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A Social Network Analysis of Active Transportation Policy Networks

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by

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Dedicated to my first teachers – my Mom and Dad.

ABSTRACT OF THE DISSERTATION

A Social Network Analysis of Active Transportation Policy Networks

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Professor Ross C. Brownson, Chair

Background: In an effort to increase physical activity, communities are recognizing the importance of policy and environmental changes to facilitate active transportation. However, evidence on the policy partnerships and processes to achieve such policy and environmental changes, particularly in non-health sectors, is lacking.

Methods: An online social network survey was administered in Fall 2015 to organizations engaged in active transportation policies in six cities across the United States. In addition to individual and organizational characteristics, relationships between organizations were assessed, including: level of collaboration around active transportation policies, frequency of contact, resource sharing to support active transportation, and perceived decisional power of partnering organizations. Descriptive and inferential network analyses were conducted.

Results: An average of 25 individuals at 22 organizations in each city participated in the online survey, with a total of 149 respondents. Organization types represented in the full sample included: advocacy/nonprofit, local government, local transit agencies, metropolitan planning organizations, planning/engineering firms, public health, state and federal transportation organizations, and academic institutions. In all six cities, the likelihood of active transportation policy collaboration increased when organizations communicated at least quarterly. In half of the cities, the probability of active transportation policy collaboration increased when resources were exchanged between two agencies. In half of the cities, active transportation policy collaboration was more likely to occur when organizations were perceived as having decisional authority around active transportation policies.

Conclusion: Information on the policy partnerships that exist around active transportation policies can help researchers, practitioners, policymakers, and advocates more effectively work together across diverse sectors to support active transportation.

Chapter 1: Specific Aims

1.1 Policy and Environmental Changes to Address Physical Inactivity

Despite the well-established health benefits of regular physical activity, only 48% of adults in the United States meet the national physical activity recommendations outlined in the 2008 Physical Activity Guidelines.[1,2] Concurrently, rates of active transportation, which includes walking and bicycling for transportation, have declined over the past few decades.[3] In an effort to increase physical activity and gain subsequent health benefits, communities are recognizing the importance of policy and environmental changes to facilitate active transportation.[4–6] However, evidence on the policy change processes and policy partnerships necessary to achieve such environmental changes, particularly in non-health sectors, is lacking.[6–8]

1.2 Cross-Sector Collaboration with Metropolitan Planning Organizations

In addressing active transportation, the development, adoption, and implementation of transportation policies requires collaboration between actors and organizations across various sectors, especially those outside the public health arena.[9–13] Within the transportation sector, Metropolitan Planning Organizations (MPOs), or regional agencies that are federally mandated to facilitate the transportation planning processes and allocate federal transportation funds in cities with a population greater than 50,000 residents, are vital organizations that serve as an important platform for advancing active transportation policies.[14,15] These organizations are increasingly recognizing that active transportation is an essential component of a safe and efficient transportation system. This recognition can be attributed at least in part to the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. ISTEA allowed federal transportation funding to be spent on active transportation infrastructure and established more local authority on how the funding could be allocated.[16] As a result, MPOs have significant influence on individuals' opportunities for active transportation.[16,17] The size, organizational structures, funding levels, policy priorities and processes of MPOs vary. Most are freestanding organizations with their own governing bodies and professional staffs; however, some are housed in local, regional, or state agencies or function as part of regional councils of government or planning commissions.[18] Despite this change in federal transportation funding and processes for allocation, previous research has demonstrated that there is still considerable variation across metropolitan areas in how federal transportation funding is spent. Consequently, there is wide variation in the quality of bicycle and pedestrian environments that support active transportation.[15,19]

1.3 Study Aims

Past research conducted by Handy and McCann has revealed that there is an important interplay between support from local governments, strong advocacy organizations, and the capacity of MPO staff that is instrumental in MPOs prioritizing active transportation projects, suggesting that networks could be important to the active transportation policy process.[15] This dissertation applies a network approach[20,21] to assess policy networks in which six MPOs across the United States are engaged to support active transportation policies. For the purposes of this project, a policy network is comprised of actors from both inside and outside an MPO that are highly involved in the active transportation policy process. An enhanced understanding of the formal and informal active transportation policy networks can enable public health researchers, practitioners, policymakers, and advocates to develop and strengthen policy partnerships across sectors to support active transportation policies that promote population physical activity. The specific aims for this study are described below.

Specific Aim 1. Assess collaboration among MPO representatives and their partners involved in active transportation policies.

- Activities: To accomplish Aim 1, the following activities were completed: (1) Surveyed MPO representatives and partners in six U.S. cities to identify those most engaged in active transportation policies, determined their roles and level of involvement in active transportation policy activities, and assessed with whom each of the MPO representatives and partners is collaborating; and (2) Conducted social network analysis to examine the composition and structures of each of the six active transportation policy networks.

Specific Aim 2. Identify predictors of collaboration around active transportation policy activities among MPO representatives and their partners for each active transportation policy network.

- Activity: To accomplish Aim 2, the following activity was completed: Developed separate statistical models to identify significant predictors of collaboration around active transportation policy activities in each of the six active transportation policy networks.

Chapter 2: Background and Significance

2.1 Physical Inactivity in the United States

Regular physical activity has wide-ranging health benefits. It can reduce the risk of depression, diabetes, heart disease, high blood pressure, obesity, stroke, and certain types of cancer.[1,22] Yet, data from various national surveillance systems consistently suggest that most adults and youth in the United States do not meet the current recommendations outlined in the 2008 U.S. Physical Activity Guidelines. According to the Centers for Disease Control and Prevention, only 48% of U.S. adults meet the Guidelines, and approximately 58% of youth do not meet the daily recommendations for children and adolescents of 60 minutes per day.[1,2,23] In a study assessing adherence to physical activity recommendations using objective measures of physical activity (accelerometry), where adherence was defined as "accumulating bouts of activity to achieve 30 or more minutes of at least moderate-intensity physical activity on five or more days out of seven days," Troiano and colleagues found that the prevalence of adherence was less than 5% among adults.[24] As the aforementioned evidence suggests, physical inactivity is a serious public health problem in the United States.[25]

2.1.1 Physical Activity Recommendations

The 2008 Physical Activity Guidelines Advisory Committee Report defines physical activity as "any bodily movement produced by contraction of skeletal muscle that increases energy expenditure above a basal level." Findings from this national report recommend that adults engage in 150 minutes of moderate-intensity aerobic activity every week, or 75 minutes of vigorous-intensity aerobic activity every week. On at least 2 days per week, adults are encouraged to engage in muscle strengthening activity. The committee recommends that children and adolescents between 6-17 years old engage in 60 minutes or more of moderate- or vigorous-intensity activity per day with participation in vigorous-intensity activity at least 3 days per week. Youth are also encouraged to participate in muscle and bone strengthening activity at least 3 days per week.[26]

2.2 Active Transportation in the United States

There are many ways for individuals to meet the recommendations outlined in the 2008 U.S. Physical Activity Guidelines, as physical activity can occur across four different domains: leisure, occupational, domestic, and transportation. The majority of studies undertaken to date have explored recreational physical activity or physical activity from a global dimension.[27] Physical activity for transportation, commonly referred to as "walking or bicycling for transportation," "non-motorized transport," "active travel," "sustainable travel," or "alternative transportation," is often defined as "any self-propelled, human-powered mode of transportation," and will hereafter be called, "active transportation," has been acknowledged as convenient and effective modes for individuals to achieve recommended levels of physical activity.[28]

Although active transportation represents an opportune medium for engaging in regular physical activity, the Federal Highway Administration has referred to active transportation as the "forgotten mode" of travel.[29] A wealth of research has demonstrated that the built environment influences activity transportation.[30] The built environment – the physical form of communities – includes land use patterns (how land is used), large- and small-scale built and natural features (e.g., architectural details, quality of landscaping), and the transportation system (the facilities and services that link one location to another).[31–33] Over the past several decades, metropolitan regions have spread over larger areas and sprawling development has typically been designed to accommodate the motor vehicle rather than more active modes of transportation.[34] As land development spreads further apart from urban cores and transportation systems offer fewer attractive and safe alternatives to driving, motor vehicle use frequently becomes a necessity rather than a choice. As such, driving rates are escalating whereas walking and bicycling rates are declining.[11,34,35]

In a review of the evidence, Brownson and colleagues reported that the relative increase in average daily vehicle miles traveled, an indicator of vehicle travel made by a private vehicle, including motor vehicles, vans, pickup trucks, or motorcycles, increased 224% between 1950 and 2000.[36] A recent report used five national surveillance systems, including the American Community Survey (ACS), the NHTS, the American Time Use Survey (ATUS), the National Health and Nutrition Examination Survey (NHANES), and the National Health Interview Survey (NHIS), to assess active transportation prevalence in the United States. Although varied definitions of the construct of active transportation and different assessment methods were used in these studies, the authors of the report presented comprehensive and multi-year (2009-2012) active transportation prevalence estimates. Using data from the ACS and NHTS, which measure active transportation as a primary mode to work in the previous week, active transportation prevalence ranged from 2.6 to 3.4%. Using data from one-day assessments of active transportation from the NHTS and ATUS, active transportation prevalence ranged from 10.5 to 18.5%. Using NHANES and NHIS data, which assess recent habitual active transportation behaviors (or habitual active transportation in the previous week or previous month), active transportation prevalence ranged from 23.9 to 31.4%. Across all of the surveillance systems, Whitfield and colleagues found that active transportation prevalence was higher among men, younger individuals, and minority racial/ethnic groups, and was more common in densely populated, urban areas.[37] As a result of rising levels of motor vehicle use and low levels of active transportation, increasing active transportation has become a national priority, as indicated by the following Healthy People 2020 developmental objectives: PA-13 (increase the proportion of trips made by walking) and PA-14 (increase the proportion of trips made by bicycling).[38]

2.3 Policies and Environments Supportive of Active Transportation

In response to these public health concerns of physical inactivity and low levels of active transportation, public health promotion efforts have expanded from individual-based approaches to promoting policy and built environment changes that support active living. In contrast to individual behavior modification strategies, policy and environmental approaches can benefit all people exposed to the environment rather than focusing on changing the behavior of one individual at a time.[12,39–43] An important framework that has guided physical activity policy research is depicted in Figure 2.1. Developed by Schmid and colleagues, the framework presents the main components of physical activity policies along the vertical axis and the settings in which policies are developed or applied along the sector and scale axes.[8]

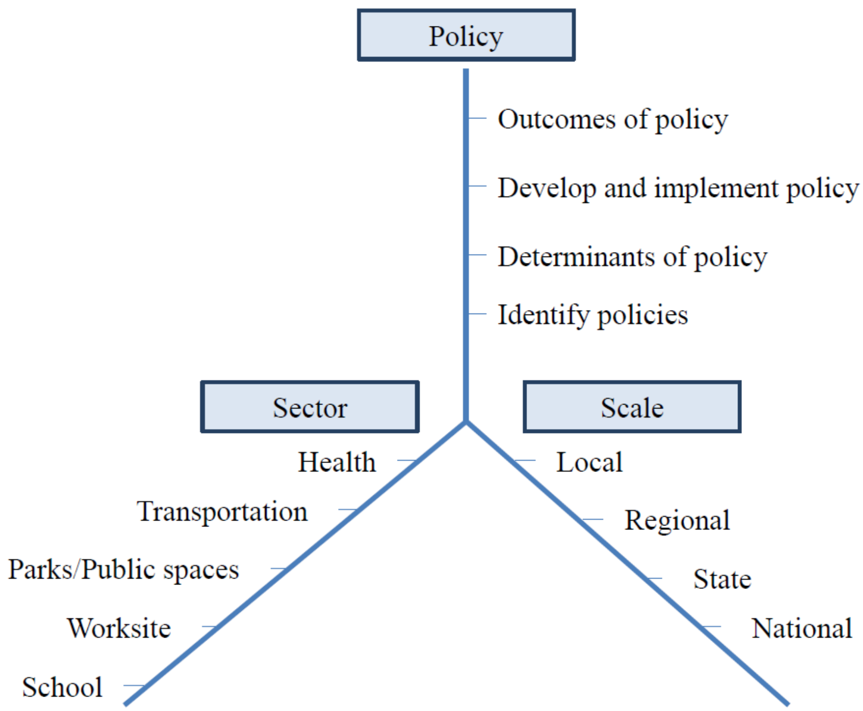


Figure 2.1 *Framework for physical activity policy research developed by Schmid and colleagues, 2006*

Policies can influence populations at the local, regional, state, or national level. Policies can also take many different forms, from unwritten social norms that may influence key stakeholders to formal legislation and regulations to informal codes and standards which can be initiated by either governmental or non-governmental organizations.[8,9,44]

2.4 Transportation Policies Supportive of Active Transportation

One overarching policy approach to support active transportation acknowledged by the U.S. Task Force of Community Preventive Services is transportation policies. Transportation policies encouraging active transportation can facilitate traffic calming and speed control; create or enhance walking or bicycling infrastructure (e.g., Safe Routes to School policies; Complete Streets policies); improve public transit services and facilities; reform transportation pricing and incentives; and promote smart growth land use and development.[45,46] These policy approaches are described below.

Traffic calming and speed reduction policies seek to lower and enforce speed limits of motor vehicles. Reduced motor vehicle speeds on roads can result in improved perceptions of and actual safety among pedestrians and bicyclists.[46] The Institute of Transportation Engineers defines traffic calming as "the combination of mainly physical measures that reduce the negative effects of motor vehicle use, later driver behavior and improve conditions for non-motorized users."[47,48] Traffic calming policies typically support four types of changes to the built environment including motor vehicle deflections (i.e., speed humps, speed tables, or raised intersections), horizontal shifts (i.e., traffic circles), narrowing roadways (i.e., road diets), and road closures.[47] Speed reduction policies can include reduced speed limits, increased signage of traffic speeds, and increased enforcement of speed limits by law enforcement agencies.[48–50]

Policies that create or enhance walking and bicycling infrastructure can allocate resources towards the development or enhancements of sidewalks, crosswalks, trails, or bicycle lanes or paths. These types of policies can also include the development and implementation of regulations supportive of active transportation, such as community design specifications or standards.[44,46,48] Complete Streets and Safe Routes to School policies and practices are specific examples of policy approaches that improve walking and bicycling infrastructure.[51,52] Complete Streets policies are a set of policies and planning practices that consider the diverse needs of all road users, including pedestrians, bicyclists, motorists, and public transit riders, of all ages and abilities.[51] Safe Routes to School policies and programs utilize principles of evaluation, engineering, encouragement, and enforcement to improve the safety of the infrastructure surrounding schools in order to encourage children to walk or bicycle to school.[52]

Policies that improve public transportation services and facilities include approaches to make public transportation more convenient for pedestrians and bicyclists to use. This consists of policy approaches that increase routes, extend service hours, and improve public transit vehicles and stations to increase access and safety for pedestrians and bicyclists. For the latter, such improvements can include secure bicycle parking and storage at public transit stations; dedicated carriers or areas for bicycles on public transit vehicles; or improvements to seating, lighting, and signage at public transportation stations.[46,48,53,54] Another important policy approach in improving public transportation services and facilities includes transit-oriented development. Transit-oriented development fosters high density, mixed-use neighborhoods surrounding public transportation stations, which can encourage active transportation modes in these areas.[55]

Transportation pricing and incentive policies represent pricing reforms to transportation and parking, as well as financial incentives for alternative modes of transportation. Transportation pricing policies aim to discourage motor vehicle use and encourage active transportation by: increasing tolls for motor vehicles, enforcing higher tolls in congested areas; increasing gasoline taxes; or increasing registration or insurance fees based on the distance traveled by motor vehicles, which are sometimes called vehicle miles traveled fees. Increasing parking fees is another strategy to decrease motor vehicle use.[46] In addition, financial incentives for active transportation typically occur at an institutional-level, where employers can incentivize public transit use through free or reduced transit passes.[46,56]

Smart Growth land use policies, which are often the responsibility of local jurisdictions to implement, can promote compact, mixed-use development and encourage multimodal transportation systems. More specifically, Smart Growth policies seek to curb suburban sprawl by implementing growth management strategies that create "compact, transit-accessible, pedestrian-oriented, mixed-use development patterns and land reuse."[57–59] Lastly, policies that promote land use patterns supportive of active transportation can include tax incentives or financing of dense and highly mixed-use development.[60] Despite the emerging evidence on how transportation policies can facilitate built environment changes to support active transportation, research on the policy change processes and policy partnerships necessary to achieve these environmental changes, particularly in non-health sectors, is limited.[6,8]

2.5 Metropolitan Planning Organizations and Active Transportation

As indicated in Figure 2.1, developing and implementing policies supportive of active living requires involvement from diverse sectors.[8,41,60] Increasingly, public health professionals are expected to engage in collaborations with organizations outside of the public health sector.[61] To support active transportation, this may include collaborations with individuals and governmental and non-governmental organizations spanning transportation transportation, planning, public works, parks and recreation, education, government, and nonprofit sectors.[62–64] Within the transportation sector, Metropolitan Planning Organizations (MPOs) are vital to the development, adoption, and implementation of active transportation policies.[15,31,46,65] MPOs are federally mandated agencies for urban areas with more than 50,000 residents that are responsible for distributing federal transportation funds and planning long- and short-term transportation projects.[14,15,66] The role of MPOs and the prioritization of active transportation changed with the passage of ISTEA of 1991, which allowed MPOs more local authority on how federal transportation funding could be allocated and enabled federal funding to be spent on active transportation infrastructure.[16]

With the aforementioned changes to federal transportation funding policies and processes that established more local authority to MPOs, the shift towards more integrated and multimodal transportation policies supportive of active transportation at the state, regional, and local levels is evolving. Conventional transportation and planning policies typically considered only the convenience, efficiency, and affordability of motor vehicle transportation. As a result, policies often favored the expansion of roads with little attention to active transportation. The new paradigm in transportation planning policies expands beyond mobility to accessibility and equity. Transportation policies are now considering a wider range of impacts and transportation options, including modes supportive of active transportation.[18,46,67] Although MPOs play a vital role in supporting active transportation policies, limited research exists on the policy activities of MPOs that impact public health, particularly active transportation policies.[15,19] Several relevant studies that explore the policy activities of MPOs that may influence active transportation are described below.

In 2009, Cradock and colleagues explored factors associated with pedestrian and bicycling investments made at the local level between 1992 to 2004. This study period captured the time following the passage of ISTEA of 1991, which authorized more flexibility in federal funding being spent towards active transportation projects by MPOs. They found disparities in local pedestrian and bicycling investments, where counties with high poverty and low educational status were less likely to utilize federal transportation funds.[68]

In 2010, Handy and McCann conducted case studies of six MPOs to understand the factors influencing municipal-level variation in pedestrian and bicycle investments. The authors found that support from the state Department of Transportation and the policies set by them, the response of the MPO to these state policies, and the support at the local level from local government officials and advocacy groups are key to increased pedestrian and bicycling investments by MPOs.[15]

In 2014, Singleton and Clifton conducted a content analysis of long-range transportation plans of selected MPOs to examine the integration of public health into transportation planning processes. Of the 18 plans that were reviewed, only seven plans included policies to increase physical activity through mentions of active transportation modes. Furthermore, results demonstrated that only four long-range transportation plans included performance measures that promoted physical activity. The investigators suggested that opportunities exist for MPOs to update their long-range transportation plans to adopt guidance statements that promote physical activity through transportation systems.[69]

Although it does not explicitly discuss active transportation policies, a 2009 study conducted by Weir and colleagues examined the local networks that influenced transportation policies in Chicago and Los Angeles to understand how regional transportation decisions were made. The investigators found that Chicago had a more centralized network with powerful actors, suggesting vertical power, and Los Angeles had a fragmented network with weak actors, demonstrating horizontal power. The investigators broadly described that the authorization of ISTEA of 1991 helped strengthen regional capacity and enabled broader participation among diverse and previously underrepresented organizations in both cities. However, the authors suggested that inclusive, collaborative networks could be more successful in advancing regional transportation policy decisions if they are additionally supported by vertical power, as in the case of Chicago.[70]

These studies offer important insight on the disparities of active transportation investments at the local level;[68] the potential organizations that can influence MPOs' active transportation investments;[15] the prioritization of public health and physical activity issues in MPOs' planning processes;[69] and the local network structures that may impact regional transportation decisions.[71] However, there is opportunity to learn more about the role of MPOs in promoting active transportation policies.

2.6 Preliminary Research with Metropolitan Planning Organizations

Previous research conducted by the study investigator provided preliminary findings on the role of cross-sector collaborations in local officials' involvement in active transportation policies and the role of MPOs in the development, adoption, and implementation of policies supportive of active transportation.

A 2014 study examined individual- and job-related predictors of involvement in transportation policies supportive of walking and bicycling among municipal officials, including transportation and planning professionals. The study was conducted in 83 urban areas with a population of

50,000 residents or more residents across 8 states. One important finding was that respondents who perceived lack of collaboration among departments as a barrier to their work on built environment issues were significantly less likely to be involved in active transportation policies. Despite this association found between lack of collaboration and low involvement in active transportation policies among local officials, limited information exists on how to foster cross-sector partnerships around active transportation, particularly between public health and transportation professionals.[72]

In 2014, a preliminary study was conducted to qualitatively examine determinants of developing, adopting, and implementing policies supportive of active transportation by MPOs. Two cities each from three states, including Memphis, Nashville, Kansas City, Saint Louis, Sacramento, and San Diego, were purposefully selected to account for state-level differences and with consideration of varied geographic locations, socioeconomic characteristics, and prevalence of active transportation. Key informant interviews were conducted with MPO staff and individuals representing active transportation advocacy organizations that partnered with the selected MPOs in each city. A snowball sampling technique was used to recruit participants and data was collected until saturation was reached, or no new information was gleaned. Fifteen semi-structured interviews were conducted with 19 key informants representing MPOs (N=13) and partnering advocacy organizations (N=6) from June to August 2014.[73]

Thematic analysis revealed that many factors related to collaboration supported or impeded active transportation policy prioritization by MPOs. MPO staff identified important partners in supporting active transportation policy prioritization by MPOs including state departments of transportation, local advocacy groups, state and local public health departments, local elected officials who are often represented on MPO boards, regional and city agencies, and academic institutions. MPO staff discussed the importance of these varied groups to increase public and political awareness of the benefits of active transportation; educate and provide technical assistance to local jurisdictions on how to integrate active transportation policies into project proposals submitted to MPOs; convene stakeholders; and support the implementation of active transportation policies and projects.[73]

Although this pilot study broadly demonstrates the importance of collaboration for a variety of active transportation policy activities by MPOs, it provides limited insights into the actual collaborations occurring with MPOs around active transportation and the factors that influence active transportation policy collaboration. An enhanced understanding of the formal and informal active transportation policy networks in which MPOs are engaged may help in identifying leverage points for future collaborations around active transportation policies.

2.7 Active Transportation Policy Networks and Systems Science Approaches

2.7.1 Cross-Sector Collaborations around Active Transportation

As discussed earlier in this chapter, a growing body of evidence has demonstrated the importance of cross-sector partnerships to health promotion and disease prevention.[61,74] Only a few studies to date have explored cross-sector partnerships working to promote active transportation. One study was conducted by Gustat and colleagues as part of a broader study called "Coalitions and Networks for Active Living (CANAL)" study. The investigators qualitatively explored the successes and challenges that active living collaborative groups faced in promoting and implementing physical activity policies, where a collaborative group was defined as any type of multidisciplinary group, coalition, or network. While most of the active living collaborative groups in this study reported successes around implementing built environment policies and projects to promote active living, participants representing the collaborative groups frequently reported challenges related to funding and personnel.[64]

Another study conducted by Litt and colleagues as part of the CANAL study examined the characteristics and activities of cross-sector collaborative groups working to advance active living. Using survey data collected from a coordinator from each of the 59 participating active living collaborative groups across 22 states, their study results highlighted that most collaborative groups had representation from a range of sectors and disciplines, including public health, planning, architecture, sports and fitness, governmental organizations, universities, schools, business leaders, and faith-based organizations. The large majority of coordinators in their sample reported that their collaborative group had expertise in public health, but only about a third of the sample indicated expertise in transportation. The collaborative groups were most engaged in the following physical activity policy areas: parks and recreation, Safe Routes to School, street improvements, and streetscaping; and the groups were least engaged in the policy areas of transit and parking, and infill and redevelopment.[75]

Using data from the overarching CANAL study previously mentioned, Litt et al.[63] examined organizational and network level characteristics that influenced active living collaborative groups' perceived success. At the organizational level, an organization occupying a leadership position and the length of time the organization was involved in the collaborative group was associated with perceived success of the active living collaborative. At the network level, reported support from community leaders emerged as a correlate of perceived success of the active living collaborative. Although the study results provide important information on the organizational and network factors that influence perceived success of cross-sector partnerships working in physical activity, no measures of dyadic relationships were assessed.[63]

These studies have provided some initial findings on the perceived challenges and successes among collaborative groups that promote active living, along with their composition, policy activities, and the factors associated with their perceived network success. However, despite the growing recognition on the importance of MPOs in supporting active transportation policy activities, limited information exists on the network structures and processes of active transportation policy networks that MPOs and public health organizations are engaged.[62,76–78]

2.7.2 Systems Science Approaches and Social Network Analysis

Over the past decade, there has been increased application of "systems science" approaches in public health.[79] Systems science is considered a "broad class of analytical approaches that aim to uncover the behavior of complex systems."[80] To study complex systems, three methodological approaches are commonly used: system dynamics, agent-based modeling, and social network analysis.[79] Because active transportation policies are complex and not commonly developed, adopted, or implemented by a single individual or organization, or even within a single sector, taking a systems approach and attempting to understand the "whole" system rather than focusing on one individual component or player within the policy process may be beneficial.[80]

Social network analysis represents a useful approach to understand and evaluate relationships between individuals or groups within a network.[20,79,81] With a focus on relationships, a network approach can be useful in understanding relationships around specific policy issues, such as active transportation.[20,82–84] Network approaches are increasingly used in public health to understand intra- and inter-organizational networks, including research examining the public and private organizations involved in delivering mental health services,[85] community health agencies addressing child abuse,[86] services for the physical and social health of older adults,[87] emergency preparedness and response,[88] tobacco control,[89,90] cancer support,[91] health policy,[92] and health promotion.[93–96] Networks have the potential to assemble diverse stakeholders, leverage resources, increase organizational capacity to achieve active transportation goals, share knowledge, build relationships, and translate research to policy throughout various stages of the policy process.[61,63,74–77] Previous studies have also demonstrated that networks can improve the performance and productivity of certain organizations and enhance the policy process by making them more efficient and innovative.[74,97–100]

Connections between organizations in a policy network can be strong or weak, formal or in-formal, and voluntary or required.[20] Evidence on the existence, strength, and formality of such ties and the roles of MPOs and their partners can inform researchers, practitioners, policymakers, and advocates from health and non-health sectors in developing stronger, more collaborative partnerships around active transportation policies.[64,101] The visual maps of active transportation policy networks provided by this analysis can be useful for practitioners and policymakers. The maps may make them aware of current collaboration around active transportation policy activities, identify prominent network organizations, examine gaps or inefficiencies in the network, and identify leverage points for future collaboration and active transportation policy advocacy.

