INTERACTIVE COMMUNITY ENGAGEMENT TOOLS FOR PUBLIC TRANSPORT PLANNING

Made possible with support from:

Barr Foundation

Tools designed and built by:

Massachusetts Institute of Technology

MOBILITY FUTURES COLLABORATIVE

Changing Places
MIT Media Lab

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BUS RAPID TRANSIT ACROSS LATITUDES AND CULTURES	

Introductory presentation at a workshop


MIT researchers and Nuestra facilitators set up for a workshop

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INTRODUCTION

The development of transportation improvements in any city poses a range of challenges, including meaningfully involving relevant stakeholders. With many members of the public generally skeptical of government's ability to generate solutions that will work for them, transport agencies and community organizations are looking for better ways to engage each other and the general public in developing project ideas. One problem is that existing representational tools are not well suited for allowing diverse stakeholders to understand, evaluate, and provide feedback on the geographically distributed benefits and tradeoffs of potential transport decisions. These decisions range widely, from local pedestrian flows around public transport stations, to parking provision on streets, to corridor alignment and priority schemes that can affect regional connectivity.

In recent years, however, new cooperative planning tools have emerged, made possible by the rapidly growing availability of open-source data platforms and interactive computing technology. These technologies promise to facilitate the inclusion of local knowledge in a way that could transform public participation. Emerging web-based tools, for example, can speed data processing, spark new ways of representing and discussing projects, and improve interpretation among a broad spectrum of community members. With support from the Barr Foundation, our team set out to assess some of these possibilities.

Starting from the premise that meaningful public engagement is fundamental to doing transit right, we developed several interactive planning tools to see if they can enable inclusive and authentic dialogue. Open dialogue is a cornerstone of meaningful engagement and learning in collaborative planning settings. We designed the interactive tools to allow individuals to explore impacts and alternatives at the regional, neighborhood, and street scales. In partnership with Nuestra Comunidad, a local community development organization, the tools were deployed in a series of public workshops held in October 2015 in Boston's Roxbury neighborhood. These pilot workshops focused on the potential for implementing bus rapid transit (BRT). While the tools were tested using the case of BRT corridors in the Boston area, we believe they have applicability to planning for a broader range of transportation alternatives in a variety of settings.

Ultimately, we seek to usher in a new form of co-creative transportation planning,

whereby a range of stakeholders work together in problem-solving and solution co-designing. In the end, the project is not about BRT, per se. Instead, this project set out to examine whether new collaborative tools can encourage social learning among stakeholders. This report summarizes our findings.

Why Bus Rapid Transit?

Like many cities across the world, Boston faces the challenge of needing transit expansion to better serve current and future demand while struggling to operate and maintain the existing system. Improved bus service can certainly help. Examples of high quality, bus-based, surface-level public transit exist in places from Mexico City to Malmö (Sweden), Cleveland to Cape Town. But, effectively running high quality bus service on city streets can be difficult, as Boston's own Silver Line attests. The best examples include separated rights of way (i.e., dedicated bus lanes) and payment of fares prior to boarding at quality stations – an approach widely known as bus rapid transit (BRT). Despite its promise for Boston and growth worldwide, BRT remains controversial. Operating on surface streets can pose salient and difficult tradeoffs in allocating limited space; exclusive bus lanes often require the removal of an existing car travel lane or parking, and they have a greater impact on the pedestrian environment than underground transit. In addition, the association of BRT with the "second class" service provided by typical buses (slow, unreliable, with long, uncomfortable waits and rides) pervades the mindset of the public.

Believing that BRT has a potential worth serious consideration in Boston, in 2013 the Barr Foundation convened the Greater Boston BRT Study Group , which consisted of individuals with deep roots across Greater Boston and expertise in transportation, development, community and environment. The study group worked together with the nonprofit Institute for Transportation & Development Policy (ITDP) to analyze a number of potential corridors for BRT in the metropolitan area. The findings were released in a 2015 report titled Better Rapid Transit for Greater Boston: The Potential for Gold Standard Bus Rapid Transit across the Metropolitan Area, which identified five corridors with particular promise for BRT implementation.

Why Roxbury?

Roxbury was selected as the community of focus for the pilot workshops for a number of reasons. First, Roxbury has a history of being underserved from a transpor-

JUN 2015

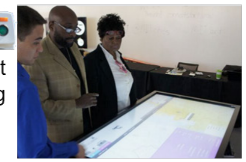
Beta test with stakeholder leaders

AUG 2015

Boston youth build LEGO model

SEP 2015

Facilitator input and training



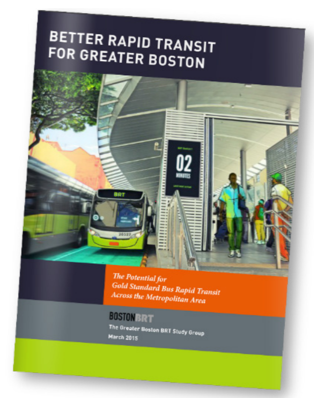
OCT 2015

Six public workshops

MAR 2016

Community follow-up

Project timeline



Greater Boston Bus Rapid Transit Study Report

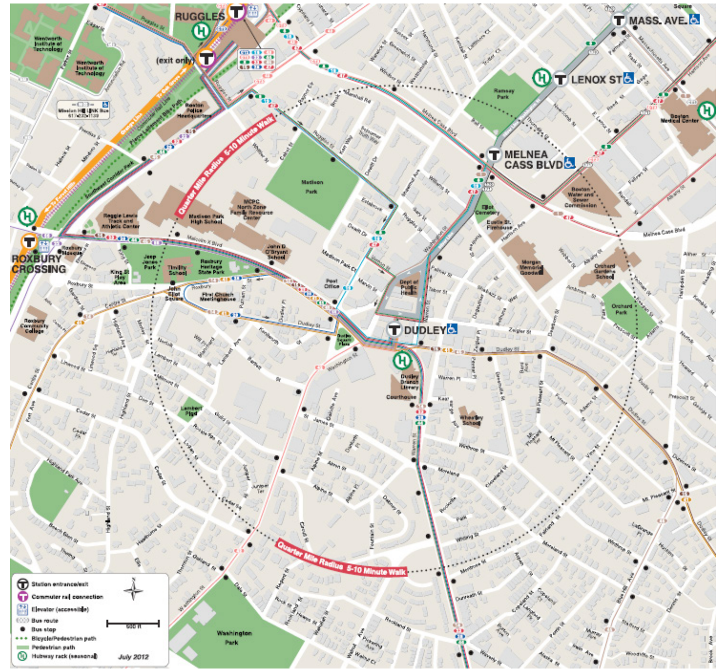
tation equity perspective. For example, the 2012 Roxbury-Dorchester-Mattapan Transit Needs Study showed how many neighborhoods in the area, beyond a half-mile of the Orange or Red Line stations, suffer from low-quality transit service. The area depends heavily on bus service; five of the MBTA's seven highest ridership bus routes operate primarily within these neighborhoods. Six of the MBTA's fifteen "Key Bus Routes" – identified due to their high ridership – provide service in Roxbury, Dorchester, or Mattapan. While many of these routes run at relatively high frequency, they suffer from a variety of problems, including poor reliability, slow travel speeds, overcrowding, and a lack of customer amenities.

In addition, three of the five potential corridors proposed in the BRT Study Group report converge at the Dudley Square Station, making Roxbury a desirable community to engage community stakeholders in the evaluation of BRT potential. Finally, the Bolling Building and the Roxbury Innovation Center, directly adjacent to Dudley Station, opened in the fall of 2015, providing an opportune venue to pilot innovative public engagement technologies.

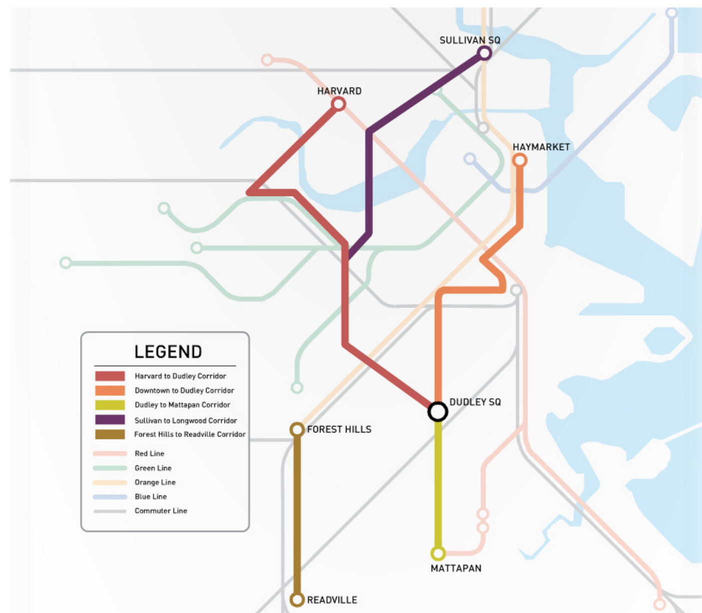
Research Objectives and Approach

Our goal in the workshops was to examine whether collaborative use of interactive planning tools might encourage social learning in public engagement workshops. We expected that individual participants might learn by interacting with the tools themselves, which would allow them to relate to different transit options based on personal experiences and specific relationships to place. We also expected the tools might support group-based interactions and deliberations, enabled by rapid computation and quick and easy comparison of alternatives, such as different types of bus stops. Overall, we anticipated that using the interactive tools in workshops would support social learning by enhancing understandability, discussion, teamwork, credibility, and imagination. Our ultimate objective was to assess the potential for these tools to increase communications among stakeholders with varying degrees of technical expertise so that, for example, "technical experts" (such as transportation system modelers) can learn from "local experts" (such as community residents), and vice versa, in an ongoing and iterative way.

To try to see whether the workshops fulfilled our expectations, we surveyed participants before and after each workshop and observed interactions during each. In addition, videos of participant interactions were recorded, allowing for the anonymized cataloging of individual and group interactions.[1] In the end, the findings from this



Dudley Square, Roxbury



Five potential BRT corridors identified by the Boston BRT Study Group analysis should be viewed as suggestive. Assessing the impacts of interactive group activities, where openness and local relevance are fundamental, is complex and difficult. The approach itself evolved iteratively over time. We do not know how much the participants actually reflect the population of Greater Boston, at large, much less people from elsewhere. Nonetheless, we hope that the findings, and the approaches used to "find" them, provide some support in the ongoing efforts to improve the way communities design, plan, and build transportation systems.

Partners

This project brought together two groups within MIT's School of Architecture and Planning: the Department of Urban Studies and Planning (DUSP) and the MIT Media Lab. More broadly, the effort entailed a much larger group of individuals and organizations, in the effort to pull together two seemingly disparate research areas — transportation planning and interactive design — to help solve problems of urban mobility in underserved communities. Facilitators for the workshops included several members from Nuestra Comunidad. Funding for the project was provided by the Barr foundation; the workshop and exhibition space was provided in partnership with the Roxbury Innovation Center.

Workshop in progress with tools and scoreboard in the background

Mobility Futures Collaborative: A research initiative within MIT's Department of Urban Studies and Planning, the Mobility Futures Collaborative focuses on collaborative approaches, leveraging various analog and digital data collection and analysis tools, to mobilize a collective intelligence towards improved mobility conditions in a range of contexts around the world. We aim to translate the knowledge gained through these diverse experiences into lasting place-based solutions.

Changing Places: The Media Lab's Changing Places research group focuses on developing fundamentally new strategies for creating places where people live and work, and the mobility systems that connect these places, in order to meet the profound challenges of the future. The Lab is committed to looking beyond the obvious to ask the questions not yet asked – the answers to which could radically improve the way people live.

Nuestra Comunidad: Nuestra Comunidad Community Development Corporation is devoted to building the wealth and enhancing the physical, economic, and social well-being of Roxbury and other underserved populations in greater Boston through a community-driven process that promotes self-sufficiency and neighborhood revitalization. Nuestra prides itself on engaging community and developing neighborhood leaders.

Barr Foundation: The mission of the Barr Foundation is to invest in human, natural, and cultural potential, serving as thoughtful stewards and catalysts. Based in Boston, Barr focuses regionally with targeted national engagement. In partnership with nonprofits, foundations, the public sector, and civic and business leaders, the Foundation works to elevate the arts, advance solutions for climate change, and expand educational opportunity. A core component of Barr's climate program is mobility and the challenge of spurring "smarter travel and smarter places" by modernizing our transportation system and accelerating development of low-carbon communities.

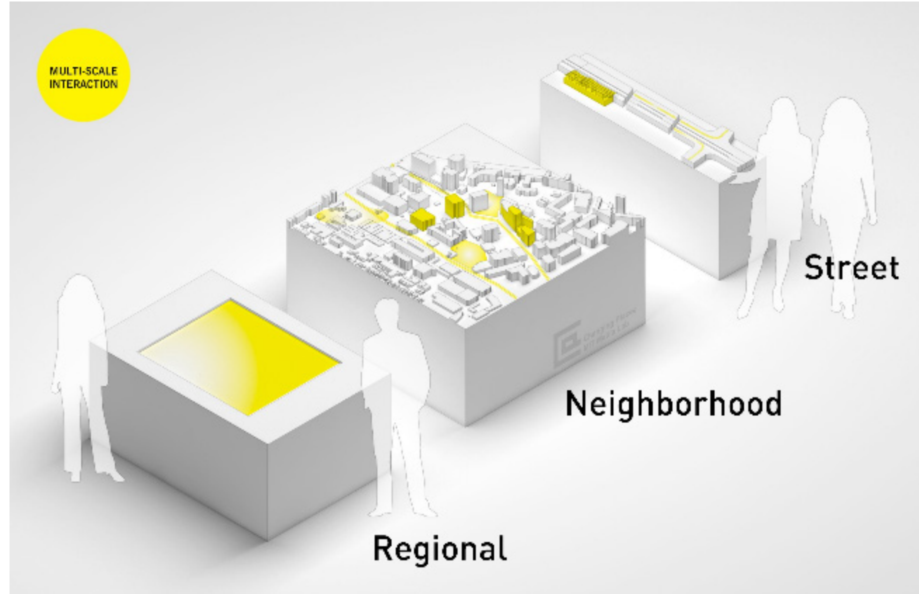
THE TOOLS

Open data, and related work to drive open planning through open-source software, inspired and enabled the interactive and tangible tools used in the project. The tools were designed to provide users a sense of the possible impacts of transit corridor implementation at three scales: the region, the neighborhood and the street. The region was represented through CoAXs, a web-based interface, presented on a large touchscreen that allowed users to explore transit system performance region-wide and how changes in the transit system, such as the addition of BRT corridors, might affect this performance. The neighborhood and street scales were represented with CityScope, an interactive platform that utilizes physical models (built from LEGO bricks) and computer projections. CityScope provides a tangible, intuitive, and easy-to-use way for users to examine how different corridor types might perform in a neighborhood, or how different street elements (such as bus station types or bike lanes in lieu of parking) might impact the streetscape and corridor performance.

