fixed fares with rising expenditures, as well as rising competition with the jitney bus and the ever increasing numbers of personal automobiles (Carson, 1981; Martin, 1975; Preston, 1979; Russell, 1988). In May of 1923, given these concerns, the city adopted the "Constructive Plan for Solving Present and Future Transportation Problems in Atlanta" to enforce existing ordinances and to supplement them as necessary (Carson, 1981).

In 1924, the city council mandated a comprehensive study of the local transportation system, which was conducted by John Beeler, to ensure and to maintain the street railroad's role in ensuring the success of the city. Per his report, the population for the city of Atlanta had grown from 37,409 people in 1880 to over 200,000 by 1920. In addition, the number of revenue passengers, those paying for a particular trip, had increased from almost 45 million in 1910 to over 75 million in 1923. Yet in contrast to these growth numbers, the Beeler Report also documented a decrease in the number of revenue generating passengers riding the streetcar from 1923 to 1924, despite an increase in the miles operated as well as in the number of passengers serviced. Fiscally, the revenue generated by the streetcar in 1920 totaled \$4,891,840 with operating expenses (including taxes) costing \$3,961,622 – yielding net earnings of \$930,218. But by 1924, the revenue generated by the streetcar had increased to \$5,057,704 with operating expenses (including taxes) costing \$4,491,346 – yielding net earnings of only \$566,358 (Beeler, 1924). Net earnings had decreased 39 percent over just 5 years. The popularity and success of the streetcar had seemed to reach its peak.

Beeler made many suggestions on how to modify the street railroad to mitigate most of the problems raised within the report. His suggestions ranged from mild modifications to simply more efficiently managed capacity on existing lines to complete elimination of others (Beeler, 1924). Ironically, despite the Georgia Railway & Power Company's intent on implementing these suggestions immediately, it wouldn't be until 1937 after much debate politically and legally with eventual defeat over those who represented the competing jitney and motor coach, that a comprehensive system, centered on the trackless trolley, would finally be established in Atlanta. On March 14, 1948, the streetcar made its last run and gave way completely to the trackless trolley. Through the 1950s, the trackless trolley was slowly replaced by the motorbus. And in April 1962, the Georgia House of Representatives formed the Metropolitan Atlanta Transit Study Commission (MATSC) such that in March 1965, the entire system would be transformed into the Metropolitan Atlanta Rapid Transit Authority (MARTA), which manages the rapid transit and motorbus system in use today (Carson, 1981; Martin, 1975).

MAPS AND METHODS

In his book *The Trolley Titans*, Carson documents the development of the Atlanta streetcar and its volatile history. Included are a series of maps that illustrate the various lines held by the different streetcar companies (Carson, 1981). Using these illustrations in tandem with historical street maps found at the Atlanta History Center, digital maps have been created, and they are compared to those maps of Haynie & Peponis illustrating both the metric densities as well as the cognitive structures of Atlanta. Similarly, the area of focus here is contained within a four-mile radius centered on downtown. A summary of the lines from 1871 to 1881 and from 1882 to 1892 have been drawn, as well as maps from 1895, 1900, 1912, 1924, and 1933. See Figure 2.

Identifying and summarizing the various lines operated by the different companies at that particular time in history creates a single, comprehensive transportation map. The map summarizing the growth from 1871 to 1881 illustrates the lines of the Atlanta Street Railway Company. The map summarizing the growth from 1882 to 1894 illustrates the lines of the Atlanta Street Railway Company as well as those of the Atlanta & Edgewood Street Railroad Company, West End & Atlanta Railroad Company, Gate City Street Railroad Company, Metropolitan Street Railroad Company, and the Fulton County Street Railroad Company. The map of 1900 illustrates the lines of the Atlanta Electric Railway Company, Atlanta Railway & Power Company, and the Atlanta Rapid Transit Company. The map of 1912 illustrates the lines of the Georgia Railway & Power Company. The map of 1924 denotes the "*present track position*" as identified and illustrated by the Beeler Report for the city of Atlanta; and similarly, the map of 1933 documents the changes and developments to the comprehensive layout for the city as compared to the street map of 1955.