Thus, social network analysis represents an appropriate approach for elucidating the roles of MPOs and key collaborations that exist around active transportation policies. This approach can also help in identifying network predictors of collaboration around specific active transportation policies.

2.8 Summary of Evidence and Significance

This dissertation, which assessed active transportation policy networks in which MPOs were engaged, is significant for a number of reasons. First, a fuller understanding is needed on the processes and partnerships necessary to support policy and environmental approaches for promoting physical activity. Second, despite the importance of collaboration with non-traditional partners outside the health sector to promote active transportation policies, limited research exists on how to foster these collaborative networks. Lastly, MPOs oversee the expenditure of billions of federal transportation dollars and have influence over important transportation decisions. As a result, an enhanced understanding of MPOs roles and partners within a policy network can help better position other MPOs and communities seeking to advance active transportation policies. This may lead to more efficient expenditure of transportation funds.

Chapter 3: Theoretical Background

The theoretical basis for this dissertation study is a combination of the Socio-Ecological Model and the Policy Network Theory.

3.1 Socio-Ecological Model

The Socio-Ecological Model is a leading framework among public health and physical activity researchers and practitioners. The foundation of this model is that behavior is influenced by factors across the following levels: intrapersonal (biological and psychological), interpersonal (social and cultural), organizational or institutional, community, and public policy.[8,12,102,103] An important premise of this model is that multiple factors at each level interact within and between each level to influence specific health behaviors, including active transportation.

As the Socio-Ecological Model suggests, policies are vital upstream factors that can influence active transportation behaviors. Policies are often considered as being further upstream than built environment attributes. Policy approaches are referred to as "upstream" because they come first in the causal process, where policy can influence the environment, which can then influence behavior.[104] Moreover, policy approaches are considered more effective in influencing large populations, often through policies that regulate, increase access, or provide incentives, whereas downstream approaches typically focus on individual-level strategies to promote physical activity.[105] While the research and practice base to promote physical activity, and specifically active transportation, is growing, physical activity policy research is still in its infancy.[8,9] Limited research has systematically examined the effectiveness of policies that influence active transportation, as well as the determinants of such policies.[48] Much of this research has also lacked theory-based approaches. Theoretical frameworks used in other disciplines, particularly the field of public policy, have important implications for an enhanced understanding of the policy mechanisms that influence active transportation environments and behaviors. One such theory is the Policy Network Theory.

3.2 Policy Network Theory

The networks that develop from relationships between actors (or individuals or organizations that are directly or indirectly and formally or informally affiliated with a policy) with shared policy interests are important to advancing the policy process. The term network is widely used across disciplines, including ecology, economics, mathematics, political science, and sociology, but the term is often nuanced and difficult to define. For the purposes of this section, a network is a formal or informal structure that links actors, representing individuals or organizations, who share a common interest on a specific issue or who share a general set of values. Within the contexts of policy, a "policy network" is frequently used as an overarching term to describe any network comprised of actors from both inside and outside government that are highly involved in the policy process.[83,106–110] More specifically, a policy network represents a group of actors with a shared interest in a specific policy topic, such as active transportation, where the actors are linked directly or indirectly to one another.[111] There is a wealth of evidence that has suggested that networks can help improve policy processes, or that actors within policy networks can influence formulation, adoption, and diffusion of policy ideas across larger policy systems.[108,111,112]

The foundation of studying policy networks is based on the concept that regular and frequent contact and exchange of information and ideas between actors can result in stronger relationships and improved coordination of policy-related activities. Still in its early stages, the concept of policy networks can be used for three different purposes: (1) to designate a distinct, new governing structure; (2) to understand different patterns of interactions between public and private actors as it relates to a specific policy topic; and (3) to provide information needed to conduct social network analysis. Policy network analysis, in particular, has been used to identify important actors involved in policymaking institutions, to describe and explain the structure of their interactions during the policy process, and to explain and predict policy decisions and outcomes.[108]

Previous research has considered five types of inter-organizational relations to explore policy networks including resource exchange, information transmission, power relations, boundary penetration, and sentimental attachments.[83] Descriptions of each of these types of inter-organizational relationships in a policy network are presented in Table 3.1.

Table 3.1 *Types of inter-organizational relationships in a policy network*

Type	**Description**
Boundary penetration	Coordination or collaboration to achieve a common goal
Information transmission	Communication of information among organizations, ranging from scientific and technical data to political advice and opinions
Power relations	Coercion, authority, or influence over another organization
Resource exchange	Voluntary or mandated exchange of money, personnel, goods, or services
Sentimental attachments	Subjective, emotional affiliations that generate solidarity, mutual assistance, or support among actors (e.g., friendship)

The Policy Network Theory is still developing, and a frequent critique of taking a policy network perspective is that it does not result in any predictive power but rather explanatory.[111] However, others have proposed that characteristics of networks and network participants can yield important information on policy outcomes.[82]

3.3 Conceptual Model

The Socio-Ecological Model and the Policy Network Theory guide the conceptual model for this study (Figure 3.1).[102,108,113] The Socio-Ecological Model describes the associations (shaded in white in the framework) between the policy and environmental factors that may influence active transportation. The Policy Network Theory, which posits that clusters of actors each with an interest or stake in a given policy can determine a policy outcome, guides the portions of the conceptual framework in gray.[83,108] The relevant domains depicted in the conceptual framework that will be examined in-depth in this study include: *node attributes*, *link attributes*, and *active transportation policy collaboration*.

Node attributes represent characteristics of individual MPOs or partnering organizations. Characteristics specific to the organization that will be assessed include the length of time the representative most engaged in active transportation efforts within that organization has been in their current position, the length of time this representative has been involved in active transportation work, organization type, organization size, and the involvement of the organization in specific active transportation policies (e.g., Complete Streets policies, Transit-Oriented Development policies).

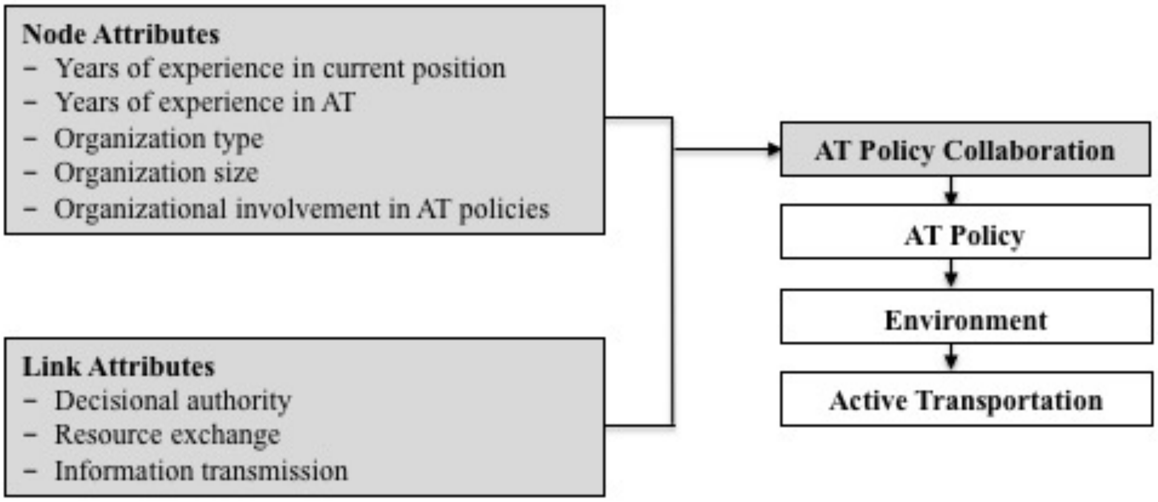


Figure 3.1. *Conceptual model: Individual, organizational, and network characteristics hypothesized to influence active transportation policy collaboration*

The connections between organizations in each network are operationalized as *link attributes.* Guided by the policy network theory, *link attributes* include decisional authority, resource exchange, and information transmission. Decisional authority refers to the actors within each network that hold the power to make final decisions on active transportation policies within their metropolitan area. Resource exchange refers to the exchange of financial resources, personnel, or services between MPOs and partnering organizations within each network. Lastly, information transmission refers to the frequency of contact or exchange of information related to active transportation policies. Central to the conceptual model is that *node attributes* and *link attributes* can influence *active transportation policy collaboration* between MPOs and partnering organizations outside MPOs. The measure for assessing *active transportation policy collaboration* is described in detail in Chapter 4.

Chapter 4: Methods

Previous studies have begun to explore the policy activities of MPOs[15,68,69] and the importance of cross-sector collaborations to support active living,[63,64,101] but questions remain about the role of MPOs and their partners in the development, adoption, and implementation of active transportation policies. To address this gap, an online survey was administered to a purposive sample of MPO staff and representatives from MPOs' partnering agencies in six metropolitan areas, including including Sacramento, California; San Diego, California; Kansas City, Missouri; Saint Louis, Missouri; Knoxville, Tennessee; and Memphis, Tennessee. Individual, organizational, and network data were collected to understand the collaborations occurring within active transportation policy networks and to examine the factors influencing active transportation policy collaboration. This chapter further details the methodological approaches employed in this study.

4.1 Sample

Purposive sampling was used to identify metropolitan areas to participate in the study. A set of criteria was developed to discern a diverse set of active transportation policy networks. Consideration was given to the characteristics of the metropolitan area each MPO represented, including population size, population density, socioeconomic characteristics of the residents, and most importantly, active transportation prevalence of residents. Organizational characteristics of the MPO were also considered, including number of operating years, structure (e.g., independent or hosted by another governmental organization), and board size. Two metropolitan cities from each of the three states were selected to account for state-level differences, or more specifically, differences in collaboration between a MPO and the state department of transportation. The final metropolitan areas included in the dissertation study were Sacramento, California; San Diego, California; Kansas City, Missouri; Saint Louis, Missouri; Knoxville, Tennessee; and Memphis, Tennessee (see Table 4.1).

Table 4.1 *Characteristics of study metropolitan areas and metropolitan planning organizations*

	Sacramento, CA	San Diego, CA	Kansas City, MO	Saint Louis, MO	Knoxville, MO	Memphis, MO
Population size[a]	2,274,557	3,095,271	1,895,535	2,571,253	542,827	1,077,697
Population density (per sq. mile)[a]	367.5	726.6	874.7	560.7	821.2	711.8
Median household income[b]	49,753	64,058	45,275	34,582	45,151	36,912
% Poverty[b]	21.9	15.6	19.1	27.4	17.3	26.9
% Walk[b]	3.1	3.1	2.2	4.3	1.4	1.8
% Public transit[b]	4.0	4.0	3.3	9.8	0.6	2.3
MPO designation year[a]	1967	1972	1974	1973	1978	1977
MPO structure[a]	Council of government	Council of government	Council of government	Council of government	Independent organization	Independent organization
MPO board size[a]	33	33	38	24	19	29

[a] Federal Highway Administration (2014). Metropolitan Planning Organization Database.
[b] U.S. Census Bureau (2014). American Community Survey Data.

Once sites were selected for the study, the sample of participants from each site were identified, which represented MPO staff who were most involved with active transportation policies within their organizations and representatives from their partnering organizations. A core assumption of the study is that each MPO represents an organization within an active transportation policy network that is critical to the development, adoption, and implementation of active transportation policies within each metropolitan area. Defining the sample and network boundary was essential to drawing conclusions about each active transportation policy network.[20,114] A modified reputational snowball sampling method was used to identify active transportation policy network members.[115,116] First, executive directors from each MPO were asked to identify all MPO staff and representatives from partnering agencies that were involved in active transportation policies.

Additional names of potential active transportation policy network members were generated using web resources, including long-range transportation plans, bicycle and pedestrian plans, and transportation improvement program documents of MPOs. Second, a representative from an active transportation advocacy organization within each metropolitan area reviewed the list and finalized the representatives who would be invited to participate.

4.2 Data Collection

Guided by the Policy Network Theory and network questions used in similar studies[93–96,117,118], An online survey was developed and tailored for each metropolitan area to reflect the final roster of MPO staff and representatives from partnering organizations. The survey was administered via Qualtrics (http://www.qualtrics.com) from September to October 2015. Recruitment occurred through email and telephone. Each network member was invited to complete the web-based survey through a personalized email invitation. Up to two email reminders were sent to network members who did not respond to the original email invitation. Individuals that did not respond to any email correspondence received up to two telephone call reminders. Respondents were offered a $20 Amazon gift card upon completion of the survey within 21-28 days. An average of 25 individuals at 22 organizations in each metropolitan area participated in the online survey, with a total of 149 respondents. This represents an organizational response rate of 78.4% for Sacramento, 78.9% for San Diego, 76.9% for Kansas City, 77.8% for Saint Louis, 68.3% for Knoxville, and 80.0% for Memphis. For robust network analysis, obtaining a high response rate, or as close to 80% as possible, was needed.

4.3 Human Subjects Protection

The study was granted exempt status by the Human Research Protection Office at Washington University in St. Louis. Online data collected via Qualtrics complied with the Health Insurance

Portability and Accountability Act rules. All Qualtrics accounts were hidden behind passwords and all data were protected with real-time data replication. Because of the nature of network data, the participants' responses were not anonymous, but were kept confidential.

4.4 Individual and Organizational Measures

Individual attributes of the active transportation network members that were assessed included gender, age, level of education, physical activity behavior in the previous week, active transportation behavior in the previous week, and social and fiscal political affiliations (the full survey instrument is provided in Appendix A). Other individual attributes measured include the following:

4.4.1 Current Position

Participants answered an open-ended question about their current job position.

4.4.2 Years Working in Current Position

The number of years that respondents had been working in their current position was assessed. Response options were: Less than 1 year, 1-5 years, 6-10 years, 11-15 years, or 16 or more years.

4.4.3 Years Working in Active Transportation

This represents the number of years that respondents had been working in the area of active transportation. Response options were: Less than 1 year, 1-5 years, 6-10 years, 11-15 years, 16 or more years, or I do not work in the area of active transportation.

4.4.4 Individual Involvement in Active Transportation Policies

Participants were asked to indicate their extent of involvement in various stages of the active transportation policy process, including active transportation policy planning or development, implementation, research or evaluation, and advocacy. Response options for each item were:

Never involved, rarely involved, occasionally involved, moderately involved, and a great deal involved.

4.4.5 Individual Motivation for Involvement in Active Transportation Policies

Participants were asked to indicate the extent public health, environmental impacts, traffic congestion, public safety, or economic development and opportunity influenced their involvement in active transportation policies. Response options for each item were: Not at all influential, slightly influential, somewhat influential, very influential, and extremely influential.

Characteristics of the organization the participant represented were assessed through the following measures:

4.4.6 Organization Size

Participants were asked to indicate the number of full-time equivalents within their organization.

4.4.7 Organizational Involvement in Active Transportation Policies

Participants were asked whether their organization had ever been engaged in the development, adoption, or implementation of the following active transportation policies: Safe Routes to School policy, Complete Streets policy, Transit-Oriented Development policy, Smart Growth or similar land use policy, Public transit policy related to improved services or facilities, and Transportation pricing or incentive policy. Response options were yes, no, or don’t know.

4.5 Network Measures

Guided by the Policy Network Theory, network questions included in the online survey covered awareness, decisional authority, resource exchange, information transmission, barriers to collaboration, and collaboration.

4.5.1 Awareness

The first network question was "Are you aware of the following individuals' work in active transportation?" Participants were provided a tailored list of all individuals identified by the MPO executive director and reviewed by a representative from an advocacy organization from each metropolitan area. Response options were yes or no. Any individual a participant was aware of was kept in the list for the remaining network questions.

4.5.2 Decisional Authority

To assess decisional authority, participants were asked the following: "Do the individuals below hold authority to make decisions that impact active transportation policies in the metropolitan area where you work?" Response options were yes or no.

4.5.3 Resource Exchange

Participants were asked "Have you shared (e.g., money, personnel, goods, or services) with the individuals below to support active transportation during the past year?" Response options were yes or no.

4.5.4 Information Transmission

Information transmission, and will hereafter be referred to as contact, was measured using the following network measure: "Please indicate how often you have had direct contact (e.g., meetings, phone calls, emails, or letters) with the individuals below during the past year." Response options were no contact, yearly, quarterly, monthly, weekly, and daily.

4.5.5 Barriers to Collaboration

Participants were asked to "Please indicate which of the following factors that impeded your ability to work with the individuals below during the past year." The following barriers to collaboration were assessed: lack of time, lack of capacity (funding, staff, etc.), lack of incentives to work together, organizational structure or bureaucracy, incompatible goals or strategies, politics, or none.[87,91] Participants were permitted to select more than one barrier to collaboration.

4.5.6 Collaboration

The primary outcome measure was collaboration, which was guided by past research.[93,95,96,117,118] Participants were asked to "Please indicate the level of collaboration with the individuals below that reflects your work together on active transportation during the past year." Response options were unlinked (do not work together at all), contact (share information only), cooperation (work together as an informal group to achieve common goals), collaboration (work together as a formal team to achieve common goals), and partnership (work together as a formal team across multiple projects to achieve common goals).

4.6 Network Data Management

Data management was conducted with SPSS, Pajek, and R. To conduct analyses at the organizational level, participants' responses for organizations with more than one respondent were combined. For binary network measures, including awareness, decisional authority, and resource exchange, the higher value (or "yes" response, if selected) was used to represent the organization. For valued network measures, including contact and collaboration, participants' responses for organizations with more than one respondent were averaged.

Consistent with previous research, the contact and collaboration network scales were dichotomized.[90,96,118–120] Organizations were considered linked if they had direct contact with one another at the level of quarterly or more. Because contact between two organizations is inherently reciprocal, the contact networks were symmetrized. The higher reported value between two organizations (or the presence of a tie) was used, as the individual reporting the higher value may be more aware of contact occurring between the organizations than the individual reporting the lower value. Therefore, dyads were considered linked if one organization indicated no contact and the other reported contact. For dyads where one of the two organizations had missing data, the value reported by the participating organization was used. Dyads were considered unlinked if both organizations reported no contact or where both partners had missing data.

The collaboration networks were also dichotomized. Dyads were considered unlinked if they did not work together at all or shared information only. Dyads were considered linked if they worked together as an informal group to achieve common goals, worked together as a formal team to achieve common goals, or worked together as a formal team across multiple projects to achieve common goals. The collaboration networks were symmetrized, where the higher value reported between a dyad was used. Similar to the contact network scale, the higher reported value between two organizations (or the presence of a tie) was used because the individual reporting the higher value may be more aware of collaboration occurring between the organizations than the individual reporting the lower value. Thus, dyads were considered linked if one organization indicated no collaboration and the other reported collaboration. The value denoted by a participating organization was used for dyads where only one of the two organizations provided a response. Dyads were considered unlinked if both organizations reported no collaboration or where both partners had missing data.

4.7 Data Analysis

4.7.1. Descriptive Data Analysis

Descriptive analyses were conducted in SPSS to summarize individual and organizational characteristics and to describe individual and organizational involvement in active transportation policies. Differences in individual and organizational characteristics across sites were examined with chi-square tests for categorical variables and one-way Analysis of Variance (ANOVA) tests for continuous variables.

Descriptive node-level measures were calculated in R to examine characteristics of specific network organizations for each metropolitan area, including degree centrality, betweenness centrality, and closeness centrality (see Table 4.2). For the directed networks of awareness and decisional authority, the distribution of incoming links (or in-degree centrality) was calculated, and the visualizations developed for these networks depict node sizes varying by in-degree; larger nodes indicate greater awareness and higher decisional authority of a given actor. For the directed network of resource sharing, the outgoing links (or out-degree centrality) was calculated, and the visualizations for this network shows node sizes based on out-degree; larger nodes indicate greater resource sharing by that actor. For the contact and collaboration networks, the node sizes in the visualizations were determined by betweenness centrality, or how often the actor acts as a bridge between other organizations that are not directly connected. Larger nodes are more central intermediaries in the network.

Descriptive network analyses were also conducted in R for the awareness, decisional authority, resource exchange, contact, and collaboration networks for each metropolitan area. Descriptive network-level measures included network size, density, diameter, transitivity, degree centralization, betweenness centralization, and closeness centralization. Descriptions of each of these network measures is provided in Table 4.2.

Table 4.2 *Node-and network-level measures*[121,122]

Characteristics	Description
Node-level measures	
Degree centrality	Connectivity of a specific actor, identified by the number of links that are connected to that node
In-degree centrality	The number of incoming nominations
Out-degree centrality	The number of outgoing nominations
Betweenness centrality	Extent an actor acts as a bridge between other organizations that are not directly connected
Closeness centrality	The average distance from one node to all others
Network-level measures	
Size	Number of organizations in the network
Density	Number of actual ties divided by the total number of possible ties in a network (lower density means greater heterogeneity)
Diameter	Useful measure of compactness; Longest of the shortest paths across all pairs of organizations (greater diameter means network less tightly connected)
Transitivity	Proportion of closed triangle formations, or triads where all three ties are observed, to the total number of open and closed triangle formations, or triads where either two or all three ties are observed (greater transitivity means more clustering in the network)
Degree centralization	Extent of variation in degree centrality among the nodes (greater degree centralization means network more hierarchical or centralized)
Betweenness centralization	Extent of variation in betweenness centrality among the nodes
Closeness centralization	Extent of variation in closeness centrality among the nodes

4.7.2 Inferential Data Analysis

Exponential random graph modeling (ERGM) is a new analytic method used to build and test social network hypotheses. Similar to logistic regression models, ERGM can serve as a powerful tool to predict the probability of a link between any two network organizations, while accounting for the assumption that ties in a network are not independent.[114] For this study, ERGM was used to identify predictors of active transportation policy collaboration based on attributes of network organizations; attributes of the relationships among network organizations, including decisional authority, resource exchange, and contact; and structural patterns of the network. Three stages of model building were performed in R:

Model 1. A null-baseline model, or one without any predictors, was developed.[123] The likelihood of a tie in this model is equal to network-level density.

Model 2. A model based on node attributes was estimated. Node attributes included in the model were the number of years the organizational representative worked in their current position (less than 1 year, 1-5 years, 11-15 years, or 16 or more years), and organizational involvement in a Safe Routes to School policy (yes or no), Complete Streets policy (yes or no), and Transit-Oriented Development policy (yes or no). This model tested whether collaboration links increased with years of experience and whether collaboration links were more common for organizations engaged in the abovementioned active transportation policies.

Model 3. A model based on relationship attributes and network structural patterns was developed. The relationship terms added to this model were decisional authority, resource exchange, and contact. The decisional authority predictor examined the relationship between the reported decisional authority of organizations (1= holds authority to make decisions that impact active transportation policies or 0= does not hold authority to make decisions that impact active transportation policies) and the likelihood of active transportation policy collaboration. The relationship term of resource exchange between organizations (1= shared resources to support active transportation or 0= did not share resources to support active transportation) was added to test how well it predicted active transportation policy collaboration. The relationship term of contact examined the relationship between contact between organizations (1= communicated with each other quarterly or more frequently or 0= communicated quarterly or less) and the likelihood of active transportation policy collaboration. The geometrically weighted degree (GWDegree) term was added to the model to account for the likelihood of organizations with higher degrees to be linked to other organizations in the network.[114]

4.7.3 Model Fit

Model fit was compared across all models using the Akaike Information Criterion (AIC). Goodness-of-fit plots, which compare observed networks to simulated networks, were produced and used to assess model fit.[123]

Chapter 5: Results

5.1 Individual and Organizational Characteristics

Individual characteristics of the sample as a whole and as stratified by metropolitan area are displayed in Table 5.1. Participants were mostly male (64.8%) and varied in age, with the majority of the sample between 50-64 years (33.8%), followed by 30-39 years (28.2%), 40-49 years (26.1%), 18-29 years (6.3%), and 65 or more years (5.6%). Most participants had either a college degree (43.0%) or a Masters degree (47.9%). The highest percentage of participants identified as socially liberal (59.9%) and fiscally liberal (33.1%). The majority of the sample engaged in physical activity in the previous week (97.9%) and walked or biked for transportation in the previous week (69.7%).