The workshops were designed to use these tools in concert, aiming to provide participants with a common, relatable experience of how transportation changes impact the system from the street to the region. Group-based discussions of concepts and tradeoffs were intended to facilitate a co-creative transportation planning process, enabled through mutual learning. Towards this end, the workshops attempted to provide a setting for dialogue based on common information and shared interactions and the possibility to stimulate new understanding and new ideas.

CityScope: Neighborhood and Street Scales

CityScope is an urban observatory, decision support system, and an urban intervention simulator developed by the City Science Initiative at the MIT Media Lab. CityScope utilizes 3D physical scale models (built out of LEGO bricks) and a series of projectors mounted directly above the models that project digital information – both static and dynamic – onto the physical model. When acting as an urban observatory, CityScope helps to illustrate urban flows, like vehicular and pedestrian traffic, energy consumption in buildings, wind, aggregate sunlight, shadows cast on buildings, as well as geo-located social media (like Twitter). Users interact with the tool by moving bricks to alter urban design and/or land uses; the urban flow implications



Each tool at a different spatial scale

CityScope LEGO model of the Roxbury neighborhood around Dudley Square of those changes are calculated via simulation. Those implications, like pedestrian flows, can then be visualized, projected back on the model, and summarized in other displays. CityScope is designed to provide stakeholders – across a range of expertise and perspectives – with a collaboration support platform to move towards more informed, evidence-based group decisions. For the purposes of this project, we adapted the CityScope tool to be able to display predicted traffic performance (of buses and cars), based on the outputs of SUMO, an open source traffic modeling software which we applied to the Boston area.

The workshops had two separate CityScope models: one representing the Roxbury neighborhood around Dudley Square; and a second representing a generic street segment and intersection. For the neighborhood model, users could select from different LEGO pieces representing different types of bus stations (e.g., regular, pre-pay boarding) and activate different corridor alignments. Based on the user selections, traffic simulations pre-run in SUMO for the specific selections were used to generate summary statistics, showing, for example, the bus speed changes or changes in estimated emissions levels. These statistics were displayed on an accompanying large screen. The neighborhood scale LEGO model was constructed by Boston high school students participating in the summer 2015 MLK Scholars Program.

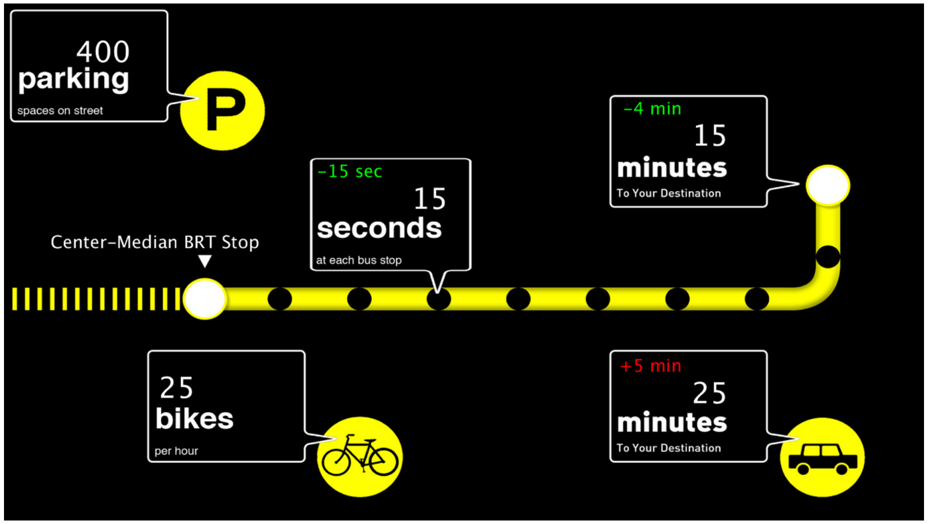
For the street segment/intersection CityScope model, users had the choice of different placements of bus lanes (curb, median) and different bus stop types and could also add/remove bike lanes and on-street parking. Similar to the neighborhood scale model, the changes in the street scale generated summary statistics, based on pre-run SUMO simulations, which were displayed on an accompanying large screen; vehicle movements were also projected on the physical model.

CoAXs: Regional Scale

Short for Co-Creative Accessibility-Based Stakeholder Engagement, CoAXs is an open-source, web-based mapping and visualization tool intended to give users a way to evaluate the benefits and costs of public transport projects. CoAXs, developed by MIT's Mobility Futures Collaborative, has two modules: the regional accessibility module, for mapping public transport opportunity space across a given region; and the modification module, allowing users to activate and modify corridors in a region and then display the results in the accessibility module.

CoAXs is a user interface built upon Conveyal Analyst, an open-source online tool

CityScope LEGO model of a street segment and intersection

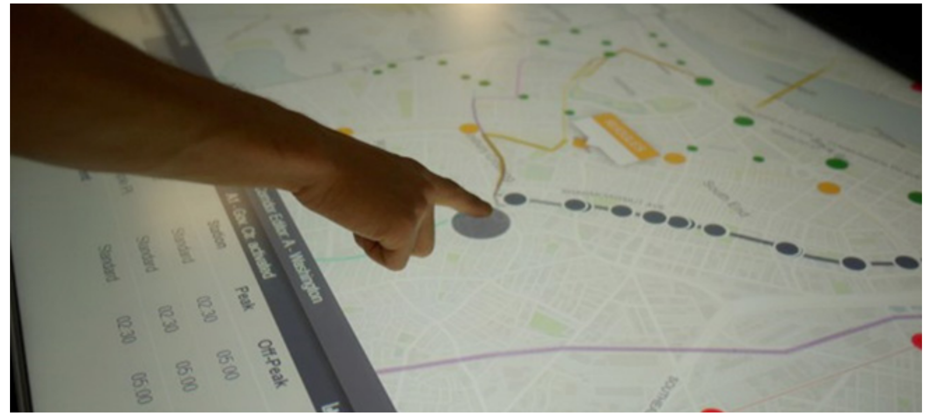


CityScope scorecard showing the impacts of adding BRT to the street-scale segment developed for professional planners to analyze land use and transportation scenarios. The software uses various open data sources, including [GTFS](), which is the format in which transit agencies publish their networks and schedules for web-based mapping (such as for the transit directions that appear in Google Maps). Road and pedestrian network data come from [OpenStreetMap](). In our application, locations of possible interest (homes, workplaces) come from the [EPA Smart Location Database]() (aggregated to the Census block-group level).

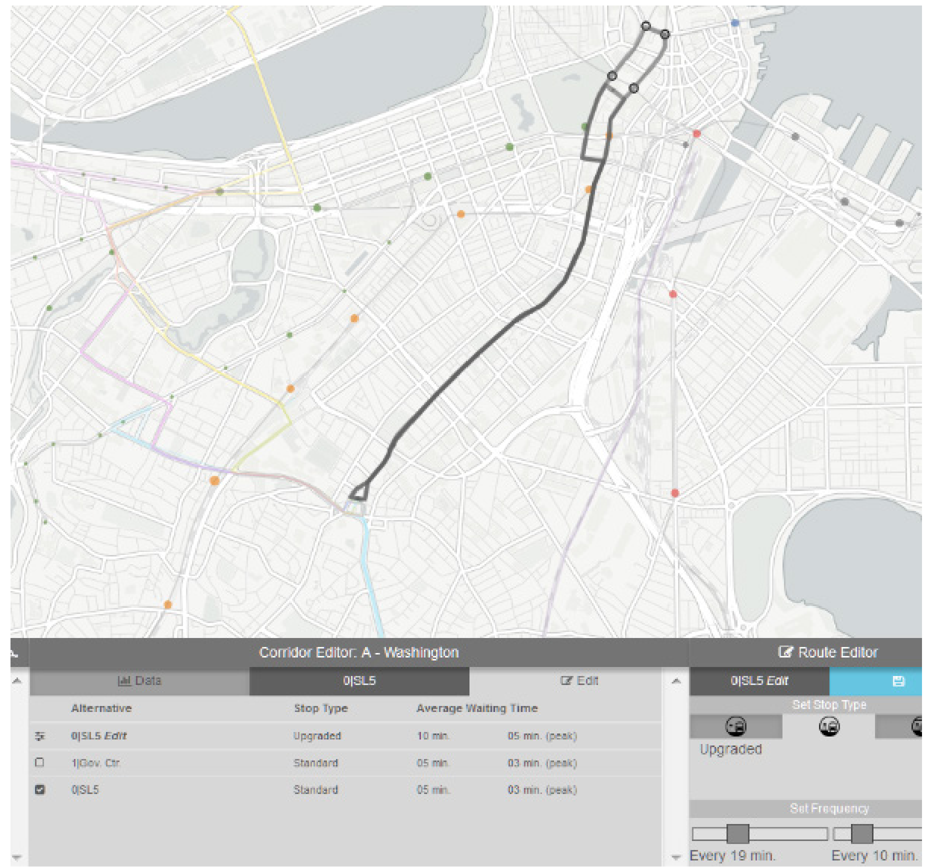
CoAXs can operate in a standard web browser like Firefox. In the workshops, we displayed it on a large, horizontally mounted touchscreen, to allow groups of people to interact with the tool together. The core of the CoAXs accessibility module consists of software and data which enable the rapid calculation (in about 6 seconds) of estimated public transport times from a chosen point on the map to all other points in the region. For example, if a user selects their house on the map, the software will use the road, pedestrian, and transit networks to calculate estimated transit times to all other parts of Greater Boston. The results displayed to the user on the map and in different summary figures and tables include travel time maps (areas reachable by transit within different time windows) and user-specified destination types (such as number of jobs by certain industries) available within different amounts of transit travel time. On the touchscreen, users can change assumptions about transit service, such as activating or de-activating routes and changing route frequencies.

CoAXs' second module allows users to modify the service characteristics of transit corridors by, for example, adding buses to a route, adding new stops, and/or changing the types of stops (such as pre-pay boarding at the bus stop). Users can also create different combinations of corridors and save them as scenarios. The Corridor Editor provides direct feedback to users including estimated costs of the options selected as well as estimated corridor performance according to key transit service indicators. In addition, this module feeds back to the regional accessibility module, to allow users to see how the new corridors and/or corridor changes impact the range of opportunities (such as jobs) available by transit across the metropolitan area.

As indicated in its name, CoAXs builds on the basic idea that regional accessibility is an important measure of transport system performance. In this context, accessibility refers to the potential for individuals (in a given place) to reach destinations (such as jobs of a certain type) by specific types of transportation. Rather than only reporting "travel time savings" for individual trips of interest, which is typical in transportation systems analysis, CoAXs can report, both visually and in summary statistics, measures of accessibility which may be more meaningful to users and encourage



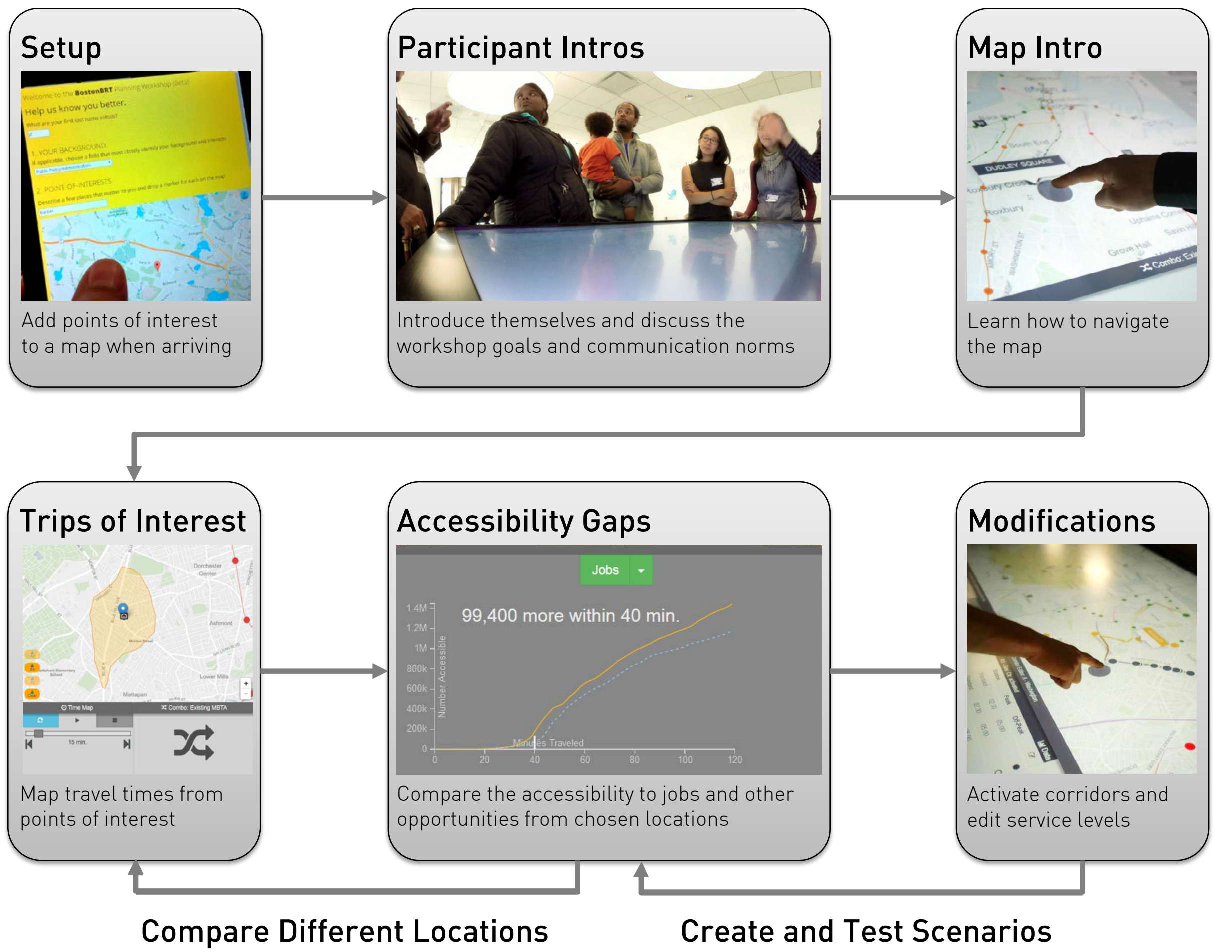
CoAXs interactive touchscreen



CoAXs Module 2: Sketch-Planning Corridor Editor, showing a change to the frequency of a new route.

thinking about broader potential impacts. The intention is to allow a user to examine accessibility in a number of ways. For example, from a given location, a user could estimate how many health care jobs could be accessed by transit for her household within, say, 25 minutes – across the entirety of the metropolitan area. After selecting a scenario of improvements, the user could then see how those changes affect the number of health care jobs that could be reached, and their locations, within the same 25 minutes.

