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RESEARCH ARTICLE

Shifting Gears: A Case Study of Cycle Planning and Decision-making in Tucson, Arizona

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Planners face a complex process from planning projects to final construction and evaluation in cycle planning. Planners tend to coordinate with peers in neighboring cities, advocates, politicians, other policymakers, and researchers to implement cycling plans. Documenting this decision-making process and the sources of information that guide decisions can provide insight into creating better cycling planning research and fostering stronger collaborations. We first provide a brief history of cycle planning in Tucson, Arizona, to demonstrate the current issues and efforts. Then, we present findings from interviews with Tucson planners and an advocate to explore information sources, collaboration, barriers, and opportunities for action for bicycle planning. Our results highlight the need for research presented in consumable ways, particularly through professional networks, and the potential for university outreach offices to assist in public participation and outreach, professional education, and collaboration on data collection and analysis on cycling projects. Focusing on these avenues can strengthen the science to decision-making pipeline. These lessons can also help improve bicycle planning in other communities.

Keywords: cycle planning; cycle policy; science and decision-making; active transportation

1. Introduction

Research can help shape cycle planning (Pucher, Dill and Handy, 2010), but only if it is salient, credible, and relevant to the issues practitioners and advocates are trying to address (Cash et al., 2005; Lemos and Morehouse, 2005). Often, researchers make their work available to practitioners without understanding the decision-making contexts (Cash, Borck and Patt, 2006). Co-production of policy can "enable researchers to respond to policy agendas, and enable more agile multidisciplinary teams to coalesce around topical policy problems" (Oliver and Cairney, 2019). Researchers can ensure their work meets demands by engaging with cycle planners and understanding the cycle planning decision-making processes. In

order to improve future work, we need to know where planners get information on cycle planning, what barriers and opportunities they face, who they collaborate with, and what role the university could play.

We use Tucson, Arizona, to better understand the cycle planning process. First, we provide a brief overview of cycle planning in Tucson to give context to the city. Next, we analyze semi-structured interviews with six local planners and an advocate on information sources, collaborators, and barriers and opportunities for cycle planning. The interviews identify five themes: safety, funding, and political support; community values; information sharing and technical communication challenges; professional networks and peer learning; and collaborators. Participants expressed ways for researchers and outreach offices at the university to help implement better cycle planning by collaborating on data analysis, ongoing education, and public outreach. These outcomes provide helpful information for researchers to tailor their work for decision-makers and can help professional organizations and peer networks improve best practices for implementing and sharing cycle planning research.

2. Tucson, Arizona: a historical and geographic context

Located in Southern Arizona, Tucson covers nearly 364 square kilometers, or 140 square miles, with a population of 1,057,597 (US Census Bureau, 2021) (see **Figure 1** for map). Several mountain ranges surround Tucson; however, it is primarily flat within the city limits, with gentle hills near usually dry riverbeds. These conditions, coupled with warm and dry conditions for most of the year, create an ideal location for cycling—for recreation and transportation.

2.1 History of cycle planning in Tucson

From the 1970s until the early 2000s, Tucson had incremental cycle projects grounded in master planning efforts to ensure regional congruency (Dames and Moore, 1989, p. 2–2). By the 1990s, cycling trips rose to 3%, "the highest level of bicycle use of any city in its size in the entire country" (Anderson, 2017). Providing cycle lanes on most roads resulted in a dense