Table 5.1 *Individual-level characteristics of respondents, by metropolitan area*

	Sacramento (n=34)	San Diego (n=18)	Kansas City (n=33)	St. Louis (n=16)	Knoxville (n=31)	Memphis (n=17)	Full Sample (N=149)	*P*[1]
	n (%)							
Gender								.095
Male	24 (72.7)	12 (70.6)	22 (73.3)	10 (62.5)	12 (41.4)	12 (70.6)	92 (64.8)	
Female	9 (27.3)	5 (29.4)	8 (26.7)	6 (37.5)	17 (58.6)	5 (29.4)	50 (35.2)	
Age								.010
18-29	3 (9.1)	0 (0.0)	1 (3.3)	0 (0.0)	1 (3.4)	4 (23.5)	9 (6.3)	
30-39	5 (15.2)	2 (11.8)	8 (26.7)	9 (56.3)	10 (34.5)	6 (35.3)	40 (28.2)	
40-49	9 (27.3)	6 (35.3)	8 (26.7)	5 (31.3)	7 (24.1)	2 (11.8)	37 (26.1)	
50-64	14 (42.4)	5 (29.4)	12 (40.0)	2 (12.5)	10 (34.5)	5 (19.4)	48 (33.8)	
65+	2 (6.1)	4 (23.5)	1 (3.3)	0 (0.0)	1 (3.4)	0 (0.0)	8 (5.6)	
Education								.139
Some college	2 (6.1)	2 (11.8)	1 (3.3)	0 (0.0)	1 (3.4)	1 (5.9)	7 (4.9)	
College degree	21 (63.6)	7 (41.2)	12 (40.0)	5 (31.3)	10 (34.5)	6 (35.3)	61 (43.0)	
Masters degree	9 (27.3)	8 (47.1)	16 (53.3)	11 (68.8)	14 (48.3)	10 (58.8)	68 (47.9)	
Doctorate	1 (3.0)	0 (0.0)	1 (3.3)	0 (0.0)	4 (13.8)	0 (0.0)	6 (4.2)	
Political affiliation (social)								.778
Liberal	19 (57.6)	11 (64.7)	14 (46.7)	10 (62.5)	19 (65.5)	12 (70.6)	85 (59.9)	
Moderate	6 (18.2)	6 (35.3)	10 (33.3)	3 (18.8)	5 (17.2)	2 (11.8)	32 (22.5)	
Conservative	4 (12.1)	0 (0.0)	3 (10.0)	1 (6.3)	3 (10.3)	1 (5.9)	12 (8.5)	
Other/Prefer not to answer	4 (12.1)	0 (0.0)	3 (10.0)	2 (12.5)	2 (6.9)	2 (11.8)	13 (9.2)	
Political affiliation (fiscal)								.983
Liberal	12 (36.4)	6 (35.3)	7 (23.3)	6 (37.5)	9 (31.0)	7 (41.2)	47 (33.1)	
Moderate	9 (27.3)	7 (41.2)	11 (36.7)	4 (25.0)	10 (34.5)	4 (23.5)	45 (31.7)	
Conservative	8 (24.2)	4 (23.5)	8 (26.7)	4 (25.0)	8 (27.6)	4 (23.5)	36 (25.4)	
Other/Prefer not to answer	4 (12.1)	0 (0.0)	4 (13.3)	2 (12.5)	2 (6.9)	2 (11.8)	14 (9.9)	
Engaged in physical activity last week								.713
Yes	32 (97.0)	17 (100.0)	30 (100.0)	16 (100.0)	28 (96.6)	16 (94.1)	139 (97.9)	
Walked or bicycled for transportation last week								.006
Yes	28 (84.8)	16 (94.1)	18 (60.0)	12 (75.0)	14 (48.3)	11 (64.7)	99 (69.7)	

[1] Chi-square analyses were conducted with categorical characteristics.

Table 5.2 describes job and organizational characteristics of the full sample and stratified by metropolitan area. The majority of the full sample represented either an advocacy or nonprofit organization (31.5%) or a local government organization (31.5%). The mean number of full time equivalents (FTEs) per all of the organizations across the entire sample was 999.1 employees.

Participants had the opportunity to specify the length of time they worked in active transportation, or if their work did not focus on active transportation. The largest proportion of participants indicated they worked in active transportation for 1-5 years (30.2%). Lastly, most participants were in their current position for 1-5 years (46.3%).

Table 5.2 *Job and organizational characteristics of respondents, by metropolitan area*

	Sacramento (n=34)	San Diego (n=18)	Kansas City (n=33)	St. Louis (n=16)	Knoxville (n=31)	Memphis (n=17)	Full Sample (N=149)	P[1]
		n (%)						
Type of organization								.060
Advocacy/ nonprofit	8 (23.5)	9 (50.0)	8 (24.2)	5 (31.3)	9 (29.0)	9 (47.1)	47 (31.5)	
Local government	9 (26.4)	3 (16.8)	13 (39.5)	5 (31.3)	14 (45.1)	3 (17.6)	47 (31.5)	
Local transit agency	6 (17.6)	1 (5.6)	1 (3.0)	1 (6.3)	0 (0.0)	2 (11.8)	11 (7.4)	
MPO	1 (2.9)	3 (16.7)	2 (6.1)	3 (18.8)	1 (3.2)	1 (5.9)	11 (7.4)	
Planning/ engineering firm	4 (11.8)	0 (0.0)	1 (3.0)	0 (0.0)	0 (0.0)	1 (5.9)	6 (4.0)	
Public health	1 (2.9)	0 (0.0)	4 (12.1)	0 (0.0)	2 (6.5)	1 (5.9)	8 (5.4)	
State-level transportation	4 (11.8)	1 (5.6)	2 (6.1)	1 (6.3)	1 (3.2)	0 (0.0)	9 (6.0)	
University	1 (2.9)	0 (0.0)	0 (0.0)	1 (6.3)	3 (9.7)	1 (5.9)	6 (4.0)	
Other	0 (0.0)	1 (5.6)	2 (6.1)	0 (0.0)	1 (3.2)	0 (0.0)	4 (2.7)	
Number of FTEs in organization								.075
Mean FTEs (SD)	1478.7 (4326.1)	2091.7 (5507.6)	845.6 (1886.5)	1212.6 (3385.3)	334.1 (749.3)	133.7 (206.8)	999.1 (3194.3)	
Time working in active transportation (in years)								.253
< 1	8 (23.5)	0 (0.0)	1 (3.0)	1 (6.3)	0 (0.0)	1 (5.9)	3 (2.0)	
1-5	11 (32.4)	6 (33.3)	4 (12.1)	5 (31.3)	13 (41.9)	9 (52.9)	45 (30.2)	
6-10	0 (0.0)	4 (22.2)	9 (27.3)	4 (25.0)	7 (22.6)	5 (29.4)	40 (26.8)	
11-15	4 (11.8)	1 (5.6)	7 (21.2)	3 (18.8)	2 (6.5)	0 (0.0)	17 (11.4)	
16 +	10 (29.4)	6 (33.3)	9 (27.3)	3 (18.8)	5 (16.1)	2 (911.8)	35 (23.5)	
Doesn't work in AT	1 (2.9)	1 (5.6)	3 (9.1)	0 (0.0)	4 (12.9)	0 (0.0)	9 (6.0)	
Time in current position (in years)								.001
< 1	1 (2.9)	0 (0.0)	0 (0.0)	4 (25.0)	3 (9.7)	5 (29.4)	13 (8.7)	
1-5	13 (38.2)	11 (61.1)	13 (39.4)	5 (31.3)	19 (61.3)	8 (47.1)	69 (46.3)	
6-10	11 (32.4)	3 (16.7)	8 (24.2)	2 (12.5)	4 (12.9)	1 (5.9)	29 (19.5)	
11-15	6 (17.6)	0 (0.0)	4 (12.1)	5 (31.3)	1 (3.2)	1 (5.9)	17 (11.4)	
16 +	3 (8.8)	4 (22.2)	8 (24.2)	0 (0.0)	4 (12.9)	2 (11.8)	21 (14.1)	

[1]Chi-square analyses were conducted with categorical characteristics and one-way ANOVA was conducted for continuous characteristic.

Participants represented nine different organization types including: (1) advocacy or nonprofit organizations; (2) local government organizations; (3) local transit agencies; (4) MPOs; (5) planning or engineering firms; (6) public health agencies; (7) state-level departments or commissions of transportation; (8) academic institutions; and (9) other agencies. A description of each organization type is provided in Table 5.3.

Table 5.3 *Description of each organization type represented in the active transportation policy networks*

Organization type	Description
Advocacy or nonprofit organizations	Local nonprofit or voluntary organizations, coalitions, or partnerships that support increased active transportation or improved air quality
Local government organizations	Local government organizations or departments; if specified, the departments within this organization type included air quality, engineering, law enforcement, parks and recreation, planning, and public works
Local transit organizations	Regional and local transit agencies plan and operate public transportation services; may include local transit districts, commissions, or authorities
Metropolitan planning organizations	Regional policy agency serving urbanized areas and responsible for carrying out the metropolitan transportation planning requirements of federal highway and transit legislation; may include metropolitan planning organizations, transportation planning organizations, or councils of government
Planning or engineering organizations	Private planning or engineering organizations or firms
Public health agencies	Local or state level health departments, or local health care organization
State-level departments or commissions of transportation	State level departments of transportation or commission tasked with transportation planning and project funding decisions in their states
Academic institutions	Local universities; if specified, the departments within this organization type included administration, public health, kinesiology, transportation, or engineering
Other agencies	Other local, state, or federal organizations not represented in the organization types above

Individual involvement in active transportation policies for the full sample and by metropolitan area are shown in Appendix B. For the full sample (Figure 5.1), participants were most frequently involved in active transportation policy planning or development (mean = 3.78), followed by active transportation policy advocacy (mean = 3.61), active transportation policy implementation (mean = 3.57), and active transportation policy research or evaluation (mean = 3.09).

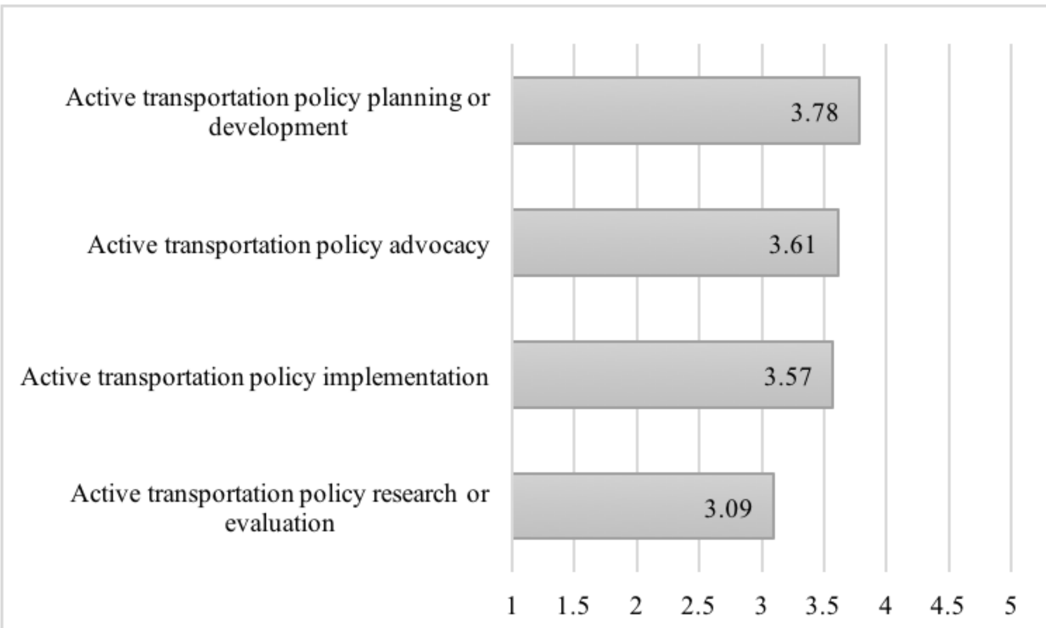


Figure 5.1. *Mean scores for personal involvement in active transportation policies for full sample (N=149). Mean scores range from 1 to 5 where 1 is never involved and 5 is a great deal involved.*

Frequencies and mean scores were calculated for personal motivation for involvement in active transportation policies and presented by metropolitan area in Appendix C. As shown in Figure 5.2, for the full sample, improving public safety (mean = 4.0) was the most influential in participants' involvement in active transportation policies, followed by improving public health (mean = 3.9) and reducing environmental impacts (mean = 3.8). Reducing traffic congestion (mean = 3.6) and increasing economic development (mean = 3.6) were least influential in participants' involvement in active transportation policies.

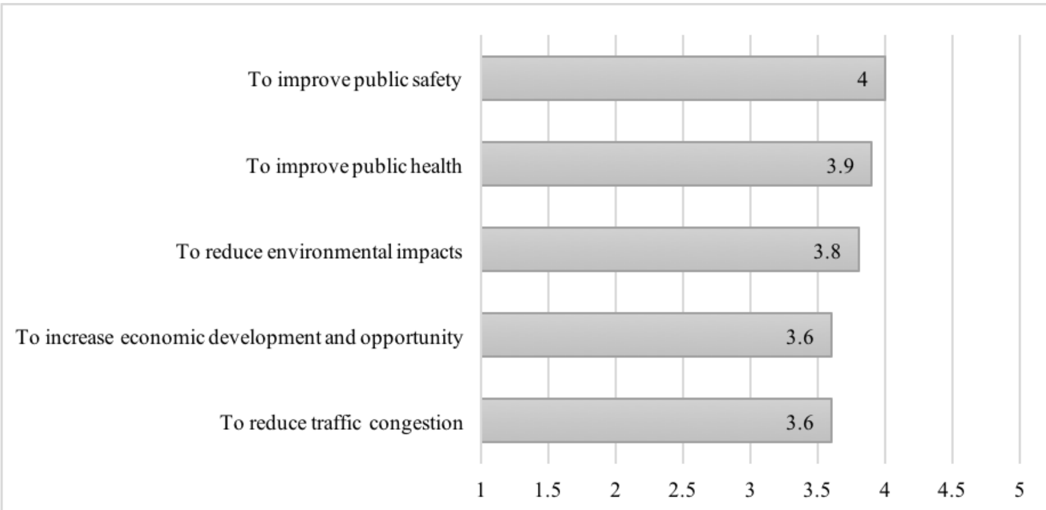


Figure 5.2. *Mean scores for personal motivation in active transportation policies for full sample (N=149). Mean scores range from 1 to 5 where 1 is not at all influential and 5 is extremely influential.*

The frequency of organizational involvement (or the development, adoption, or implementation) of active transportation policies varied widely across the full sample and by metropolitan area (Table 5.4). Overall, the active transportation policies that organizations were most frequently involved in were: Complete Streets policy (87.9%), Safe Routes to School policy (77.7%), Smart Growth or similar land use policy (63.5%), public transit policy related to improved services or facilities (62.8%), and transit-oriented development policy (60.1%). Transportation pricing or incentive policy was the category in which the fewest organizations were involved (31.1%).

Table 5.4 *Organizational involvement in active transportation policies, by metropolitan area*

Involved in the following policy	Sacramento (n=34)	San Diego (n=18)	Kansas City (n=33)	St. Louis (n=16)	Knoxville (n=31)	Memphis (n=17)	Full Sample (N=149)
				Yes, n (%)			
Safe routes to school policy	28 (82.4)	16 (88.9)	26 (81.3)	12 (75.0)	22 (71.0)	11 (64.7)	115 (77.7)
Complete streets policy	29 (85.3)	17 (94.4)	31 (93.9)	15 (93.8)	25 (80.6)	14 (82.4)	131 (87.9)
Transit-oriented development policy	18 (52.9)	16 (88.9)	22 (68.8)	10 (62.5)	13 (41.9)	10 (58.8)	89 (60.1)
Smart growth or similar land use policy	27 (79.4)	14 (77.8)	19 (59.4)	6 (37.5)	18 (58.1)	10 (58.8)	94 (63.5)
Public transit policy related to improved services or facilities	22 (64.7)	14 (77.8)	22 (68.8)	5 (31.3)	17 (54.8)	13 (76.5)	93 (62.8)
Transportation pricing or incentive policy	14 (41.2)	11 (61.1)	6 (18.8)	4 (25.0)	7 (22.6)	4 (23.5)	46 (31.1)

5.2 Network Characteristics

Appendices D-H display network characteristics including network size, density, diameter, transitivity, degree centralization, betweenness centralization, and closeness centralization for the awareness, decisional authority, resource sharing, contact, and collaboration relationships across metropolitan areas. Network size varied across metropolitan areas, where the Sacramento network consisted of 37 organizations, San Diego included 19, Kansas City had 39, Saint Louis had 18, Knoxville had 41, and Memphis had 20.

Figures 5.3 through 5.6 summarize several of the key network characteristics presented in appendices D-H, including network density (Figure 5.3), degree centralization (Figure 5.4), betweenness centralization (Figure 5.5), and closeness centralization (Figure 5.6) results. The metropolitan areas are ordered by network size in each figure, which can influence density and other centralization values. As depicted in Figure 5.3, the density of the awareness networks varied (0.32-0.62, mean = 0.45), as well as decisional authority (0.18-0.38, mean = 0.27), resource sharing (0.13-0.28, mean = 0.20), contact (0.23-0.55, mean = 0.39), and collaboration (0.25-0.54, mean = 0.40). These results demonstrate that the awareness, contact, and collaboration networks were most dense across the metropolitan areas.

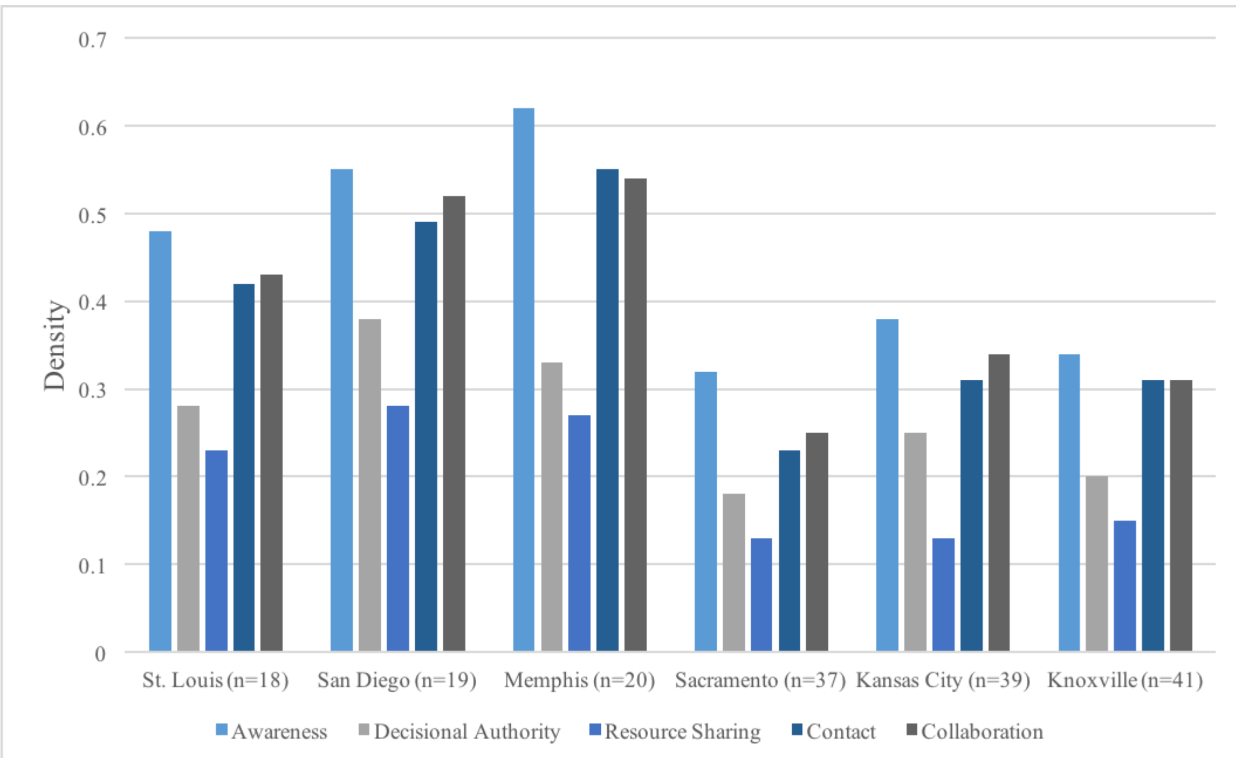


Figure 5.3. *Density for all network measures for each metropolitan area*

Degree centralization, or the extent of variation in the connectivity of members within the network, also varied for awareness (0.34-0.52, mean = 0.45), decisional authority (0.23-0.54, mean = 0.40), resource sharing (0.27-0.57, mean = 0.43), contact (0.38-0.73, mean = 0.55), and collaboration (0.39-0.73, mean =0.51) (Figure 5.4).

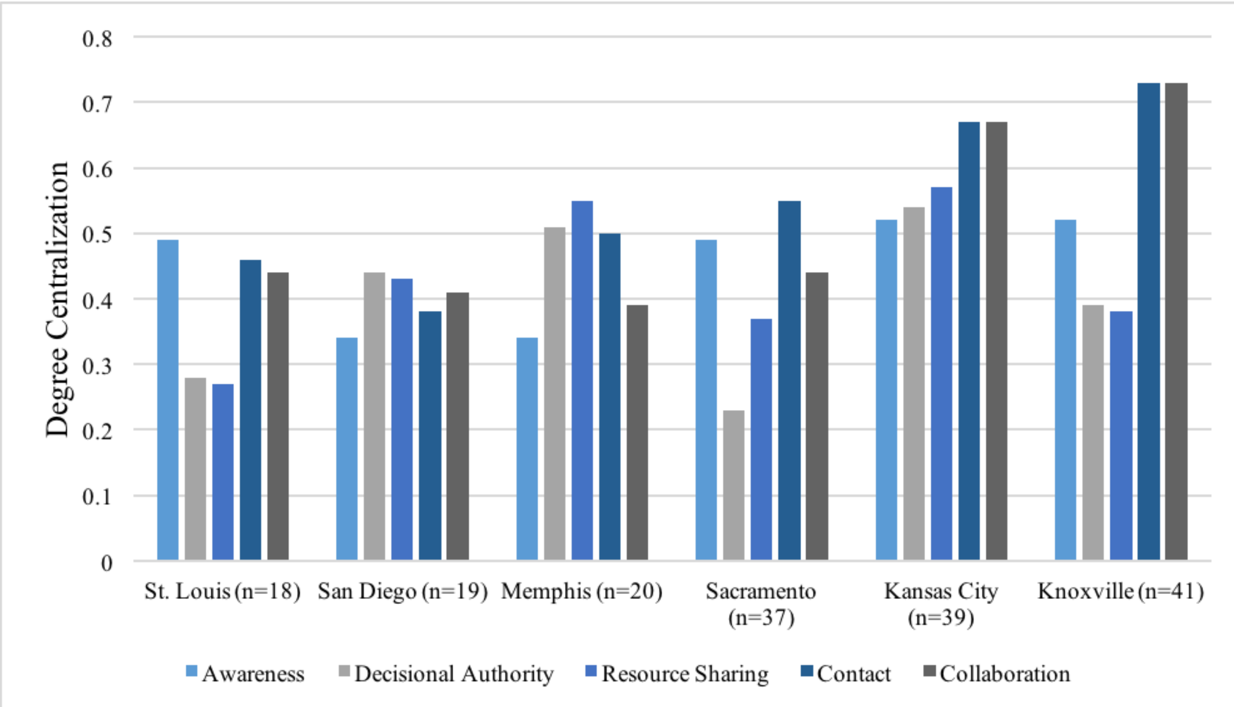


Figure 5.4. *Degree centralization for all network measures for each metropolitan area*

As shown in Figure 5.5, betweenness centralization among networks also varied for awareness (0.03-0.14, mean = 0.08), decisional authority (0.09-0.24, mean =0.14), resource sharing (0.06-0.25, mean =0.17), contact (0.14-0.34, mean = 0.22), and collaboration (0.12-0.29, mean = 0.19). These betweenness centralization scores indicate that the contact and collaboration networks have a more hierarchical network structure.

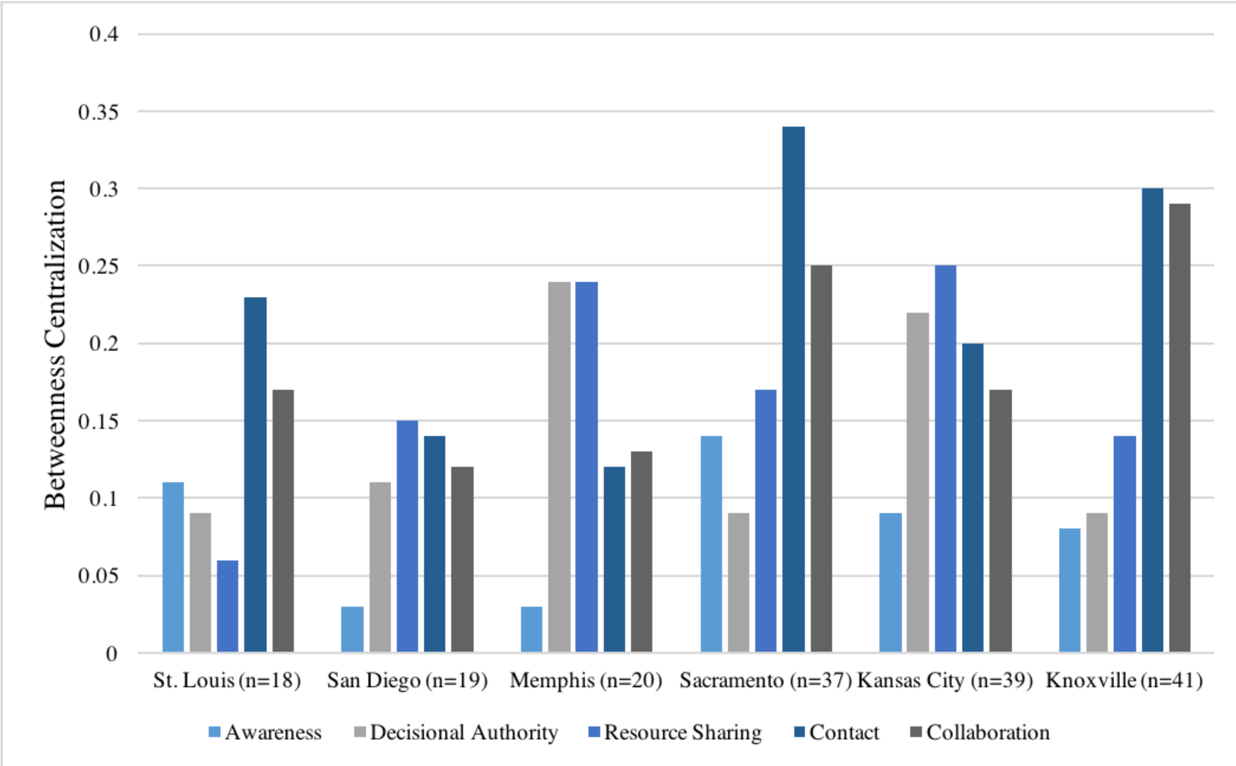


Figure 5.5. *Betweenness centralization for all network measures for each metropolitan area*

Lastly, there were notable differences for closeness centralization results for awareness (0.35-0.56, mean = 0.45), decisional authority (0-0.60, mean =0.39), resource sharing (0-0.61, mean = 0.32), contact (0-0.42, mean = 0.27), and collaboration (0-0.42, mean = 0.26) (Figure 5.6). The closeness centralization equals 0 for several of the networks when the network has separate components, not allowing closeness centralization to be computed, or when the network has a completely even distribution in the node's closeness centralities.