ASSESSMENT OF CONNECTIVITY

As illustrated in Figure 2, the streetcar was initially concentrated on the south side of the city, but eventually, it bridged the Western & Atlantic Railroad tracks and radiated upward and outward to the north and east sides of the city. The only connection between the rail system north of the train tracks and that to the south occurred at Broad Street; and this single point remained as the only point of connection between the two systems until the completion of the viaducts, which raised several streets and isolated them from the extremely active train tracks below. Interestingly, the 1864 map for directional reach in figure 6 from

Haynie & Peponis (2009) similarly illustrates two independent structures separated by the railroad with concentration on the south side of the city. It is even more ironic then that in the 1886 map and again in the 1892 map, the two distinct structures are joined simply via Broad Street (Haynie, Dawn & Peponis, 2009).

By 1900 and with the viaducts well established, the streetcar introduced 3 additional crossings adjacent to the original crossing at Broad Street, which substantially increased its connectivity at the city center. Simultaneously, as the street railroads sought to service areas isolated between the initial central radiating lines, 3 more cross connections were made in the surrounding suburbs. Yet even with this expansion, there were still only 7 nodes available to navigate across the very active Western & Atlantic Railroad tracks within the 2-mile city radius. Reference Figure 3 to see these nodes highlighted in yellow.

As illustrated within the early maps and described by Carson (1981), the street railways were initially focused on extending lines radially from the center in an attempt to give easy access to downtown from those newly established perimeter properties; but soon thereafter, they introduced a sufficient number of shorter lines to cross connect the system. With each map shown in Figure 3, there is an increase in the intersection to end ratio across the street railway system thus creating overall, a more connected structure. In 1894, there were 61 intersections with only 24 end stops. In 1912, the number of intersections grew to 89, and by 1933, the number of intersections had grown to 100 with only 4 new end stops. Eventually, the emphasis on growth for the street railroads shifted back to the dispersed radial lines emanating from the center to service the interurban areas.

EXPLORATION INTO METRIC DENSITY

To more closely study the street railway system in relation to the densities of the street structure at a pedestrian scale, maps of the streetcar lines are overlaid the metric reach maps of Haynie & Peponis (2009). To do so, each era captured for the street railroad lines is superimposed onto the corresponding street centerline map. To clarify, the streetcar summary map of 1871 – 1881 was overlaid the street map of 1871; the streetcar summary map of 1882 – 1894 was overlaid the street map of 1886; the streetcar maps of 1900 and 1912 were overlaid the street map of 1892; the streetcar map of 1924 was overlaid the street map of 1928; and lastly, the streetcar map of 1933 was overlaid the street map of 1955 to analyze considerable changes within the resulting structure as it clearly shifted towards decentralization and fragmentation. See Figure 4. Remarkably, almost every highlighted area of highest density had direct access to the streetcar. For example, in the 1912 map, there were 5 areas that emerged beyond the original central downtown, and yet, the streetcar already provided access to and/or through every cluster.

Traditional theories in transportation would suggest that these emerging clusters of density resulted from the introduction of an “attractor” – one such as the streetcar line, its intended stop, and/or the intersection between lines. In reverse, a dense area could act as an attractor for the street railroad (Cervero & Kockleman, 1997; Cervero R. , 1993; Levinson & Wynn, 1963). In theory, one would not necessarily preclude the other, but as expected, few clusters, beyond the original downtown core with its obvious reactive position, emerged independent of a streetcar line to service them. Most areas of density appeared after the insertion of the street railroad. Several clusters of metric density emerged immediately while others took decades to establish suggesting that metric density does not immediately follow the insertion of a streetcar line and that one does not inherently guarantee the other.

EXPLORATION INTO COGNITIVE ACCESSIBILITY

Alternate then to exploration into the traditional notions and relations between metric densities and transportation, the street railroad lines can be compared to the measures of directional reach and its shifting core cognitive structure. See Figure 5. Using again the work from Haynie & Peponis (2009), maps of the Atlanta street railroads are overlaid the corresponding directional reach core cognitive maps as appropriate with metric density shown beneath for reference.

In 1864, two core cognitive structures existed, each separated by the railroad. To the north of the Western & Atlantic Railroad, Peachtree Street, as it transitioned to West Peachtree Street, stood as a single spine. To the south, the core cognitive structure was far more extensive across the street network. By 1871, the core cognitive structure was seemingly more equally distributed across the city, yet the streetcar lines, when introduced to the city, were concentrated to the south side of the system, following much more closely the core cognitive structure of 1864. Similarly, in 1886, the core cognitive structure had clearly shifted to the northern and eastern sides of the street railroad system, yet the new streetcar lines constructed from 1882 to 1894 captured the more distributed core cognitive structure illustrated in 1871. By 1892, the directional reach core had shifted again, this time to the southern and western sides, and yet again, the streetcar lines showed increases in services on the 1900 and 1912 to those areas highlighted in the 1892 directional reach core cognitive map. By 1928, Atlanta's core cognitive structure had reached the densest, most clearly integrated structure in the illustrated evolutionary history – with its concentration still located to the south of the city center. It also marked the peak in the coverage of the street railroad lines downtown. In 1933, with the suggestions from the Beeler report under way, duplicative lines downtown were removed and extensions were made to the suburbs. By 1955, the core cognitive structure lost all ties to the city center – clearly illustrating the beginning of the decentralization and eventual fragmentation the city struggles with today.