The main promise of CoAXs lies in its potential to connect users' everyday experiences (trips between points of interest) with map-based representations of those same places and the possibilities for movement through and to them. Essentially, the tool seeks to link accessibility maps and measures with various common travel patterns people themselves deem important. Aiming to allow intuitive comparisons between different possible trip origins and destinations, based on estimated transit system performance, CoAXs intends to support group dialogue by making the abstract more familiar.



Sequence of participants' interactions with the regional-scale tool, CoAXs

WORKSHOP DESIGN

We carried out six facilitated workshops over the course of four days in October, 2015. Each workshop lasted approximately two hours and followed the same basic agenda and approach. We held a follow-up debrief at the same venue in March 2016 to share our preliminary findings from the October workshops with the participants and invite their inputs and reactions.

Venue

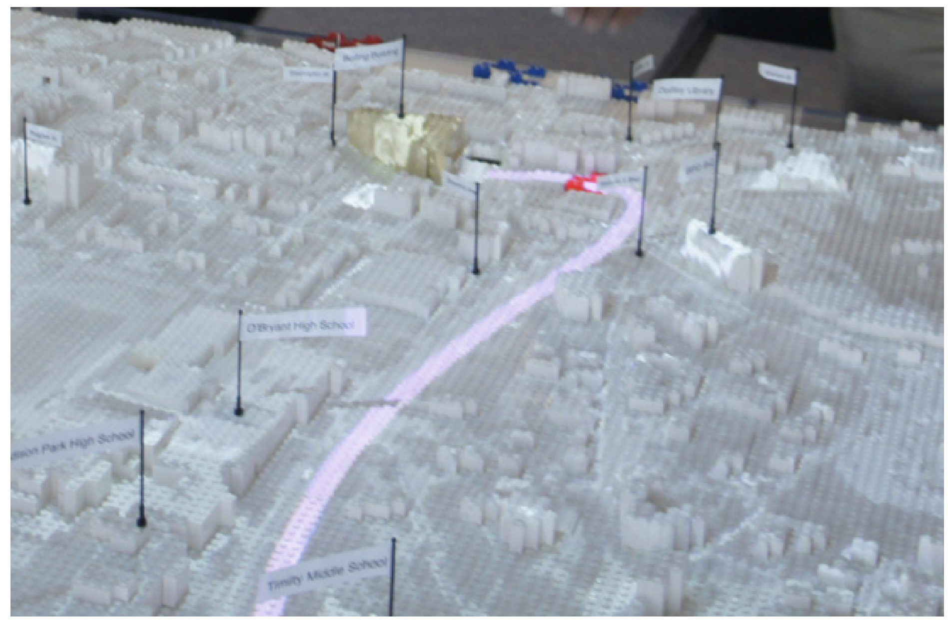
The Roxbury Innovation Center (RIC), located in the newly opened Bolling Municipal Building, was the venue for the workshops. The Bolling Building is located in Dudley Square, the heart of the Roxbury neighborhood, and stands directly adjacent to Dudley Station, one of the Boston area's most important public transportation hubs. The workshop space provided ample room for participants to engage with the tools as well as gather together to debrief.

Workshops were held in the new Roxbury Innovation Center location adajacent to Dudley Station.

Facilitators

Nuestra Comunidad played a major role in the workshops, contributing to the workshop design and serving as facilitators. This relationship resulted in mutual learning among the academics and the community partners. For example, training sessions were held with the facilitators prior to the workshops. These sessions not only gave facilitators familiarity with the tools, but also provided valuable feedback on usability. In one of the trainings, for instance, facilitators recommended including "flags" for key landmarks to help participants better orient themselves. In addition, many of the facilitators had taken part in administering Barr Foundation sponsored surveys of attitudes toward BRT, giving them unique insights into local perceptions.

At another level, having community members as lead facilitators was an attempt to make the entire workshop experience peer-based and inclusive. Community facilitators led the discussions at each tool station, aiming to reduce participants' potential perception that control of the technology, and therefore the analyses, is in the hands of the tool developers. An open, interactive, peer-led process intended to empower people to play an active role in the planning exercise. Facilitators had template scripts for guidance but responded flexibly to different audiences as they saw fit.



Location identifier flags were added at the suggestion of the Nuestra facilitators.

Agenda

Each workshop followed the same agenda:

Registration. As participants entered, they were asked to register, which included reading and signing a form indicating consent to participate in the research and filling out a pre-workshop questionnaire. Participants used a tablet to map points of interest to them (e.g. home, work, school, recreation, and healthcare locations) which were saved for later use in the workshop with CoAXs. Participants were then permitted to wander among the tools to familiarize themselves with the space and each tool.

Orientation (30 minutes). Participants were first given an opportunity to introduce themselves to each other. One of the lead researchers then presented an overview of transportation issues facing Boston and the neighborhood, explained the purpose of the workshops, and introduced the team members and key elements of Bus Rapid Transit systems.

Exploration using BRT Tools. Participants were divided into three groups. Each group started at a particular station and then rotated to another station after 20 minutes. A member of the research team and a facilitator from Nuestra Comunidad was at each station.

- First station (20 minutes)
- Second station (20 minutes)
- Third station (20 minutes)

Debrief discussion (30 minutes). At the end of each workshop, all participants gathered for a facilitated discussion of the experience. Participants sat in a circle, with the format designed to be open and informal. One of the researchers facilitated each of these sessions with open-ended questions to the participants. Attempts were made to engage each of the participants during this session.

Post-workshop survey. Before leaving, participants were asked to fill out a post-workshop questionnaire, which included space for open-ended feedback.

Data collection

To assess the workshops, the tools, and their impacts on participants, we collected

A workshop in progress

Posters were available around the room providing information about key elements of Bus Rapid Transit data using: (1) pre- and post-workshop written surveys, (2) verbal feedback provided during the debrief session, and (3) observations and video/audio recordings.

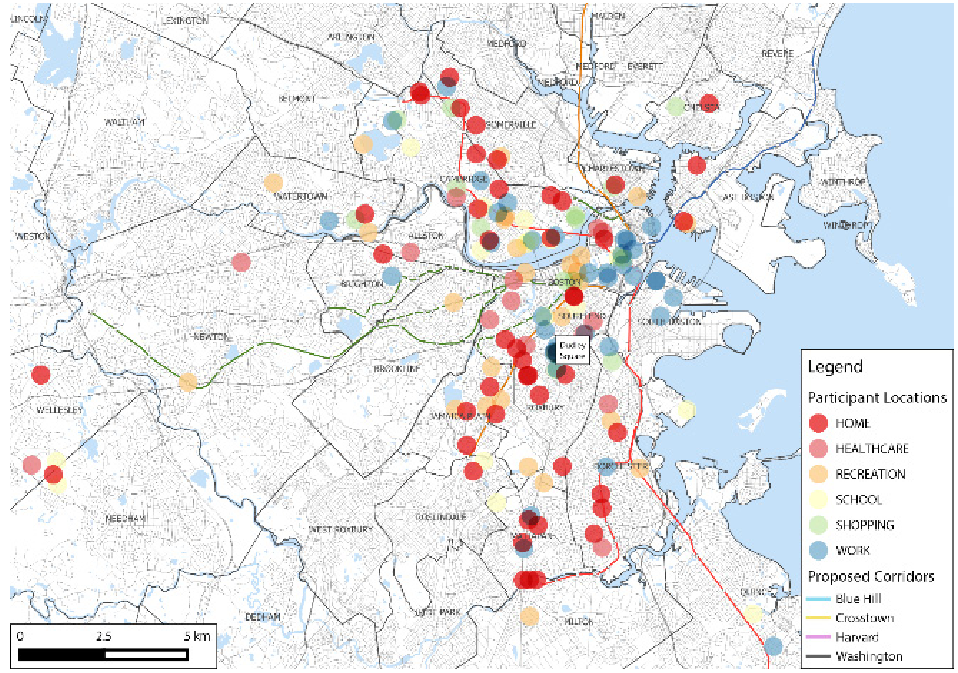
All participants were asked to complete pre- and post-workshop questionnaires. The pre-workshop survey collected basic demographics, and measures of previous familiarity with visual representations of information, public meetings, and BRT. The post-workshop survey consisted of two sections: one asked questions about the overall experience of the workshop, and the second asked a series of identical questions about each of the three stations. The questionnaires can be found in the appendix. Finally, we collected input and feedback during the informal discussions with participants during the March 2016 follow-up workshop.

Participant characteristics

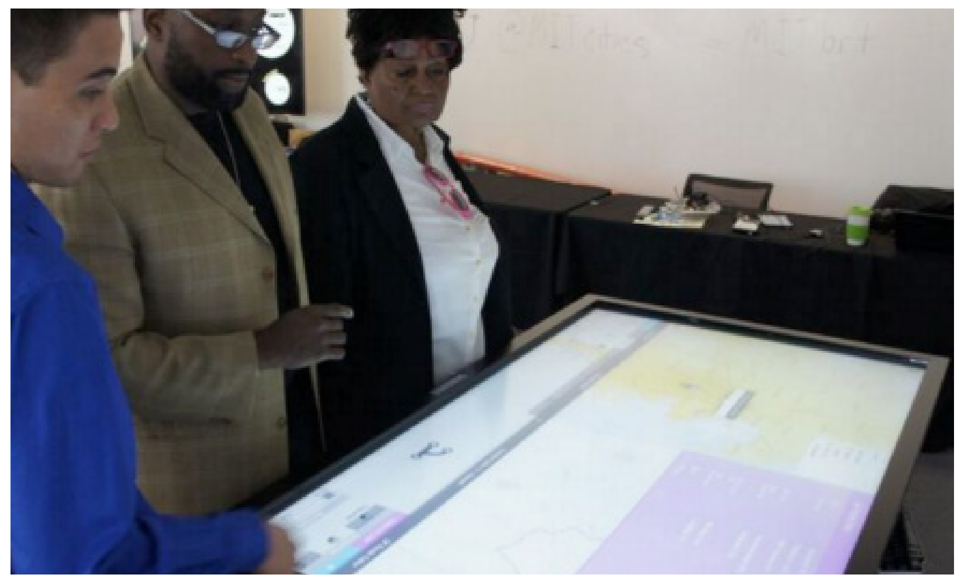
Over the six workshops a total of 51 individuals participated from a range of advocacy, policy, neighborhood, and professional organizations. About 10 percent of participants chose not to respond to the survey or did not complete enough of the questionnaire for it to be useful for analysis.

Workshop	Number of participants	Number of valid responses (completed pre- and post-survey)
1	7	6
2	10	9
3	12	12
4	5	3
5	10	10
6	7	5
	TOTAL = 51	TOTAL = 45

Of the participants, 13 were classified as transportation, policy, or planning experts, and 15 reported attending no public planning meetings within the preceding year. Participants ranged in age from under 21 to over 75, although most participants

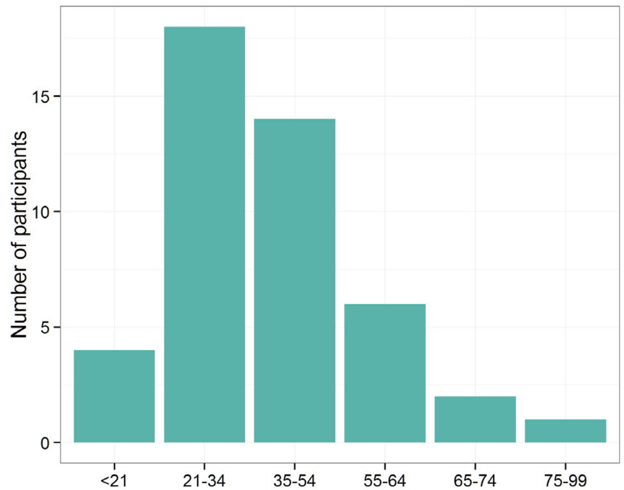


Workshop participants live in a variety of areas within the Metropolitan Boston area as shown with red dots.



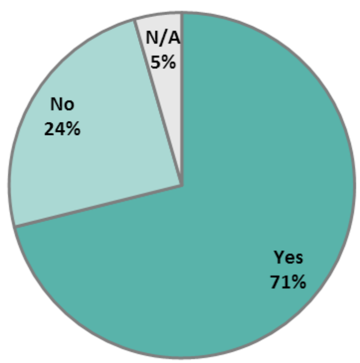
CoAXs facilitators during the pre-workshop sessions

were between 21 and 54 years old. Participants reported having a diverse range of professions, with about 20% identifying as an engineer, architect, planner, transportation professional, or consultant and 10% identifying as a student. Almost three quarters answered yes to the question, "Are you familiar with the concept of bus rapid transit (BRT)?"