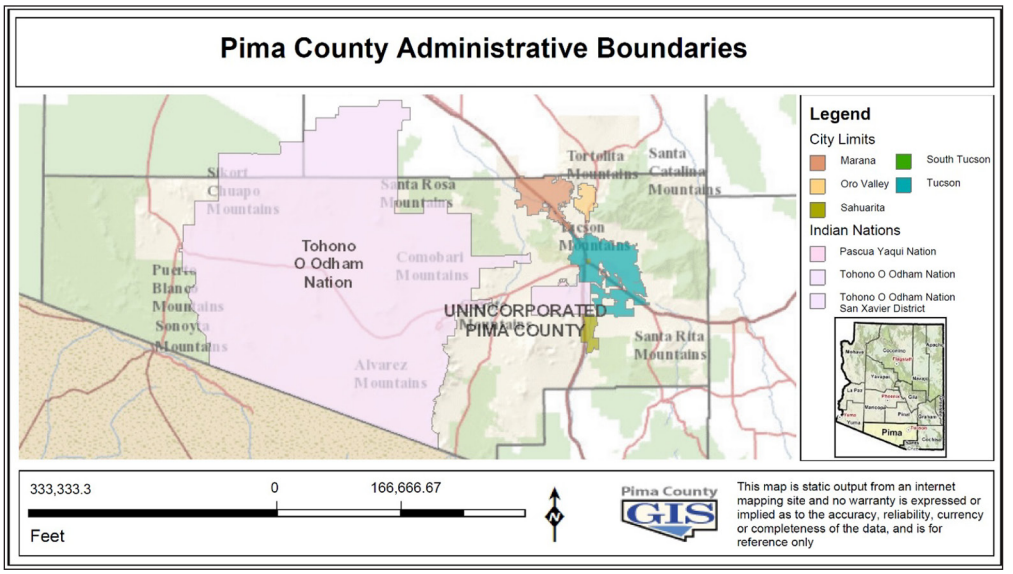

Figure 1: Administrative Boundaries in Pima County (Arizona County Maps, 2021).

infrastructure network, but it can be dangerous to ride on. Riding on a six-lane arterial with only paint as protection is unnerving at best and deadly at worst (Iuliano, 2022; **Figure 2**). Further, the arterial roads, which form a grid system spaced out every 1.6 kilometers (1 mile) with limited safe walking or cycling crossings, act as a barrier for residents. Without a comprehensive network of low-stress infrastructure (**Figure 3**), cyclists in the region often detour to avoid intersections based on previous driver interactions or avoid using the infrastructure altogether if it presents a delay or difficulty (Iuliano and Keith, 2022).

To help improve low-stress connectivity, the city announced 64 (311 kilometers/193 miles) bicycle boulevards in 2017 that crisscross the city, with six completed so far and several more under design (Tucson Bicycle and Pedestrian Program, 2017, p. 3–5; **Figure 3**). Bicycle boulevards are low-traffic residential streets redesigned with speed tables, green infrastructure, and enhanced crossings to make it safer to cycle or walk (Tucson Bicycle and Pedestrian Program, 2017). This program was followed by a complete streets ordinance in 2019 (City of Tucson, 2021a). The complete street ordinance outlines design recommendations to enhance safety,

Figure 2: A typical arterial street in Tucson with three lanes of traffic in each direction and an unprotected cycle lane (Photo credit: author).

Figure 3: A typical low-stress bicycle boulevard (Tucson Bicycle and Pedestrian Program, 2017, p. 6).

comfort, and equity for all road users during a road project's planning and conceptual design phases (City of Tucson, 2021a, p. 1–14). Finally, the city adopted a new mobility master plan, Move Tucson, in 2021 to "create a mobility blueprint for the City's future in a rapidly changing world" across all modes, emphasizing outreach and participation from marginalized communities (City of Tucson, 2021b). These plans represent a significant shift from treating cycling as recreation and instead embracing what Tschoerner-Budde (2020) refers to as "mobility culture" or a focus on "everyday routines, structures, and norms of movement." Under this view, supporting riding as a valid means of urban transportation becomes the primary focus versus just a form of recreation.

Despite new infrastructure and obtaining a "Gold" rating for the League of American Bicyclists, Tucson struggles to increase ridership beyond 2.9% of commutes (McLeod et al., 2018). Additionally, the average cycling fatality rate increased from 3.6 per year from 2012 to 2016 to 4.8 per year from 2017 to 2021 (League of American Bicyclists, 2023). The fatality increase and ridership stagnation may partly come from what Isaksson, Antonson, and Eriksson (2017) call "policy drift," where policy goals change, but the implementation tools remain the same. The city's plans outline progressive policies for cycle infrastructure, yet constructed projects often continue to incorporate traditional cycle lane designs that result in deadly conditions. Tucson could lead in promoting active transportation, and there are numerous avenues for collaboration between planners and researchers to help achieve this goal. To achieve these goals, however, it is critical to understand the barriers and opportunities for collaboration, and engaging with planners is a crucial step to shed light on these issues. The following section describes the methods and approaches employed to understand this relationship.

