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TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Behavioral Science and Nudge Applications in Transportation

November 8, 2024

1:00 – 2:30 PM



PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.



AICP Credit Information

1.5 American Institute of Certified Planners Certification
Maintenance Credits

You must attend the entire webinar

Log into the American Planning Association website to claim your
credits

Contact AICP, not TRB, with questions

Purpose Statement

This webinar will provide innovative strategies and practical applications of nudges can initiative change in transportation systems. Presenters will share how user segmentation and targeted behavioral interventions can significantly reduce travel demand across diverse demographics and geographical regions. Presenters will also provide real world examples of how behavioral science can enhance the efficiency, sustainability, and user-friendliness of transportation systems.

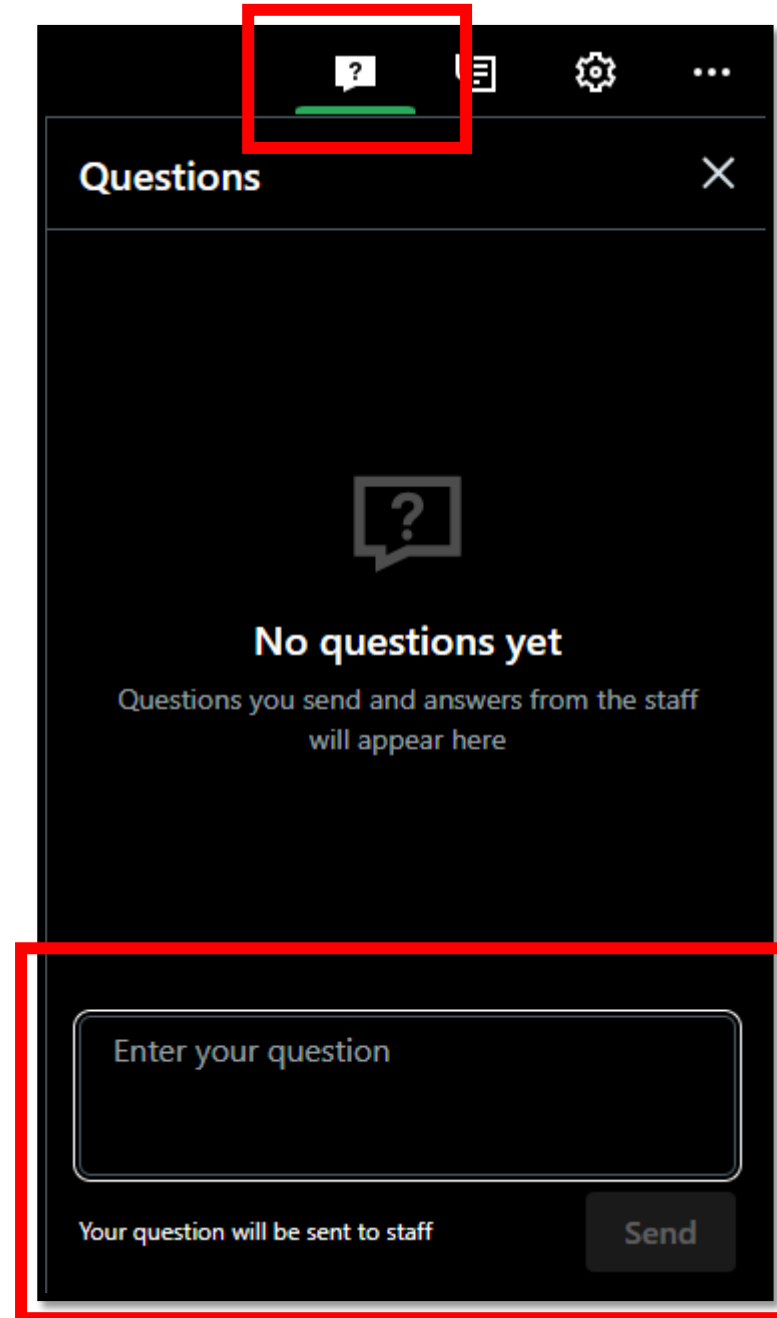
Learning Objectives

At the end of this webinar, you will be able to:

- Use the principles of behavioral science and nudge applications in influencing travel behavior to mitigate travel demand
- Explore compelling case studies and practical applications of nudges in various demographic and geographical contexts within the transportation sector
- Foster sustainable and efficient transportation systems by designing and implementing behavioral interventions

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters



Krute Singa

ksinga@bayareametro.gov

MTC



Maggie Dennis

mdennis@povertyactionlab.org

J-PAL North America



Yi-Chang Chiu

yc.chiu@metropia.com

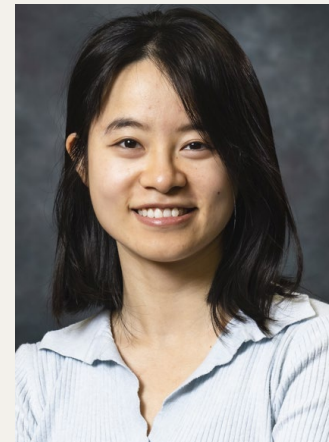
Metropia, Inc.



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METROPOLITAN
TRANSPORTATION
COMMISSION



Incentivizing Active and Shared Travel Pilot Program

TRB Webinar: Behavioral Science and Nudge Applications in Transportation

Krute Singa, Metropolitan Transportation Commission (MTC)

Yi-Chang Chiu, Metropia, Inc.

November 8, 2024

Incentivizing Active and Shared Travel Pilot Overview

Pilot Duration

- 9 months
- Delayed start due to COVID

Purpose

- To identify what drives people's decisions and behaviors, rather than relying on assumptions of how people should act
- Not commonly done for transportation demand management (TDM) campaigns

Recommendations

- Targeted recruitment
- Personalized incentives, travel options, and messaging
- Mobility platform adoption

Who We Are

Metropolitan Transportation Commission (MTC) is the metropolitan planning organization and the transportation planning, financing and coordinating agency for the 9-county Bay Area

Association of Bay Area Governments (ABAG) is the region's Council of Governments, whose mission is to strengthen collaboration across the 101 jurisdictions to build healthier, stronger communities

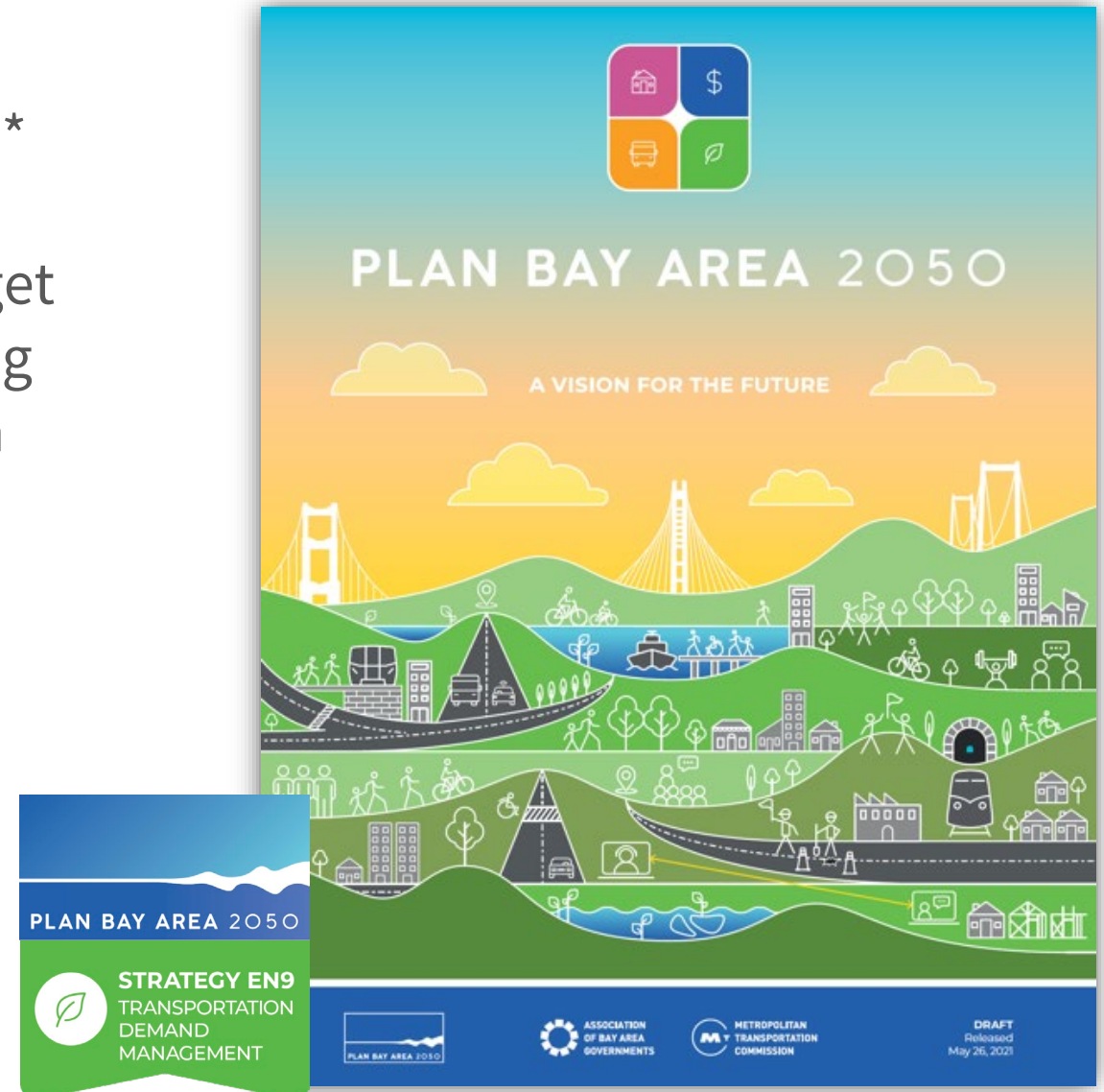


Incentivizing Active and Shared Travel Strategy in Plan Bay Area 2050

The Incentivizing Active and Shared Travel* Pilot Program contributes to the 19% per-capita GHG emissions reduction CARB target by reducing solo driving trips and supporting other strategies identified in Plan Bay Area 2050, the Bay Area's 30-year regional transportation plan.