Age distribution of participants (N=45)

Participants working with the CoAXs tool during a workshop



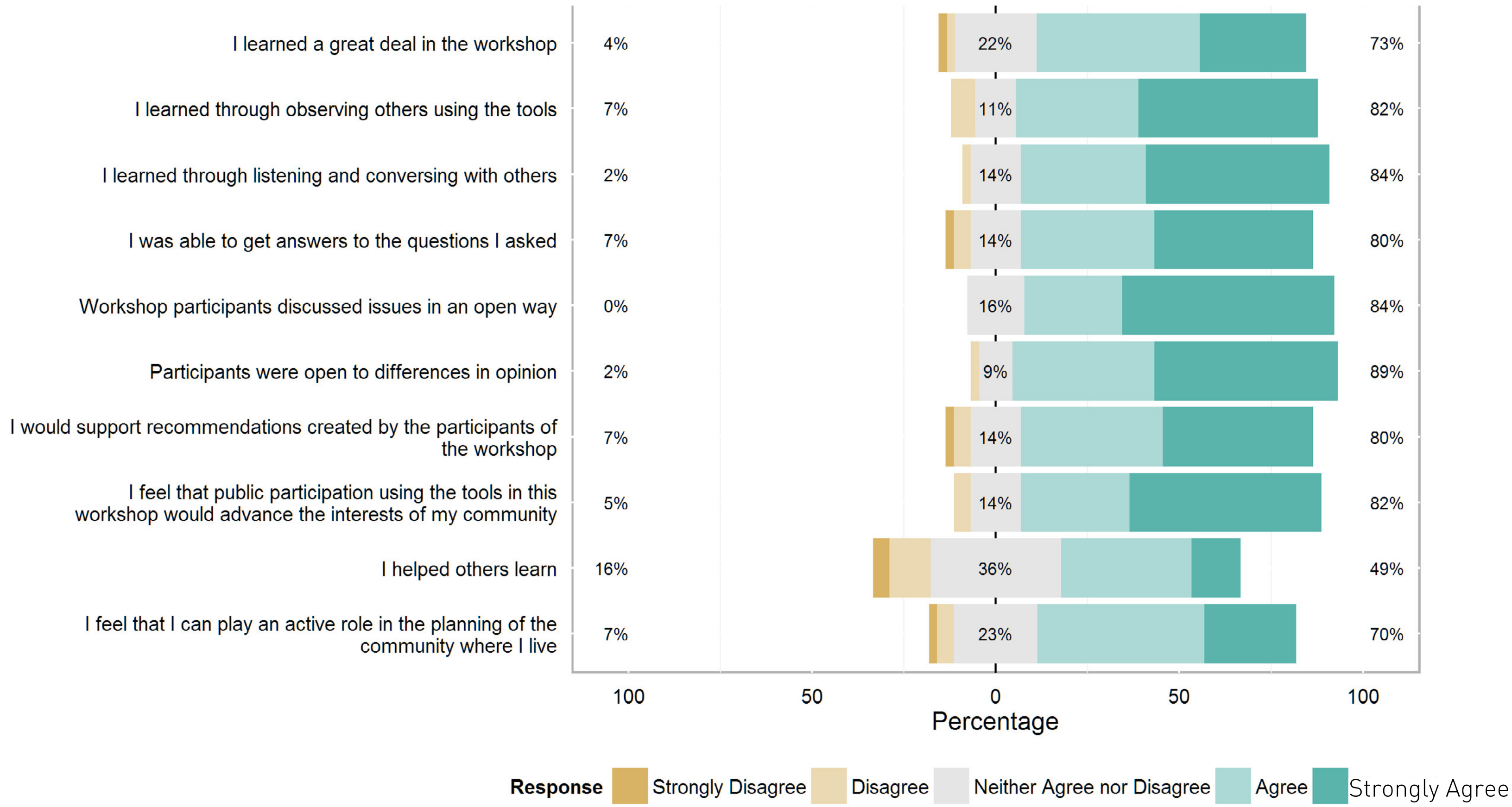
Percent of participants who indicated some familiarity with BRT

FINDINGS

We used a mix of methods to analyze the workshops and the tools in an attempt to understand whether they encouraged social learning, changed perspectives regarding transportation options, and increased communication across a range of stakeholder types. This section reports on participants' overall opinions regarding the workshops, participants' reported or estimated learning in various dimensions, indicators of potential change in users' behaviors and attitudes, and the comparative performance of the three tools used in the workshops.

Overall impressions

Overall, respondents were positive about the workshop. The two questions that generated the most neutral or negative responses had to do with the role of the individual: "I helped others learn" and "I feel that I can play an active role in the community where I live." Examining survey responses by workshop (Appendix, page 26), show modest differences.



Post-workshop survey responses (n=45)

Overall reported learning

We assessed the potential impacts of the use of the tools in terms of two basic ways individuals can learn from their experiences: "Single-loop" learning and "double-loop" learning. Single-loop learning refers to the typical learning style where individuals use the results from some action to inform what they do later. Double loop learning goes further, feeding back to their overall goals and objectives; in double loop learning individuals use the results from some action to inform why they do what they do. We assess learning at the overall workshop level, rather than attempting to isolate what participants learned from individual tools or other workshop elements (such as the introduction, unstructured interactions with other participants, etc.).

We measure single loop learning effects via a straightforward question, widely used in higher education research and course evaluations:

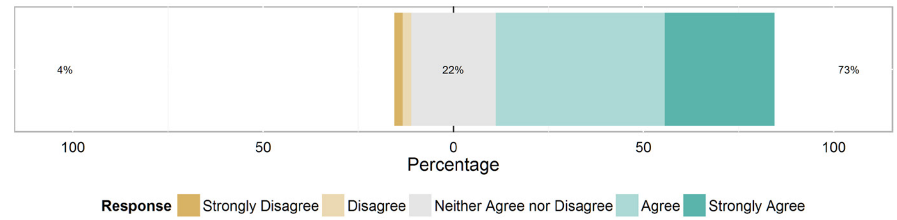
- I learned a great deal in the workshop.

Almost three quarters of participants responded positively to this question on reported learning.

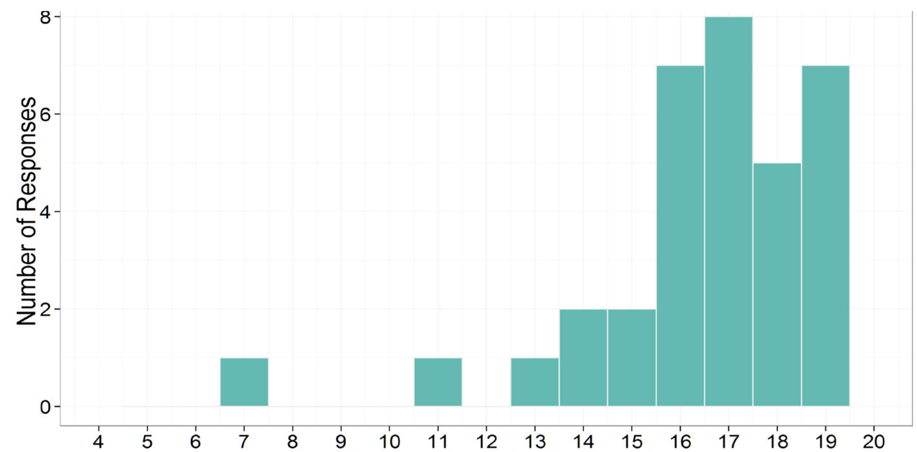
Four survey questions were used together to provide evidence of double-loop learning. Each of these questions aimed to represent a particular characteristic [in brackets] important to enabling double-loop learning:

- I was able to get answers to the questions I asked.
  [Evidence seeking]
- Workshop participants discussed issues in an open way.
  [Valid information]
- Participants were open to differences in opinion.
  [Free and informed choice]
- I would support recommendations created by the participants of the workshop.
  [Internal commitment to choice]

Individuals' responses to these questions suggested that they can be taken together to represent an overall index of double-loop learning[2]. When questionnaires had valid responses for all four questions, they were summed to create an "open dialogue index" which aims to measure the potential for eventual double loop learning, with



Overall responses to "I learned a great deal in the workshop"



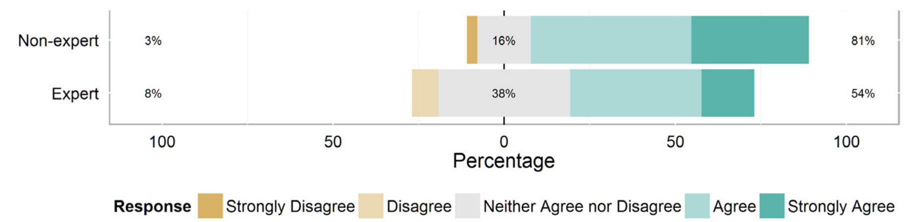
Open Dialogue index (n=42)

possible values ranging from 4 to 20. Taken together, the answers to these questions suggest a positive impact on potential double-loop learning, with more than half of the respondents having an index value of 16 or more.

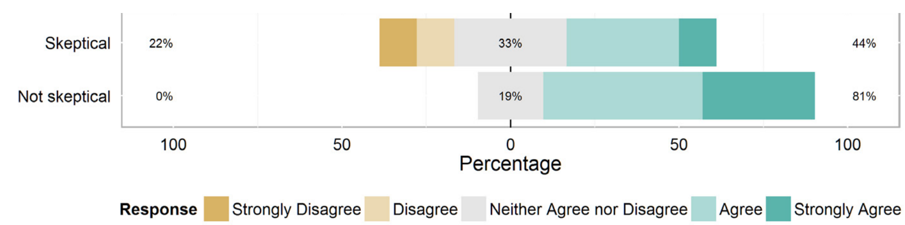
Learning by different types of participants: expert vs. non-expert and skeptic vs. non-skeptic

Participants bring with them different predispositions, influenced by current knowledge and experiences, which may influence their amount of learning. We examined reported learning based on two crude dimensions related to individuals' past planning experience: (1) whether one was a transportation planning "expert" and (2) whether one was a "skeptic" about public planning meetings. Neither of these distinctions was asked explicitly on the entry survey. Instead, we identified transportation/ policy/ planning experts based on participants' open-ended descriptions of their professions. Thirteen participants (about one third) were classified as "experts", interpreted as coming with existing transportation planning/engineering professional experience; and 32 as "non-experts," interpreted as coming from another discipline or life experience. In general, non-experts reported more single-loop learning.

To categorize a participant as a "skeptic," we used participants' responses to how many planning meetings they had attended in the preceding year, and the number of these meetings at which they learned something about the project being planned. The difference between the former and the latter represented a measure of skepticism about learning in planning meetings. Participants who reported attending more total meetings than meetings at which they actually learned something were classified as skeptics. About nine (about 20%) were classified as "skeptics". Non-skeptics reported higher levels of single-loop learning in the workshops, and several skeptics reported that they did not learn anything in the workshops.



"I learned a great deal in the workshop" - experts v. non-experts



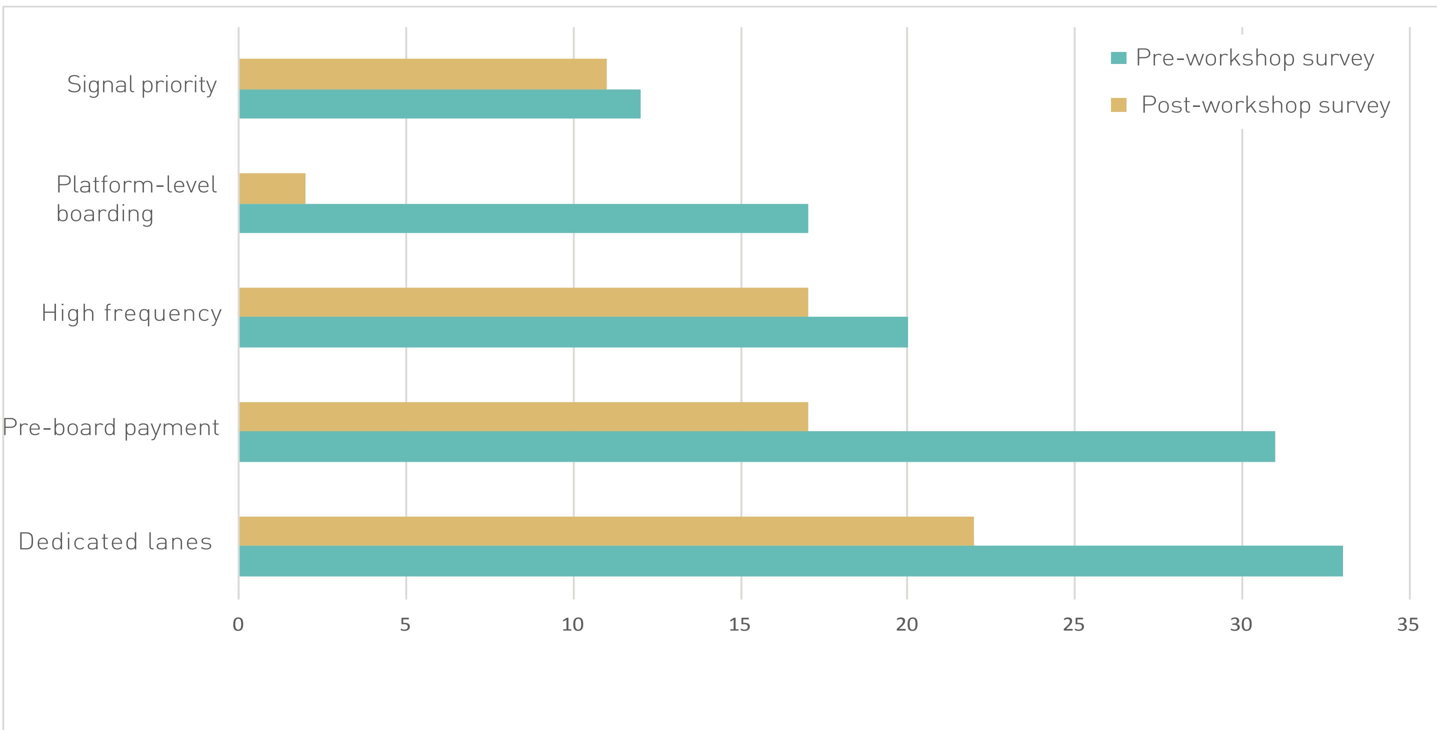
"I learned a great deal in the workshop" - skeptics v. non-skeptics

Learning about BRT

Since the workshops were organized around the topic of BRT, we also attempted to understand learning outcomes specific to BRT. Towards this end, we used participants' responses to a question asking them, open-endedly, to identify several elements (up to four) of BRT in both the pre- and post-workshop surveys. From the post-workshop survey, over 80% of the BRT elements identified concentrated among 5 characteristics of BRT:

- Traffic signal priority,
- Platform-level boarding,
- High frequency service,
- Off-board fare collection, and
- Dedicated bus lanes.