RIDERSHIP ON THE ATLANTA STREETCAR

As part of the Beeler Report (1924), revenue generated from the streetcar, as well as the associated operating costs and miles traveled for each line, was reported. The most profitable line, in terms of potential, was the Forrest – Capitol Line at 20.95 cents per mile, followed closely by the Ponce de Leon – West View Line at 19.46 cents per mile. As seen in Figure 6, both lines intersect the original, central downtown cluster and radiate outward. But beyond the center, these lines fail to capture any of the other emerging clusters of metric density scattered across the city – although arguably they link to them via the other lines within the street railroad system. When these particular street railroad lines are compared to the directional reach core, illustrated in Figure 7, significant overlap can be seen. Almost every section of the Forest – Capitol Line has been situated at some point in history on the directional reach core, even as the structure shifted, with the south section of the line congruent in every directional reach core map examined here. Interestingly, the dependency between the streetcar lines and the core cognitive structure is substantiated further by the success of the streetcar, as measured by its ridership and profitability, at the point in time when the routes were the most closely associated with the core cognitive structure.

DISCUSSION

Not surprisingly, when analyzed, the streetcar lines captured the emerging clusters measuring the metric density of the street structure. So understanding then that metric density followed the growth patterns of the streetcar, the question then arises: what influenced and/or determined the placement of the street railroad?

Perhaps one of the more interesting findings within this work is the result illustrating that the development of the streetcar tended to follow the shifts within the directional reach core rather than increasing service to the emerging areas of highest metric reach. Investment within the street railroad consistently followed the directional reach core as identified in the previous decade suggesting that the core cognitive structure was a “lagging indicator” of sorts for the projected growth of the streetcar. The two systems reach their peak and overlap in the 1928 map. As each grew from then onward, they became increasingly more incongruent, and the system began to visibly show signs of failure. Ironically, in 1933, when the directional reach core began to show significant decentralization and fragmentation, the city made the decision to completely transform the street railroad system into a more modern version, known today as MARTA, to better service the suburban areas. In 1927, the local public transportation in Atlanta was revered and often touted as one of the better systems in the US, as evidenced by its consideration for the street railway industry’s Coffin Award (Carson, 1981). But by 1995, this would no longer be the case.

CONCLUSION

The findings reveal that although the growth of the streetcar lines remarkably captured almost every cluster of metric density that emerged, the patterns of its growth and its points of investment followed much more closely the shifting directional reach core structure of the city. Thus it can be argued that one became a “lagging indicator” of sorts for the other, particularly when the adaptation of the structure was left to its natural tendencies and not interrupted by regulation. In essence, clusters of metric density emerged at points following investment in the streetcar, and the placement of the streetcar tracked, intuitively, the shifting directional reach core cognitive structure.

According to Carson (1981) and Preston (1979), the demise of the streetcar can be blamed on a multitude of factors – the cost of the infrastructure and associated maintenance, the lack of flexibility in setting routes, labor disputes, the introduction of the jitney bus and motor coach, and/or the accessibility and affordability of the individual automobile; but perhaps the true demise lies in the streetcars ineffectiveness to align with the shifting directional reach core cognitive structure of the city coupled with the poor planning of the city’s growth which precipitated significant changes within that structure.

ILLUSTRATIONS



Figure 1: Atlanta's first Streetcar Line

The first street railroad line to service the city was introduced in 1871 and is shown here in blue.