Pilot part of the transportation demand management set of strategies in the Plan.

*Active and shared travel = walk, bike, transit, carpool



New Approach for Travel Campaigns

FROM...

Traditional/Current Approach:

- Based on rational decision-making
- Blanket campaigns, treating all travelers the same which leads to low results



“How much longer do we have to wait until a customer finds us, walks into this meeting room, and places a big order?”

TO...

Behavioral Science Approach:

- Incorporates psychological and social factors impacting decision-making, understanding individuals make choices that are not rational
- Personalized messaging – requires more work and money up front but better results overall



Inspiration from Other Efforts

- **Public Sector**

- King County, In Motion
- Portland, SmartTrips
- BART, Perks
- Santa Monica, GoSaMo

- **Private Sector**

- Uber
- Duolingo
- Fitbit



Pilot Purpose



- To understand behavior and the tradeoffs people face when deciding between driving alone and using an active or shared travel option (e.g., public transit and cycling)
- To determine what types of messaging can compel solo drivers to shift to an active or shared transportation mode
- To learn how to scale a behavior change program
- To include any type of habitual trip (e.g.; shopping, medical/dental appointments, gym, work)
 - Habitual trip = a repeated trip between an origin and destination

Consultant Team

- Prime
 - Metropia
- Subconsultants
 - The Behaviouralist
 - Transportation Analytics

The advertisement features a grid of gift cards including Amazon, Starbucks, National Park Foundation, CVS pharmacy, and Visa. A woman's face is overlaid on the bottom right of the grid, and a play button icon is centered over the CVS pharmacy card. The text above the grid reads: 'Earn gift cards on your way to work or school, running errands & more! 🤖 Get started today.' Below the grid, it says 'Coins 10.00' and 'Buy More'. At the bottom, there is a URL 'mtc.ca.gov', the text 'Time is limited ⌚ Smarter way to travel', and a 'Learn more' button.

Metropia GoEzy
Sponsored · 🌐

Earn gift cards on your way to work or school, running errands & more! 🤖 Get started today.

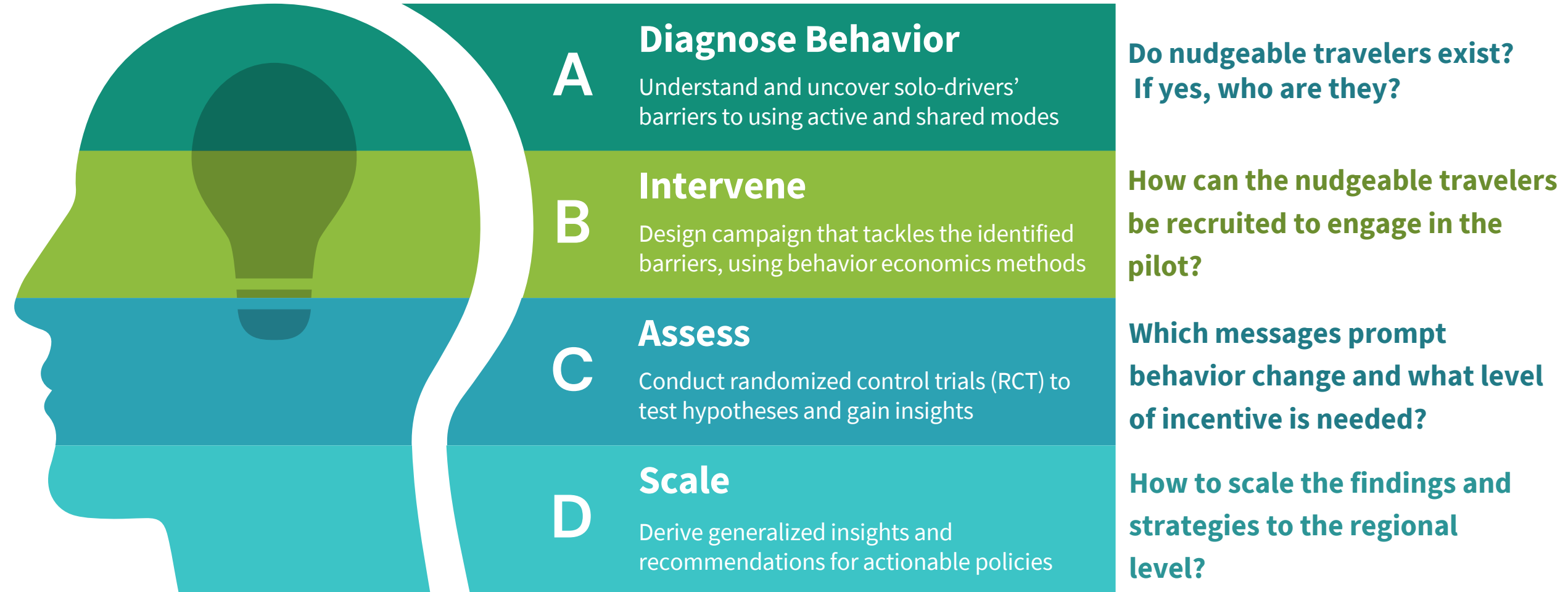
Coins 10.00 [+ Buy More](#)

amazon
Starbucks
National Park Foundation
CVS pharmacy
4000 1234 5678 9010
VISA

mtc.ca.gov
Time is limited ⌚
Smarter way to travel

[Learn more](#)

Key Questions



Pilot Approach

Pilot

COVID-19:

- Delayed start of pilot - 9 months in duration
- Impacted how frequently people travel and the modes
- Effected both participant recruitment and messaging available
- Increased cost per participant (due to increased marketing costs)

As a result, pilot used focus group approach

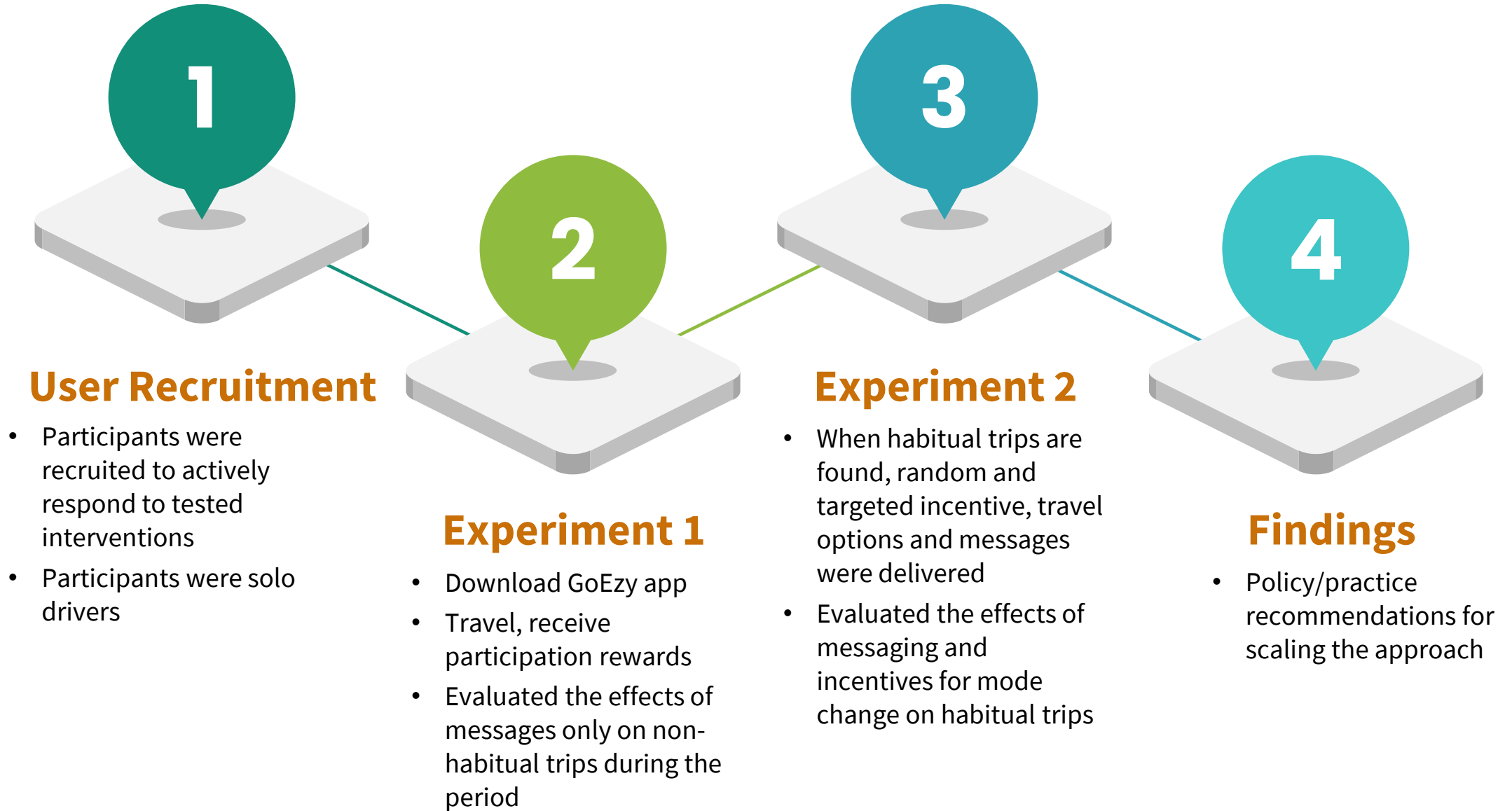
Approach

- Treatment and control groups to test different messages and incentive levels
- 10 months of data collection
- 216 participants
- Nearly 30K trips, 7,400 habitual driving trips
- Statistically significant sample size