Of these, platform-level boarding, off-board fare collection and dedicated bus lanes experienced the largest increases in the number of times being mentioned by participants in the post-workshop survey compared to the pre-workshop survey. The two station-specific characteristics – platform-level boarding and pre-board payment – increased the most. This provides some evidence of "learning" about BRT, particularly the "basic" physical elements associated with successful BRT.



BRT elements mentioned in pre and post-workshop surveys

We also devised a metric attempting to measure overall learning about BRT, using ITDP's [BRT Standard Scorecard] as a reference. The BRT Standard provides an evaluation tool for "scoring" BRT corridors based on "best practice" of BRT around the world. The BRT Standard Scorecard contains 30+ individual corridor design elements that improve operations and service quality. Each design element has a maximum value of attainable points and the sum of these points across all elements for a specific BRT corridor produces the "score" for a corridor. The scoring system can result in one of four levels of BRT "certification": "Gold Standard," "Silver Standard," "Bronze Standard," or "Basic."

We used the ITDP BRT Standard Scorecard to develop a BRT knowledge index for each respondent before and after the workshop. Basically, we use the Scorecard's maximum possible score for each BRT element to weight those BRT elements identified by each respondent in the pre- and post-workshop surveys. For example, if a respondent listed "Off board fare collection, designated bus lane, median busway, signal priority" in the post-workshop questionnaire, the individual's post-workshop BRT knowledge would be calculated as 8 (pre-board payment) + 8 (dedicated lane) + 8 (median alignment) + 7 (intersection treatment) = 31. Any difference when comparing total scores between the pre- and post-workshop surveys serves as a proxy indicator for learning outcome. Using this approach suggests some BRT "learning" took place: participants' scores increased by an average of nearly 7 points per person, with over 60% of participants' responses indicating some amount of BRT knowledge gain.

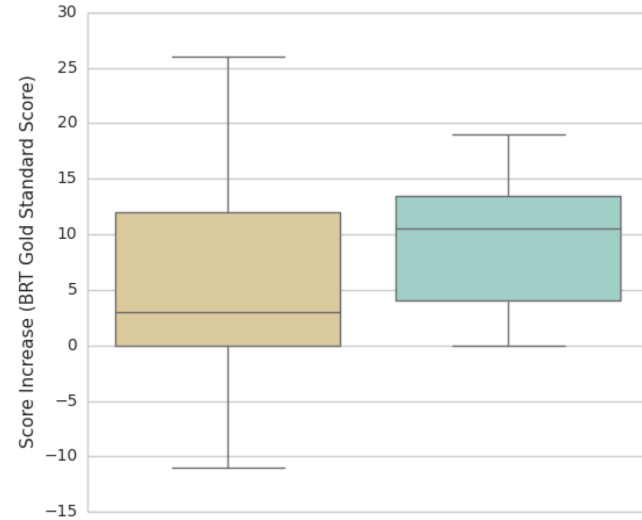
Comparing this BRT learning across participants who were classified as "experts" compared with "non-experts" shows that the learning appeared to be dominated by the non-experts, with experts reporting a far smaller increase in learning.

How might learning happen?

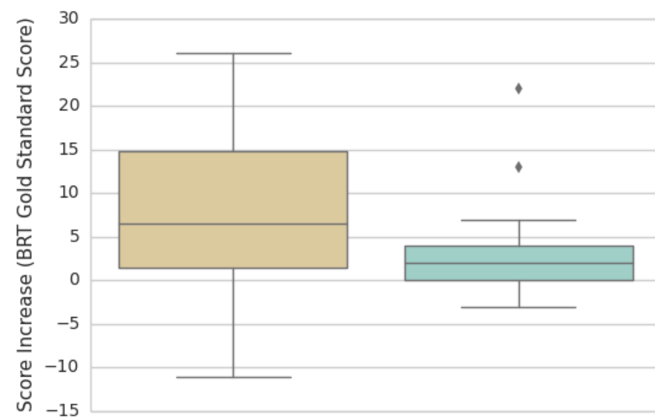
We also examined in detail participants' use of one of the tools, CoAXs (the interactive map), to attempt to identify the mechanisms through which social learning might occur. Learning could be enabled through interaction with the tool, both individually and as a group, as well as through the tool's contribution to enhancing understandability, discussion, and imagination related to the project in question. We used the survey results to construct two outcome measures of interest:

- "Alignment," which attempts to reflect whether the tool helped to raise important issues for discussion and enhanced teamwork; and
- "Plausibility," which attempts to measure how much the participants believed in the data and results demonstrated and helped to imagine alternative travel scenarios.

Analyzing actions (conversation, interactions, etc.) from the videos of the 6 workshops at the CoAXs station suggests that the workshop groups with the highest average levels of Alignment and Plausibility were smaller and relatively homogenous in terms of race and age. This result could partly be due, for example, to differences in workshop dynamics and/or different experiences in mobility across the city that correlate to Boston's racial geography (e.g., transit service quality in historically African American neighborhoods). Higher measures of Alignment and Plausibility were also measured in workshops that featured relatively high levels of participant interaction with the tools (touches), relatively high amounts of time spent questioning the tool, and less time discussing personal experiences relative to considering other peoples' points of view and broader impacts. The dynamics of interaction with the tool (tapping and gesturing and observing others doing so) may aid group conversation and learning, in part by focusing attention of participants.



BRT learning for non-skeptics (left) compared to skeptics (right)



BRT learning for non-experts (left) compared with experts (right)

Learning: Possible impacts on changing attitudes and intentions

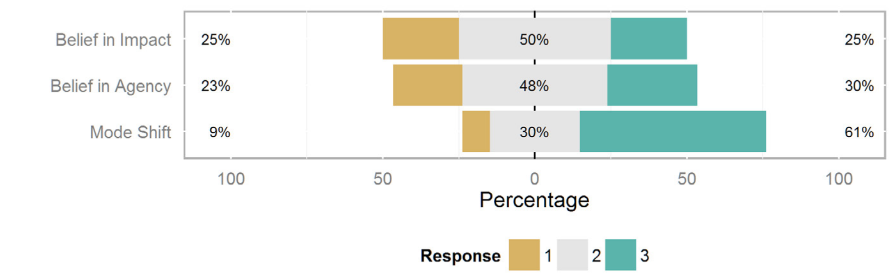
To measure whether the workshops affected participants' attitudes and intentions, we compared responses to statements and questions asked in both the pre- and post-workshop surveys. One statement targeted the idea of "Agency," or the capacity of a person to act:

- "I can play an active role in the planning of the community where I live."

A second statement intended to represent an individual's belief in potential "Impact":

- "Public participation in planning advances the interests of my community."

Finally, to preliminarily gauge possible impacts learning might have on eventual behavior change (increased use of public transit), we compared an individual's response to the pre-workshop question "in the last week, how many times did you travel by: car; subway/train; bus?" to her response to the post-workshop question "if corridors like we discussed today are implemented, do you imagine yourself changing the way you travel? If so, how many times per week would you travel by: car; subway/train; bus?"

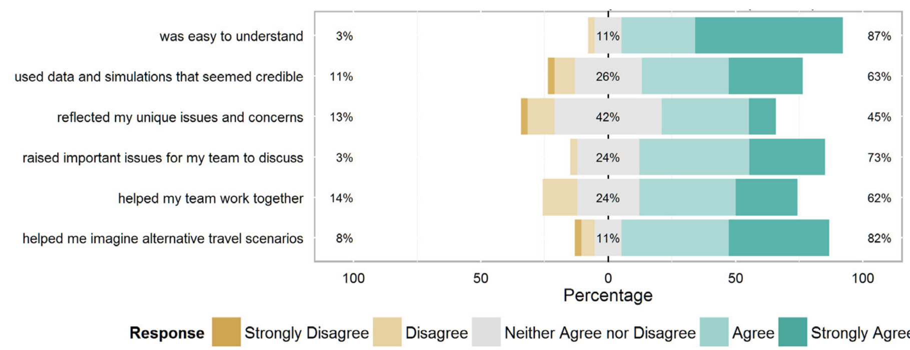


Evidence of learning impact on behavior change

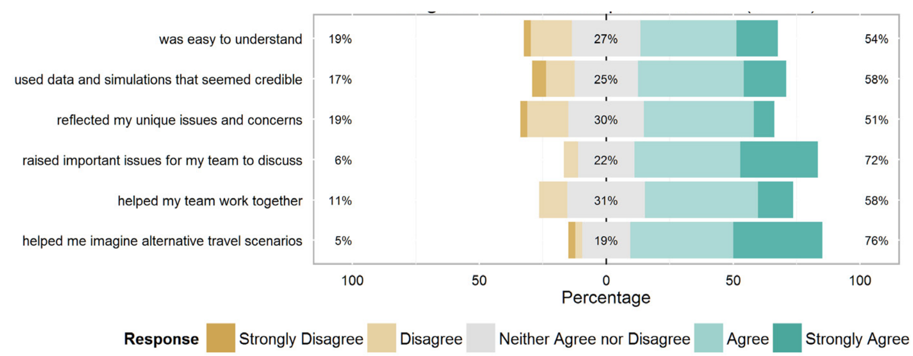
In each of the above three cases, we counted the number of negative, zero, and positive changes. For the beliefs in Impact and Agency, nearly half of responses indicated no change, with the other half split almost equally across positive and negative changes. These somewhat surprising findings indicate that the tools and the workshops as delivered in this pilot did not relate to an increase in individuals' perception of the effectiveness of public participation in planning processes nor in their confidence that that they could play a more active role in planning. In terms of possible changes in future behavior, over one-half of the respondents indicated they would increase their weekly frequency of using public transit, if a BRT-type system were implemented in Boston. Of course, such stated intentions do not mean such changes would actually materialize.

Comparing the three tools

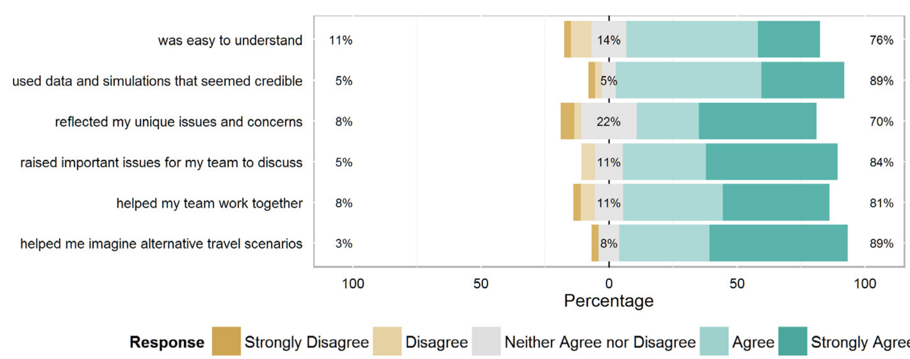
Finally, we turn to a comparative assessment of the tools used at each of the three stations. For this, we use responses to the post-workshop survey which included a series of identical questions about each of the tools (regional, neighborhood, and street scale). Overall, participants reported a positive experience with each of the tools. Salient findings include:



Streets Scale



Neighborhood Scale



Regional Scale

- The street-scale appeared to be the easiest to understand.
- The regional-scale scored the highest overall.
- Respondents were more ambivalent (i.e., more answering 3 on the 1-5 scale) regarding the two Lego-based models.

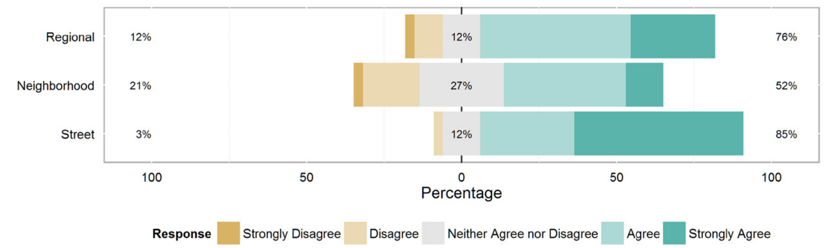
The appendix contains additional results comparing across scales and also across the six workshops, which shows some mix. The overall trends seem to hold for each of the workshops, with a few exceptions. Workshop #1 had higher overall positive feedback for the street-scale, while all the other workshops reported higher ratings for the regional scale. Workshop #3 had fairly consistent ratings for each of the scales. Workshop #2 reported a far greater amount of negative responses overall than each of the other workshops. These variations point to expected peculiarities of group dynamics, workshop implementation approaches, etc.

We examined the relative performance of the three tools, by examining three basic dimensions (usability, relevance, and credibility) as indicated by responses to the statements:

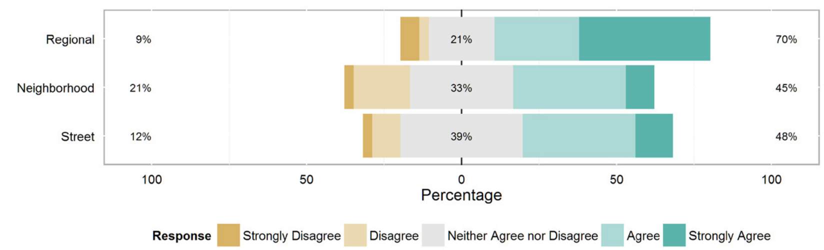
- "The tool was easy to understand." [Usability]
- "The tool reflected my unique issues & concerns." [Relevance]
- "The tool used data & simulations that seemed credible." [Credibility]

Participants reported the street scale to be more usable (over 50% of responses gave it the highest rating), which aligns with intuition. The street scale model was intentionally designed to represent BRT at its most literal, human-scale (or, rather, LEGO figure-scale). Key features of BRT such as prepayment gates, elevated platform, shelter and dedicated lane were clearly understandable and relatable at this scale, as compared to the neighborhood scale and regional scale models where BRT features become increasingly abstracted. One participant commented "you can see the changes as you go," referring to the changes in the visualization immediately apparent as a user replaces one LEGO station with another.