3. Methodology

We interviewed three planners at the City of Tucson, one at the University of Arizona and two from Pima County, to understand cycle planning at different jurisdictional levels, and an advocate from the Tucson-Pima County Bicycle Advisory Committee (TPBAC) to gain additional perspective. Members of the TPBAC are involved in the planning process, meeting monthly with these planners to review documents and provide feedback on projects. We invited other advocates, but they either declined or did not respond. We focused the interview sample on those involved directly in the planning process to focus on the relationship between research and cycle planning. To protect the anonymity of participants, we cannot disclose the number of invitations or declinations because there is a small number of professionals in these departments and advocacy groups (see University of Arizona IRB: Study #1904499197).

We conducted seven 45–60 minute semi-structured interviews from fall 2019 to spring 2020. We modified these interview questions from a study on the barriers and opportunities of climate change planning (Keith and Iuliano, 2019; see Appendix A). We used an inductive thematic analysis method, which involves noting critical text before analysis, to aid in developing codes and themes (Fereday and Muir-Cochrane, 2006). We established a codebook by first reviewing the interviews to identify patterns and repetition in the responses, then reanalyzed the interviews applying the codes, and finally, we grouped similar coded quotes into themes (Fereday and Muir-Cochrane, 2006). We wanted the themes to develop through the analysis instead of trying to 'fit' the data into a preexisting codebook. The following discussion provides an understanding of cycle planning in Tucson to help researchers improve future collaborations—both here and more broadly.

4. Results and discussion

While we interviewed various cycle planners from the university, county, city, and an advocate to represent a range of possible viewpoints, they shared similar perspectives on cycle planning. Following Fereday and Muir-Cochrane's (2006) inductive method, we noted critical

phrases such as safety, injuries, funding, partnership, collaboration, information sources, community feedback, and political support in the even semi-structured interviews. Further analysis of the interviews and coded phrases resulted in five main themes: 1) safety, funding, and political support; 2) community values; 3) information sharing and technical communication challenges; 4) professional networks and peer learning; and 5) collaborators. The participants provided valuable insights into how they conduct cycle planning in Tucson and the collaborations between governments and advocacy groups.

4.1 Safety, funding, and political support

Five planners and the advocate mentioned cycling safety as a top priority. One planner stated, "Safety is everybody's biggest concern. I think we know that speed is an issue and separation is an issue—physical separation [of cyclists from cars]. These are not always the easiest to address from a political standpoint, from a funding standpoint, or from a right-of-way and space standpoint." Another planner added, "Safety, followed by accessibility, equity, climate change. It is hard to address these factors when safety is such a huge concern." Part of reducing roadway fatalities is the political support to implement the required safety changes. Three planners and the advocate mentioned needing political support to create safer conditions.

Participants noted that issues such as safety get attention when an elected official champions them and provides the department with the impetus to act. These "political champions" often do not support car dependency, perhaps making active transportation a central component of their campaign, and are not afraid to lose some support over voting for cycling projects (Wilson and Mitra, 2020). The Tucson city council recently had two former members of the TPBAC, which may have played a role in the focus on cycle boulevards in recent tax propositions.

Participants also mentioned that power structures within the department, resulting from funding priorities based on political and social pressures, continue to support driving projects. One planner mentioned needing "additional leadership support, consistent and continued, when making difficult decisions that may be unpopular with some" regarding cycle planning. Politicians often step in when residents push back against cycle-focused projects. One planner shared, "The sort of culture pushback we get around taking parking spots and narrowing travel lanes. People feeling like they are getting their rights taken away." Robartes et al. (2021) also found community pushback as a significant barrier in Virginia, with residents concerned about a lack of parking or traffic impacts.