Cost

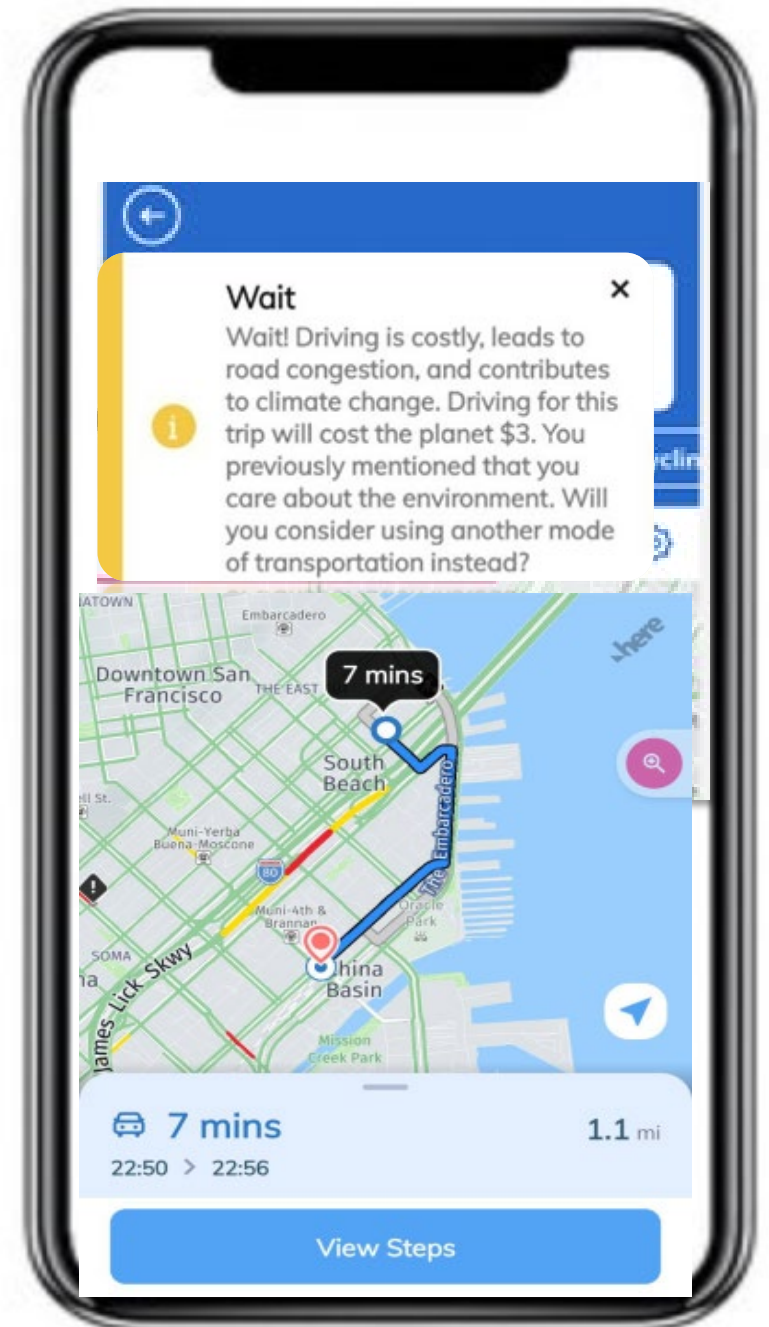
- Consultant contact (includes marketing):
\$325,000
- Incentive budget:
\$10,000
- Average incentive amount:
\$3

Experiment Road Map



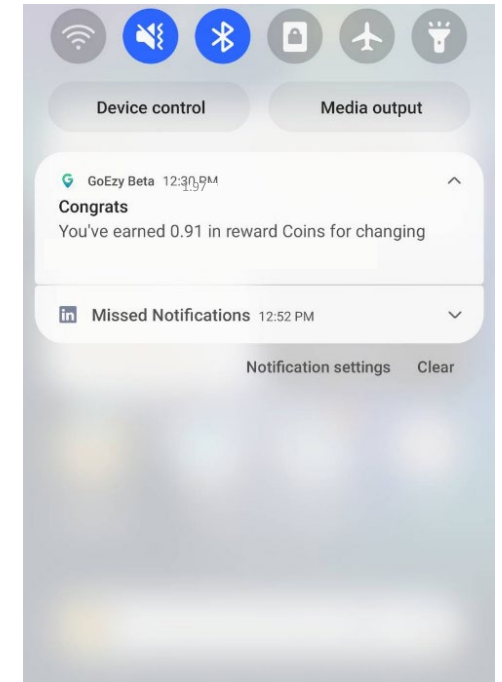
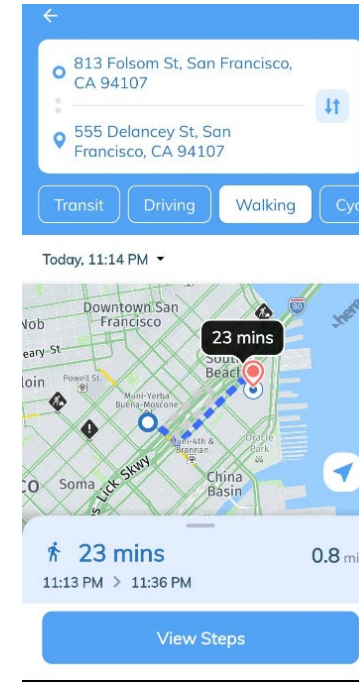
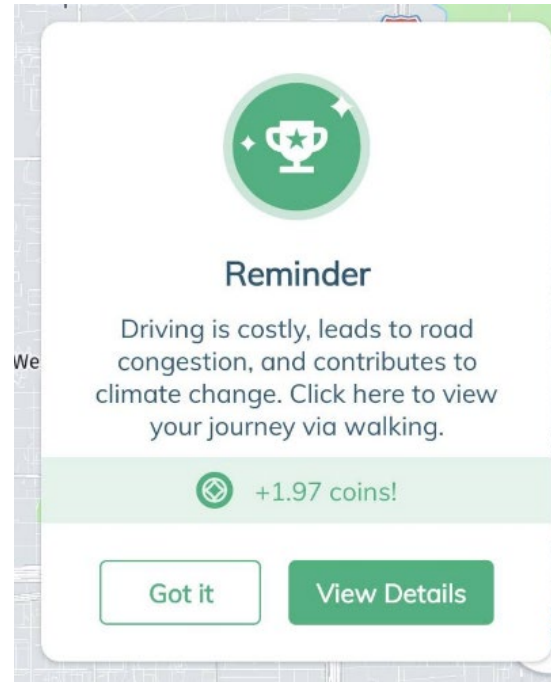
Experiment 1 Objectives

- To determine if messages alone could compel a participant to use an active or shared mode instead of driving alone
- Tested 2 types of messages:
 - Social cost of driving
 - Reminder to participants of their previously stated concern about climate change
- Message delivered when planning the trip



Experiment 2 Objectives

- To determine if offering an incentive/reward could compel a participant to use an active or shared mode instead of driving alone for their habitual trip
- Tested variety of offers based on mode and incentive amounts
- Incentive delivered an hour before the habitual trip made



Pilot Results

Overall

- Offering a \$3-\$5 incentive increased usage of multiple modes for a given trip
- Lower incentive amounts needed when presenting a feasible, personalized option compared to random suggestions



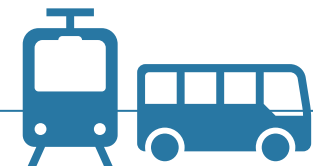
Walk/Bike

- Suggestions to walk or bike that included incentives increased their use



Transit

- A blanket transit message had no significant effect on mode adoption
- Message plus incentive led to behavior change when the walk to the transit stop is less than 15 minutes and in-vehicle time is up to 20 minutes



Recommendations



1. Targeting Recruitment



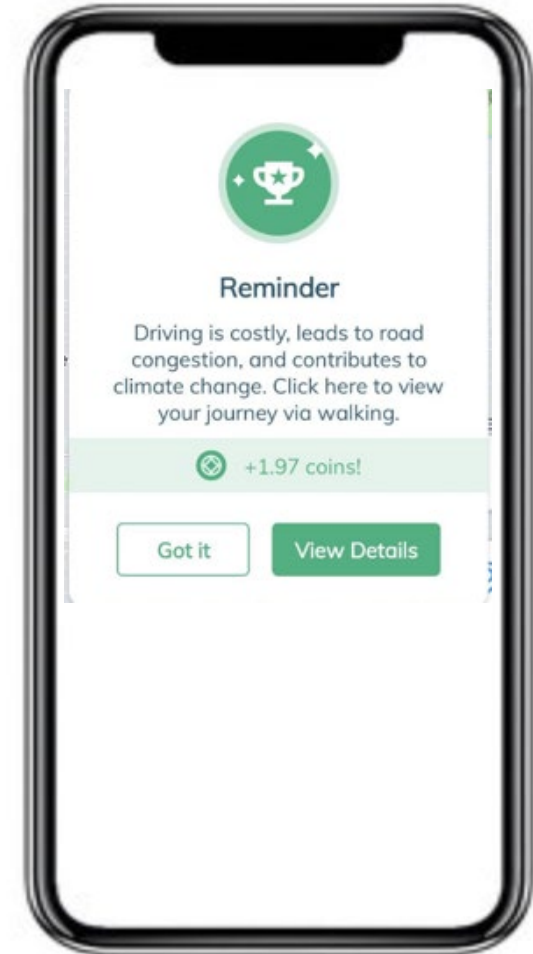
2. Personalizing Messaging, Incentives, and Engagement