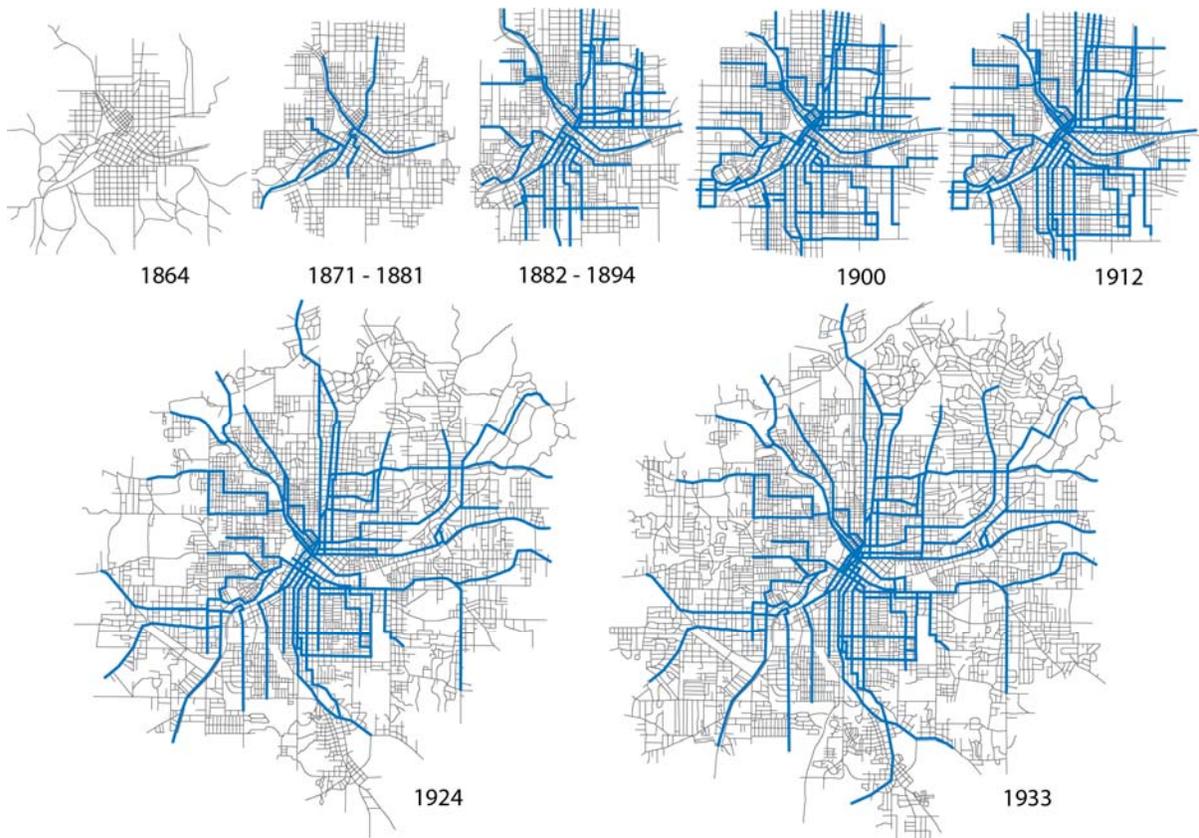


Figure 2: Evolution of the Atlanta Street Railroad

Each maps illustrates the extent of the Streetcar Railroads accessible during that era.