Interviewees also discussed funding, data analysis, and region size. Tucson's sprawling low-density development pattern complicates data analysis and funding projects with thousands of kilometers of roadways, making implementing many planned cycling projects difficult. All participants mentioned the difficulties in funding cycling projects. We see similar results in Virginia, where 57 jurisdictions (out of 94) cited funding as a significant barrier because investments in cycling are not a top issue (Robartes et al., 2021). Additionally, three planners and the advocate mentioned needing additional resources for further data analysis. One planner said, "Better data and data analysis would be helpful in showing planners: 1) where investments are most needed, and 2) how to best target new riders." Building better models to help predict cycling uptake on completed projects could be one avenue for researchers to help—particularly when revising transportation models that often neglect or downplay cycling (Aldred et al., 2019).

4.2 Community values

Four planners and the advocate discussed the importance of values within the community regarding cycle planning. Many residents are used to driving single-occupant vehicles for trips and expect infrastructure, planning, and funding to support this choice. Accelerating

the shift towards other forms of transportation within the community means increasing education and outreach. Pushing back against those residents against cycle projects also requires what Curtis and Low (2012) call "politically effective actors," or people within the community who "build broadly based advocacy coalitions to bring irresistible pressure on governments." These actors may come from existing groups, such as Living Streets Alliance (LSA) and Familias Unidas Ganando Accesibilidad (FUGA), or advocates on the TPBAC.

Notably, there may also be resistance to transportation and land-use projects from the Tucson community stemming from longstanding mistrust in government and gentrification. One planner explained the importance of recognizing this historical mistrust, "learning how to acknowledge and respect that and move forward [effectively]. Also, realizing it is not a one-size-fits-all for parts of our community, and there are many layers to that." Another planner offered a potential solution for mistrust to assist with cycle planning: "Having information coming from trusted neighborhood groups would be huge."

4.3 Information sharing and technical communication challenges

Several participants also reported that communicating and sharing information, internally and with the public, is challenging due to technical terms and knowledge barriers. Two planners and the advocate discussed technical jargon on cycling projects as a hindrance. The advocate shared, "It is very helpful if we [understand] the [National Association of City Transportation Officials] NACTO standards." While TPBAC members are generally knowledgeable about planning and design, a gap in knowledge and terminology—such as understanding design schematics and abbreviations—is evident for new members, which can hinder participation and feedback quality on upcoming projects. Onboarding tools that provide education on the committee structure and planning specific terms could lower this barrier to new members (Burlington City Clerk, 2021).

The barrier from jargon becomes more pronounced when engaging the community. A planner shared, "We don't even want to call them bike boulevards and [try to call] them biking and walking safety improvement projects because of the backlash we get just hearing bike boulevard. They're like, 'Oh I don't bike and why are you spending my money on this?'" Here, language is a barrier that undermines community and political support (Burby, 2003). However, explaining projects clearly and hosting open houses in non-traditional settings, such as a park on the weekends, can bolster understanding, attendance, and feedback (Spivak, 2019).

4.4 Information sources: professional networks and peer learning

Participants discussed solutions to issues through information sources and collaboration, ranging from professional groups to social media. One planner stated, "I look to a lot of other cities in terms of who is leading the way. I feel like it's Portland and Seattle who stand out." Five planners described the importance of peer exchanges on cycle planning, "The network (of peer cities) has been huge, and seeing what is possible has been important." The planners sought information from leading cycle cities in these examples. These answers demonstrate the regional diffusion of ideas and solutions (Shipan and Volden, 2008) and the need for evidence-based practice (Krizek, Forysth and Slotterback, 2009). Additionally, five planners identified NACTO as a source for design guidelines, even though these often differ from federal standards, and tried to implement these new designs when possible. Seeing other cities implementing NATCO designs and research on safety and performance metrics may encourage others to follow and drive a much-needed shift in federal design standards (Hess and Lae, 2014).