3. Adopting a Mobility Platform

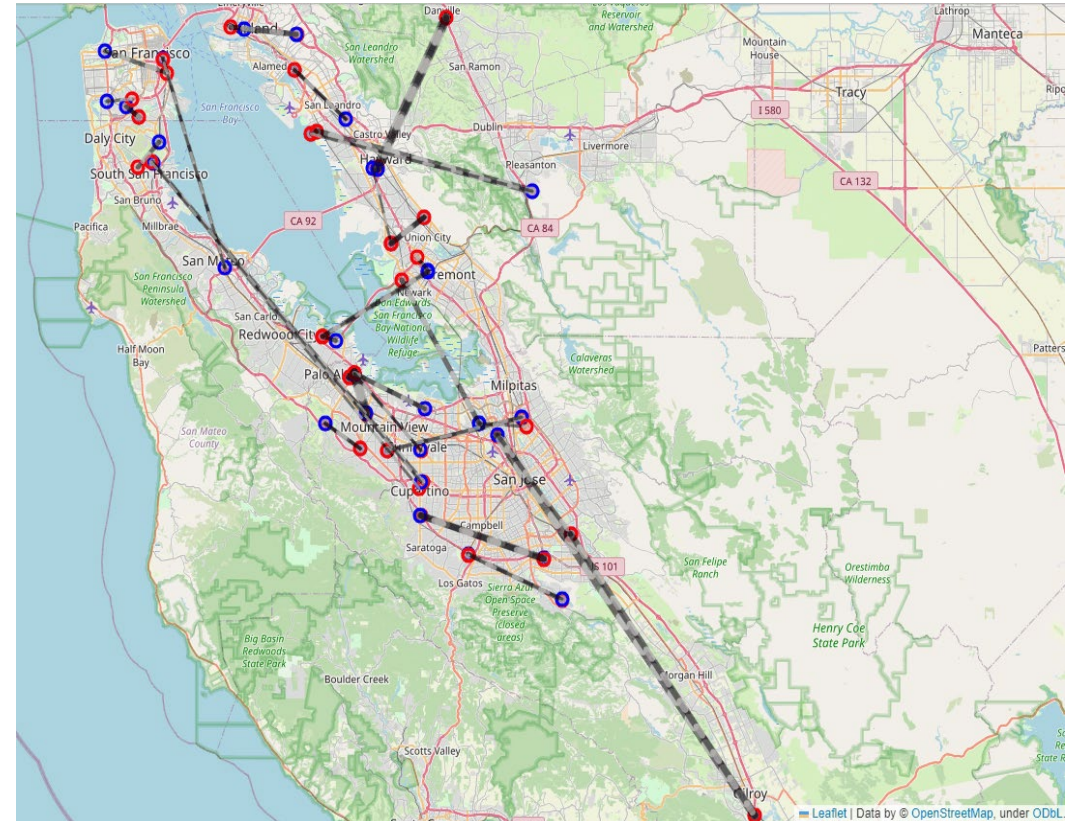
1. Targeted Recruitment - Audience

- Target the nudgeable drivers identified by the pilot:
 - Older working-age adults between 37 and 56
 - Have access to multiple travel options
 - Bike owner
 - More likely to switch to walking for trips < 3 miles
 - More likely to switch to cycling for trips < 10 miles
 - Higher responsiveness to nudges for weekday trips than weekend



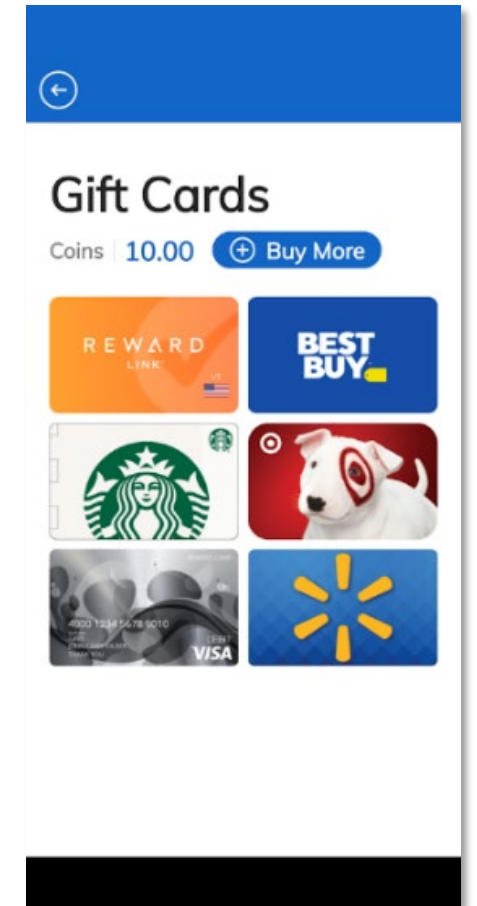
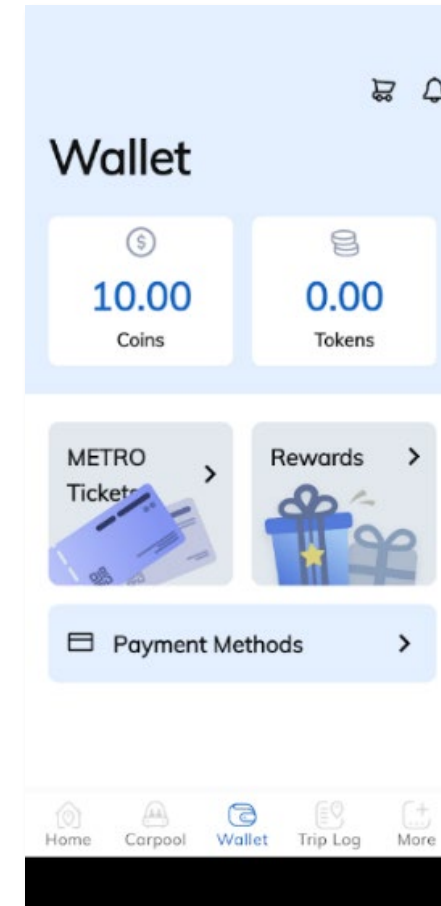
1. Targeted Recruitment - Areas

- Target:
 - Walking for short trips under 3 miles
 - Biking for trips under 10 miles
 - Transit stop is less than 15 minutes walk/bike and in-vehicle time is up to 20 minutes



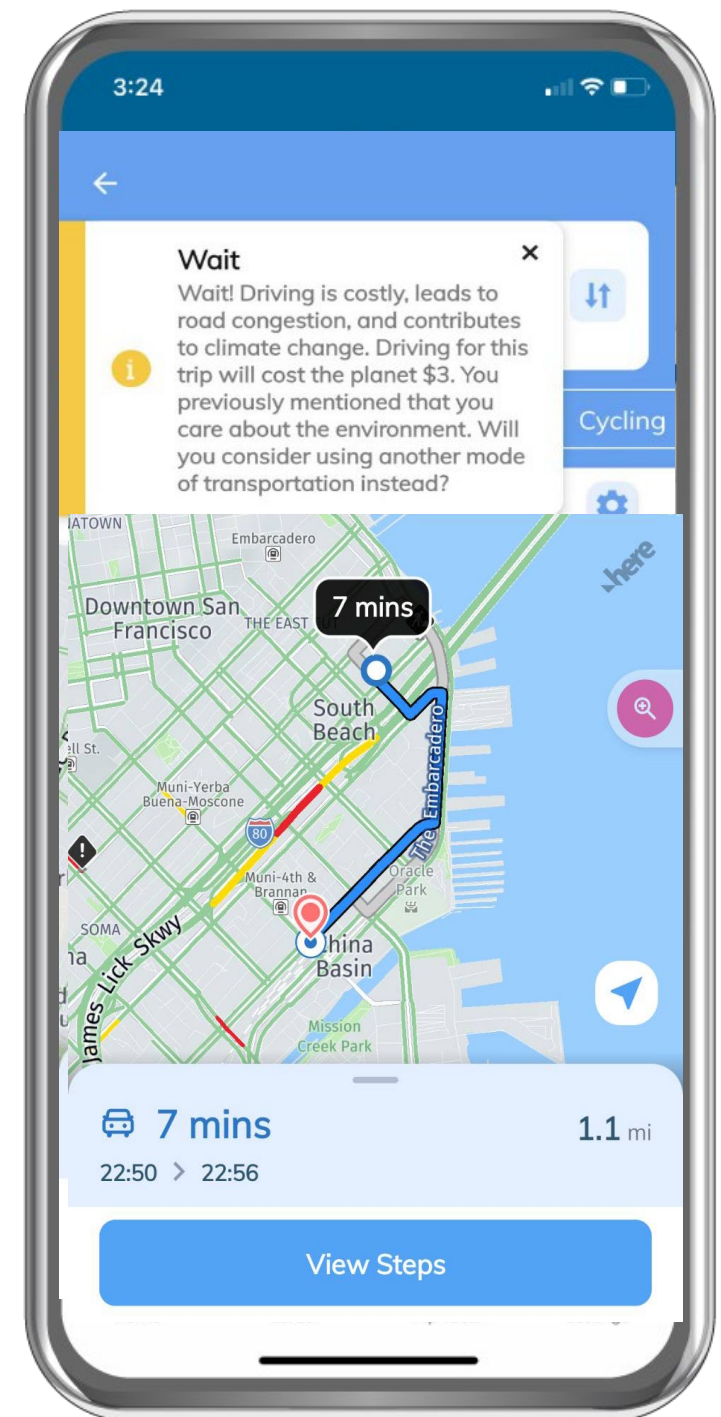
2. Personalized Messaging, Incentives, and Engagement Techniques