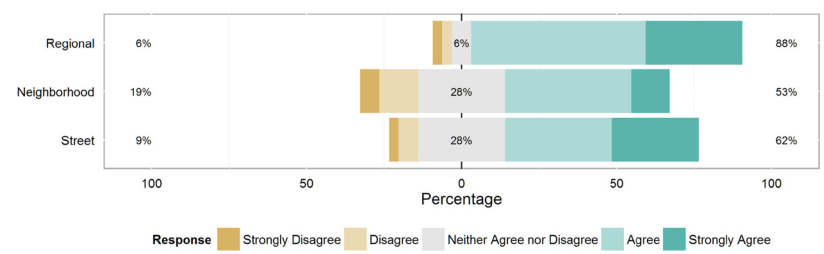
In terms of relevance, participants gave the highest scores to the regional scale tool (with almost 50% of responses giving it the highest score of 5). This finding could be attributed to the fact that the regional scale tool has three features that enabled the participants to personalize the input and output. Participants could: 1) place icons on the map to indicate their homes and frequented destination as a form of book-



"The tool was easy to understand". [Usability]



"The tool reflected my unique issues and concerns." [Relevance]



"The tool used data and simulations that seemed credible." [Credibility] mark; 2) choose to edit the service of a corridor of their interest, and; 3) visualize accessibility based on a point of their own interest. The street scale and neighborhood scale tools did not have features that so explicitly enable some degree of "personalization." Referring to the street scale, one participant commented: "It won't work on my street," while another reflected that "Every street block has different problems." On the contrary, the regional station was seen as "more integrated with more functionalities." Commenting on the regional scale tool, a participant pointed out the possibility to "see transit deserts," those parts of the city not easily accessed by transit service.

Finally, almost 90% of participants' judged the regional scale as credible (scores of 4 or 5), while the other two scales obtained lower scores on this measure. Some participants commented on the relatability of the information presented relative to their personal experience. In the regional station, for example, a few participants mentioned how one could use personal commuting experience to frequented destinations as a reference for evaluating the accuracy of CoAXs' travel time map. For the neighborhood- and street- scale models, on the other hand, travel time appeared "hypothetical." Some focus group participants also pointed to the difference in breadth and depth of information across the three stations. One person, for example, attributed the credibility of the regional station to its "limitless variations" of the travel time map where people could input various destinations and "see all the places they want to go to", vis-à-vis the limited variations found in the street and neighborhood stations. Another pointed out that while the regional station allowed each user to visualize their individual travel time map based on different transit service scenarios, in both neighborhood and street stations, there were "too many numbers to figure out which ones to trust" and the "tradeoffs were hard to see."

Limitations

The results from this initial pilot should be taken as indicative. The participants, recruited through various channels including a local community development organization, were not necessarily representative of the population at large. Furthermore, despite our attempts to frame the workshop around a locally relevant transportation issue, the workshops were not organized around an official (government-led) planning effort around BRT. This lack of an immediate decision to be made hindered our ability to clearly communicate the workshop purpose and recruit participants. In short, who walked in the door, and the expectations they brought based on how the workshop was promoted, likely affected our findings in important but largely unexamined ways. Such complications of representation and representativeness are not limited to this research; they arguably play a major role in planning practice as well.

The workshops themselves were not consistently implemented; for example, flow, duration, and facilitation varied between the different sessions. Delays in developing the tools and planning for the workshop also meant that we did not incorporate important feedback from the facilitators until partway through the series of workshops. Some of the interactions and dialogues that the tools apparently enabled may simply be a result of the small group format (6-10 individuals) of each workshop. In terms of the inferred learning from the workshops, we cannot know whether and how such learning might have occurred in other ways and through other formats (we did not, for example, have a control group).

The three tools and their implementation had strengths and weaknesses. In one of the sessions, a technical failure with the underlying maps in CoAXs meant the participants could not zoom to specific locations. Participants also noted discrepancies in how accurately the schedule-based metrics in CoAXs compared to their actual experience; representations of rail journeys were generally judged to be more accurate than bus journeys, where congestion and unreliable operations cause greater deviations from schedules. Modeling and displaying variation in actually operated service, instead of just schedules, is an important next step for CoAXs to foster improved plausibility. The LEGO-based models suffered from somewhat limited actual possibilities for interacting" and playing" – only a few pieces could be moved/swapped out, constraining potential creative exploration. Physically separating the scorecard from the LEGO models forced users to turn their attention from the models themselves. In none of the three scales did we document the findings/outcomes produced by the users (e.g., preferred corridor type or alignment and willingness to trade-off bus priority for parking spaces). Overall, the two-hour window of the workshops inevitably limited the depth of exploration and collaboration made possible.

CONCLUSIONS

In this project we attempted to see if new interactive and tangible tools have the potential to help create meaningful public engagement around transportation planning. The pilot planning workshops where the tools were tested used BRT as the transportation option of focus, but the project itself was about testing the value of new collaborative planning tools, not about any particular transportation innovation.

The series of six workshops, held over 4 days with over 50 different individuals from a range of backgrounds, reveal some evidence of learning among the participants. Not only did participants report having learned "a great deal," but they also provided evidence of deeper, longer-term learning potential (double loop learning). Participation also seemed to generate better knowledge about BRT, although this effect dominated among "non-expert" participants. The evidence collected during the workshops hints at some mechanisms through which the tools contribute to learning, such as enabling: high levels of interaction with the tools and conversation with others, questioning of the tools and their assumptions, and users to somewhat easily relate to other peoples' points of view. Among the three different tools used in the workshop, participants judged the LEGO-based one representing the street scale to be the easiest to use, while they judged the regionally scaled interactive touch screen map to be the most relevant and credible.

Our findings from this analysis should be viewed as suggestive. Assessing the impacts of interactive group activities, where openness and local relevance are fundamental, is complex and difficult. The approach itself evolved iteratively over the course of the workshops. The participants were not necessarily representative of the population at large and some interactions may be a result of the particularities of each of the groups. Similar results, including learning among users, may have occurred in other ways and through other formats.

These various limitations and shortcomings point towards areas for future work. If these tools are to be used in the future, together or separately, questions immediately arise about scalability and portability. Building LEGO-based models to represent a large number of neighborhoods and bringing those models to such neighborhoods is not a minor undertaking. CoAXs can be relatively easily adapted to other places (with the right data available) and viewed by anyone with a web-browser and an Internet connection; but, presumably much of the tool's value lies in inducing group interactions and common understanding while gathered around the touchscreen table. We need to better comprehend how these tools work together, or with other tools, to enhance effective stakeholder engagement for planning purposes. The tools may also have applications beyond community-based planning workshops – in, for example, the service planning work of public transit operators or to help train people about travel alternatives (e.g., taking the bus instead of driving).

Ultimately, the workshops represent very initial small steps in the direction of leveraging new interactive tools for more inclusive and meaningful engagement in planning.

LINKS AND ENDNOTES

Endnotes

1. Due to gaps in the recorded video and other inconsistencies (e.g. groups where the number of participants dropped to fewer than three), interaction results were available for a subset consisting of 21 individuals in 6 of the 11 total groups.

2. Statistically, the variables had high internal consistency, meaning they reasonably measure the same general construct (in this case, "double loop learning"). We use a measure of the internal consistency of a scale used widely in social research: the Cronbach alpha coefficient, which is a direct function of the number of items and their inter-correlation. The coefficient takes values between 0 and 1, and higher values correspond with higher internal consistency. A widely accepted rule of thumb for internal consistency is a value of at least 0.70. The alpha value for the four questions listed above is 0.78.

Document links

- https://www.barrfoundation.org/
- http://nuestracdc.org/
- https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/
- https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/
- http://www.bostonbrt.org/
- https://www.itdp.org/
- http://brtdata.org/
- http://www.bostonbrt.org/the-brt-report/
- http://www.massdot.state.ma.us/rdm/
- http://www.mbta.com/about_the_mbta/t_projects/?id=19047
- http://roxburyinnovationcenter.org/
- http://mfc.mit.edu/
- http://cp.media.mit.edu/
- http://nuestracdc.org/
- https://www.barrfoundation.org/
- http://coaxs.mit.edu/
- http://cp.media.mit.edu/city-simulation/
- http://sumo.dlr.de/wiki/Main_Page
- http://conveyal.com/projects/analyst/
- https://developers.google.com/transit/gtfs/#submitting-a--transit-feed-to-google
- http://www.openstreetmap.org/#map=5/51.500/-0.100
- https://www.epa.gov/smartgrowth/smart-location-mapping
- https://dspace.mit.edu/handle/1721.1/81739
- https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/the-scorecard/

Better Transit?

PRE-WORKSHOP SURVEY

Username: ________

Welcome! Please help our MIT team evaluate new technologies by answering the following questions:

Age __________________

Occupation ____________________________________

Please list any community organization(s) you are affiliated with:

____

Over the past year, how many public planning meetings have you attended?

(circle one option) 0 1-2 3-5 6+

At how many did you make a formal presentation? __________________

At how many did you speak and share your opinion? __________________

At how many did you learn new things about planned projects? __________________

In the last week, how many times did you travel by:

Car? __________ Subway/Train? __________ Bus? _________

Are you familiar with the concept of bus rapid transit (BRT)? Yes | No

If yes, try to list four important elements of BRT:

________________________________ ________________________________

________________________________ ________________________________

How familiar are you with digital graphical representation of information and data?

Not familiar 1 2 3 4 5 Very Familiar

To what extent do you agree with the statements…

"I can play an active role in the planning of the community where I live"

Disagree 1 2 3 4 5 Agree

"Public participation in planning advances the interests of my community"

Disagree 1 2 3 4 5 Agree

Better Transit?

POST-WORKSHOP OVERALL SURVEY

Username: ________

Thanks for coming. Please fill out both sides of this survey before you leave.

	(Disagree)				(Agree)
I learned a great deal in the workshop	1	2	3	4	5
I learned through observing others using the tools	1	2	3	4	5
I learned through listening and conversing with others	1	2	3	4	5
I helped others learn	1	2	3	4	5
I was able to get answers to the questions I asked	1	2	3	4	5
Workshop participants discussed issues in an open way	1	2	3	4	5
Participants were open to differences in opinion.	1	2	3	4	5
I would support recommendations created by the participants of the workshop	1	2	3	4	5
I feel that I can play an active role in the planning of the community where I live	1	2	3	4	5
I feel that public participation using the tools in this workshop would advance the interests of my community	1	2	3	4	5

If corridors like we discussed today are implemented, do you imagine yourself changing the way you travel? If so, how many times per week would you travel by:

Car? __________ Subway/Train? __________ Bus? _________

Try to list four important elements of BRT:

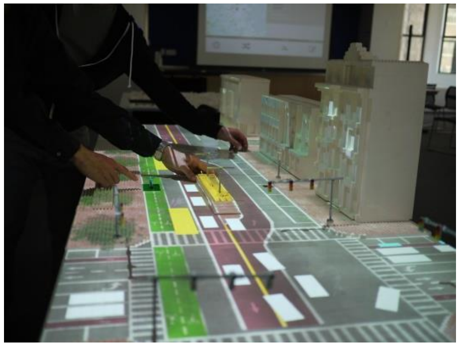
________________________________ ________________________________

________________________________ ________________________________

1. How do you think corridors like those discussed today might impact your travel?
2. How do you think corridors like those discussed today might impact others' travel in the region?
3. What was the most interesting part of this workshop?

POST-WORKSHOP SURVEY BY STATION

Station 1... (Disagree) (Agree)



was easy to understand
1 2 3 4 5
reflected my unique issues and concerns
1 2 3 4 5
raised important issues for my team to discuss
1 2 3 4 5
helped my team work together
1 2 3 4 5
used data and simulations that seemed credible
1 2 3 4 5
helped me imagine alternative travel scenarios
1 2 3 4 5

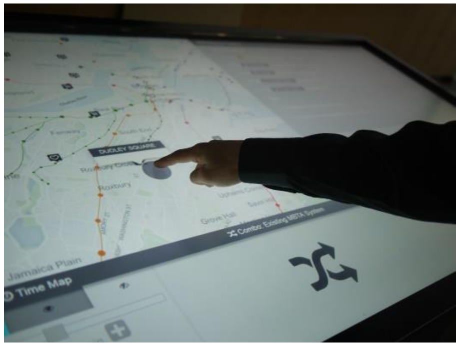
What other suggestions do you have on Station 1?

Station 2...

was easy to understand
1 2 3 4 5
reflected my unique issues and concerns
1 2 3 4 5
raised important issues for my team to discuss
1 2 3 4 5
helped my team work together
1 2 3 4 5
had data and simulations that seemed credible
1 2 3 4 5
helped me imagine alternative travel scenarios
1 2 3 4 5

What other suggestions do you have on Station 2?

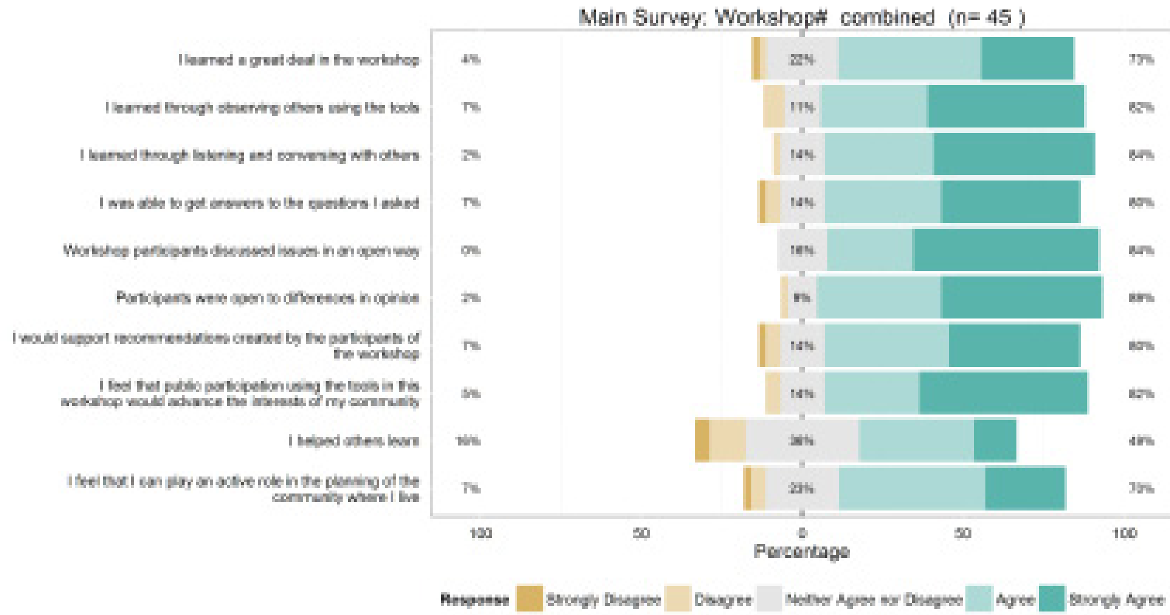
Station 3...