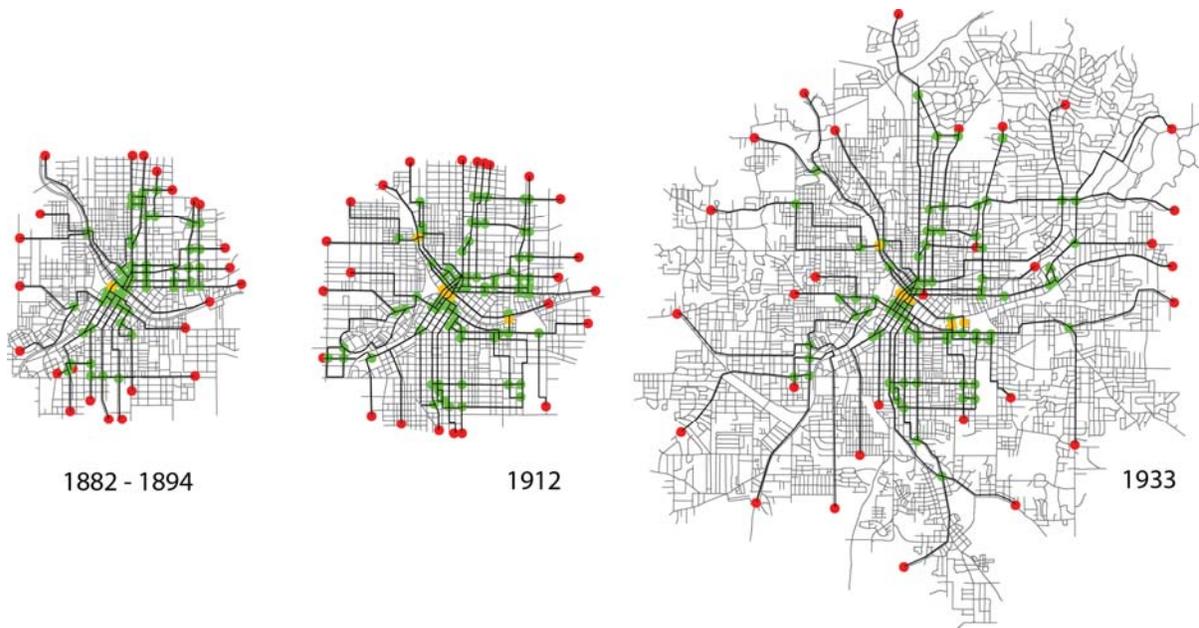


Figure 3: Streetcar Connectivity

Nodes between intersecting street railroad lines are shown in green, end points are shown in red with the street railroad lines shown in black.

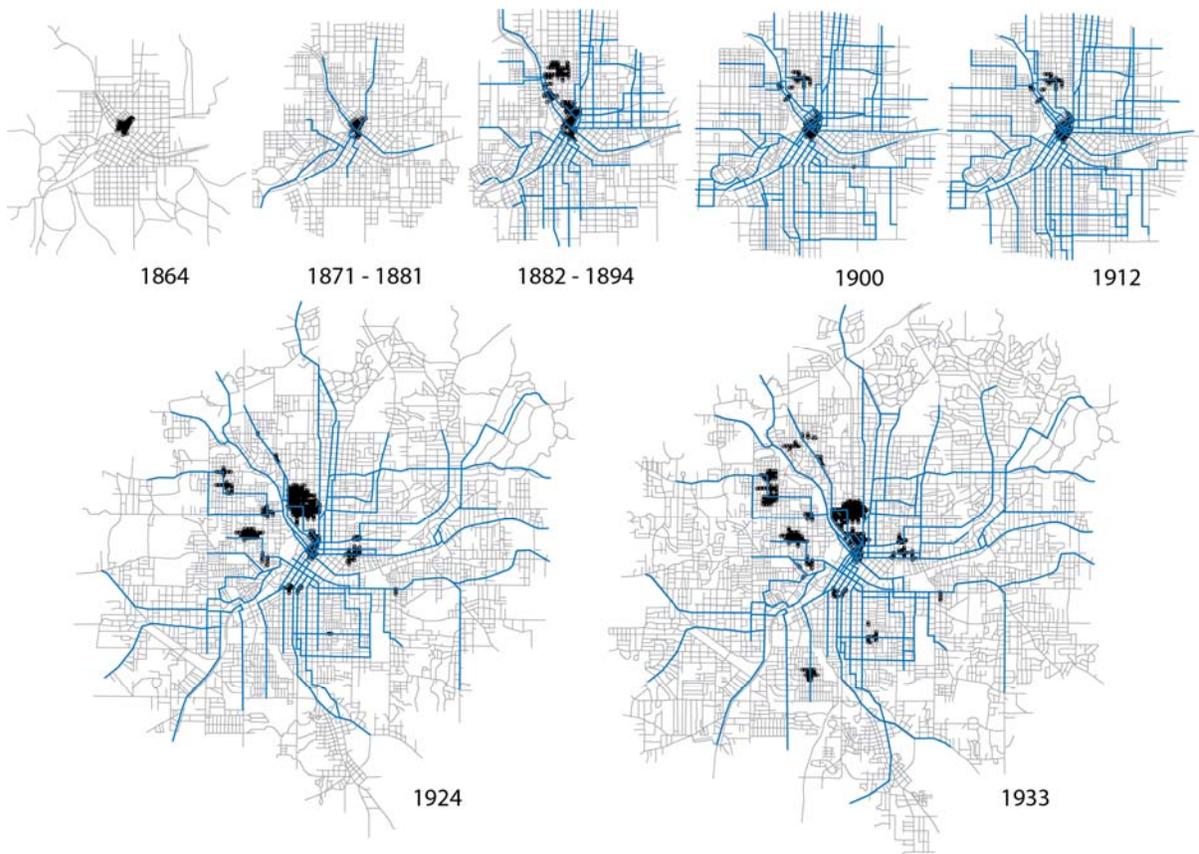


Figure 4: Atlanta Streetcar in relation to Metric Reach

Street railroad lines, shown in blue, are overlaid the associated Haynie & Peponis (2009) Metric Reach Maps of Atlanta, shown here as analyzed with a maximum reach set at $\frac{1}{4}$ mile. The emergence of clusters illustrating higher local densities is evident and shown in black.