- Test and iterate on messages sent to the targeted audience in the identified origin-destination pairs
 - Use control and treatment groups
- Use techniques to enhance engagement and motivation, including:
 - Gamification
 - Goal setting
 - Positive reinforcement
 - Behavioral prompts
 - Dynamic incentives



Mobility Platform

- Mobility platform to onboard, retain, coach, educate, and deliver personalized messages and incentive campaigns
 - Using the mobility platform/app is common in the areas of fitness and health, education language learning, personal finance, etc.
 - Apps can play role in engaging and guiding users through onboarding and coaching processes, contributing to enhanced user experiences and successful outcomes



Thank you

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Yi-Chang Chiu
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Project site and reports:
<https://mtc.ca.gov/planning/transportation/regional-transportation-studies/incentivizing-active-shared-transportation-pilot-program>





Designing and Implementing a Research Agenda for Transportation Decarbonization

Maggie Dennis
J-PAL North America

November 8, 2024



Agenda

- J-PAL and research context
- Randomized evaluation
- Research findings
 - Methodology
 - Findings
 - Recommendations
- Engagement opportunities

J-PAL's mission is to reduce poverty by ensuring that policy is informed by scientific evidence



Research

We fund and run **randomized evaluations** across major policy areas to identify effective ways to help people experiencing poverty.



Policy outreach

We synthesize research results and build partnerships to inform decision-making and scale-up of proven programs.



Capacity building

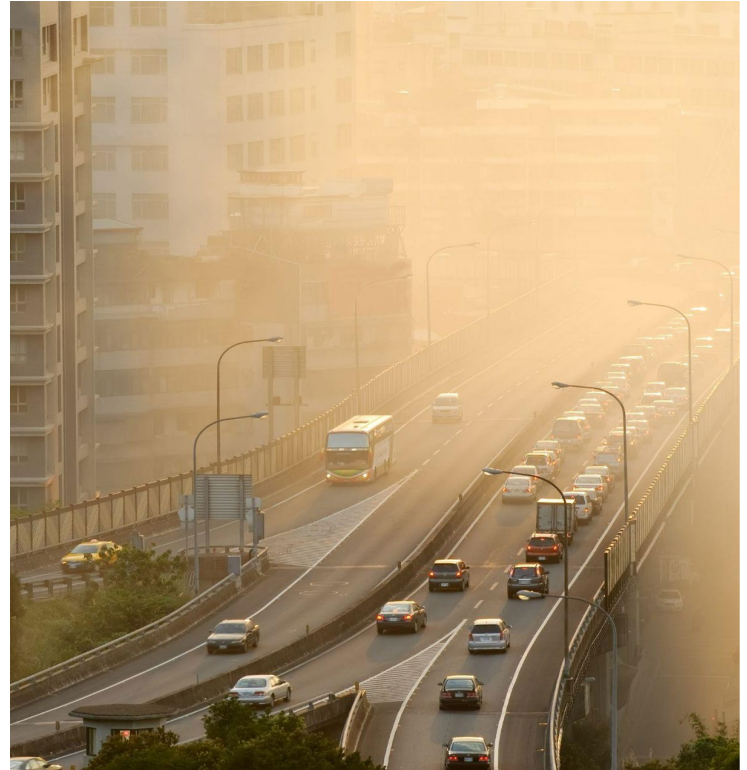
We lead evaluation trainings to build the capacity of organizations to generate and use evidence.

J-PAL aims to add value to determining how we confront climate change using causal impact

- Synthesize transportation decarbonization research in North America that utilizes **experimental, causal evaluation methods**
- Identify gaps where academic research and local priorities are not aligned and develop a research agenda for researchers and governments to leverage randomized evaluation to identify **high-impact, equitable, and cost effective transportation decarbonization policies**
- **Build researcher/practitioner partnerships** to conduct future evaluations and support the evidence base

Behavior change and passenger transportation

- Transportation is the fastest growing contributor to global CO2 emissions. Passenger transportation makes up eighty percent of transport sector emissions in the United States.
- Current transportation systems perpetuate fossil fuel reliance and enforce systemic inequities.
- Decarbonization will require long term systemic changes, but in the short term we need to understand behavioral mechanisms.
- There are historic levels of federal funding to move transportation decarbonization forward:
 - Bipartisan Infrastructure Law: \$1.2 trillion
 - Inflation Reduction Act: \$5.6 billion
 - Equity priority



A roadmap of questions that can be informed by evidence along a project lifecycle



Identify and diagnose the problem

- What is the extent of the problem?
- Who is most in need?
- What are possible barriers?
- What are possible opportunities?

Needs assessment



Adapt or design program

- How have similar challenges been addressed in other contexts?
- What has worked/not worked?
- What are some general lessons about behavioral mechanisms that can be used to support the theory of change?

Inspiration for program design

Support theory of change



Implement and evaluate program/analyze results

- Is program implemented as intended?
- Does it reach the intended audience?
- Does the program have the intended impact?
- What are possible mechanisms through which the program works?

6

Process evaluation

Impact evaluation



Decision about scale/use evidence in future decisions

- Should we scale the program?
- If so, to whom?
- Should we adapt the program and test it again?
- Should we discard/scale down the program?

Decision to scale

Different types of evidence can provide valuable inputs at different stages of the project lifecycle

Descriptive and qualitative evidence

- Needs assessment
- Process evaluations
- Mechanisms through which a program worked

Correlational evidence

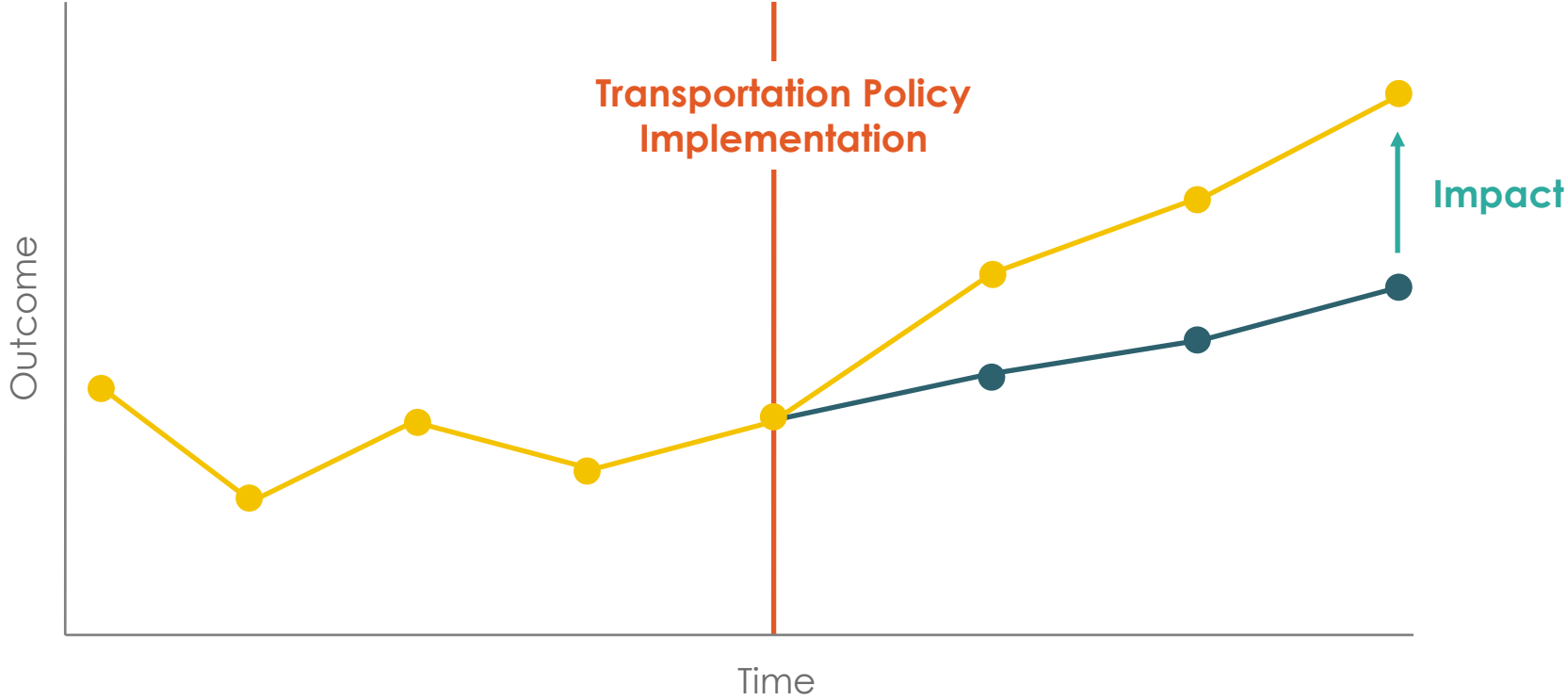
- Opportunities and barriers in the needs assessment
- Program components that might work to address the need

Causal evidence

- Inspiration for program design
- Support for theory of change
- **Impact evaluation**
- Decision of whether to scale