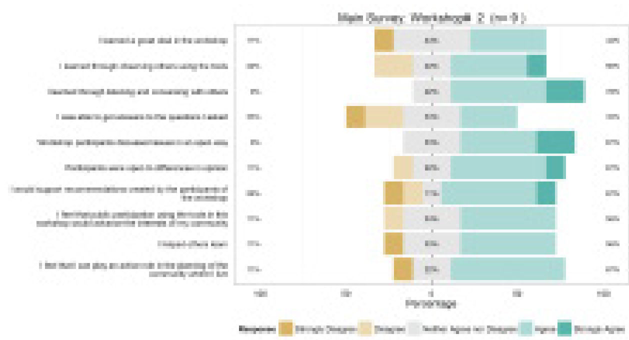


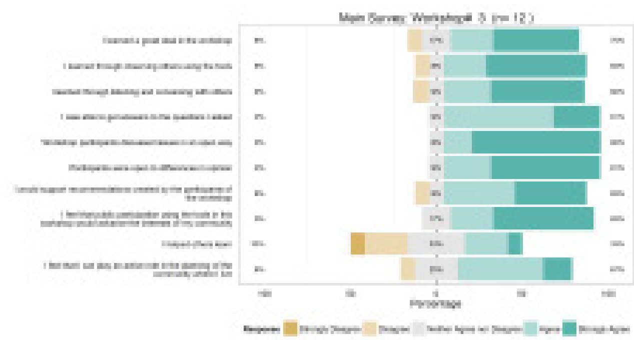
was easy to understand
1 2 3 4 5
reflected my unique issues and concerns
1 2 3 4 5
raised important issues for my team to discuss
1 2 3 4 5
helped my team work together
1 2 3 4 5
had data and simulations that seemed credible
1 2 3 4 5
helped me imagine alternative travel scenarios
1 2 3 4 5

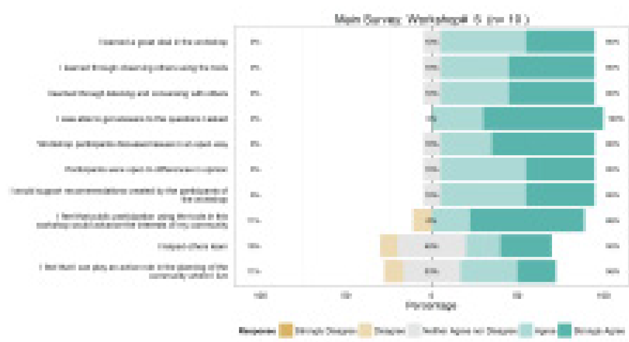
What other suggestions do you have on Station 3?

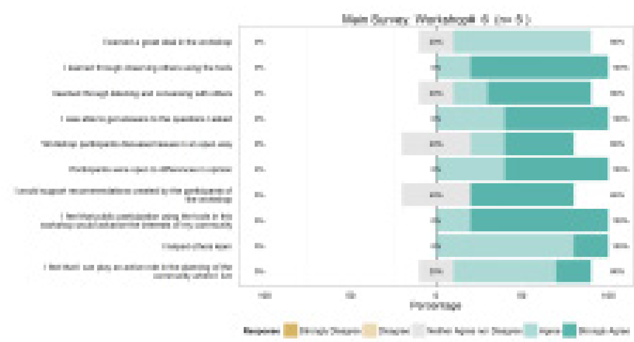
Post-workshop survey by workshop session



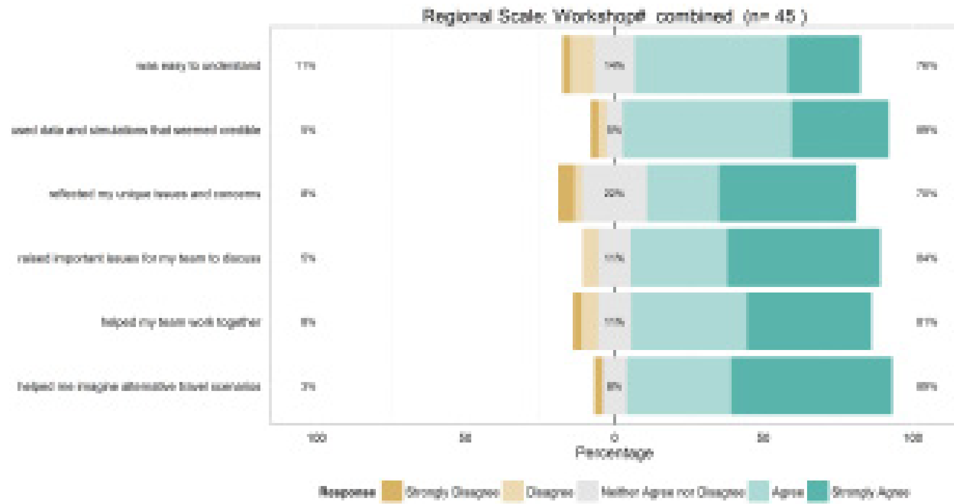


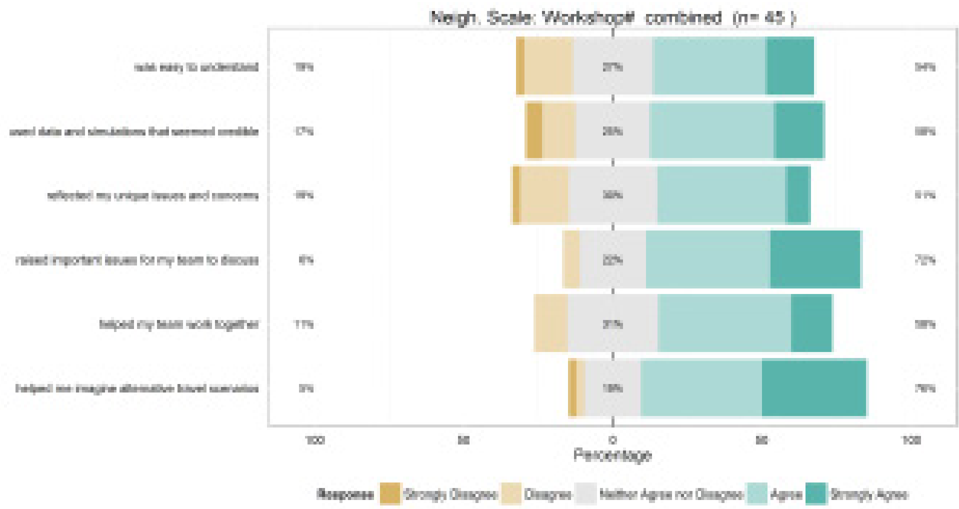


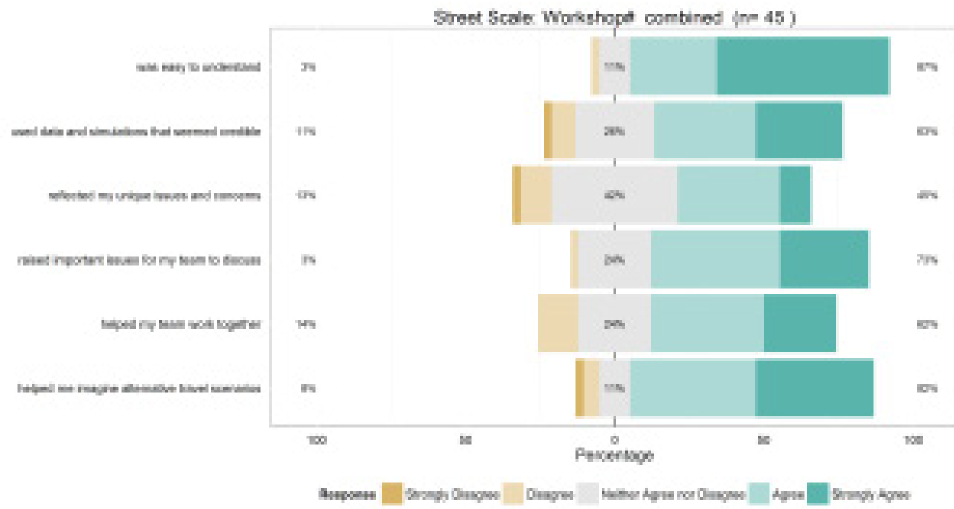




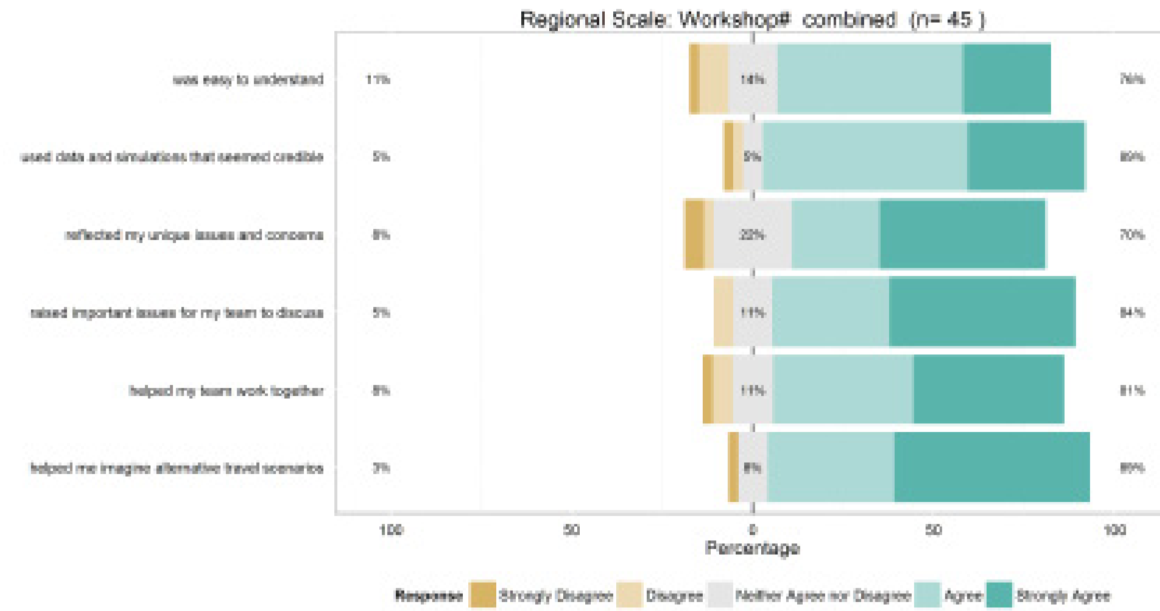
Post-workshop survey by scale (all workshop sessions included)