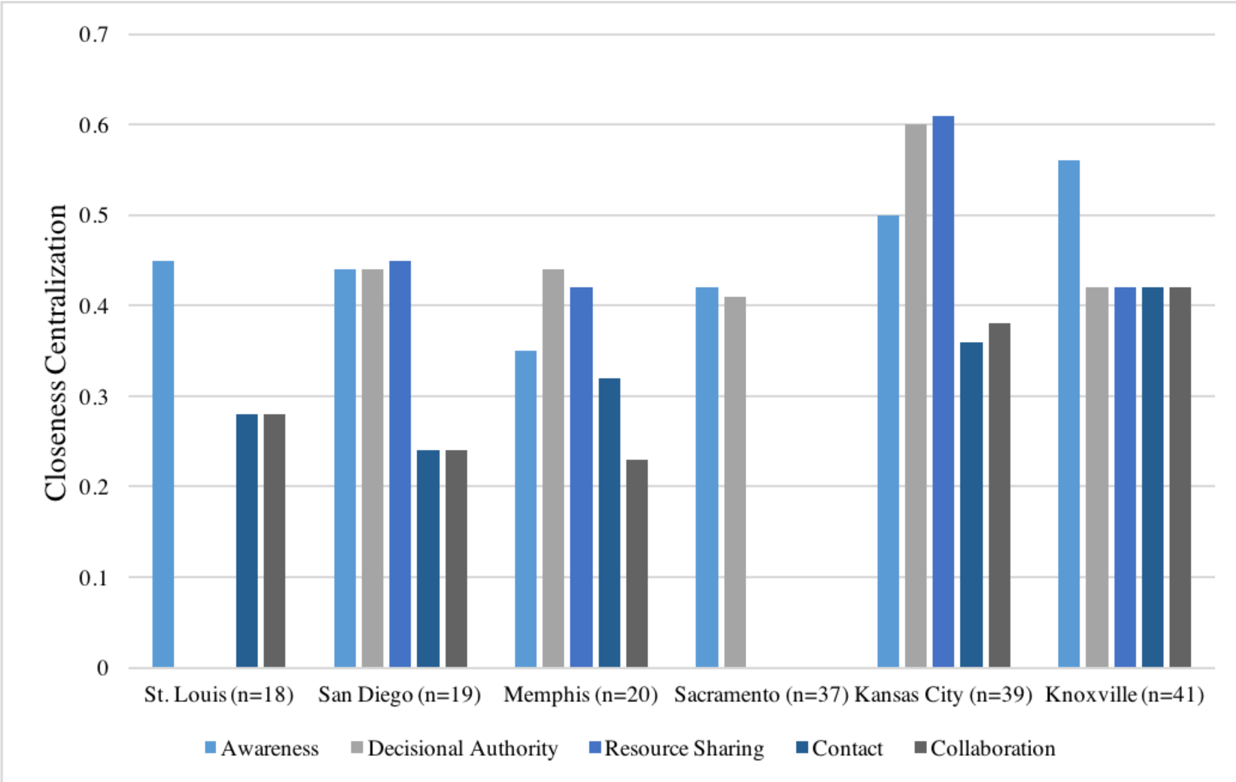


Figure 5.6. *Closeness centralization for all network measures for each metropolitan area*

5.2.1 Awareness Networks

Appendix I depicts the awareness network for each metropolitan area, where the node sizes vary by in-degree centrality score, or incoming nominations. In most metropolitan areas, the organizations with the highest in-degree for awareness were MPOs. The exception was Memphis, where the City of Memphis and an active transportation advocacy organization called Livable Memphis had the highest in-degree of 16.

5.2.2 Decisional Authority Networks

Appendix J displays the decisional authority network for each metropolitan area where the node sizes differ by in-degree centrality score, or the number of organizations that nominated a particular organization as possessing the authority to make decisions on active transportation policies in their metropolitan area. For most metropolitan areas, the organizations receiving the greater share of incoming nominations for decisional authority were MPOs. However, the City of Memphis had the highest in-degree for the decisional authority in Memphis (in-degree = 15), and the MPO and an active transportation advocacy organization called Great Rivers Greenway were tied for highest in-degree for the decisional authority network in St. Louis (in-degree = 10).

5.2.3 Resource Exchange Networks

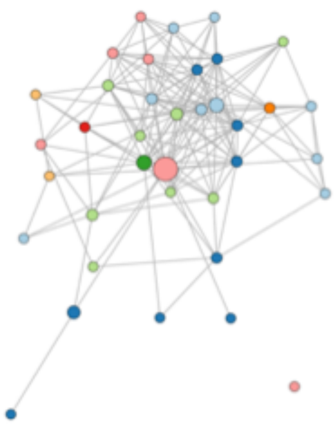
Appendix K shows the resource exchange network for each metropolitan area where the node sizes vary by out-degree centrality score, or the number of times an organization nominated sharing resources with other organizations to support active transportation. The organization types with the highest out-degree for resource exchange varied across metropolitan area. Active transportation advocacy organizations in Sacramento (out-degree = 21), San Diego (out-degree = 14), and Memphis (out-degree = 15) had the highest out-degree for resource exchange. The MPO in Kansas City (out-degree = 35), a local transit agency in St. Louis (out-degree = 10), and the county health department in Knoxville (out-degree = 22) had the highest out-degree for resource exchange in their respective networks.

5.2.4 Contact Networks

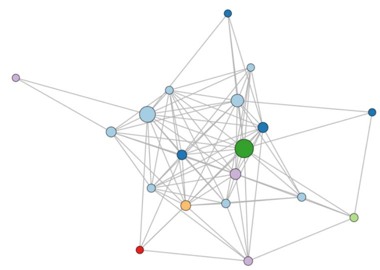
Appendix L shows the contact network for each metropolitan area, where the node size corresponds to the organization's betweenness centrality score. Betweenness centrality values varied according to the network size. The organizations with the highest betweenness centrality score for contact, or the extent to which an organization serves as a link in facilitating contact with other organizations, varied across metropolitan area. The MPOs in Sacramento (betweenness centrality = 223.0) and Knoxville (239.2) were the organizations with the highest betweenness centrality score in their networks. A local bicycle coalition in San Diego (26.4), a local public health organization in Kansas City (150.9), and a local government organization in

Saint Louis (35.2) had the highest betweenness centrality scores in their networks. The City of Memphis and a local active transportation advocacy organization had the highest centrality scores in the Memphis network (23.1).

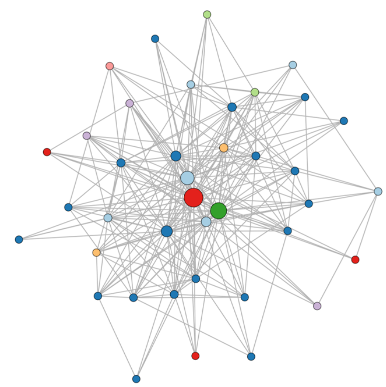
Sacramento, California



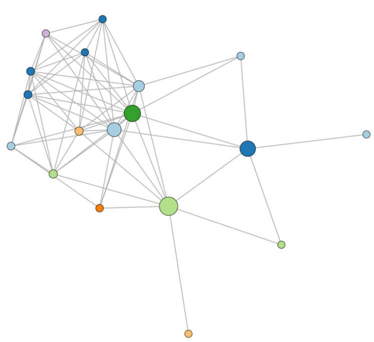
San Diego, California



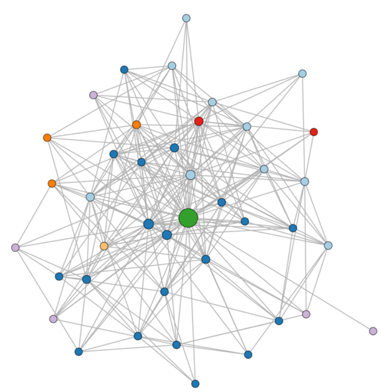
Kansas City, Missouri



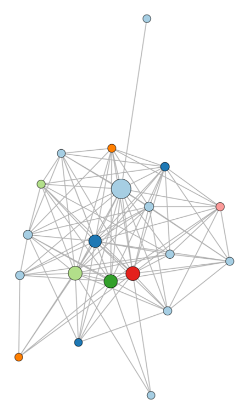
St. Louis, Missouri



Knoxville, Tennessee



Memphis, Tennessee



Legend

Figure 5.7. *Visualizations depicting collaboration network for each metropolitan area, with node size based on betweenness. Collaboration was dichotomized and considered present if reported the level of work together informally or more.*

5.2.5 Collaboration Networks

Because collaboration represents the outcome of interest for this study, the visualizations for each collaboration network are depicted in Figure 5.7, where node sizes were determined by betweenness centrality score. Larger versions of these visualizations are available in Appendix M. In San Diego, Saint Louis, and Knoxville, the MPOs had the highest betweenness centrality scores. A private planning firm in Sacramento (betweenness centrality = 171.3), a health care organization in Kansas City (131.0), and a local active transportation advocacy organization in Memphis (24.8) had the highest betweenness centrality scores in their respective networks. To note, because betweenness centrality values were not normalized for the collaboration networks, values vary according to the network size.

5.3 Stochastic Modeling

ERG models were built to predict active transportation policy collaboration relationships based on a variety of attributes of the organizations; relational attributes, including decisional authority, resource exchange, and contact relationships; and network structural characteristics. Appendices

N-Y show the full ERGM results for each metropolitan area, in addition to figures depicting structural model goodness-of-fit for each metropolitan area. The dependent variable was whether active transportation policy collaboration occurred between two organizations. The tables featured in the appendices have three models for each metropolitan area: the first represents a null-baseline model. The second model added network partner attributes (years in current position, Complete Streets policy involvement, Safe Routes to School policy involvement, and Transit Oriented Development policy involvement). The third model added relational attributes (decisional authority, resource exchange, and contact) and the network structural pattern of GWDegree. The final model (Model 3) for each metropolitan area is depicted in Table 5.5. The odds ratios of the final models for each metropolitan area are shown in Table 5.6.

As shown in Table 5.5, when controlling for all other variables, the likelihood of active transportation policy collaboration increased when there was an existing contact relationship between two agencies across all metropolitan areas. Additionally, the coefficients across the contact networks had consistent values, indicating the likelihood of a contact tie between two organizations across all of the metropolitan areas was similar. For Sacramento, San Diego, and Knoxville, when controlling for all other variables, the probability of active transportation policy collaboration increased when resources were exchanged between two agencies. For Sacramento, Kansas City, and Knoxville, active transportation policy collaboration was more likely to occur when organizations were perceived as having decisional authority around active transportation policies.

The association between years of experience and collaboration were mixed. For most metropolitan areas, years of experience was positively associated with collaboration except for San Diego and Saint Louis, where results varied. No consistent significant relationships emerged for involvement in Safe Routes to School policies, Complete Streets policies, and Transit Oriented Development policies and collaboration.

Table 5.5 *Final exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy for all networks*

Parameters	Sacramento (n=37)	San Diego (n=19)	Kansas City (n=39)	St. Louis (n=18)	Knoxville (n=41)	Memphis (n=20)
	b (SE)					
Edges	-3.33 (.51)*	-3.8 (1.04)*	-3.26 (.41)*	-1.22 (1.15)	-4.10 (.49)*	-3.09 (.95)*
Node attributes						
Experience (in years)						
< 1	Ref.	--	--	Ref.	Ref.	Ref.
1-5	.69 (.49)	Ref.	Ref.	-.18 (.84)	-.14 (.38)	.35 (.52)
6-10	.98 (.43)*	1.26 (.75)	.12 (.39)	1.83 (1.21)	.64 (.49)	1.33 (1.28)
11+	.15 (.37)	-.16 (.63)	.30 (.25)	-1.16 (.82)	.27 (.42)	2.18 (.84)*
Complete Streets involvement	-.61 (.38)	-.24 (.71)	.53 (.37)	-1.77 (1.02)	.05 (.37)	.09 (.89)
SRTS involvement	-.49 (.39)	.48 (1.35)	-.13 (.31)	.93 (.70)	.34 (.31)	-.57 (.83)
TOD involvement	1.15 (.39)*	.39 (1.21)	-.18 (.26)	.20 (.75)	.01 (.27)	-.07 (.52)
Link attributes						
Resource exchange	1.96 (.48)*	3.39 (1.10)*	1.20 (.65)	--	3.11 (.78)*	1.52 (.89)
Decisional authority	1.72 (.39)*	.59 (.70)	1.08 (.32)*	1.04 (1.00)	2.01 (.39)*	1.13 (.89)
Contact[2]	3.56 (.34)*	4.67 (.77)*	4.40 (.33)*	4.91 (1.03)*	4.76 (.33)*	4.30 (.80)*
Structural predictor						
GWDegree	-1.56 (.83)	-.31 (3.47)	-3.94 (.95)*	-2.64 (1.58)	.10 (2.04)	-2.55 (1.48)
Model fit						
AIC	335.3	107.7	394.0	78.1	325.2	129.3

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.
* p-value<.05

Table 5.6 *Odds ratios for final model for all networks*

	Sacramento (n=37)	San Diego (n=19)	Kansas City (n=39)	St. Louis (n=18)	Knoxville (n=41)	Memphis (n=20)
			OR (95% CI)			
Edges	**.04 (.01-.10)**	**.02 (.00-.16)**	**.04 (.02-.09)**	.30 (.03-2.81)	**.02 (.01-.04)**	**.05 (.01-.29)**
Node attributes						
Experience (in years)						
< 1	Ref.	--	--	Ref.	Ref.	Ref.
1-5	1.99 (.77-5.16)	Ref.	Ref.	.83 (.16-4.29)	.87 (.42-.1.82)	1.42 (.51-3.95)
6-10	**2.66 (1.16-6.12)**	3.54 (.81-15.49)	1.13 (.64-1.98)	6.25 (.59-66.47)	1.89 (.72-4.99)	3.78 (.31-46.62)
11+	1.17 (.57-2.40)	.85 (.25-2.91)	1.35 (.82-2.22)	.31 (.06-1.57)	1.31 (.57-2.97)	**8.85 (1.71-45.76)**
Complete Streets involvement	.55 (.26-1.15)	.79 (.20-3.16)	1.70 (.82-3.51)	.17 (.02-1.27)	1.05 (.51-2.18)	1.10 (.19-6.24)
SRTS involvement	.61 (.28-1.32)	1.62 (.12-22.66)	.87 (.48-1.60)	2.54 (.65-9.95)	1.41 (.76-2.60)	.57 (.11-2.88)
TOD involvement	**3.15 (1.46-6.79)**	1.47 (.14-15.75)	.84 (.50-1.39)	1.23 (.28-5.32)	1.01 (.59-1.72)	.93 (.33-2.60)
Link attributes						
Resource exchange	**7.11 (2.78-18.19)**	**29.79 (3.44-257.96)**	3.32 (.93-11.84)	--	**22.40 (4.87-103.00)**	4.58 (.80-26.09)
Decisional authority	**5.59 (2.61-12.00)**	1.81 (.46-7.19)	**2.96 (1.59-5.52)**	2.82 (.40-19.99)	**7.48 (4.87-16.19)**	3.09 (.91-10.53)
Contact[2]	**35.23 (18.06-68.71)**	**107.00 (23.53-486.45)**	**81.21 (42.42-155.44)**	**135.60 (17.85-1030.01)**	**116.36 (61.53-220.06)**	**73.86 (15.39-354.49)**
Structural predictor						
GWDegree	.21 (.04-1.07)	.74 (.00-658.90)	.02 (.00-.13)	.07 (.00-1.60)	1.11 (.02-59.89)	.09 (.00-1.43)

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.
Bold text indicates significance at p-value < .05.

5.3.1 Model Fit

To determine the best fitting model for each metropolitan area, Akaike information criterion (AIC) scores between the models within each metropolitan area were compared. For all metropolitan areas, the third model had the best AIC fit. To evaluate model fit, observed and simulated networks were compared using the following characteristics: minimum geodesic distance, edge-wise shared partners, degree, and triad census. Goodness-of-fit graphics for each model are displayed in Appendices N-Y. In each goodness-of-fit graphic, a panel is displayed for each of the four network statistics, which includes a boxplot and 95% confidence intervals that depict the variability of the network statistic across the simulated networks.[121,123] All graphics displayed good fitting models, where the black lines were within the gray 95% confidence interval boundaries.

Chapter 6: Discussion

The purpose of this study was to better understand formal and informal active transportation policy networks by assessing collaboration among MPO representatives and their partners around active transportation policies, and identifying predictors of active transportation policy collaboration. This chapter summarizes the main findings of the dissertation and draws comparison to the literature on the role of MPOs and public health organizations in active transportation policies, the organizational and network predictors of active transportation policy collaboration, and the policy activities and motivations of active transportation policy networks. The chapter concludes with a discussion of the study strengths and limitations; an overview of plans for research translation and dissemination; and a presentation of implications for research, policy, and practice.

The movement towards cross-sector collaborations in health promotion and disease prevention, and particularly physical activity promotion, has accelerated over the past several years.[8,61,104,124] National, state, and local funding organizations, along with research and governmental organizations, are increasingly encouraging communities around the country to develop and nurture diverse, cross-sector collaborations to implement built environment and policy changes to support physical activity.[61,74,125,126] Within the transportation sector, MPOs are influential to the development and implementation of built environment and policy changes that promote active transportation, as these organizations are responsible for distributing approximately $300 million a year in federal transportation funds to large urban areas.[14,66] Although efforts to strengthen cross-sector collaborations to promote physical activity are well underway, limited information exists on the organizational structures and relationships that facilitate collaboration around active transportation. This study addressed this research gap by assessing collaboration among MPO representatives and their partners involved in active transportation policies and identifying predictors of active transportation policy collaboration.

6.1 Role of MPOs in Active Transportation Policy Networks

Using descriptive network analyses, some patterns around the role of MPOs within active transportation policy networks emerged. For five of the six networks, MPOs were perceived as having the highest decisional authority around active transportation policies, compared to all other members in each network. As discussed in Chapters 1 and 2, the role of MPOs in transportation planning changed significantly with the passage of the federal ISTEA of 1991, where the advisory roles of MPOs evolved to MPOs becoming the lead agencies responsible for regional transportation planning. For some metropolitan areas, this has led to increased increased decisional power in the allocation of federal transportation funds.[15,16,127] The findings from the present study support this historical shift in the role of MPOs, where organizations working in active transportation perceived MPOs as possessing high decision-making power. This perceived decisional power of MPOs could potentially influence active transportation policy planning and development. Thus, it may be beneficial for other agencies working in active transportation to strengthen ties or form new ones with MPOs, including advocacy organizations that can help organize people and promote issues to help MPOs develop active transportation policy agendas.

Despite MPOs representing an important intermediary for the distribution and allocation of federal transportation funds,[14,15,66] MPOs were considered important in connecting other organizations for only half of the collaboration networks and no consistent patterns emerged in the role of MPOs within the resource exchange networks. This suggests that opportunities exist for MPOs to share resources more than they currently are with partnering organizations to support the development, adoption, and implementation of active transportation policies. In a recent study that utilized a mixed-methods network mapping approach to evaluate a cross-sector network aimed at improving livability issues, the investigators found that actors in the network that received funding from another entity within the network positively influenced the actor's work around livability.[128] Therefore, the increased sharing of resources by MPOs to other organization in active transportation policy networks may help further the work of other organizations' around active transportation.

Similarly, there were no consistent patterns in the role of MPOs within the contact networks. This suggests that increased efforts may be needed for MPOs to facilitate communication among organizations working on active transportation in each metropolitan area. On the contrary, no consistent pattern may indicate that MPOs may not the appropriate intermediary for communication within active transportation policy networks. More research on the perceived role of MPOs in bridging communication channels in active transportation policy networks could elucidate this null finding.

6.2 Role of Public Health Organizations in Active Transportation Policy Networks

Public health agencies were not considered central organizations across the decisional authority, resource exchange, contact, and collaboration networks for all metropolitan areas. The exception to this was in the Kansas City contact network, where a local public health organization had the highest betweenness centrality score for the network. This finding suggests that opportunities exist for public health organizations to become more integrated in active transportation policy networks, which aligns with two of the ten essential public health services articulating the role of public health systems in mobilizing partnerships (4) and developing policies (5) to address public health problems and support community health.[129] Furthermore, public health organizations in these active transportation policy networks may be able to use their current positions as non-central actors to their advantage to support their respective networks. Past research has indicated that partners with fewer ties within a network typically have more ties outside the network, which can bring new partners into the network and facilitate the adoption of new information.[130]

In a preliminary qualitative study that informed the current investigation, representatives from MPOs and partnering active transportation advocacy organizations provided a number of recommendations for public health agencies to become more involved in active transportation policy processes. Recommendations included: (1) framing current transportation policy problems and solutions through economic, environmental, and health lenses; (2) engaging with media to increase public awareness and promote active transportation benefits; (3) partnering with transportation and planning professionals to integrate criteria that considers health into their transportation and funding decisions, in addition to incorporating health goals and objectives into transportation plans; and (4) considering political and administrative turnover within MPOs, including board members, committees, and staff, as a window of opportunity for establishing new relationships and promoting active transportation policies. This preliminary study demonstrated that the implementation of the aforementioned strategies by public health professionals may help create windows of opportunities for MPOs and supporting organizations in active transportation policy networks to increase their prioritization of active transportation policies.[73] A window of opportunity represents the confluence of problem, policy, and political streams, which is often created by a policy entrepreneur, or a key player willing to invest resources for a potential return.[131,132] Implementing these recommendations may increase engagement among public health organizations in the active transportation policy process and enhance relationship building with active transportation stakeholders.

6.3 Predictors of Collaborations around Active Transportation Policy Networks

Policy networks are important to the policy process because of the actions and interactions of diverse individuals and organizations working together around a specific policy issue, like active transportation. Past research has demonstrated that policy networks often achieve desired policy changes through regular contact, frequent exchange of information, and coordination of mutual interests.[108] Regular contact proved to be an important predictor of collaboration for all of the active transportation policy networks in the current study. These results align with a previous social network analysis conducted of a physical activity network in Brazil, where frequency of contact was positively related to the likelihood of collaboration.[93] Given this finding, there may be opportunities to "forge a transdisciplinary paradigm" through existing and future communication channels to promote active transportation.[42] This may include increasing the amount and range of professional meetings that intentionally convene experts from diverse sectors that influence active transportation, which could encourage "cross-pollination" and build consensus around the prioritization of active transportation policies. Another opportunity to improve communication channels around active transportation may be utilizing websites, online discussion forums, social media, text messaging, and other virtual mediums where professionals can identify and connect with other professionals across varied sectors to collaborate around active transportation. It may also be important to promote and develop regular avenues for cross-sector conversations outside of professional meetings and online mediums (e.g., bicycle and pedestrian advisory committees, coalitions, or boards) to ensure frequent communication among active transportation stakeholders.[7,42,133–135]

The relationship between decisional authority and active transportation policy collaboration was explored. For Sacramento, Kansas City, and Knoxville, collaboration was more likely to occur when organizations were perceived as having decisional authority around active transportation policies. In a recent study, Litt et al. examined organizational and network level factors associated with perceived network effectiveness in supporting environmental improvements and policies among 53 active living collaboratives in the United States. Although not a measure for decisional power, and while their investigation did not assess dyadic relationships, their study findings revealed a significant relationship between organizations in leadership positions and perceived effectiveness of the network.[63] If not currently involved, this may suggest that local and regional leaders who possess decisional authority should be invited to engage in active transportation policy networks to improve collaborations and position networks for success.[101,136]

Another discovery in the current study was that the likelihood of active transportation policy collaboration increased when resource sharing occurred between two agencies; this held true for half of the active transportation policy networks. Policy changes often require long-term investments in not only relationships and time, but also resources. In a 2010 review of the evidence on the use of partnerships to advance the performance of public health systems, Mays and Scutchfield note that the array of varied actors in a network can influence the amount and type of organizational resources that are shared.[74] All three of these networks, including Sacramento, San Diego, and Knoxville, had representation from varied organization types and sizes. Moreover, Woulfe and colleagues described the importance of resources, including money, skills, and expertise, to population health improvement in a 2010 review of the evidence. The authors suggest that while resources alone do not ensure effective cross-sector partnerships, sufficient and sustainable resources are vital to supporting the partnerships' goals and objectives.[125] For organizations within active transportation policy networks with limited fiscal resources, considerations should be given to what other human and built capital resources can be shared to support active transportation policies in a given metropolitan area. This could include in-kind resources, data, information technology, web sources, staff and volunteers, and health, planning, and legal expertise.[64,101,136]

6.4 Policy Activities and Motivations of Active Transportation Policy Networks

In addition to the findings from the network analysis, this study contributes to a small but growing body of knowledge on the policy involvement and motivations of individuals and organizations engaged in active transportation policies. The active transportation policies that organizations in the current study were most engaged in included: Complete Streets policies, Safe Routes to School policies, and a Smart Growth or similar land use policy. Organizations were the least engaged in transportation pricing or incentive policies, which could also be indicative that fewer of these policies exist. In a study examining the policy activities of active living collaboratives across the country, Litt et al. presented similar results where the most frequently cited being engaged in Complete Streets policies and zoning ordinances, and where collaboratives were least engaged in transit and parking policies and projects.[136] The frequent involvement in Complete Streets policies, in addition to Safe Routes to School and Smart Growth policies, may be due to the increasing attention and widespread diffusion of these policies.[109] The less frequent involvement in transportation pricing and incentive policies, as well as transit and parking policies, demonstrates the need for additional research on the barriers associated with the development, adoption, and implementation of these types of polices and whether these policies are perceived as effective in increasing active transportation. Furthermore, opportunity exists to explore how active transportation policy activities are being integrated by specific regional or local organizations, including MPOs, and to encourage more uptake and integration of these policies. For example, national organizations are increasingly encouraging MPOs to integrate transportation and land use planning and policies. However, because transportation planning tends to occur at a regional scale by MPOs and land use authority is primarily held by local jurisdictions, it is often difficult for metropolitan areas to integrate transportation and land use policies and processes.[137] More information on how policy activities are being integrated within and across active transportation policy networks may help foster more effective and streamlined policy processes.