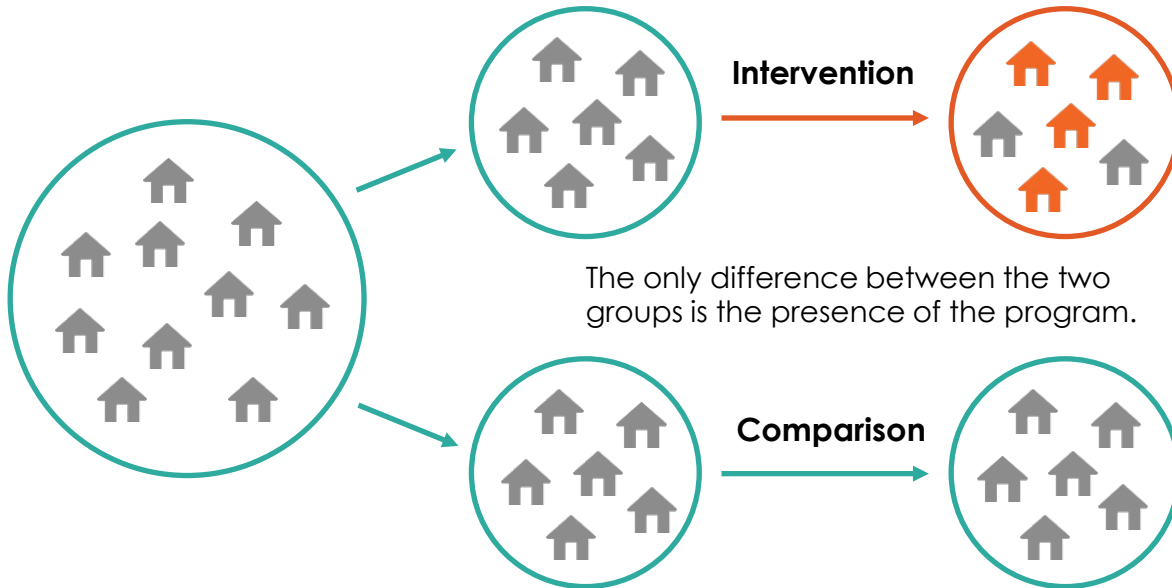
Does the claim match the data analysis?

In the field of impact evaluation, the most rigorous type of evaluation is a randomized evaluation.



How does randomization work?

Before a program starts, individuals are **randomly assigned** to two groups. With enough people, both groups have **statistically identical** characteristics, on average.



We measure outcomes of both groups.

Any differences in outcomes can be attributed entirely to the program.

Methodology

- Systematic literature review across 45 journals in the economic, environmental and transportation space
- Individual, land-based passenger transportation
- Inclusion criteria
 - Studies conducted in North America published between 2000 and September 2023
 - Methodologies with credible identification strategies including RCT, RDDs, and DID.
 - Policies and behavior shifts related to decarbonization
 - Policy feasibility
- Informal conversations with state and local policymakers
- Review of local Climate Action Plans

Overall findings

- Twenty-nine studies across three topic areas: **fleet transitions, public transit, and traffic congestion**
- **Four studies quantify the welfare impacts** of transportation policies
- **Six studies address the cost efficacy** of transportation policies
- **Fourteen studies address equity considerations** in some capacity, but how it is addressed varies widely
- There are **misalignments between the existing evidence and current policy priorities**. The research topics covered most frequently in the literature review are EV purchase incentives and tolls and congestion pricing

Recommendations

- **Align research with policy priorities**
 - Fleet shift
 - Public transportation
 - Traffic congestion
- Integrate equity into standardized measurements and data collection frameworks
- Design research using credible identification strategies and standardized welfare metrics

Research Priority Areas: Fleet Shift

- **Literature themes:** fuel economy information, EV subsidies, off-peak EV charging
- **Local priorities:** EV adoption and charging infrastructure
- **Research priorities:**
 - EV charger placement
 - Incentives for EV charger installation
 - Distributional impacts of EV adoption policies
 - Ongoing validation of existing policy estimates

Research Priority Areas: Public Transportation

- **Literature themes:** the impact of real time information on ridership, how other modes (e.g., bike or car share programs) complement or substitute transit, price elasticity
- **Local priorities:** increasing ridership and adjusting to new transit needs post COVID-19, first and last mile transit access, mobility hubs, fleet electrification
- **Research priorities:**
 - Micro-mobility and transit access
 - Behavioral messaging
 - Trade-offs between increased access and potential environmental impacts

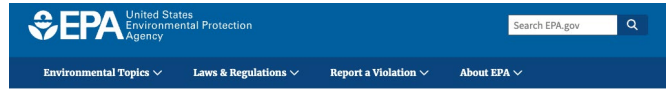
Research Priority Areas: Traffic congestion

- **Literature themes:** driving disincentives, infrastructure shifts, tolls or congestion pricing
- **Local priorities:** transportation demand management through behavior shift, universal basic mobility
- **Research priorities:**
 - Tolls and dynamic pricing
 - Universal basic mobility schemes

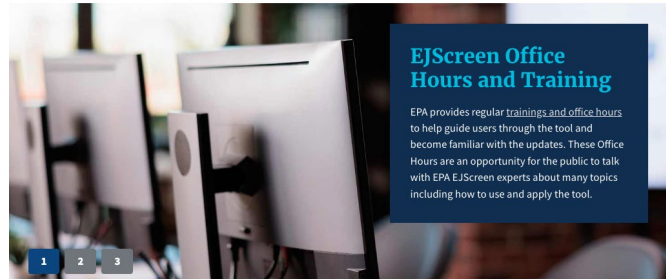
Recommendations

- Align research with policy priorities
 - Fleet shift
 - Public transportation
 - Traffic congestion
- **Integrate equity into standardized measurements and data collection frameworks**
- Design research using credible identification strategies and standardized welfare metrics

Integrating equity into standardized measurement and data collection frameworks



EJScreen: Environmental Justice Screening and Mapping Tool



Energy Justice Dashboard (BETA)

Office of Energy Justice and Equity



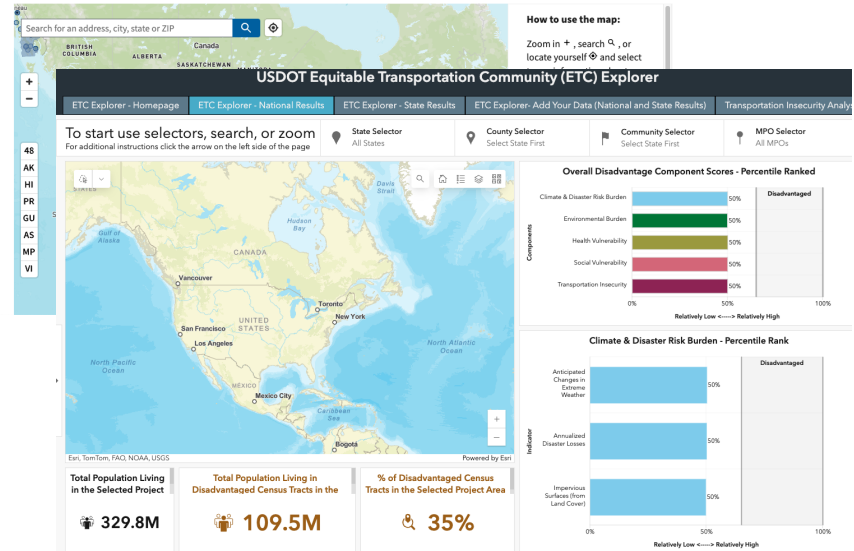
Explore the map

Census tracts that are overburdened and underserved are highlighted as being disadvantaged on the map. Federally Recognized Tribes, including Alaska Native Villages, are also considered disadvantaged communities.

Zooming in and selecting shows information about each census tract.

Get the data

Download the data with documentation and shapefile from the [downloads](#) page.



Recommendations

- Align research with policy priorities
 - Fleet shift
 - Public transportation
 - Traffic congestion
- Integrate equity into standardized measurements and data collection frameworks
- **Design research using credible identification strategies and standardized welfare metrics**

Design research using credible identification strategies and standardized welfare metrics

- Studies that quantified welfare or environmental impacts used a variety of outcome metrics and assumptions, making it **difficult to compare studies against each other**
- To enable policymakers to make faster and more accurate decisions, future research should:
 - Leverage credible identification methods to increase **generalizability**
 - Standardize welfare and environmental metrics through measures such as the **Marginal Value of Public Funds**, which can capture distributional policy benefits and enable policymakers to compare policy results

Learn more and collaborate with us!

- The *Designing and Implementing a Research Agenda for Transportation Decarbonization* white paper is available through the J-PAL website
- Visit the J-PAL North America Evidence for Climate Action Project web page to learn more
- Sign up for the J-PAL newsletter to stay to connect to stay up to date



Contact: Maggie Dennis
mdennis@povertyactionlab.org



Stanford

School of Engineering &
Doerr School of Sustainability
Civil & Environmental Engineering



BILLINGTON LAB
BUILDING FOR WELLBEING

Human-Centered Engineering Design

How architectural interventions can impact wellbeing

Prof. Sarah Billington

*UPS Foundation Professor and Chair
Civil & Environmental Engineering*



Webinar: Behavioral Science and Nudge Applications in Transportation

Billington Lab

Building for Wellbeing



Buildings

Nature

People

The History of our Lab

1997-2019

How can innovative materials create more durable infrastructure?

Cement-based Materials

2004-2018

Can we develop building materials that are better for the environment?

Bio-based Polymeric Composites

2018 - present

How are our materials and designs impacting our wellbeing?