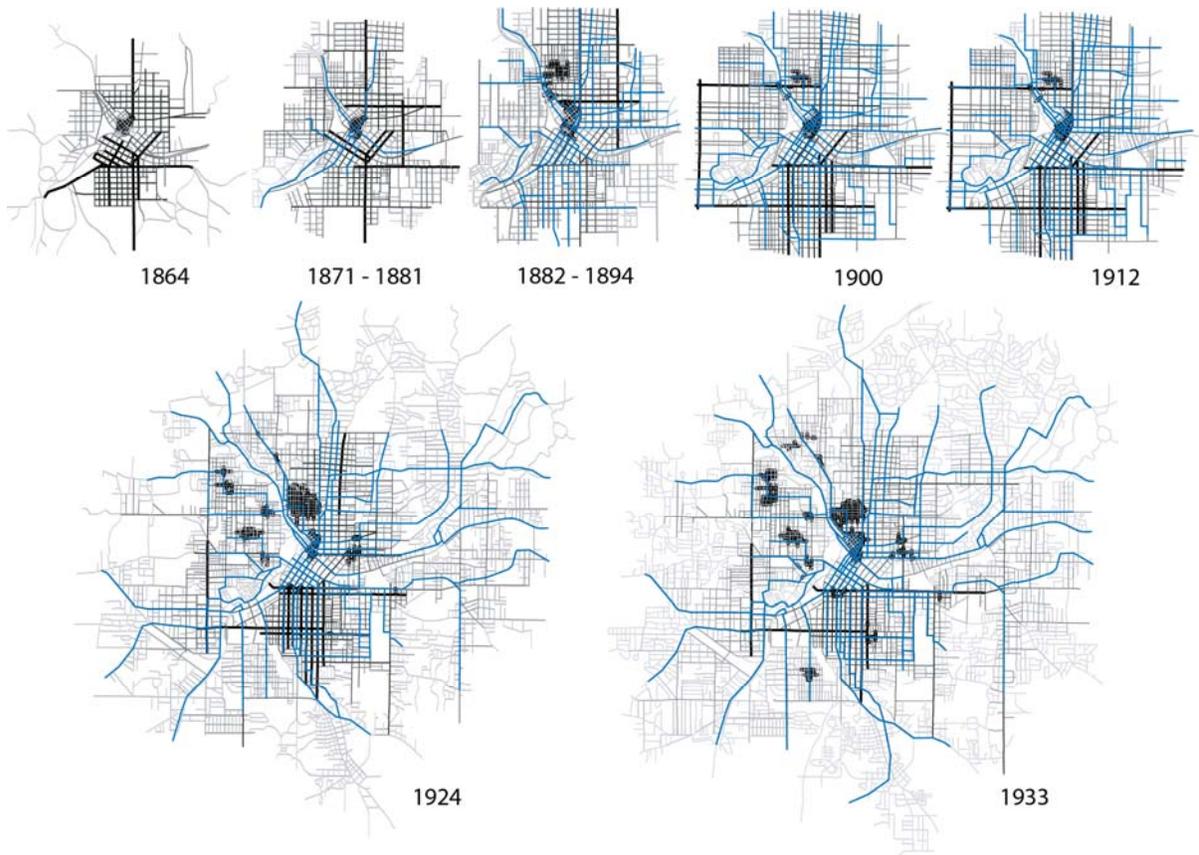


Figure 5: Atlanta Streetcar in relation to Directional Reach

Street railroad lines, shown in blue, are overlaid associated Haynie & Peponis (2009) Core Cognitive Structure Maps of Atlanta, as derived from directional reach at 2 direction changes superimposed on metric reach at ¼ mile.



Figure 6: Atlanta Streetcar Ridership in relation to Metric Reach

The street railroad line of Forrest – Capitol is shown dashed in red, with Ponce de Leon – West View shown dashed in black. Both are overlaid with the associated Haynie & Peponis 1924 map of metric reach for reference.



Figure 7: Atlanta Streetcar Ridership in relation to Directional Reach

The Street railroad line of Forrest – Capitol is shown dashed in red, with Ponce de Leon – West View shown dashed in black. Both are overlaid with the associated Haynie & Peponis 1924 map of directional reach core cognitive structure. For clarity, the portions of the street rail lines that intersected the directional reach core are shown highlighted in yellow on the right.

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