Five planners discussed collaboration with the University of Arizona on cycle planning research as desirable. One planner described the need for usable research, "Research from UA [University of Arizona] is helpful…if it is presented in a consumable way." One issue working with

university researchers is that applied research is discouraged for tenure and promotion in favor of articles that are often difficult to access regarding language and price, and usually another study is not needed (Button, 2005). Because many decision makers are time-poor, any collaboration must consider delivering a product concisely with ready-to-go solutions that speak to their issues or goals (Dabelko, 2005; Dilling and Lemos, 2011; Hurley, Lamker and Taylor, 2016). Peer exchanges and professional organizations such as NACTO and the Association of Pedestrian and Bicycle Professionals (APBP) are excellent avenues for researchers to present case studies. They are essential for cities without a university or strong advocacy group partners.

4.5 Non-government collaborators

Participants reported that collaboration on cycle projects ranged from other location governments to local advocacy groups (see Table 3 for all collaborators). Five planners mentioned reliance on the bicycle advisory committee and the public for concerns. One planner said, "I do rely a lot on the public and members of the Bicycle Advisory Committee (TPBAC) to bring us issues. We can't be everywhere." The advocate mentioned how the TPBAC could "provide that conduit between local government" and concerned residents. The advocate also noted that the TPBAC provides invaluable feedback to the city and county on projects and provides a direct forum for residents to have issues heard by decision-makers.

Four planners described the collaboration with local advocacy groups, such as Living Streets Alliance (LSA) and Familias Unidas Ganando Accesibilidad (FUGA). LSA spearheaded the Complete Streets Policy, adopted in 2019 (City of Tucson, 2020; LSA, 2019a), and coordinates the Cyclovia event twice a year, which attracts 40,000 people and generates roughly $1.2 million in economic activity (LSA, 2019b). FUGA is a group on the south side of Tucson and plays a vital role in increasing participation in planning projects, identifying areas of need, and increasing ridership. Collaborations with LSA and FUGA demonstrate how local knowledge from advocates on projects can complement expert knowledge from planners, resulting in cycle planning projects that better serve the community (Afzalan and Sanchez, 2017).

Five planners discussed collaboration with the University of Arizona as a partner for future outreach. University outreach organizations are critical in facilitating the co-production of knowledge between scientists, stakeholders, and decision-makers (D. B. Ferguson, Rice and Woodhouse, 2014; Guston et al., 2000). One planner mentioned that the "Drachman Institute [the research and outreach program for the College of Architecture, Planning and Landscape Architecture] could be super helpful—the potential is there through research, access to students, tools, etc. But, the community must be at the core of this approach and driving the needs."

Overall, centering the community in decision-making is critical, which the university can assist with (Burby, 2003). Doing so can identify quick wins to improve safety and ridership while building political support for larger projects and plans. The process for these best practices needs to be shared through peer networks via conference presentations, blogs, social media, or policy briefs (Oliver and Cairney, 2019). Lessons from Tucson can serve as a model for other locations by demonstrating collaboration between researchers and planners.

5. Conclusion

We examined the history of cycle planning in Tucson, Arizona, and utilized interviews with active transportation planners and an advocate to understand the decision-making process on current projects. All participants expressed concerns over safety, funding, and political support, three interrelated concerns. However, as with many cities, public funds are limited (Robartes et al., 2021), meaning planners work to identify projects that significantly impact safety.

One of the best ways to identify projects that address safety concerns with limited funding is by centering communities in the planning process (**Figure 4**). Increasing the number of riders means planners need to understand cycling's nuances in the city. Planners cannot be everywhere and rely on public feedback to identify issues. Empowering residents through education, advocacy groups, and focused outreach to low-income and marginalized communities is critical for learning what keeps them from riding. Increased participation in support of cycling investments could help reduce pushback as well. By strengthening relationships with outreach programs that work as a conduit between residents and the city, Tucson could become a model for others.