Human-Building Interaction

Our Current Projects



**Hybrid physical
+ digital spaces**



**Affordable
Housing**



**Biophilic
Design**



**Ethical Supply
Chains**





The future is urban

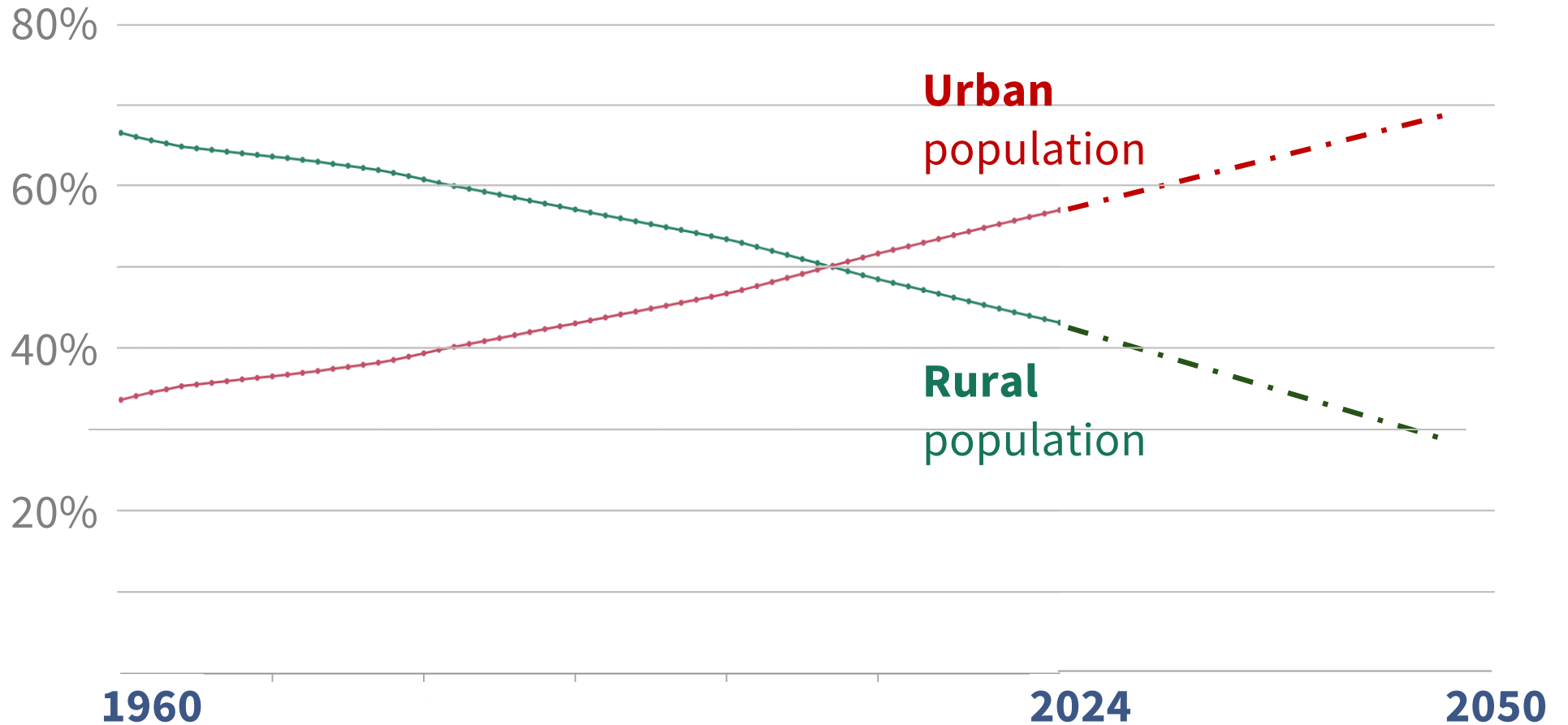
2050

No data

Majority Rural

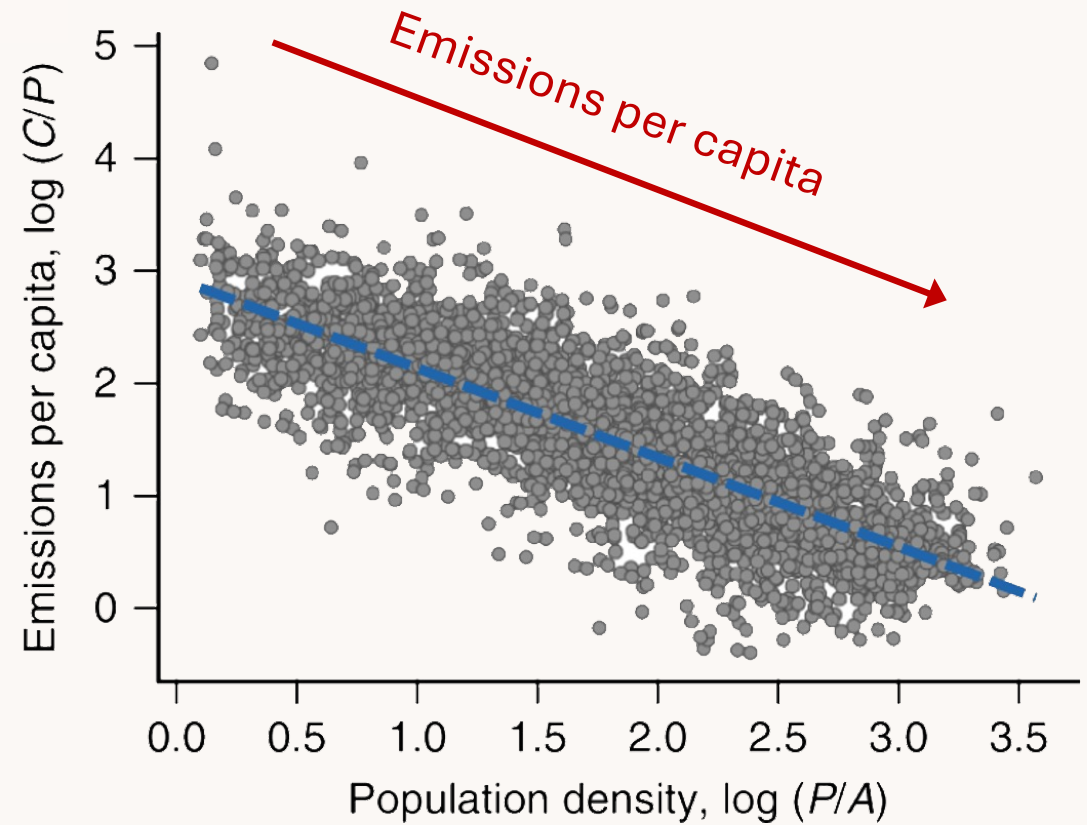
Majority Urban

Our shift from rural to urban environments



Adapted from World Bank based on data from the UN Population Division

When developed successfully, dense urban settings have environmental benefits



Ribeiro et al., 2019

Challenge: Dense urban environments can feel like concrete jungles



Hybrid Physical + Digital Spaces (HPDS)



How do built features impact occupants?



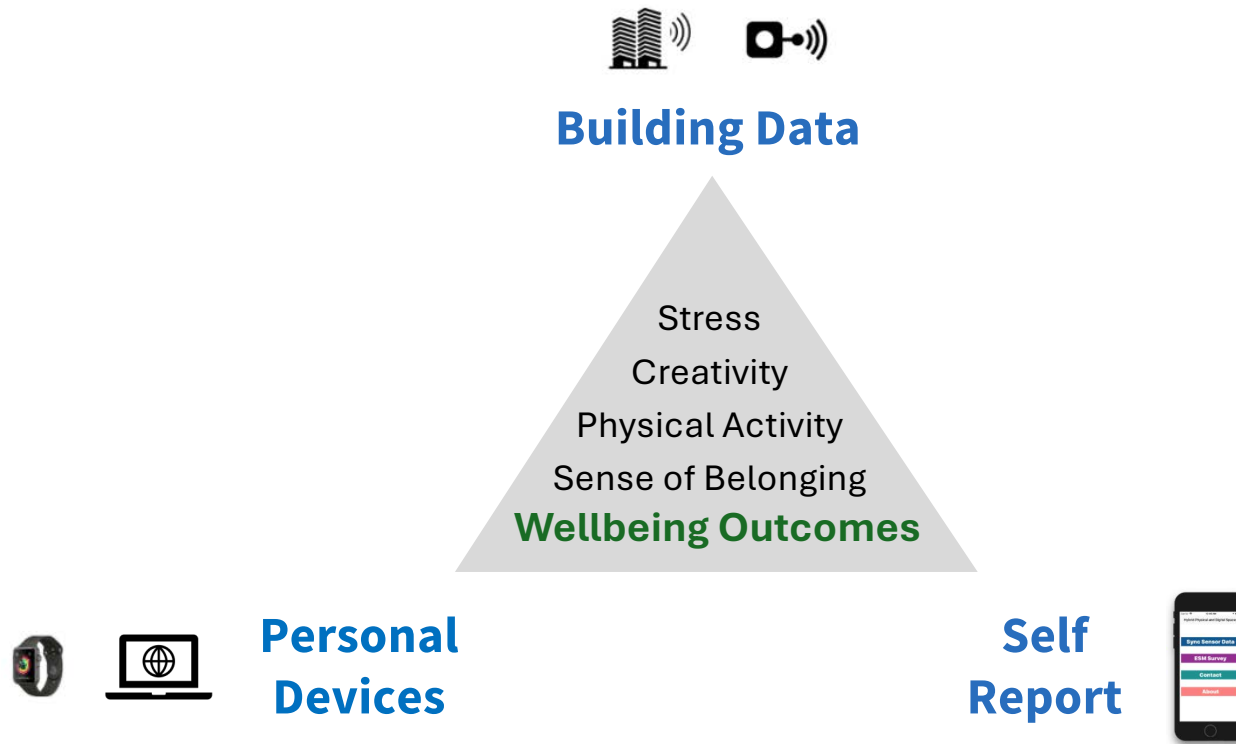
How can we design buildings to promote wellbeing over time?