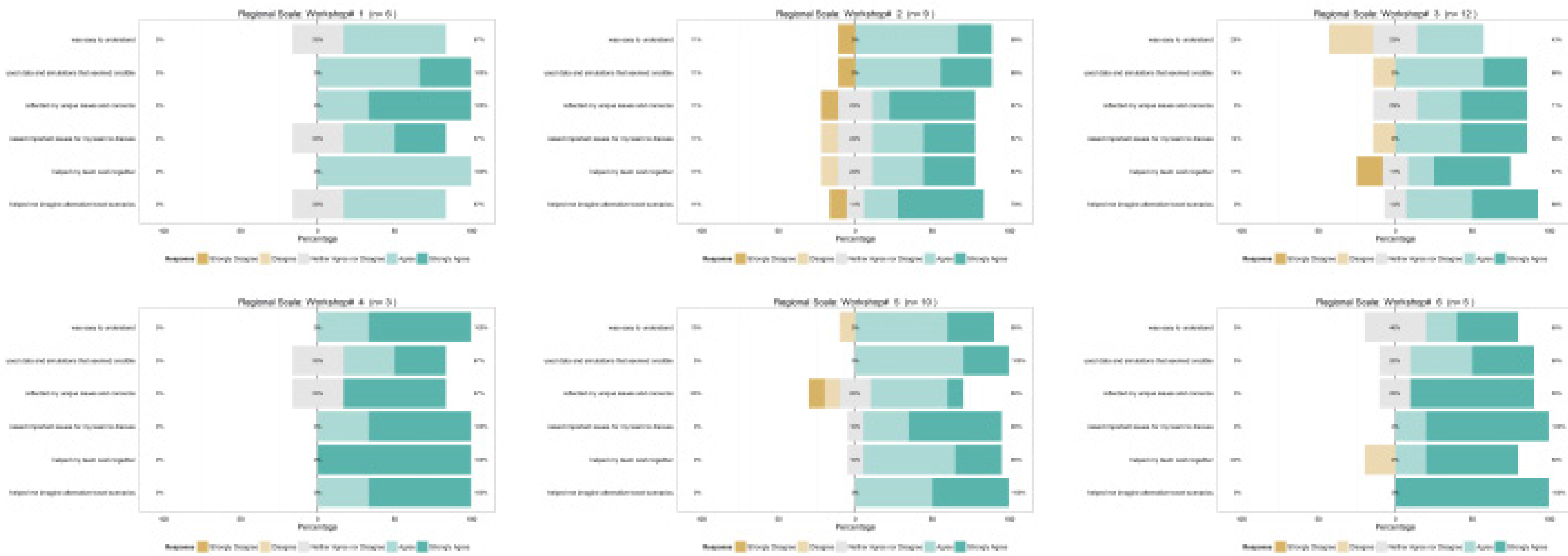




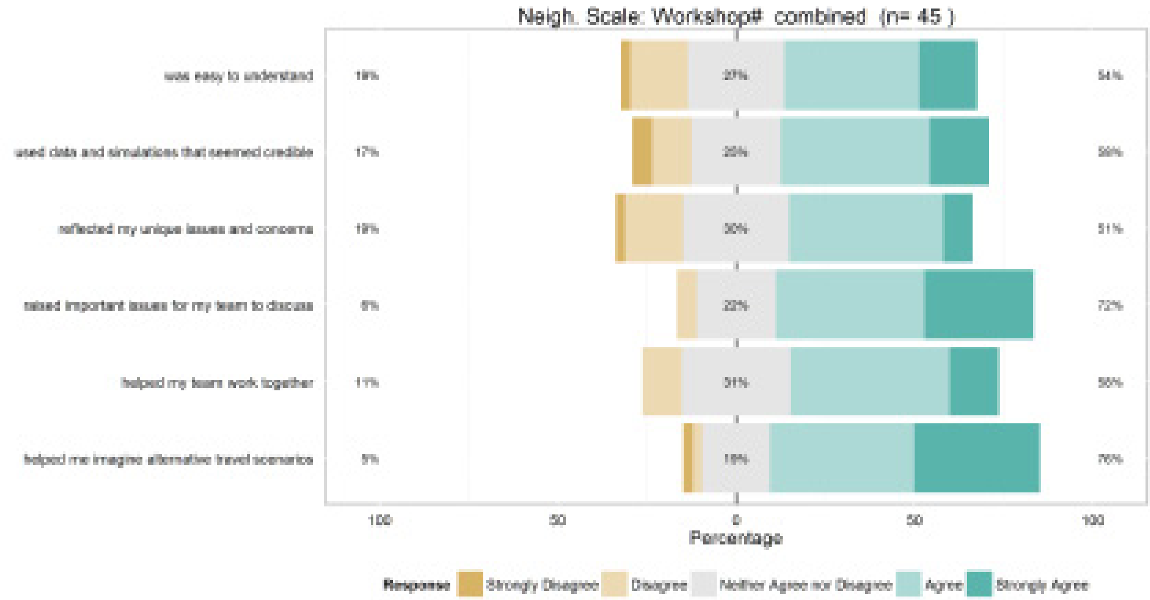


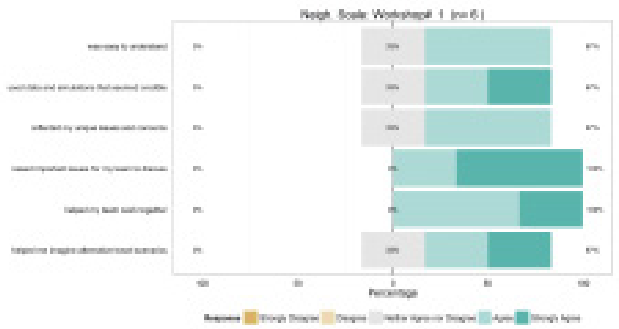
Post-workshop survey by scale and workshop session (reg)

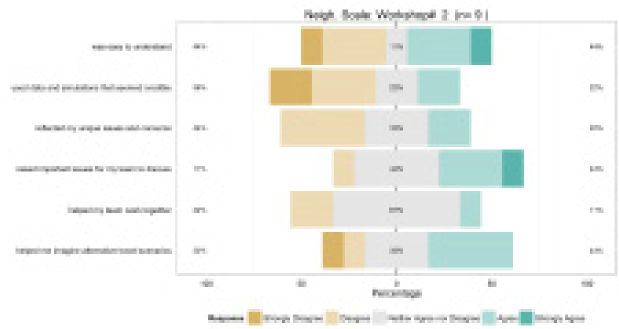


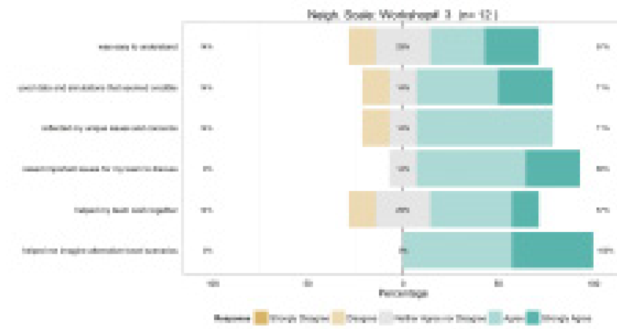


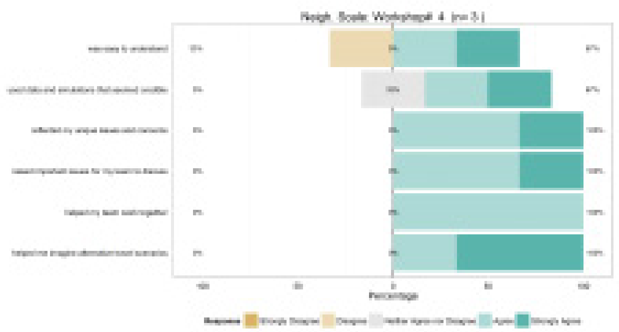
Post-workshop survey by scale and workshop session (nel)

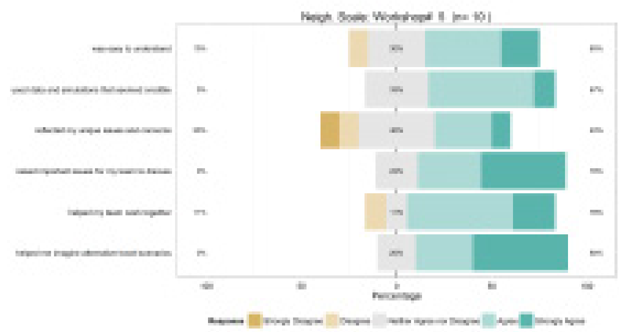


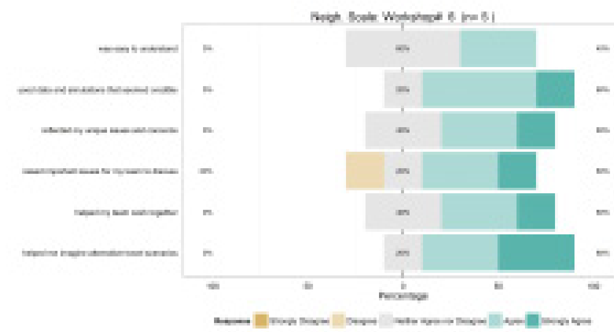




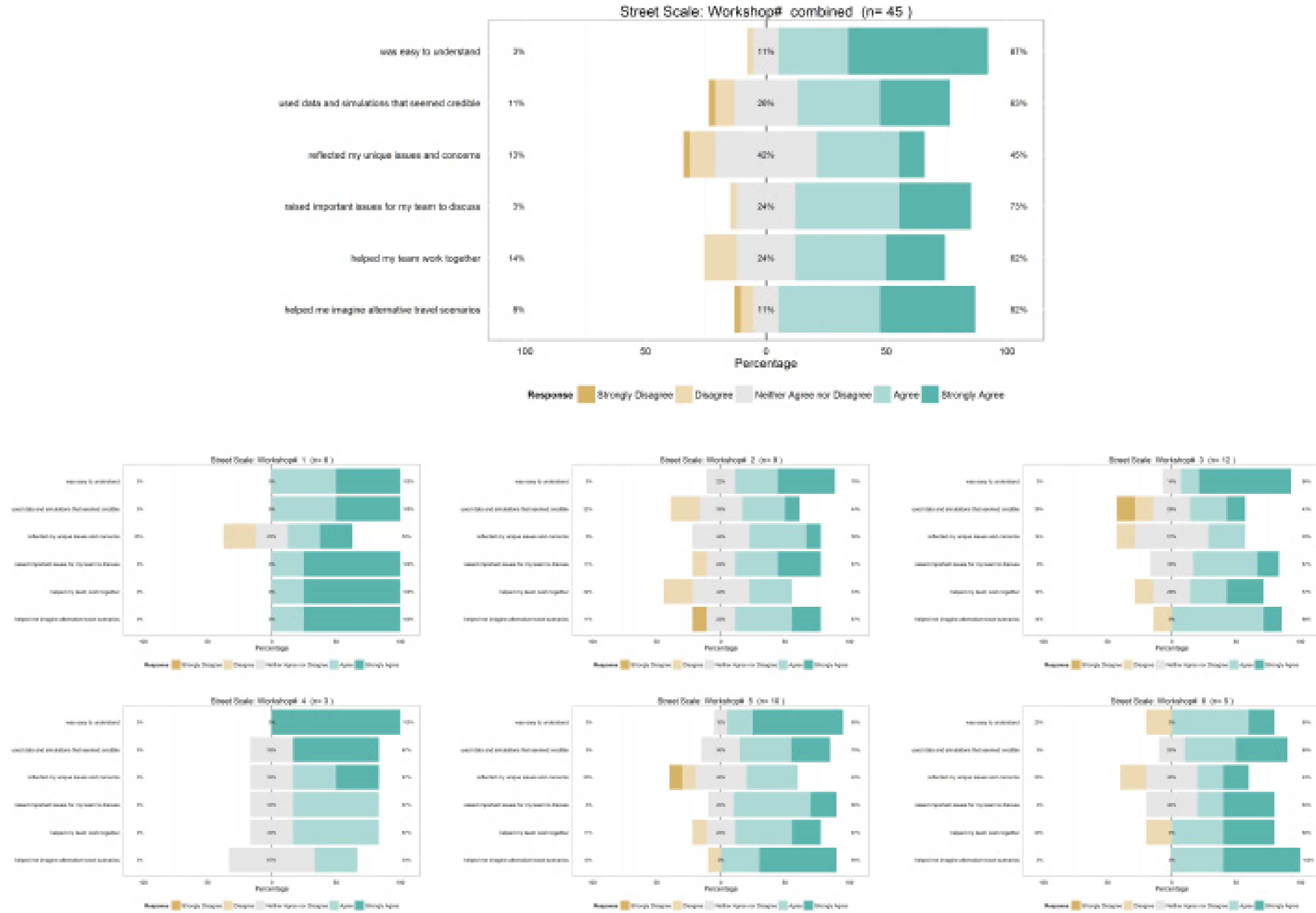




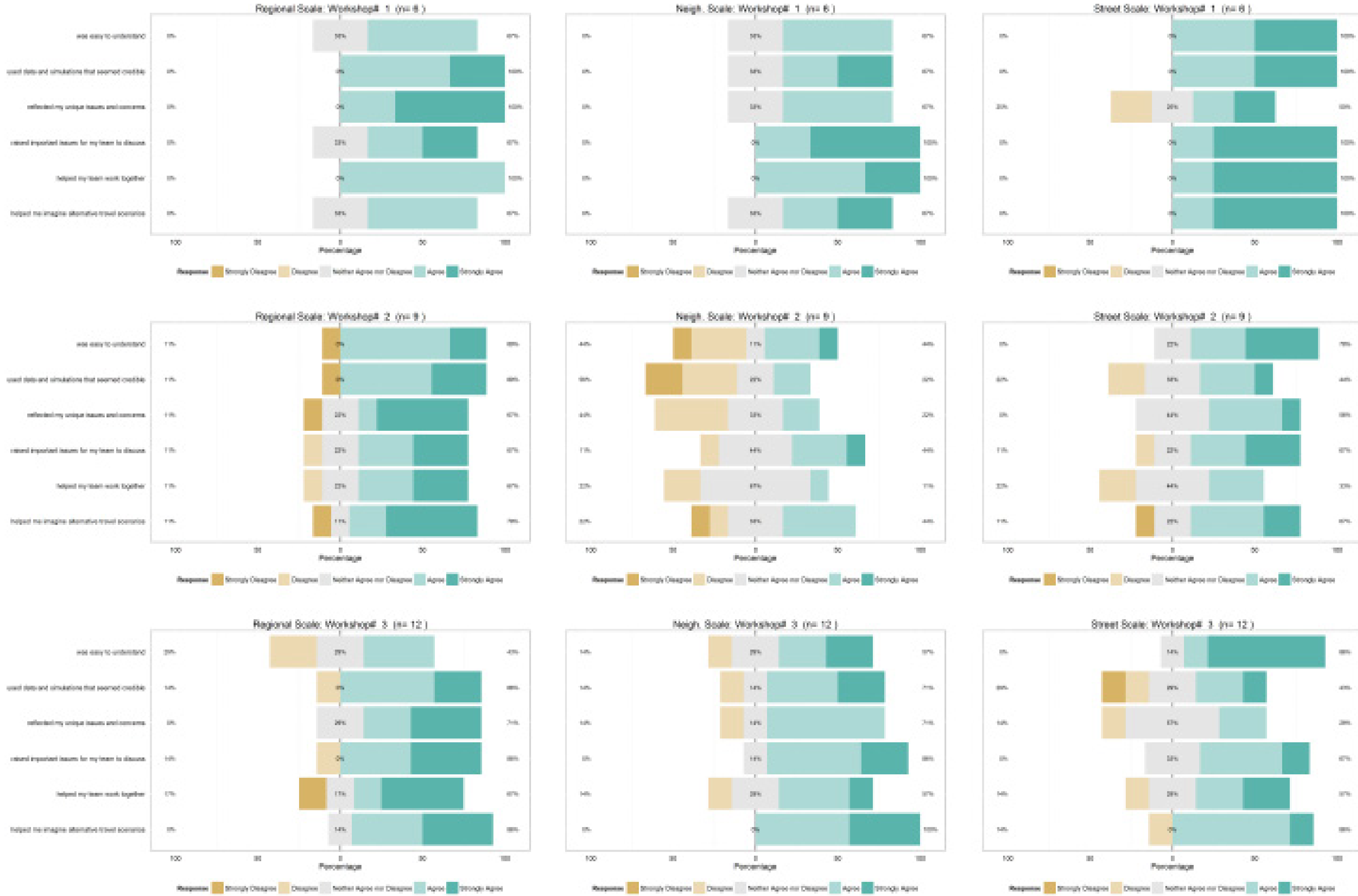




Post-workshop survey by scale and workshop session (str)



Post-workshop survey by workshop and scale



Post-workshop survey by workshop and scale (continued)