There are several ways to center a community:

1. Cities should create mobility master plans integrating best practices from peer cities for outreach and public participation. Move Tucson provides a model to follow for outreach by using door-to-door surveying in underrepresented neighborhoods and open houses at parks to help increase attendance and feedback. By focusing on mobility, which encompasses transportation, land use, zoning, and other lifestyle impacts, we can achieve a more holistic view of how transportation impacts everyday lives and start to reduce automobile dependency (Robartes et al., 2021; Tschoerner-Budde, 2020).
2. Researchers can partner with planners on bicycling projects to produce usable science, create outreach material to overcome knowledge barriers, and assist in data collection or analysis of public feedback. Critically, planners mentioned the usefulness of these partnerships but only if the community was a part of the process. Finally, we must consider the number of existing partnerships to ensure we are not overburdening staff.
3. Researchers should engage with peer professional planning networks before determining research questions to help define needs. Further, researchers should distribute summaries of projects and collaborations through these networks to help other regions implement successful public outreach, education, and involvement programs. Working within these networks can help keep research and tools more accessible than within traditional publications (Hurley, Lamker and Taylor, 2016).

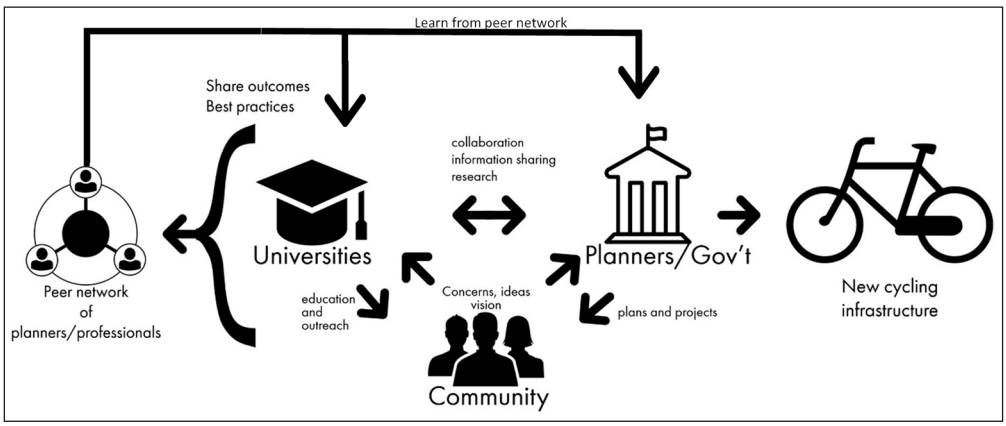

Figure 4: Best Practices Model: Centering communities in cycle planning by educating, empowering, listening to their concerns, and building projects that improve their safety.

Overall, understanding how cycle planners use research and information in their decision making can help researchers improve how we structure our work, collaborate, and share information. More attention and investments must be made in cycle planning to address climate change, reduce pollution, improve public health, and improve road safety. Facilitating a shift towards increasing ridership and embracing mobility planning requires researchers, outreach organizations, and advocates to collaborate on salient, credible, and relevant information for planners to utilize to implement the proper infrastructure. One participant summed up a goal of cycle planning, "At the end of the day, we're all working on getting people out of their cars."

Appendix A: Interview Questions

1. In your experience, what are the primary concerns about transportation planning and active transportation in Tucson?
2. Where do you get information about active transportation planning to help inform planning and policymaking? What type of information is most often used?
3. What specific planning or policy decisions does your department make that works to encourage active transportation?
4. What events or circumstances might increase planning efforts around active transportation planning?
5. What are the barriers to these actions?
6. What groups do you work with to design and implement policies and projects to encourage active transportation? To what degree do you collaborate with other government offices?
7. What would help you better plan for and implement active transportation policies and projects?

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IRB Approval

University of Arizona IRB: Study #1904499197

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Competing Interests

The corresponding author, Joseph Iuliano, serves on the Tucson-Pima County Bicycle Advisory Committee. The research reported may affect this citizen advisory organization, but there is no financial stake.

Dr Ladd Keith has no competing interests to declare.

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