Understanding the motivations of individuals and organizations for engagement in active transportation policies can inform the tailoring and framing of policy messages. Across the full sample, the top motivations among participants to engage in active transportation policies were to improve public safety, improve public health, and increase economic development. Although no studies to date have examined the motivations for involvement in active transportation policies, previous research has examined the perceived importance or prioritization of various policies supportive of physical activity. Physical activity and public health were not commonly perceived important or highly prioritized among the local policymakers and government officials assessed. This finding spanned multiple audiences engaged in the policy process from varied locations, including state legislators from Kansas,[138] state and local policymakers from Hawaii,[139] and planning directors from 53 communities across the United States.[140] Hollander and colleagues examined differences in perceptions between local government officials and planners and found that planners perceived physical activity as a less important issue to address in land use and planning policies in comparison to local officials.[141] Results from a 2014 study found that municipal officials' perceived importance of economic development in their day-to-day job responsibilities and perceived support from residents to address economic development were significant predictors of their participation in active transportation policies.[72] Thus, it is surprising that improving public safety and improving public health emerged as top motivations for involvement in active transportation policies in the descriptive analysis, and promoting economic development and opportunity was not as influential. However, differences were not examined by metropolitan area or organization type and more rigorous statistical analyses were not conducted, which warrants further study. Overall, as communities face the health, social, environmental, and economic consequences of not only physical inactivity and low active transportation rates, but also population growth, climate change, and traffic congestion, there are unique opportunities to motivate organizations to engage in active transportation policies through a cross-sector lens.[142]

6.5 Study Strengths and Limitations

This study contributes to the growing body of evidence on cross-sector partnerships working to promote physical activity. Results enhanced our understanding of the individual and organizational characteristics, policy activities, and relationships among organizations engaged in active transportation policies. This was also one of the first studies to examine the predictors of collaboration among MPOs and their partners around active transportation, and one of the first to use ERGM. ERGM allowed the investigation to extend beyond descriptive network analyses into inferential network analyses to explore how organizational and network characteristics influenced the probability of active transportation policy collaboration.

This study can help identify opportunities for collaboration, in addition to necessary organizational and partnership changes, to advance active transportation policies. By identifying organizations that play a more central role in active transportation policies, public health and transportation researchers, practitioners, policymakers, and advocates can be more strategic in identifying partner organizations. Findings also contribute to the growing body of systems science public health research; transdisciplinary research and practice approaches, particularly between public health and transportation stakeholders; and relatively new theoretical perspectives related to policy network theory.

Despite these strengths of the current study, there are a few limitations worth noting, several of which are related to the sampling strategies used. For most of the organizations in each network, the survey was completed by one or few individuals within an organization, which assumes that his or her responses accurately represented the entire organization. Since the sampling strategy relied on the MPO within each network to identify partners and then an active transportation advocacy organization from each network to verify the partner list, it is also possible that findings were biased in favor of these two organization types. Although this is a common approach for network delineation, there may be partners that were excluded that may have been identified if another sampling method was used.[143] However, given the research aims of the study to explore the role of MPOs and their collaborations, MPOs represented an appropriate starting point for network sampling.

The network measures used for contact and collaboration were selected because of their use in previously published studies.[93,95,96] The contact question asked network members how frequently they had direct contact with others in the network; the content of contact, and specifically content around active transportation policies, or the quality of contact was not measured. The collaboration question asked participants to select the level of interaction they felt best represented their relationship with a specific partner; the measure may not have captured the number of collaborative interactions around active transportation policies or around which type of active transportation policy they collaborated. For both contact and collaboration, methods used in past studies were replicated to symmetrize data to the highest level of contact and collaboration, which may have increased the number of network ties, but would have done so for all six active transportation policy networks.[95,96,144]

A limited number of individual and organizational characteristics were assessed to decrease respondent burden. Other individual and organizational characteristics, such as expertise of respondent and whether the respondent held a leadership position, were not explicitly captured and may influence active transportation collaboration. The measurement of individual and organizational involvement in active transportation policies relied on respondents' retrospective perceptions of participation, and the number of times they were engaged in active transportation policies were not assessed.

There were some limitations associated with the network analysis methods used. First, the node-level centrality measures that were calculated were not normalized and comparisons of these measures across the networks, which are all of different sizes, could not be made. Second, although all of the ERG models converged, several of the estimates for the networks with smaller sample sizes had wide confidence intervals; thus, the estimates should be interpreted with consideration of the precision of the estimates. Third, because the outcome of interest (i.e., active transportation policy collaboration) was considered an undirected relationship, the independent variables of resource exchange and decisional authority in the final models were also considered undirected relationships. Future research should explore these as asymmetric ties, where one link exists between two partners, and as mutual ties, where both links exist between two partners.[145,146]

The cross-sectional design of the study does not allow causality to be inferred. Data were also self-reported and thus potentially influenced by inaccuracies and recall bias. Additionally, the selected sample included only networks within six metropolitan areas with a population of 50,000 or more residents. The findings may not be generalizable to active transportation policy networks in other cities, particularly rural areas. Lastly, data collected represented one point in time from one or few members within an organization. Because the active transportation policy process is inherently longitudinal, where current policy collaborations and outcomes may or may not reflect previous policy collaborations, findings from this study offer opportunities for future analyses to examine longitudinal changes in active transportation policy networks and relationships. Despite these limitations, this is among the first studies to examine the policy activities and collaborations among organizations engaged in active transportation policy networks.

6.6 Research Translation and Dissemination of Findings

Dissertation findings will be synthesized into research briefs tailored to each metropolitan area included in the study. Survey respondents who indicated interest in the study results will be provided a research brief, which will include visual network maps that will omit organization names, but include organization types. Opportunities to present the findings via teleconference or webinar will be explored with each study MPO. Research briefs will also be provided to key policy and practice representatives that provided insight throughout the study and regularly collaborate with MPOs across the United States.

Scientific abstracts will be submitted to the American Public Health Association annual meeting, the Active Living Research annual conference, and the Transportation Research Board annual meeting. Several manuscripts for peer-review journal publications are also planned. The first paper will present the active transportation policy activities and motivations for involvement in active transportation policies, which will further explore differences by individual and organizational characteristics of the respondents. The second paper will present the main findings from Aim 2 of the study, which examine the organizational and network predictors associated with active transportation policy collaboration. Opportunities also exist to develop papers based on the additional network measures used in the study, including contact, decisional authority, resource exchange, and barriers to active transportation policy collaboration.

6.7 Research Implications

In developing the conceptual framework for physical activity policy research discussed in Chapter 2, Schmid and colleagues referred to policy as art, claiming that it was “generally understood but difficult to define.”[8] Just as the term policy can be difficult to define, it can be challenging to research, but it is necessary to study. More evidence on the health outcomes of active transportation policy processes and partnerships can help identify effective policy solutions to address physical inactivity. Additional research opportunities that arise from the current study are presented below:

- As calls for natural policy experiments increase, research questions that assess policy processes and partnerships should be integrated into these studies. Natural experiments are the study of a policy occurrence in one group and a comparison group, in which they are not exposed to the policy. While research involving natural experiments aim to understand the impact of a particular policy following its adoption, it is also vital to explore the partnerships engaged.[147,148]
- Investigate the policy process, or what Sabatier defined as: “the manner in which policies get formulated and implemented, as well as the effects of those actions on the world.”[149] More studies are needed that investigate the upstream determinants of the development, adoption, and implementation of a transportation policy, which can ultimately impact physical activity behaviors. Most studies to date that examine the active transportation policy process use case studies or key informant interviews, or collect data from one metropolitan area or state.[138,139,150,151] Opportunities exist to combine such qualitative methods with quantitative ones.

- Examine active transportation policy partnerships upstream from MPOs, including state-level relationships that engage state departments of transportation and federal-level partnerships that engage organizations like the Federal Highway Administration, the Centers for Disease Control and Prevention, and the Environmental Protection Agency. These organizations influence the work of MPOs and warrant further study.
- Utilize multilevel public policy theories and frameworks in future studies. The aspects of public health and transportation theories that have dominated the literature on active transportation are focused at the individual rather than the policy level. Research on the relationship between transportation policies and active transportation behaviors, and the determinants of these policies, could be enhanced by developing study designs guided by public policy theories.
- Examine the unintended consequences, including the unintended effects of promoting active transportation policy collaborations and encouraging transportation policies supportive of active transportation. Just as sprawled development and increased roadways that primarily accommodated motor vehicles resulted in the unintended consequences of contributing to higher rates physical inactivity, the unintended consequences of active transportation partnerships and policies discussed throughout this dissertation should be considered. As communities with policies that facilitate multimodal transportation systems become more desirable to live in, potential social and economic concerns include gentrification, the displacement of low income residents, and sustaining economic vitalities within communities.[14,66] Thus, researchers should not only collaborate with community stakeholders and organizations to explore the community context in which active transportation policies

are being developed, adopted, and implemented – but also measure and evaluate these partnerships as they change over time and under certain conditions.

- Utilize systems science methods. Because policy can be complex, additional systems science methods beyond social network analysis, including agent-based modeling and system dynamics modeling, could be applied in examining the relationship between transportation policy determinants and policies and active transportation. Network analysis proved to be an applicable method in understanding the organizations engaged in active transportation policy networks. More opportunities exist to assess policy networks related to other areas related to physical activity and public health.

6.8 Policy and Practice Implications

Transportation policies can have significant public health impacts on active transportation, as well as other health, environmental, and economic outcomes. As the paradigm in transportation policies begins to shift away from promoting mobility towards encouraging accessibility,[46] opportunities exist for researchers, policymakers, advocates, and practitioners from multiple sectors to collaborate to further promote healthy and equitable transportation policies. MPOs oversee the allocation and expenditure of billions of dollars that impact our transportation systems, thus playing a major role in providing opportunities for individuals to participate in AT in their communities.

This study provides information on the policy processes and partnerships that MPOs are engaged to support active transportation policies. It not only provides insights into MPOs' central role in active transportation policy networks, but also the role of public health organizations working to advance active transportation policies. Specific policy and practice opportunities are detailed below:

- For active transportation policy networks participating in this study, younger policymakers and practitioners, or ones new to an organization or metropolitan area, may find the network visuals for their metropolitan area useful in strategically identifying future collaborators. Furthermore, organizations currently represented in each active transportation policy network may find motivation to increase their efforts around collaboration, contact, resource sharing, or making decisions, given their connections that were assessed.
- For public health organizations not currently engaged in active transportation policy networks, low hanging fruit for policy collaboration may be involvement in Complete Streets policies, Safe Routes to School policies, and Smart Growth or similar land use policies, given their high frequency of involvement among active transportation policy network members.
- Public health funding agencies and supportive organizations should enhance and increase technical support around the development, adoption, and implementation of transportation pricing and incentive policies, given the low frequency of involvement among active transportation policy network members.
- To promote active transportation policies, policymakers and practitioners should reframe current transportation problems and active transportation policy solutions through public health, public safety, environmental, and economic lenses.
- Given the important role of MPOs in decision making around active transportation policies, researchers, policymakers, advocates, and practitioners from various sectors should seek to participate in committees or planning processes that already exist at the MPO-level. This

could include the involvement in the development or update of long-range transportation plans or short range transportation improvement programs and participation on bicycle and pedestrian advisory committees. Representation of stakeholders and institutions that support active transportation on these committees and in these planning processes is crucial.

- Train new public health and transportation professionals on the intersection between public health, transportation, and policy. Leaders from these disciplines are needed to encourage cross-sector collaborations, in addition to implement and assess active transportation policies and their health impacts. Skills need to go beyond the usual public health training in epidemiology or health education to include skills in strategic communication, policy dissemination research, or systems thinking.
- Public health professionals should encourage the use of Health Impact Assessments in their communities as a tool for effective collaboration between public health organizations and non-traditional partners. Health Impact Assessments represent a "combination of procedures, methods and tools that systematically judges the potential—and sometimes unintended—effects of a policy, plan, program, or project on the health of a population and the distribution of those effects within the population. Health Impact Assessments identify appropriate actions to manage those effects."[152–154]

6.9 Conclusions

Transportation policies have contributed to physical inactivity and other health problems in the United States, and now they must address them. Public health and transportation organizations at the federal level have identified the connection between transportation policies and active transportation in their national priorities. For example, the Department of Health and Human Services has called for an "increase in transportation and travel policies for the built environment that enhance access to and availability of physical activity opportunities" in their Healthy People 2020 goals.[38] The Department of Transportation issued a recent policy statement that states "every transportation agency has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems".[155]

Meeting the aforementioned goals is beyond the purview of one organization, sector, or level of government. Collaborating with organizations across diverse sectors will help establish healthy and equitable transportation policies and systems in the United States. This research applied network analysis approaches to assess the policy networks in which six MPOs across the United States are engaged to support active transportation policies. In addition to demonstrating the central role that MPOs play in advancing active transportation, study results indicate that varied organizations working to support active transportation policies are more likely to collaborate if they possess decision-making authority, share resources, and are in regular contact with others in their network. Thus, by fostering decisional authority among organizations working to support active transportation policies, pooling resources, and communicating frequently, organizations across diverse sectors can more effectively work towards achieving these public health and transportation goals, and affect population health.

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Appendix

Appendix A. Survey Instrument

Purpose: The Prevention Research Center in St. Louis is collecting information on collaborations among Metropolitan Planning Organizations (MPOs) and their partners around active transportation. As a representative of an MPO or a partner agency, we are asking you to help us by completing this survey. We will use the findings to support improved collaborations around active transportation policies. The survey will take approximately 15 minutes of your time. Your responses are confidential and participation is voluntary.

To thank you for your time, we are offering everyone who completes the survey a $20 Amazon gift card. At the end of the survey, you will be directed to a separate webpage where you can choose to accept or decline the gift card

Some formatting of this survey is not compatible with the Safari Internet browser. Please use a different browser. Thank you.

Please answer the following questions about you and your work related to active transportation.

1. What is your position within your agency/organization?

2. How long have you been in your current position?

❍ Less than 1 year
❍ 1-5 years
❍ 6-10 years
❍ 11-15 years
❍ 16 or more years

3. How long have you been working in the area of active transportation?

❍ Less than 1 year
❍ 1-5 years
❍ 6-10 years
❍ 11-15 years
❍ 16 or more years
❍ I do not work in the area of active transportation.

4. Approximately how many full time employees (FTEs) does your agency/organization employ? Please include ALL regular full-time, part-time, and contractual employees. To calculate FTEs, count a full-time employee as 1 FTE, a half-time employee as a 0.5 FTE, etc.

The next few questions will ask about your involvement in active transportation policies, or any policies that encourage walking or bicycling for transportation.

5. Please use the scale below to indicate the extent to which you are involved in the following active transportation policy activities as part of your day-to-day job responsibilities.

	Never involved	Rarely involved	Occasionally involved	Moderately involved	A great deal involved
Active transportation policy planning or development	❍	❍	❍	❍	❍
Active transportation policy implementation	❍	❍	❍	❍	❍
Active transportation policy research or evaluation	❍	❍	❍	❍	❍
Active transportation policy advocacy	❍	❍	❍	❍	❍

6. Please use the scale below to indicate the extent to which the following items influence your involvement in active transportation policies.

	Not at all influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
To improve public health	❍	❍	❍	❍	❍
To reduce environmental impacts	❍	❍	❍	❍	❍
To reduce traffic congestion	❍	❍	❍	❍	❍
To improve public safety	❍	❍	❍	❍	❍
To increase economic development and opportunity	❍	❍	❍	❍	❍
Other	❍	❍	❍	❍	❍

7. Has your agency/organization ever been engaged in the development, adoption, or implementation of the following active transportation policies? Hover over blue text for a description of each policy.

	Yes	No	Don't know
Safe Routes to School policy	❍	❍	❍
Complete Streets policy	❍	❍	❍
Transit-oriented development policy	❍	❍	❍
Smart Growth policy or similar land use policy	❍	❍	❍
Public transit policy related to improved services or facilities	❍	❍	❍
Transportation pricing or incentive policy	❍	❍	❍
Other	❍	❍	❍

Now we are shifting to your collaborations around active transportation policies. Please answer the following questions about your relationships with active transportation partners.

8. Are you aware of the following individuals' work in active transportation? Please check "No" for your own name.

	Yes	No
Individual 1 (Organization A)	❍	❍
Individual 2 (Organization B)	❍	❍
Individual 3 (Organization C)	❍	❍
Individual 4 (Organization D)	❍	❍
Individual 5 (Organization E)	❍	❍
Other 1	❍	❍
Other 2	❍	❍
Other 3	❍	❍
Other 4	❍	❍
Other 5	❍	❍

[Response options for remaining network questions include only those individuals the participant selected "Yes" they were aware]

9. Please indicate the level of collaboration with the individuals below that reflects your work together on active transportation during the past year.

	Do not work together at all	Share information only	Work together as an informal group to achieve common goals	Work together as a formal team to achieve common goals	Work together as a formal team across multiple projects to achieve common goals
Individual 1 (Organization A)	❍	❍	❍	❍	❍
Individual 2 (Organization B)	❍	❍	❍	❍	❍
Individual 3 (Organization C)	❍	❍	❍	❍	❍
Individual 4 (Organization D)	❍	❍	❍	❍	❍
Individual 5 (Organization E)	❍	❍	❍	❍	❍
Other 1	❍	❍	❍	❍	❍
Other 2	❍	❍	❍	❍	❍
Other 3	❍	❍	❍	❍	❍
Other 4	❍	❍	❍	❍	❍
Other 5	❍	❍	❍	❍	❍

10. Please indicate how often you have had direct contact (e.g., meetings, phone calls, emails, or letters) with the individuals below.

	No contact	Yearly	Quarterly	Monthly	Weekly	Daily
Individual 1 (Organization A)	❍	❍	❍	❍	❍	❍
Individual 2 (Organization B)	❍	❍	❍	❍	❍	❍
Individual 3 (Organization C)	❍	❍	❍	❍	❍	❍
Individual 4 (Organization D)	❍	❍	❍	❍	❍	❍
Individual 5 (Organization E)	❍	❍	❍	❍	❍	❍
Other 1	❍	❍	❍	❍	❍	❍
Other 2	❍	❍	❍	❍	❍	❍
Other 3	❍	❍	❍	❍	❍	❍
Other 4	❍	❍	❍	❍	❍	❍
Other 5	❍	❍	❍	❍	❍	❍

11. Have you shared resources (e.g., money, personnel, goods, or services) with the individuals below to support active transportation during the past year?

	Yes	No
Individual 1 (Organization A)	❍	❍
Individual 2 (Organization B)	❍	❍
Individual 3 (Organization C)	❍	❍
Individual 4 (Organization D)	❍	❍
Individual 5 (Organization E)	❍	❍
Other 1	❍	❍
Other 2	❍	❍
Other 3	❍	❍
Other 4	❍	❍
Other 5	❍	❍

12. Do the individuals below hold authority to make decisions that impact active transportation policies in the metropolitan area where you work?

	Yes	No
Individual 1 (Organization A)	❍	❍
Individual 2 (Organization B)	❍	❍
Individual 3 (Organization C)	❍	❍
Individual 4 (Organization D)	❍	❍
Individual 5 (Organization E)	❍	❍
Other 1	❍	❍
Other 2	❍	❍
Other 3	❍	❍
Other 4	❍	❍
Other 5	❍	❍

13. Please indicate which of the following factors have impeded your ability to work with the individuals below during the past year. Check all that apply.

	Lack of time	Lack of capacity (funding, staff, etc.)	Lack of incentives to work together	Organizational structure / bureaucracy	Incompatible goals or strategies	Politics	None
Individual 1 (Organization A)	❍	❍	❍	❍	❍	❍	❍
Individual 2 (Organization B)	❍	❍	❍	❍	❍	❍	❍
Individual 3 (Organization C)	❍	❍	❍	❍	❍	❍	❍
Individual 4 (Organization D)	❍	❍	❍	❍	❍	❍	❍
Individual 5 (Organization E)	❍	❍	❍	❍	❍	❍	❍
Other 1	❍	❍	❍	❍	❍	❍	❍
Other 2	❍	❍	❍	❍	❍	❍	❍
Other 3	❍	❍	❍	❍	❍	❍	❍
Other 4	❍	❍	❍	❍	❍	❍	❍
Other 5	❍	❍	❍	❍	❍	❍	❍

Please answer these final few questions about yourself.

14. What is your gender?
❍ Female
❍ Male

15. How old are you?
❍ 18-29
❍ 30-39
❍ 40-49
❍ 50-64
❍ 65 or older

16. What is the highest level of education you have achieved?
❍ Less than high school diploma
❍ High school diploma
❍ Some college
❍ College degree
❍ Masters degree
❍ Doctorate
❍ Other ____________________

17. During the past week, other than for your regular job, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, or walking for exercise?
- ❍ Yes
- ❍ No

18. During the past week, did you walk or bicycle for transportation, such as to and from work or shopping?
- ❍ Yes
- ❍ No

19. When it comes to social issues, do you usually think of yourself as:
- ❍ Extremely liberal
- ❍ Liberal
- ❍ Slightly liberal
- ❍ Moderate
- ❍ Slightly conservative
- ❍ Conservative
- ❍ Extremely conservative
- ❍ Other
- ❍ Prefer not to answer

20. When it comes to fiscal issues, do you usually think of yourself as:
- ❍ Extremely liberal
- ❍ Liberal
- ❍ Slightly liberal
- ❍ Moderate
- ❍ Slightly conservative
- ❍ Conservative
- ❍ Extremely conservative
- ❍ Other
- ❍ Prefer not to answer

We would like to thank you once again for completing this survey! Your time and responses are greatly appreciated by all of us here at the Prevention Research Center in St. Louis. Your efforts today will help us understand and disseminate information about active transportation collaborations between MPOs and their partners. If you have any questions, please email Marissa Zwald at MZwald@wustl.edu. After you select the forward arrows below, you will be directed to a separate webpage where you can request a summary of our project findings and/or accept your optional Amazon gift card. The information you provide on this separate webpage cannot be traced to your survey responses and will be kept confidential.

Appendix B. *Personal Involvement in Active Transportation Policies, by Metropolitan Area*

	Sacramento (n=34)	**San Diego (n=18)**	**Kansas City (n=33)**	**St. Louis (n=16)**	**Knoxville (n=31)**	**Memphis (n=17)**	**Full Sample (N=149)**
				n (%)			
Active transportation policy planning or development							
Never involved	1 (2.9)	0 (0.0)	1 (3.0)	1 (6.3)	2 (6.5)	1 (5.9)	6 (4.0)
Rarely involved	3 (8.8)	1 (5.6)	2 (6.1)	1 (6.3)	6 (19.4)	1 (5.9)	14 (9.4)
Occasionally involved	7 (20.6)	5 (27.8)	8 (24.2)	**7 (43.8)**	**11 (35.5)**	5 (29.4)	43 (28.9)
Moderately involved	10 (29.4)	5 (27.8)	5 (15.2)	2 (12.5)	5 (16.1)	3 (17.6)	30 (20.1)
A great deal involved	**13 (38.2)**	**7 (38.9)**	**17 (51.5)**	5 (31.3)	7 (22.6)	**7 (41.2)**	**56 (37.6)**
Mean (SD)[1]	3.91 (1.11)	4.00 (.97)	4.06 (1.14)	3.56 (1.21)	3.29 (1.22)	3.82 (1.24)	3.78 (1.17)
Active transportation policy implementation							
Never involved	1 (2.9)	1 (5.6)	3 (9.1)	2 (12.5)	2 (6.5)	0 (0.0)	9 (6.0)
Rarely involved	7 (20.6)	2 (11.1)	3 (9.1)	2 (12.5)	**10 (32.3)**	2 (11.8)	26 (17.4)
Occasionally involved	5 (14.7)	0 (0.0)	6 (18.2)	4 (25.0)	8 (25.8)	**8 (47.1)**	31 (20.8)
Moderately involved	10 (29.4)	5 (27.8)	6 (18.2)	**6 (37.5)**	5 (16.1)	5 (29.4)	37 (24.8)
A great deal involved	**11 (32.4)**	**10 (55.6)**	**15 (45.5)**	2 (12.5)	6 (19.4)	2 (11.8)	**46 (30.9)**
Mean (SD)[1]	3.68 (1.22)	4.17 (1.25)	3.82 (1.36)	3.25 (1.24)	3.10 (1.25)	3.41 (.87)	3.57 (1.26)
Active transportation policy research or evaluation							
Never involved	2 (5.9)	1 5.6)	3 (9.1)	1 (6.3)	3 (9.7)	1 (5.9)	11 (7.4)
Rarely involved	7 (20.6)	2 (11.1)	9 (27.3)	**7 (43.8)**	**10 (32.3)**	2 (11.8)	37 (24.8)
Occasionally involved	**16 (47.1)**	5 (27.8)	**10 (30.3)**	2 (12.5)	**10 (32.3)**	**7 (41.2)**	**50 (33.6)**
Moderately involved	4 (11.8)	**7 (38.9)**	3 (9.1)	4 (25.0)	6 (19.4)	5 (29.4)	29 (19.5)
A great deal involved	5 (14.7)	3 (16.7)	8 (24.2)	2 (12.5)	2 (6.5)	2 (11.8)	22 (14.8)
Mean (SD)[1]	3.09 (1.08)	3.50 (1.10)	3.12 (1.32)	2.94 (1.24)	2.81 (1.08)	3.29 (1.05)	3.09 (1.15)
Active transportation policy advocacy							
Never involved	**8 (23.5)**	1 (5.6)	4 (12.1)	1 (6.3)	2 (6.5)	0 (0.0)	16 (10.7)
Rarely involved	5 (14.7)	1 (5.6)	0 (0.0)	2 (12.5)	4 (12.9)	1 (5.9)	13 (8.7)
Occasionally involved	6 (17.6)	2 (11.1)	7 (21.2)	5 (31.3)	9 (29.0)	5 (29.4)	34 (22.8)
Moderately involved	7 (20.6)	5 (27.8)	8 (24.2)	1 (6.3)	**11 (35.5)**	4 (23.5)	36 (24.2)
A great deal involved	**8 (23.5)**	**9 (50.0)**	**14 (42.4)**	**7 (43.8)**	5 (16.1)	**7 (41.2)**	**50 (33.6)**
Mean (SD)[1]	3.06 (1.52)	4.11 (1.18)	3.85 (1.33)	3.69 (1.35)	3.42 (1.12)	4.00 (1.00)	3.61 (1.32)

[1]5-point scale: Never involved, Rarely involved, Occasionally involved, Moderately involved, A great deal involved
Bold text indicates highest proportion for each category.

Appendix C. *Personal Motivation for Involvement in Active Transportation Policies, by Metropolitan Area*

	Sacramento (n=34)	**San Diego (n=18)**	**Kansas City (n=33)**	**St. Louis (n=16)**	**Knoxville (n=31)**	**Memphis (n=17)**	**Full Sample (N=149)**
				n (%)			
To improve public health							
Not at all influential	1 (2.9)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.3)
Slightly influential	4 (11.8)	0 (0.0)	3 (9.1)	3 (18.8)	2 (6.5)	2 (11.8)	14 (9.4)
Somewhat influential	**11 (32.4)**	3 (16.7)	7 (21.2)	4 (25.0)	4 (12.9)	2 (11.8)	31 (20.8)
Very influential	8 (23.5)	**7 (38.9)**	10 (30.3)	**7 (43.8)**	12 (38.7)	**10 (58.8)**	**54 (36.2)**
Extremely influential	10 (29.4)	**7 (38.9)**	**14 (39.4)**	2 (12.5)	**13 (41.9)**	3 (17.6)	48 (32.2)
Mean (SD)[1]	3.7 (1.1)	4.1 (1.1)	4.0 (1.0)	3.5 (1.0)	4.2 (.9)	3.8 (.9)	3.9 (1.0)
To reduce environmental impacts							
Not at all influential	1 (2.9)	0 (0.0)	1 (3.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.3)
Slightly influential	1 (2.9)	0 (0.0)	2 (6.1)	3 (18.8)	6 (19.4)	3 (17.6)	15 (10.1)
Somewhat influential	8 (23.5)	2 (11.1)	**14 (42.4)**	4 (25.0)	6 (19.4)	3 (17.6)	37 (24.8)
Very influential	**12 (35.3)**	7 (38.9)	9 (37.3)	**8 (50.0)**	**10 (32.3)**	4 (23.5)	**50 (33.6)**
Extremely influential	**12 (35.3)**	**9 (50.0)**	7 (21.2)	1 (6.3)	9 (29.0)	**7 (41.2)**	45 (30.2)
Mean (SD)[1]	4.0 (1.0)	4.4 (.7)	3.6 (1.0)	3.4 (.9)	3.7 (1.1)	3.9 (1.2)	3.8 (1.0)
To reduce traffic congestion							
Not at all influential	2 (5.9)	0 (0.0)	2 (6.1)	0 (0.0)	2 (6.5)	0 (0.0)	6 (4.0)
Slightly influential	3 (8.8)	1 (5.6)	5 (15.2)	5 (31.3)	4 (12.9)	**5 (29.4)**	23 (15.4)
Somewhat influential	9 (26.5)	4 (22.2)	8 (24.2)	4 (25.0)	**10 (32.3)**	**5 (29.4)**	40 (26.8)
Very influential	9 (26.5)	6 (33.3)	**11 (33.3)**	**6 (37.5)**	6 (19.4)	4 (23.5)	**42 (28.2)**
Extremely influential	**11 (32.4)**	**7 (38.9)**	7 (21.2)	1 (6.3)	9 (29.0)	3 (17.6)	38 (25.5)
Mean (SD)[1]	3.7 (1.2)	4.1 (.9)	3.5 (1.2)	3.2 (1.0)	3.5 (1.2)	3.3 (1.1)	3.6 (1.1)
To improve public safety							
Not at all influential	1 (2.9)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.4)
Slightly influential	2 (5.9)	0 (0.0)	3 (9.4)	4 (25.0)	1 (3.2)	5 (29.4)	15 (10.1)
Somewhat influential	10 (29.4)	0 (0.0)	6 (18.8)	3 (18.8)	5 (16.1)	1 (5.9)	25 (16.9)
Very influential	**14 (41.2)**	6 (33.3)	**12 (37.5)**	4 (25.0)	12 (38.7)	5 (29.4)	**53 (35.8)**
Extremely influential	7 (20.6)	**11 (61.1)**	11 (34.4)	**5 (31.3)**	**13 (41.9)**	**6 (35.3)**	**53 (35.8)**
Mean (SD)[1]	3.7 (1.0)	4.4 (1.0)	4.0 (1.0)	3.6 (1.2)	4.2 (.8)	3.7 (1.3)	4.0 (1.0)
To increase economic development and opportunity							
Not at all influential	4 (11.8)	1 (5.6)	3 (9.1)	1 (6.3)	0 (0.0)	0 (0.0)	9 (6.0)
Slightly influential	7 (20.6)	1 (5.6)	2 (6.1)	1 (6.3)	4 (12.9)	2 (11.8)	17 (11.4)
Somewhat influential	8 (23.5)	6 (33.3)	5 (15.2)	4 (25.0)	7 (22.6)	2 (11.8)	32 (21.5)
Very influential	**9 (26.5)**	**7 (38.9)**	11 (33.3)	**9 (56.3)**	**11 (35.5)**	6 (35.3)	**53 (35.6)**
Extremely influential	6 (17.6)	3 (16.7)	**12 (36.4)**	1 (6.3)	9 (29.0)	**7 (41.2)**	38 (25.5)
Mean (SD)[1]	3.2 (1.3)	3.6 (1.0)	3.8 (1.3)	3.5 (1.0)	3.8 (1.0)	4.1 (1.0)	3.6 (1.2)

[1]5-point scale: Not at all influential, Slightly influential, Somewhat influential, Very influential, Extremely influential

Bold text indicates highest proportion for each category.

Appendix D. *Network characteristics of each active transportation policy network, for Awareness*

Metropolitan area	Size	Density	Diameter	Transitivity	Centralization		
					Degree	Betweenness	Closeness
Sacramento	37	.32	3	.63	.49	.14	.42
San Diego	19	.55	2	.82	.34	.03	.44
Kansas City	39	.38	2	.65	.52	.09	.50
St. Louis	18	.48	2	.67	.49	.11	.45
Knoxville	41	.34	2	.65	.52	.08	.56
Memphis	20	.62	2	.77	.34	.03	.35

Appendix E. *Network characteristics of each active transportation policy network, for Decisional Authority*

Metropolitan area	Size	Density	Diameter	Transitivity	Centralization		
					Degree	Betweenness	Closeness
Sacramento	36	.18	5	.54	.23	.09	.41
San Diego	19	.38	3	.63	.44	.11	.44
Kansas City	39	.25	3	.60	.54	.22	.60
St. Louis	18	.28	3	.49	.28	.09	.00
Knoxville	41	.20	4	.53	.39	.09	.42
Memphis	20	.33	3	.60	.51	.24	.44

Appendix F. *Network characteristics of each active transportation policy network, for Resource Exchange*

Metropolitan area	Size	Density	Diameter	Transitivity	Centralization		
					Degree	Betweenness	Closeness
Sacramento	36	.13	5	.47	.37	.17	.00
San Diego	19	.28	4	.57	.43	.15	.45
Kansas City	39	.13	3	.35	.57	.25	.61
St. Louis	18	.23	3	.57	.27	.06	.00
Knoxville	36	.15	5	.41	.38	.14	.42
Memphis	20	.27	4	.45	.55	.24	.42

Appendix G. *Network characteristics of each active transportation policy network, for Contact*[1]

Metropolitan area	Size	Density	Diameter	Transitivity	Centralization		
					Degree	Betweenness	Closeness
Sacramento	37	.23	4	.49	.55	.34	.00
San Diego	19	.49	4	.75	.38	.14	.24
Kansas City	39	.31	3	.49	.67	.20	.36
St. Louis	18	.42	3	.66	.46	.23	.28
Knoxville	41	.31	2	.50	.73	.30	.42
Memphis	20	.55	2	.69	.50	.12	.32

[1]Contact was dichotomized and considered present if reported quarterly or more.

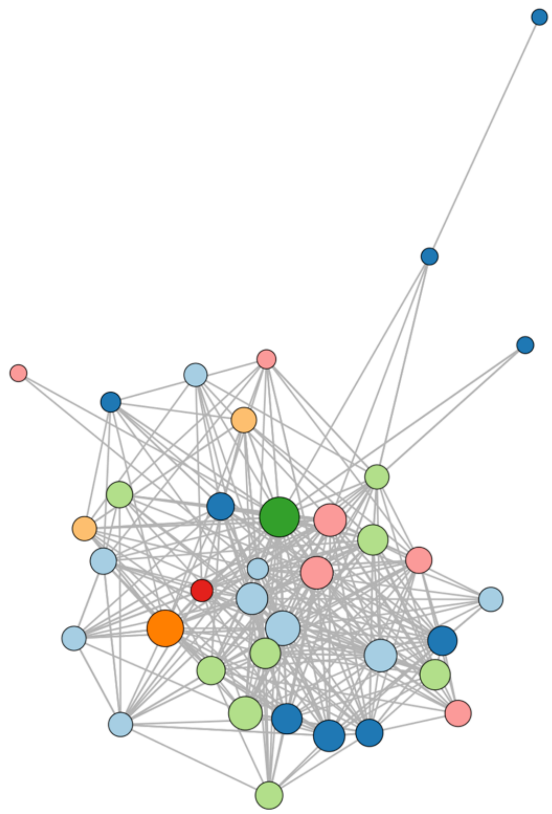
Appendix H. *Network characteristics of each active transportation policy network, for Collaboration*[1]

Metropolitan area	Size	Density	Diameter	Transitivity	Centralization		
					Degree	Betweenness	Closeness
Sacramento	37	.25	4	.48	.44	.25	.00
San Diego	19	.52	3	.69	.41	.12	.24
Kansas City	39	.34	3	.51	.67	.17	.38
St. Louis	18	.43	3	.68	.44	.17	.28
Knoxville	41	.31	2	.48	.73	.29	.42
Memphis	20	.54	3	.68	.39	.13	.23

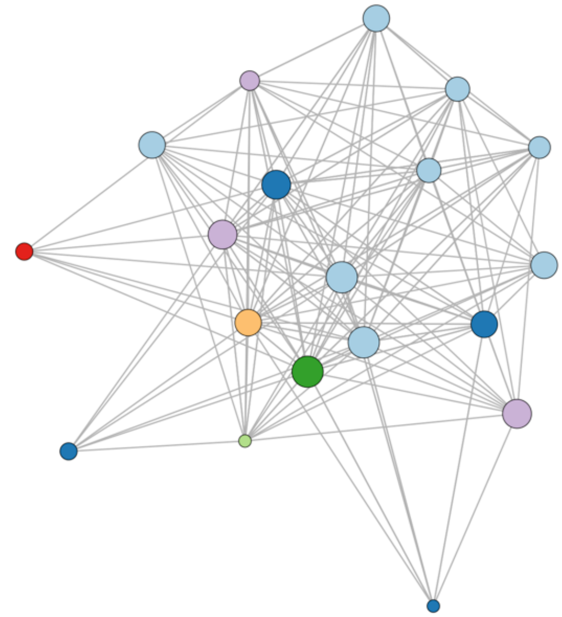
[1]Collaboration was dichotomized and considered present if reported the level of work together informally or more.

Appendix I. *Visualizations depicting awareness network for each metropolitan area, with node size based on in-degree*

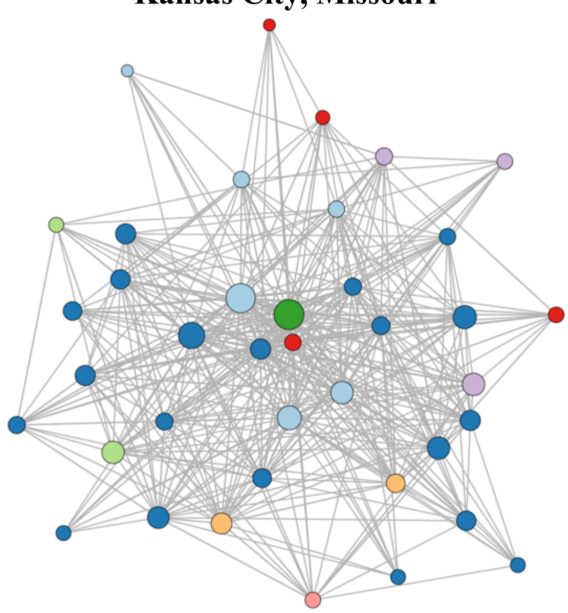
Sacramento, California



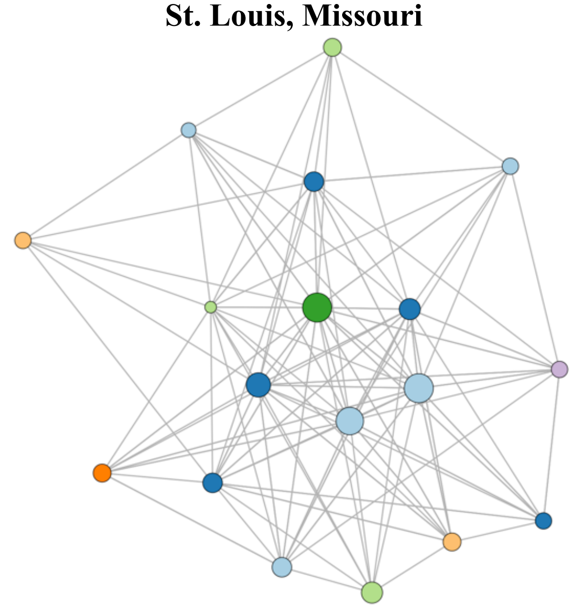
San Diego, California

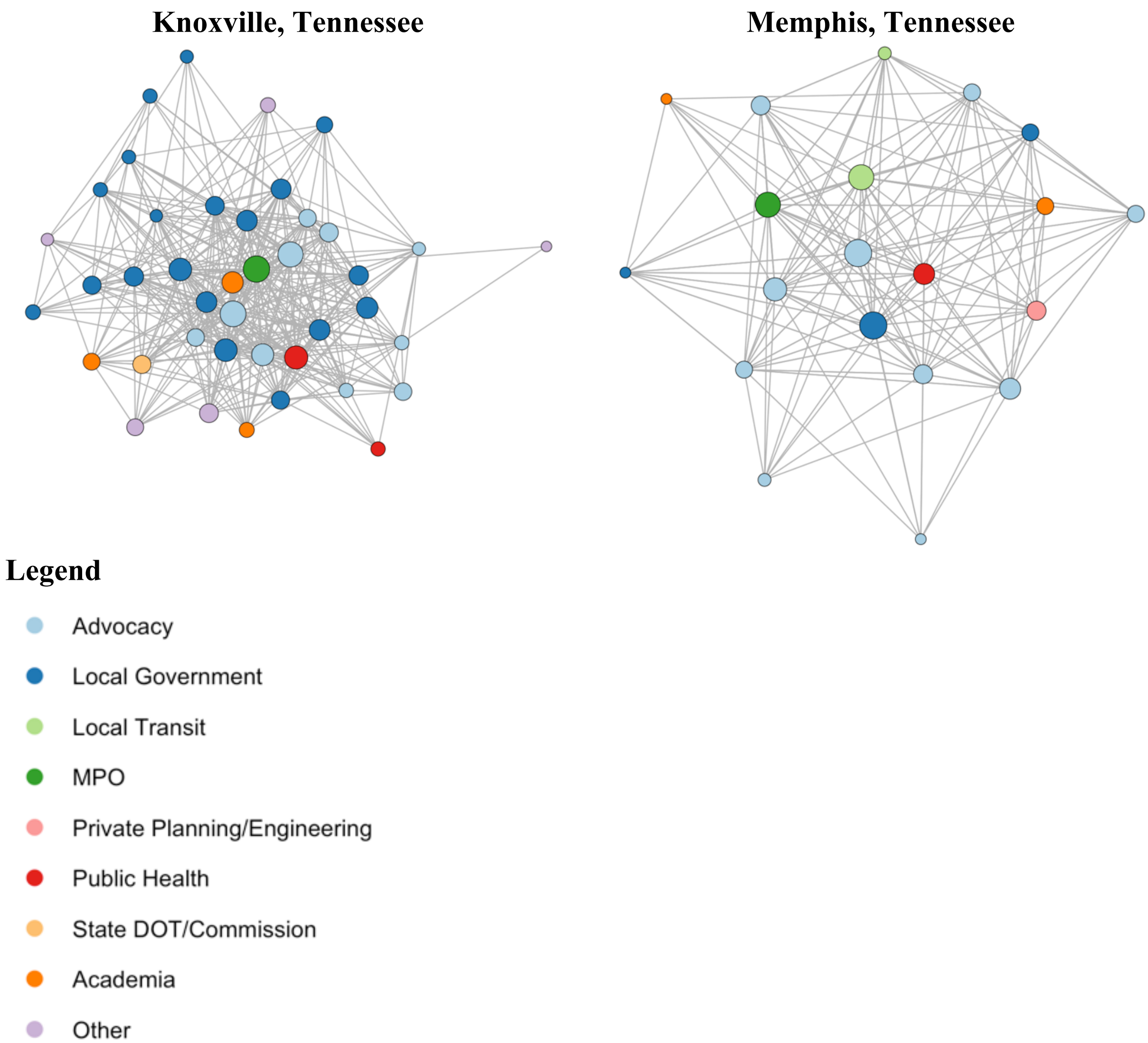


Kansas City, Missouri



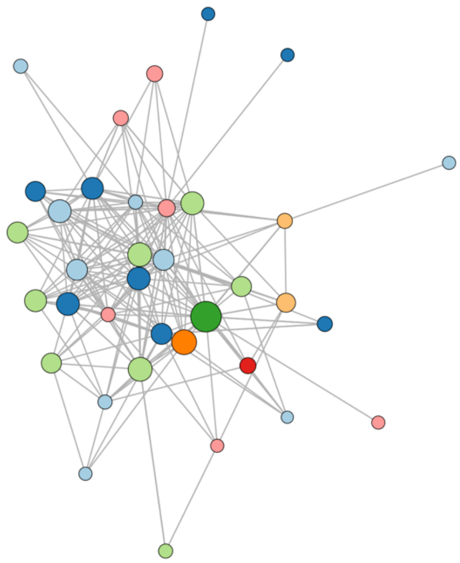
St. Louis, Missouri



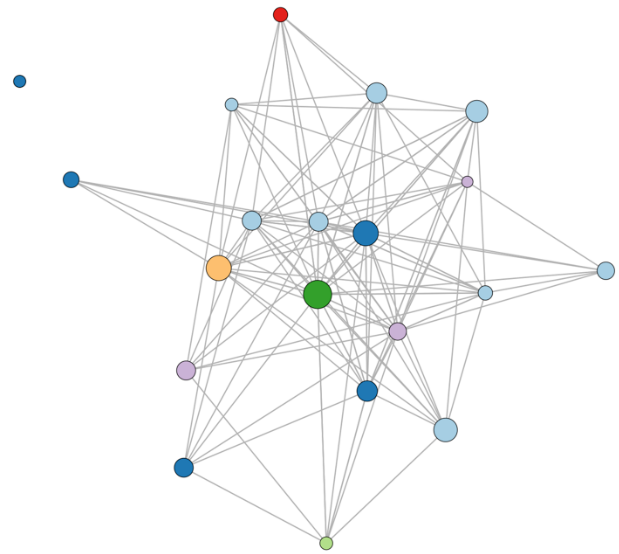

Knoxville, Tennessee
Memphis, Tennessee
Legend
Advocacy
Local Government
Local Transit
MPO
Private Planning/Engineering
Public Health
State DOT/Commission
Academia
Other

Appendix J. *Visualizations depicting decisional authority network for each metropolitan area, with node size based on in-degree*

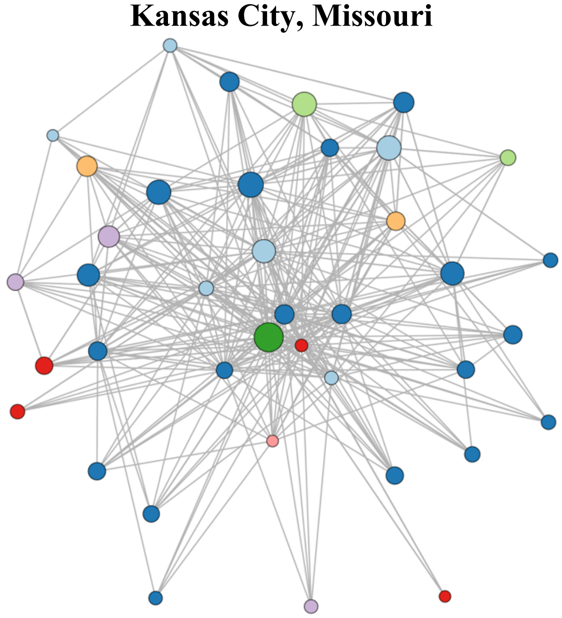
Sacramento, California



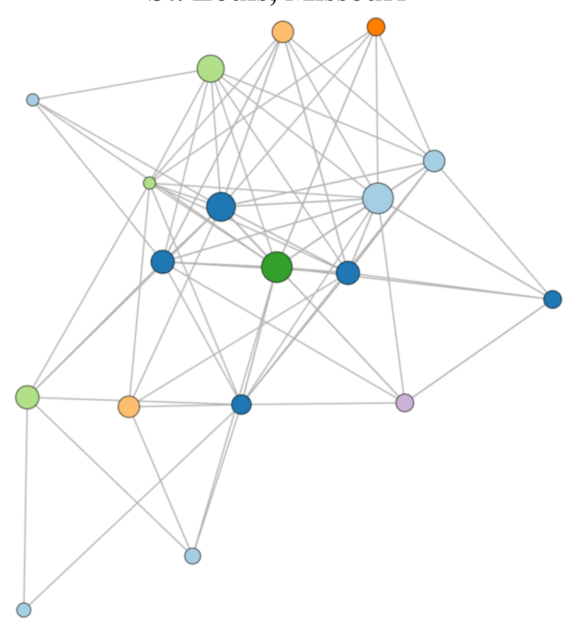
San Diego, California



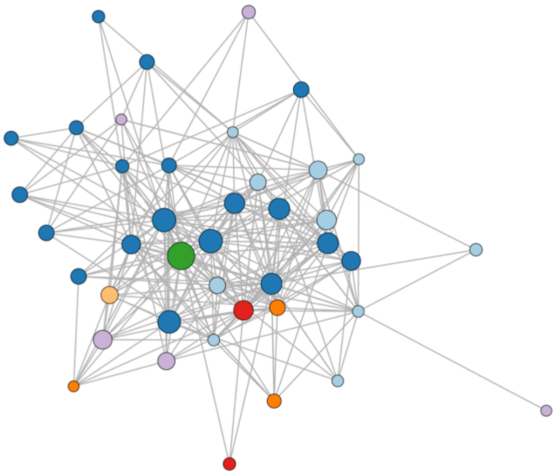
Kansas City, Missouri



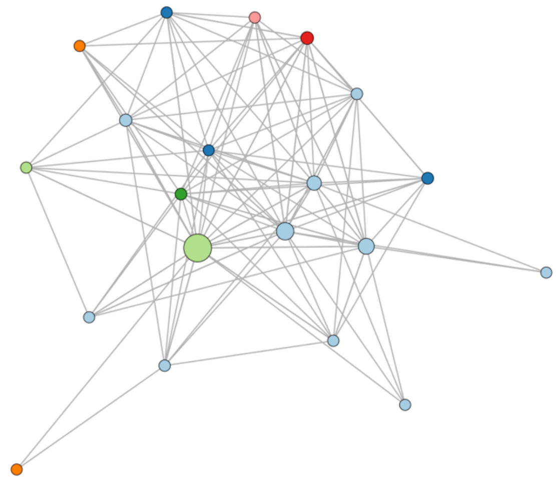
St. Louis, Missouri



Knoxville, Tennessee



Memphis, Tennessee

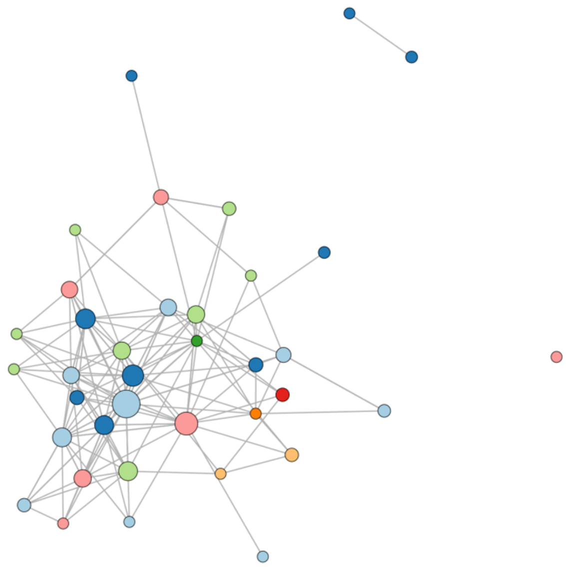


Legend

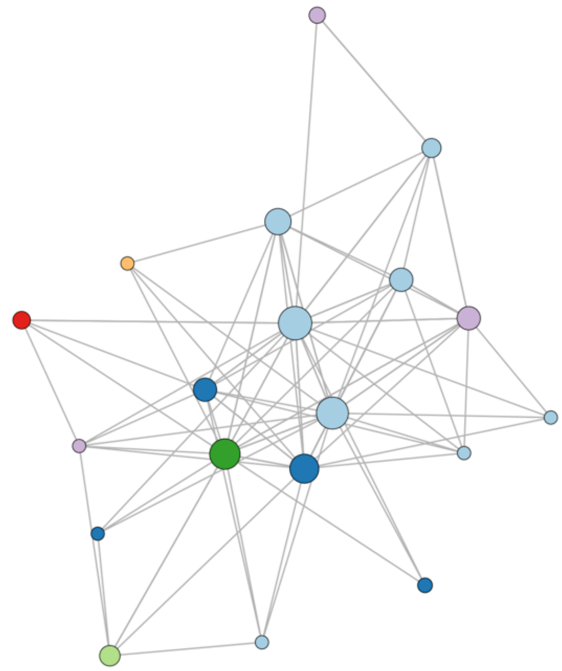
- Advocacy
- Local Government
- Local Transit
- MPO
- Private Planning/Engineering
- Public Health
- State DOT/Commission
- Academia
- Other

Appendix K. *Visualizations depicting resource exchange network for each metropolitan area, with node size based on out-degree*

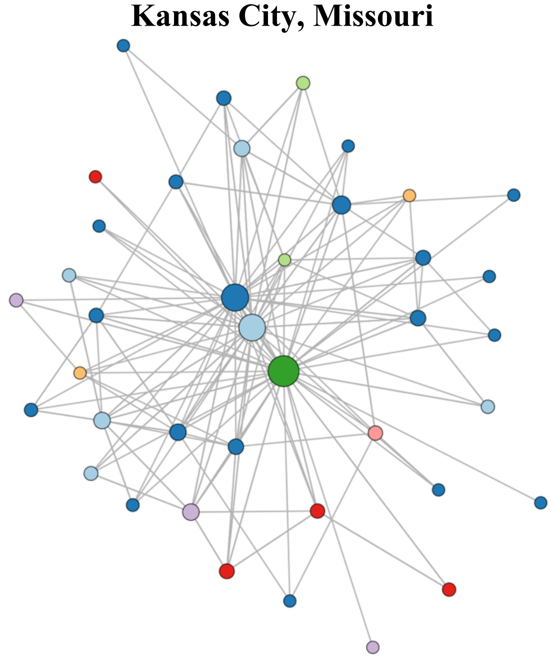
Sacramento, California



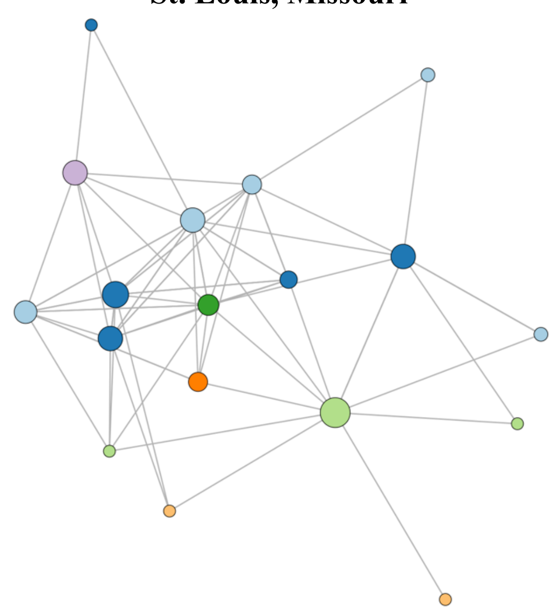
San Diego, California

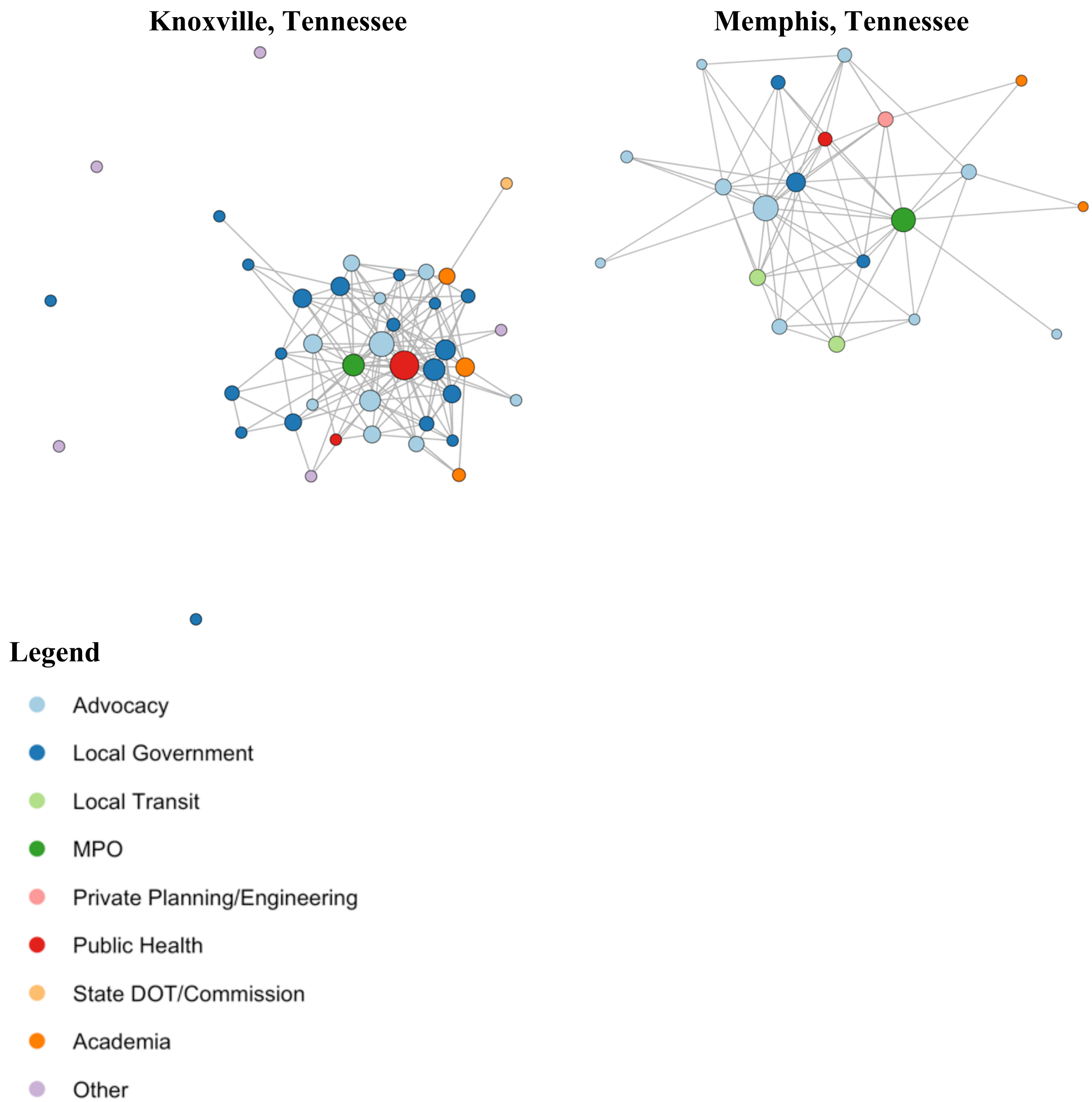


Kansas City, Missouri



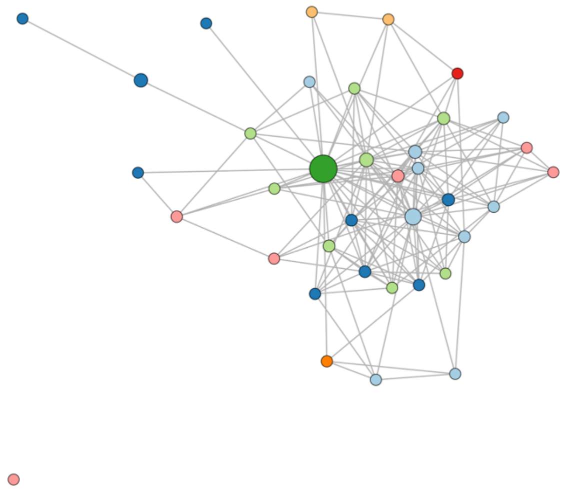
St. Louis, Missouri



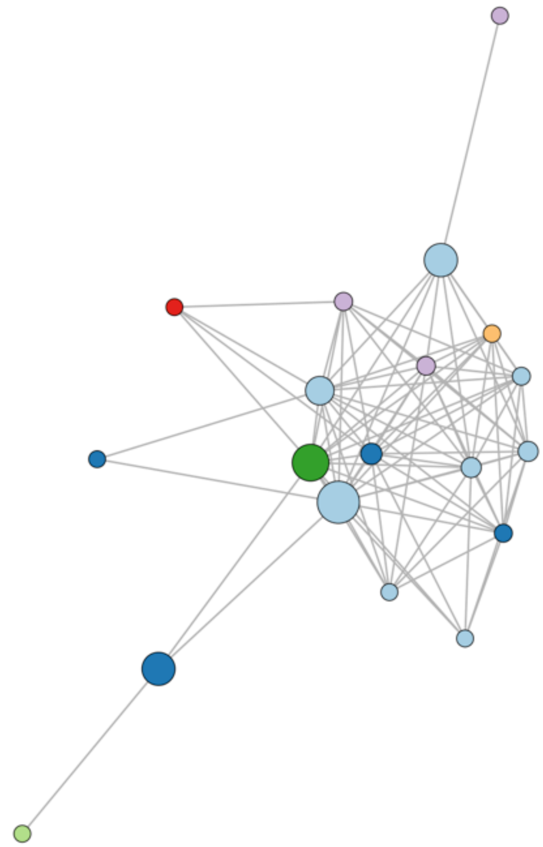

Knoxville, Tennessee
Memphis, Tennessee
Legend
Advocacy
Local Government
Local Transit
MPO
Private Planning/Engineering
Public Health
State DOT/Commission
Academia
Other

Appendix L. *Visualizations depicting contact network for each metropolitan area, with node size based on betweenness. Contact was dichotomized and considered present if reported quarterly or more.*

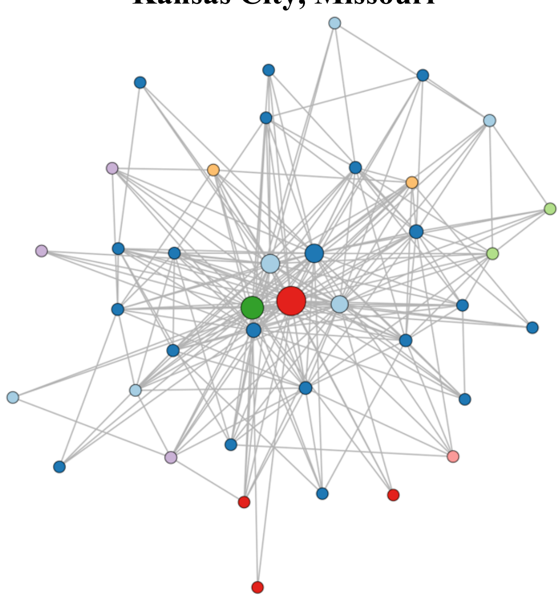
Sacramento, California



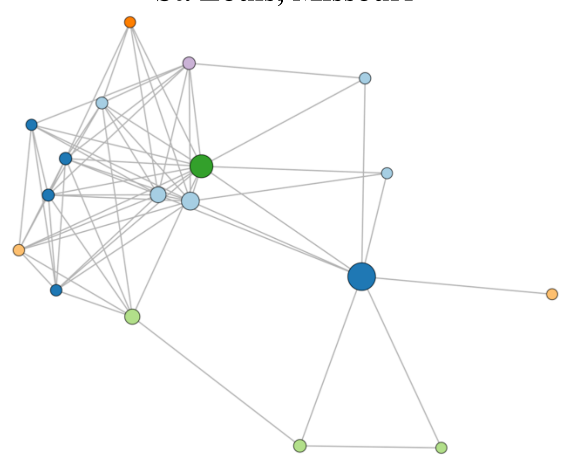
San Diego, California

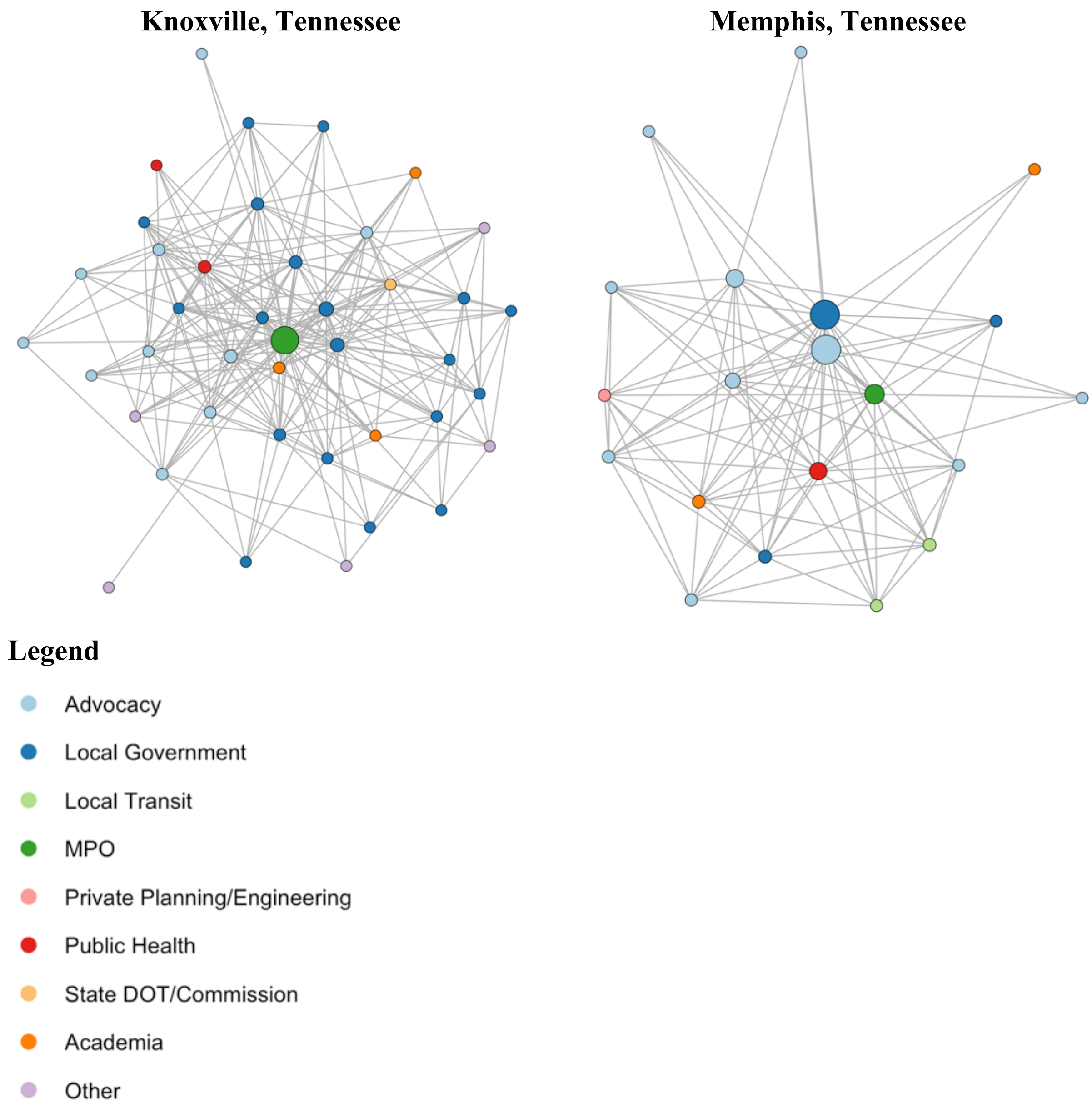


Kansas City, Missouri



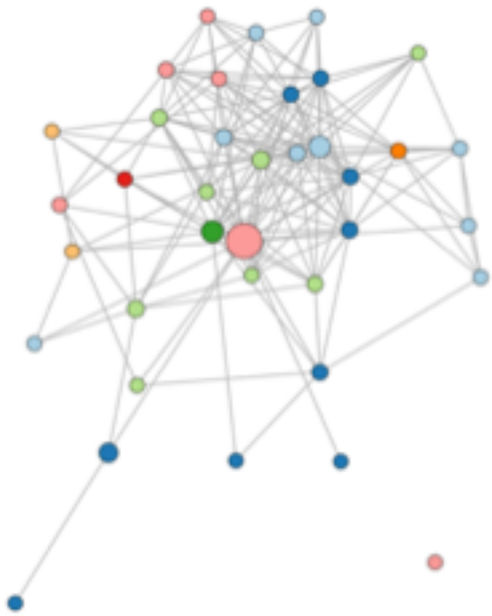
St. Louis, Missouri



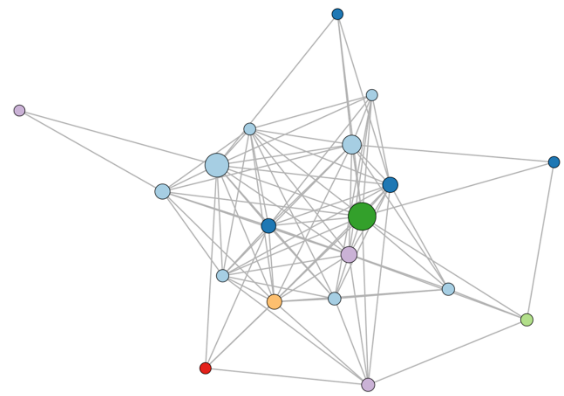

Knoxville, Tennessee
Memphis, Tennessee
Legend
Advocacy
Local Government
Local Transit
MPO
Private Planning/Engineering
Public Health
State DOT/Commission
Academia
Other

Appendix M. *Visualizations depicting collaboration network for each metropolitan area, with node size based on betweenness. Collaboration was dichotomized and considered present if reported the level of work together informally or more.*

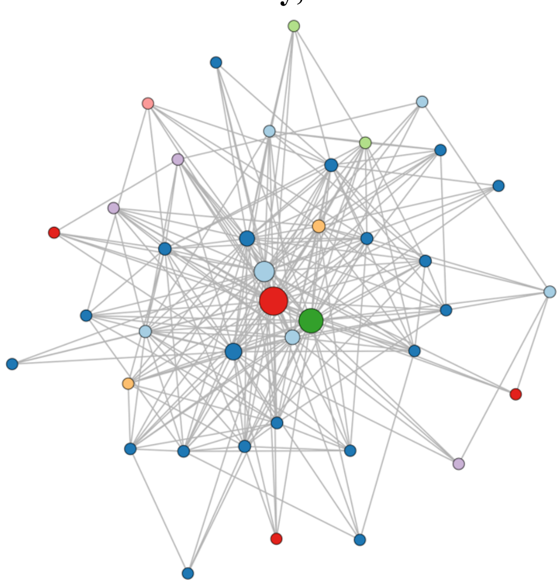
Sacramento, California



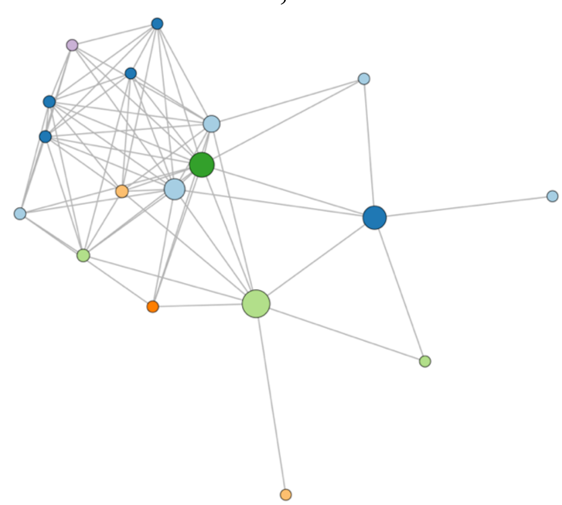
San Diego, California

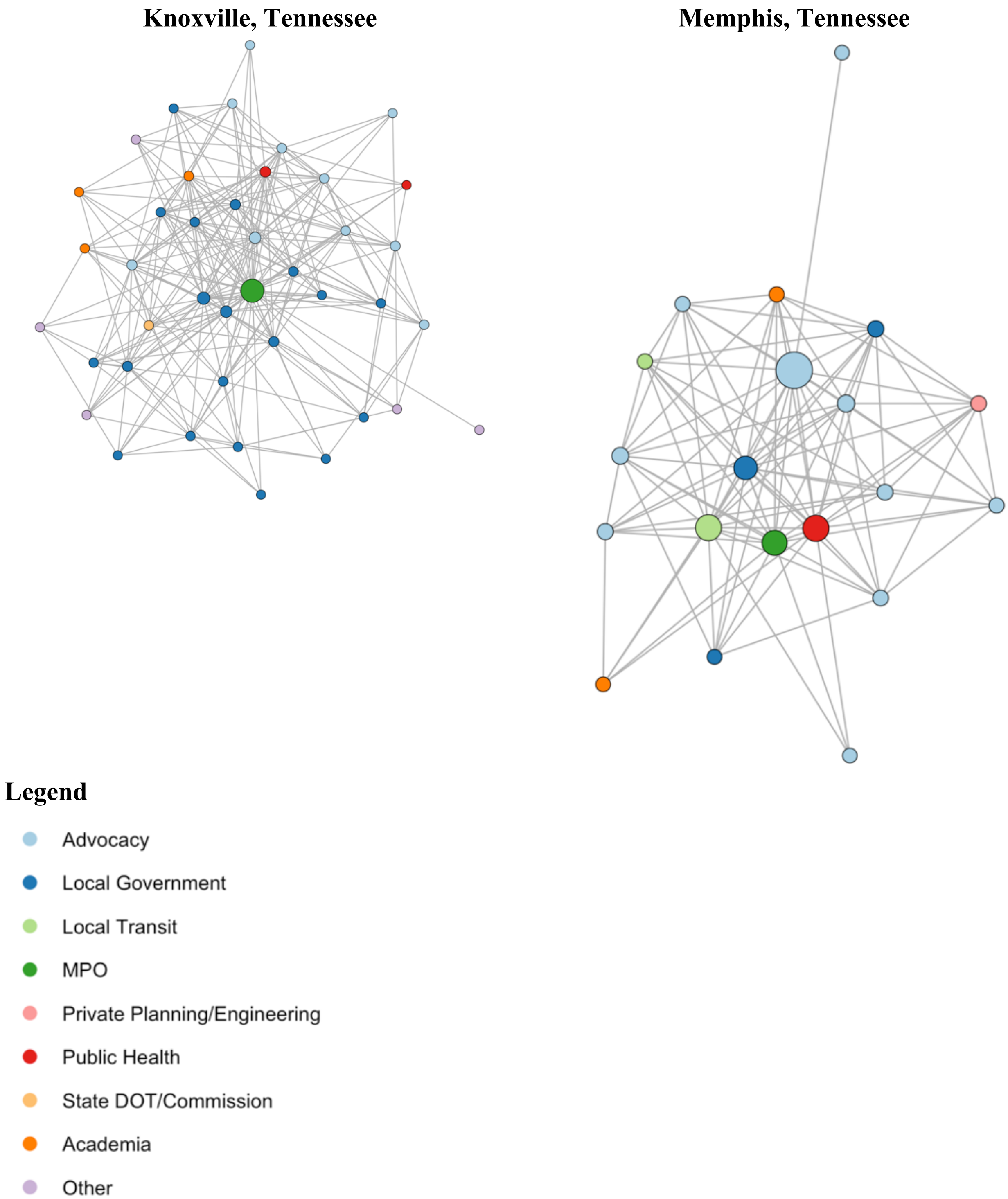


Kansas City, Missouri



St. Louis, Missouri




Knoxville, Tennessee
Memphis, Tennessee
Legend
Advocacy
Local Government
Local Transit
MPO
Private Planning/Engineering
Public Health
State DOT/Commission
Academia
Other

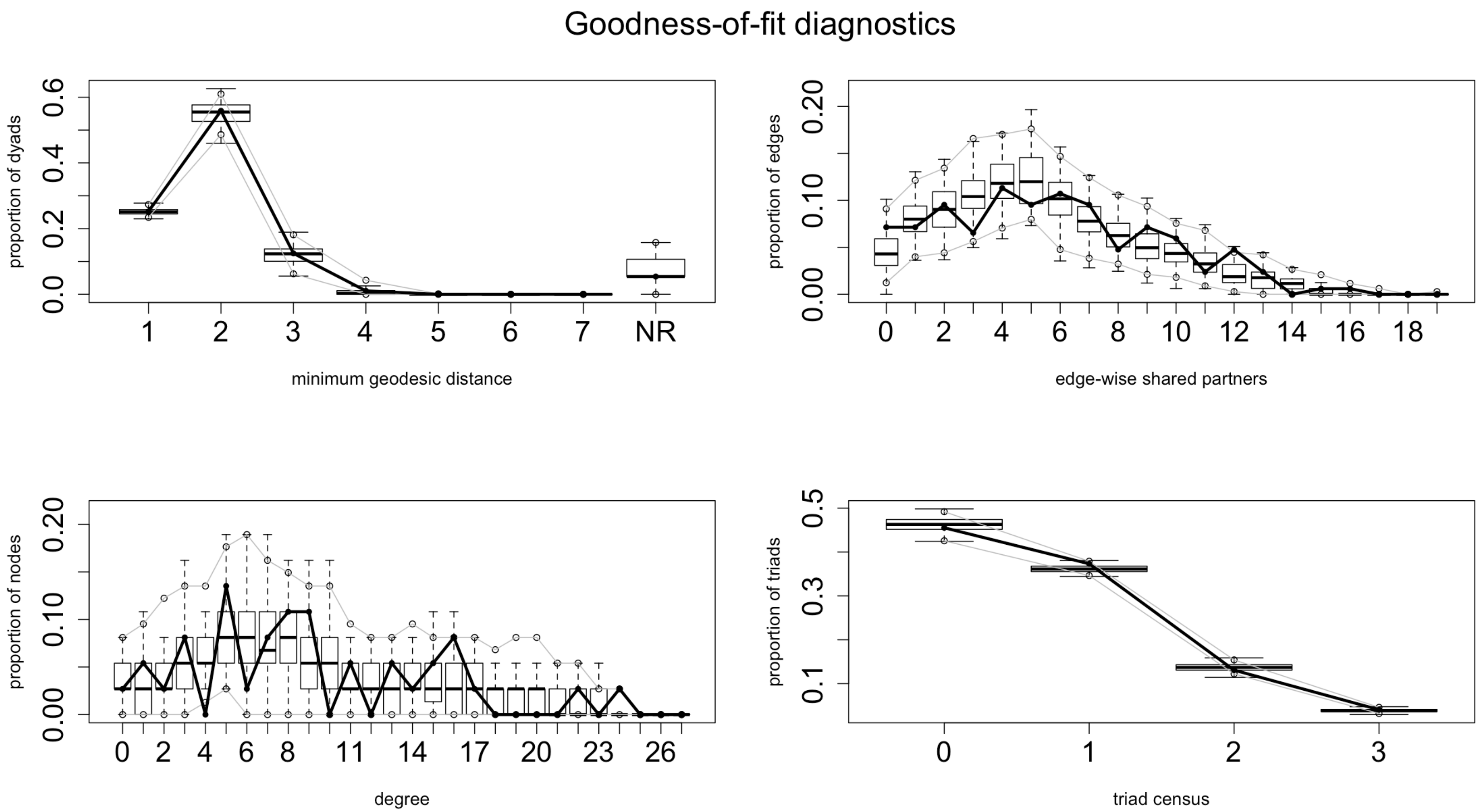
Appendix N. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in Sacramento, CA (N=37)*

Parameters	**Model 1: Null model**		**Model 2: Attribute predictors**		**Model 3: Attribute and structural predictors**	
	b (SE)	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**
Edges	-1.09 (.09)*	.34 (.28-.40)	-2.70 (.31)*	.07 (.04-.12)	-3.33 (.51)*	.04 (.01-.10)
Node attributes						
Experience						
< 1 year			Ref.	Ref.	Ref.	Ref.
1-5 years			1.07 (.30)*	2.91 (1.61-5.25)	.69 (.49)	1.99 (.77-5.16)
6-10 years			.77 (.27)*	2.16 (1.27-3.66)	.98 (.43)*	2.66 (1.16-6.12)
11+ years			.40 (.24)	1.49 (.93-2.40)	.15 (.37)	1.17 (.57-2.40)
Complete Streets involvement			.47 (.27)	1.60 (.94-2.72)	-.61 (.38)	.55 (.26-1.15)
Safe Routes to School involvement			-.91 (.26)*	.40 (.24-.67)	-.49 (.39)	.61 (.28-1.32)
Transit Oriented Development involvement			1.18 (.23)*	3.26 (2.07-5.13)	1.15 (.39)*	3.15 (1.46-6.79)
Link attributes						
Resource exchange					1.96 (.48)*	7.11 (2.78-18.19)
Decisional authority					1.72 (.39)*	5.59 (2.61-12.00)
Contact[2]					3.56 (.34)*	35.23 (18.06-68.71)
Structural predictor						
GWDegree					-1.56 (.83)	.21 (.04-1.07)
Model fit						
AIC		754.3		682.6		335.3

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.

* p-value<.05

Appendix O. *Structural model goodness of fit for Sacramento, CA.*

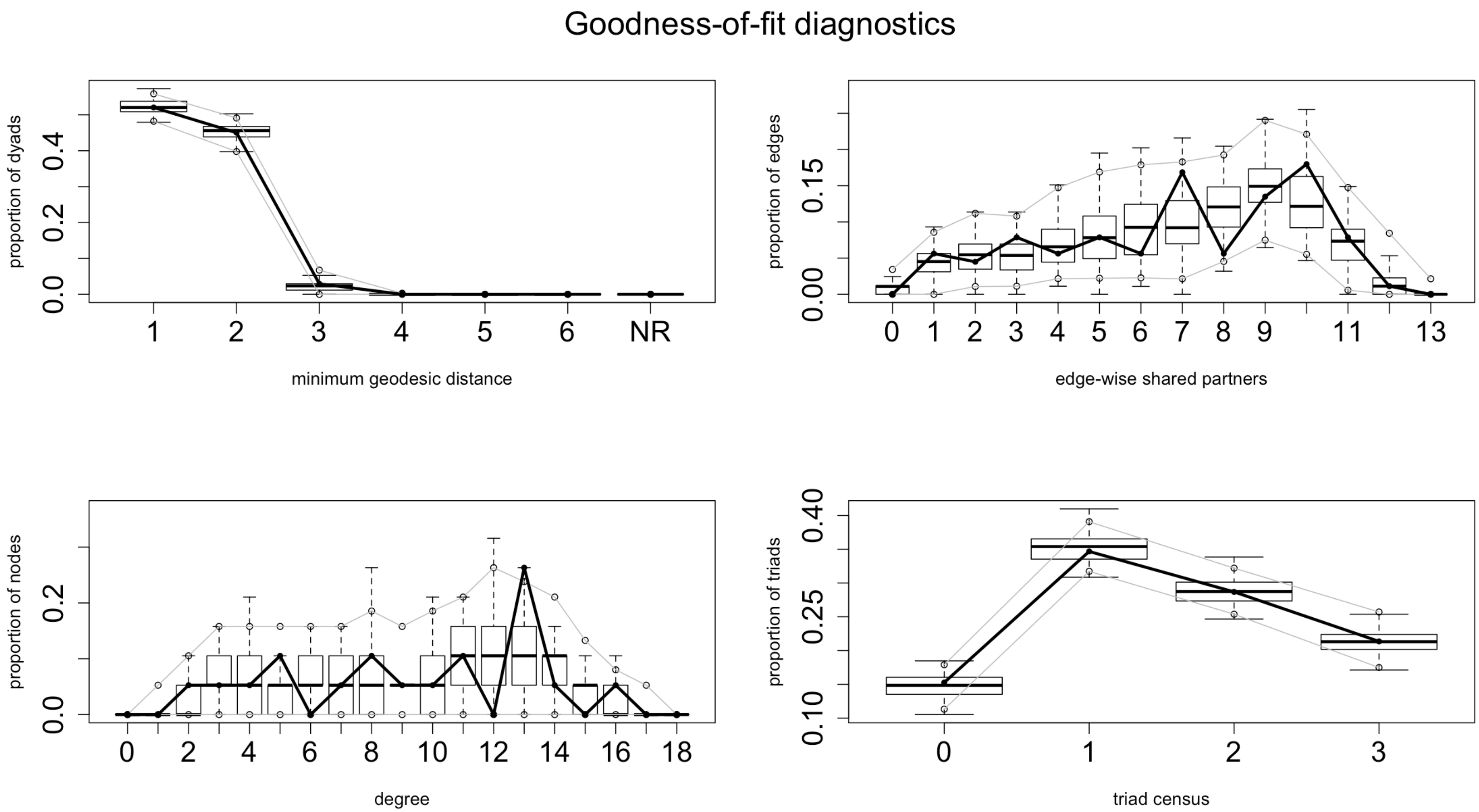


Appendix P. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in San Diego, CA (N=19)*

Parameters	**Model 1: Null model**		**Model 2: Attribute predictors**		**Model 3: Attribute and structural predictors**	
	b (SE)	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**
Edges	.08 (.15)	1.09 (.80-1.47)	-1.52 (.48)*	.22 (.09-.56)	-3.89 (1.04)*	.02 (.00-.16)
Node attributes						
Experience						
< 1 year			--	--	--	--
1-5 years			Ref.	Ref.	Ref.	Ref.
6-10 years			-.47 (.41)	.63 (.28-1.40)	1.26 (.75)	3.54 (.81-15.49)
11+ years			.05 (.33)	1.05 (.55-1.98)	-.16 (.63)	.85 (.25-2.91)
Complete Streets involvement			1.23 (.41)*	3.42 (1.52-7.70)	-.24 (.71)	.79 (.20-3.16)
Safe Routes to School involvement			-.52 (.64)	.59 (.17-2.08)	.48 (1.35)	1.62 (.12-22.66)
Transit Oriented Development involvement			.47 (.54)	1.60 (.55-4.63)	.39 (1.21)	1.47 (.14-15.75)
Link attributes						
Resource exchange					3.39 (1.10)*	29.79 (3.44-257.96)
Decisional authority					.59 (.70)	1.81 (.46-7.19)
Contact[2]					4.67 (.77)*	107.00 (23.53-486.45)
Structural predictor						
GWDegree					-.31 (3.47)	.74 (.00-658.90)
Model fit						
AIC		238.8		229.9		107.7

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.
* p-value<.05

Appendix Q. *Structural model goodness of fit for San Diego, CA.*



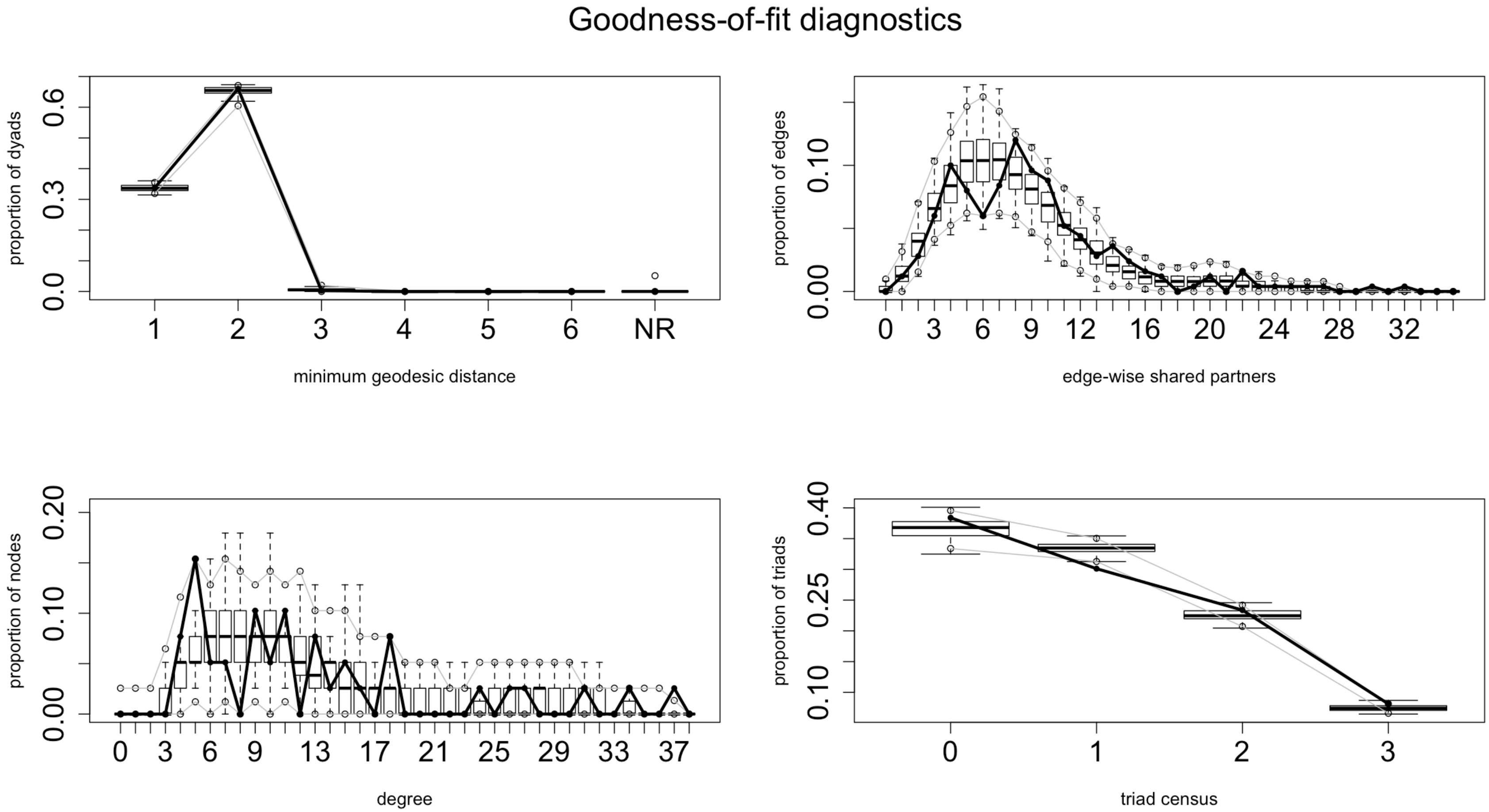
Appendix R. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in Kansas City, Missouri (N=39)*

Parameters	**Model 1: Null model**		**Model 2: Attribute predictors**		**Model 3: Attribute and structural predictors**	
	b (SE)	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**
Edges	-.68 (.08)*	.51 (.44-.59)	-2.44 (.26)*	.09 (.05-.15)	-3.26 (.41)*	.04 (.02-.09)
Node attributes						
Experience						
< 1 year			--	--	--	--
1-5 years			Ref.	Ref.	Ref.	Ref.
6-10 years			.51 (.17)*	1.67 (1.20-2.33)	.12 (.39)	1.13 (.64-1.98)
11+ years			.90 (.15)*	2.47 (1.82-3.34)	.30 (.25)	1.35 (.82-2.22)
Complete Streets involvement			.52 (.22)*	1.68 (1.08-2.60)	.53 (.37)	1.70 (.82-3.51)
Safe Routes to School involvement			-.50 (.18)*	.61 (.43-.87)	-.13 (.31)	.87 (.48-1.60)
Transit Oriented Development involvement			.75 (.17)*	2.11 (1.53-2.92)	-.18 (.26)	.84 (.50-1.39)
Link attributes						
Resource exchange					1.20 (.65)	3.32 (.93-11.84)
Decisional authority					1.08 (.32)*	2.96 (1.59-5.52)
Contact[2]					4.40 (.33)*	81.21 (42.42-155.44)
Structural predictor						
GWDegree					-3.94 (.95)*	.02 (.00-.13)
Model fit						
AIC		949.4		842.4		394.0

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.

* p-value<.05

Appendix S. *Structural model goodness of fit for Kansas City, MO.*



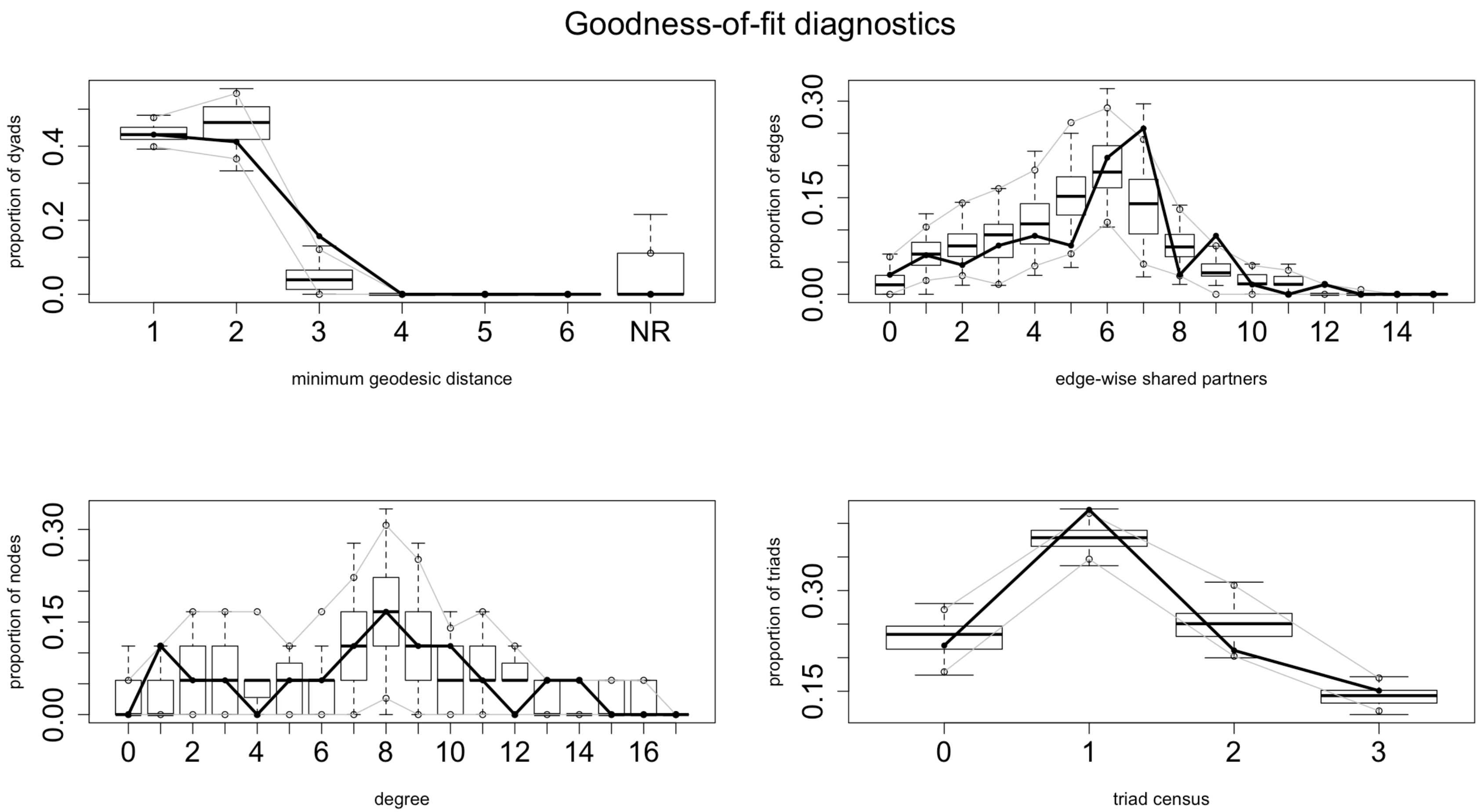
Appendix T. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in St. Louis, MO (N=18)*

Parameters	**Model 1: Null model**		**Model 2: Attribute predictors**		**Model 3: Attribute and structural predictors**	
	b (SE)	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**
Edges	-.28 (.16)	.76 (.55-1.05)	-2.05 (.62)*	.13 (.04-.43)	-1.22 (1.15)	.30 (.03-2.81)
Node attributes						
Experience						
< 1 year			Ref.	Ref.	Ref.	Ref.
1-5 years			-.76 (.38)*	.47 (.22-.98)	-.18 (.84)	.83 (.16-4.29)
6-10 years			.37 (.49)	1.45 (.55-3.77)	1.83 (1.21)	6.25 (.59-66.47)
11+ years			-.38 (.34)	.69 (.36-1.33)	-1.16 (.82)	.31 (.06-1.57)
Complete Streets involvement			.52 (.44)	1.68 (.70-4.01)	-1.77 (1.02)	.17 (.02-1.27)
Safe Routes to School involvement			.75 (.31)*	2.13 (1.15-3.93)	.93 (.70)	2.54 (.65-9.95)
Transit Oriented Development involvement			.42 .(35)	1.53 (.77-3.01)	.20 (.75)	1.23 (.28-5.32)
Link attributes						
Resource exchange					--	--
Decisional authority					1.04 (1.00)	2.82 (.40-19.99)
Contact[2]					4.91 (1.03)*	135.60 (17.85-1030.01)
Structural predictor						
GWDegree					-2.64 (1.58)	.07 (.00-1.60)
Model fit						
AIC		211.2		196.7		78.1

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.

* p-value<.05

Appendix U. *Structural model goodness of fit for St. Louis, MO.*

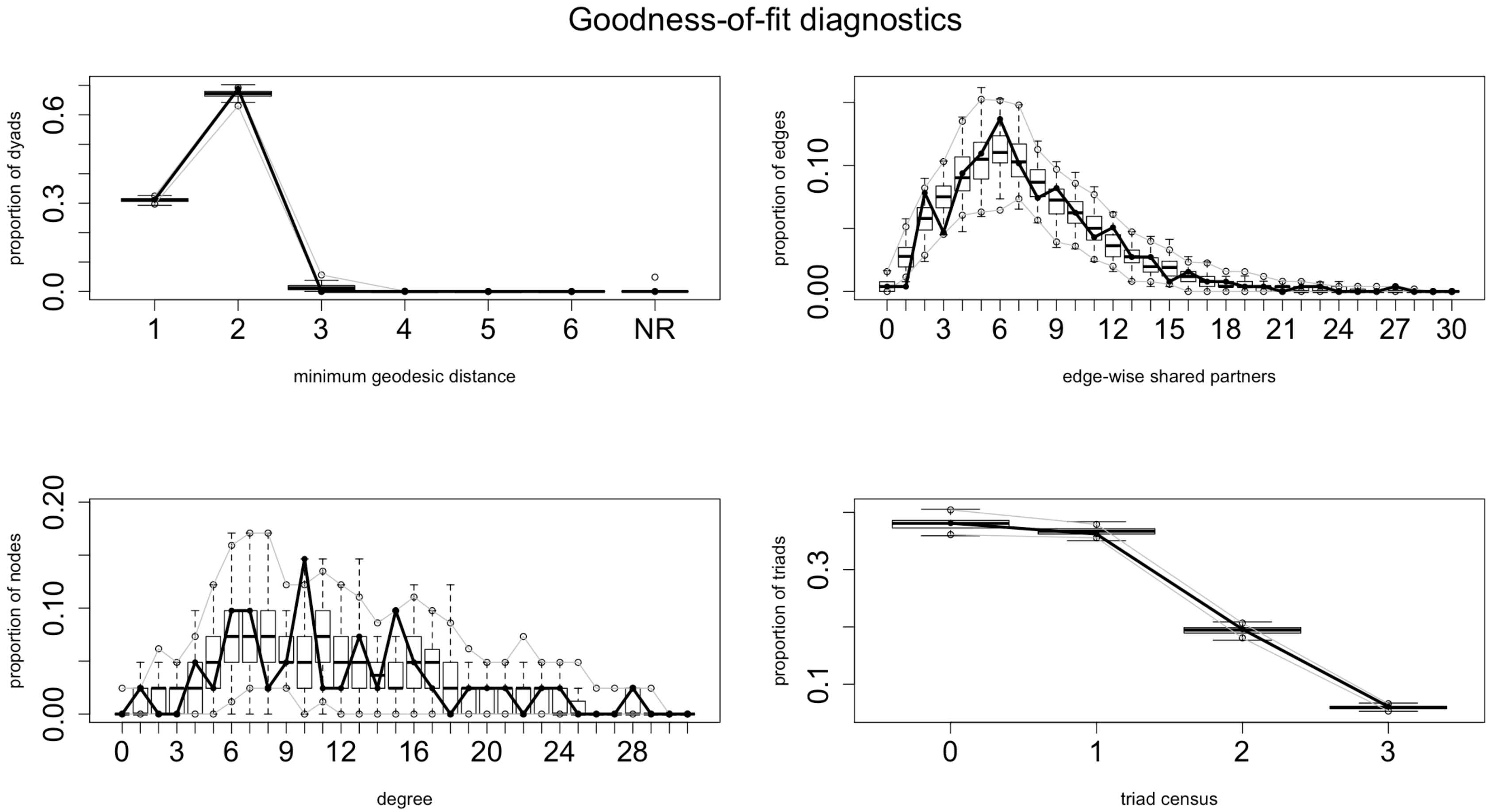


Appendix V. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in Knoxville, TN. (N=41)*

Parameters	Model 1: Null model		Model 2: Attribute predictors		Model 3: Attribute and structural predictors	
	b (SE)	OR (95% CI)	b (SE)	OR (95% CI)	b (SE)	OR (95% CI)
Edges	-.79 (.08)*	.45 (.39-.53)	-2.37 (.22)*	.09 (.06-.14)	-4.10 (.49)*	.02 (.01-.04)
Node attributes						
Experience						
< 1 year			Ref.	Ref.	Ref.	Ref.
1-5 years			.11 (.17)	1.12 (.79-1.57)	-.14 (.38)	.87 (.42-.1.82)
6-10 years			.64 (.24)*	1.89 (1.8-3.01)	.64 (.49)	1.89 (.72-4.99)
11+ years			.25 (.21)	1.28 (.86-1.92)	.27 (.42)	1.31 (.57-2.97)
Complete Streets involvement			.74 (.19)*	2.10 (1.45-3.05)	.05 (.37)	1.05 (.51-2.18)
Safe Routes to School involvement			.11 (.16)	1.11 (.82-1.51)	.34 (.31)	1.41 (.76-2.60)
Transit Oriented Development involvement			.42 (.13)*	1.52 (1.17-1.96)	.01 (.27)	1.01 (.59-1.72)
Link attributes						
Resource exchange					3.11 (.78)*	22.40 (4.87-103.00)
Decisional authority					2.01 (.39)*	7.48 (4.87-16.19)
Contact[2]					4.76 (.33)*	116.36 (61.53-220.06)
Structural predictor						
GWDegree					.10 (2.04)	1.11 (.02-59.89)
Model fit						
AIC		1020		924.5		325.2

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.
* p-value<.05

Appendix W. *Structural model goodness of fit for Knoxville, TN.*



Appendix X. *Exponential random graph (ERGM) results predicting the probability of a collaborative tie between two organizations working on active transportation policy in Memphis, TN. (N=20)*

Parameters	**Model 1: Null model**		**Model 2: Attribute predictors**		**Model 3: Attribute and structural predictors**	
	b (SE)	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**	**b (SE)**	**OR (95% CI)**
Edges	.17 (.15)	1.18 (.89-1.58)	-2.46 (.51)*	.09 (.03-.23)	-3.09 (.95)*	.05 (.01-.29)
Node attributes						
Experience						
< 1 year			Ref.	Ref.	Ref.	Ref.
1-5 years			.99 (.33)*	2.71 (1.43-5.16)	.35 (.52)	1.42 (.51-3.95)
6-10 years			1.29 (.79)*	9.90 (2.10-46.62)	1.33 (1.28)	3.78 (.31-46.62)
11+ years			.36 (.45)	1.43 (.59-3.44)	2.18 (.84)*	8.85 (1.71-45.76)
Complete Streets involvement			1.41 (.49)*	4.08 (1.55-10.76)	.09 (.89)	1.10 (.19-6.24)
Safe Routes to School involvement			.16 (.47)	1.17 (.47-2.96)	-.57 (.83)	.57 (.11-2.88)
Transit Oriented Development involvement			-.60 (.36)	.55 (.27-1.11)	-.07 (.52)	.93 (.33-2.60)
Link attributes						
Resource exchange					1.52 (.89)	4.58 (.80-26.09)
Decisional authority					1.13 (.89)	3.09 (.91-10.53)
Contact[2]					4.30 (.80)*	73.86 (15.39-354.49)
Structural predictor						
GWDegree					-2.55 (1.48)	.09 (.00-1.43)
Model fit						
AIC		264		227.4		129.3

[1]Collaboration was dichotomized and considered present if reported at the level of work together informally or more.
[2]Contact was dichotomized and considered present if reported the level of quarterly or more.

* p-value<.05

Appendix Y. *Structural model goodness of fit for Memphis, TN*