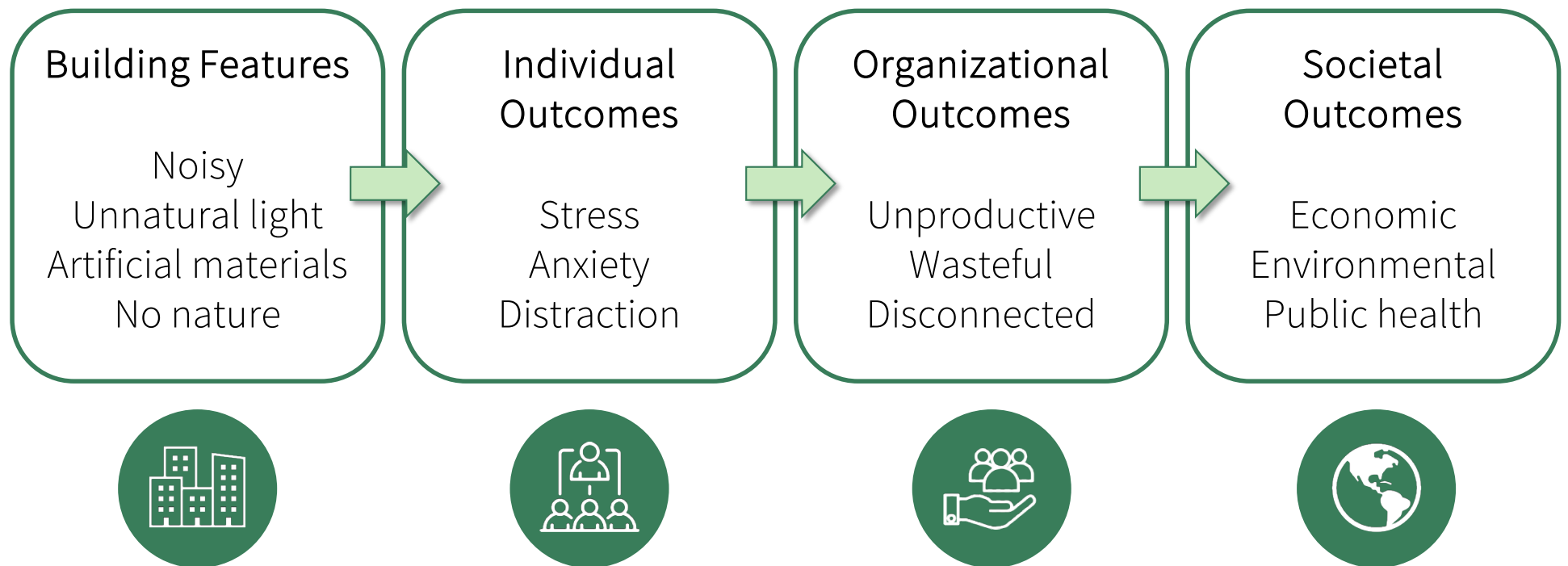
Civil Engineering
Computer Science
Environmental Behavior
Law/Privacy
Psychology

Hybrid Physical + Digital Spaces (HPDS)

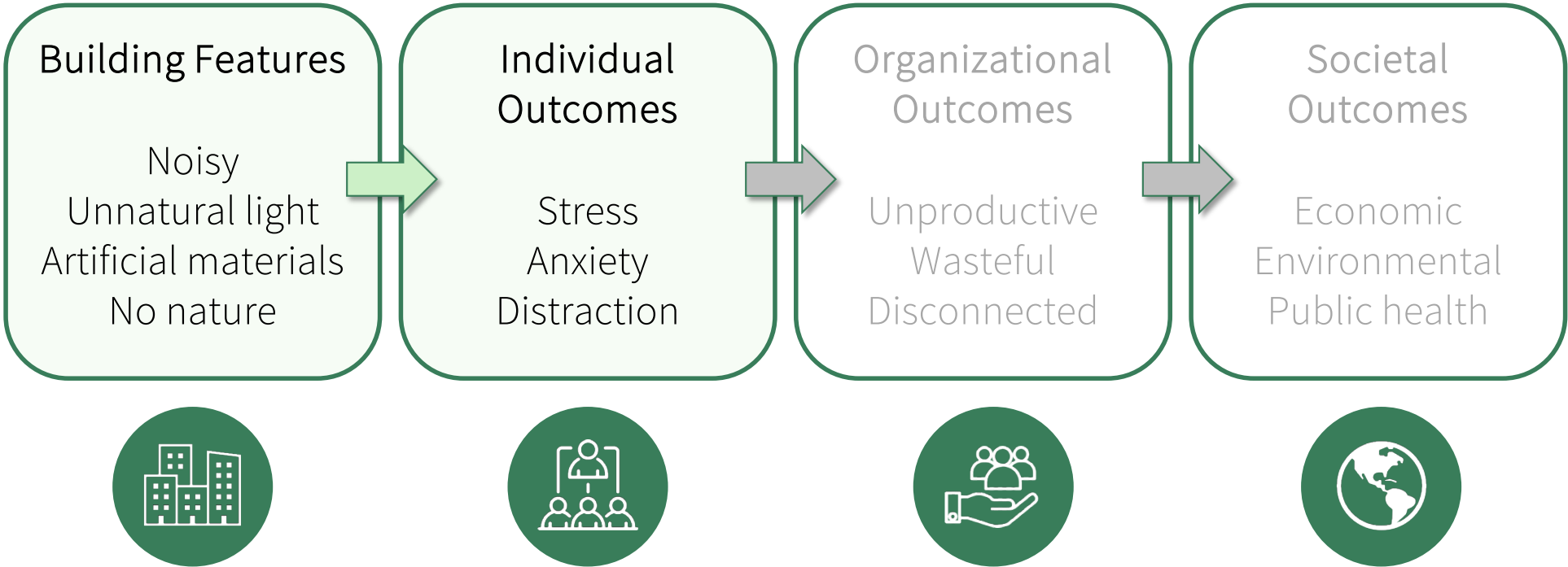
A platform to understand how building design impacts human wellbeing over time



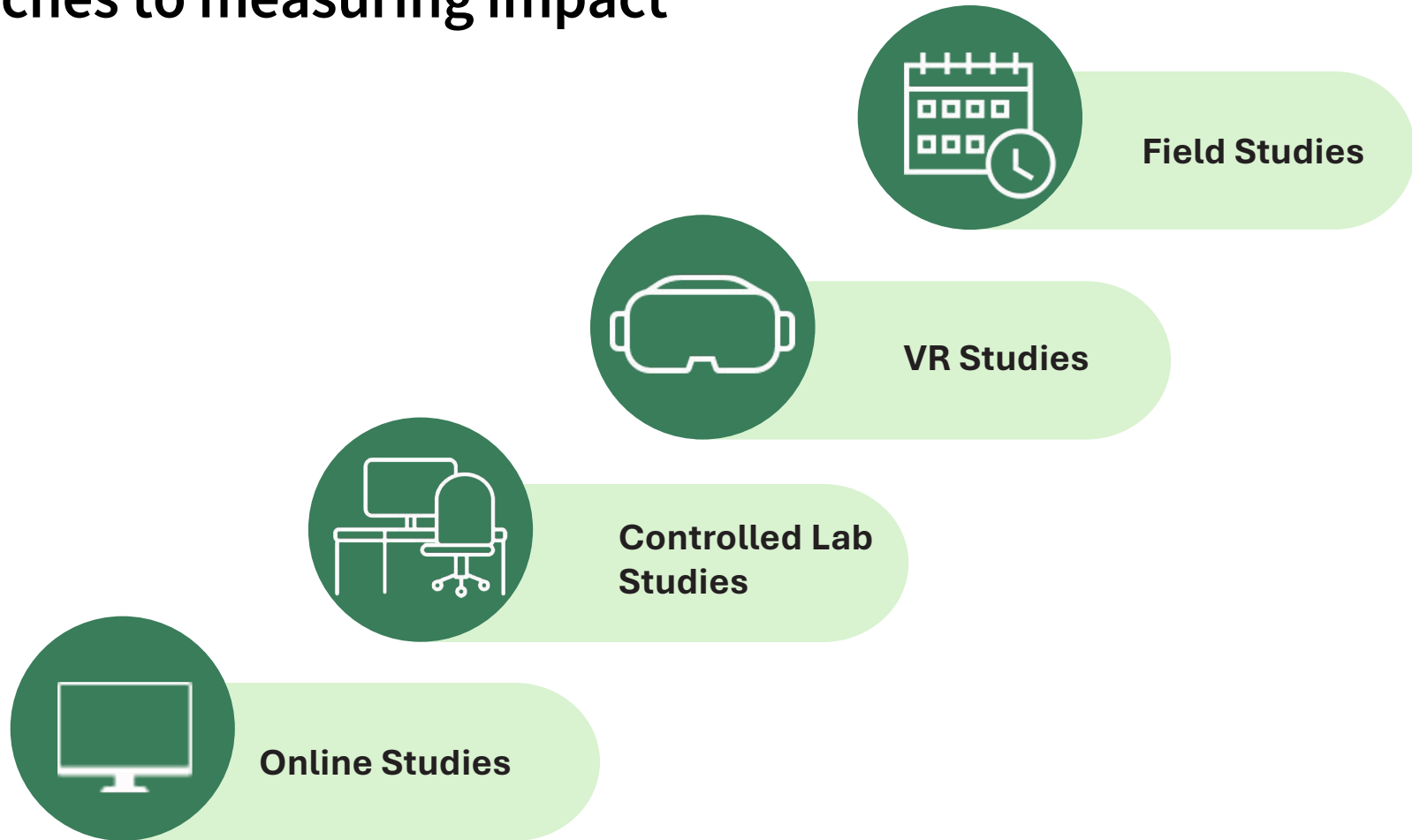
Why measure the impact of built & digital features?



Why measure the impact of built & digital features?



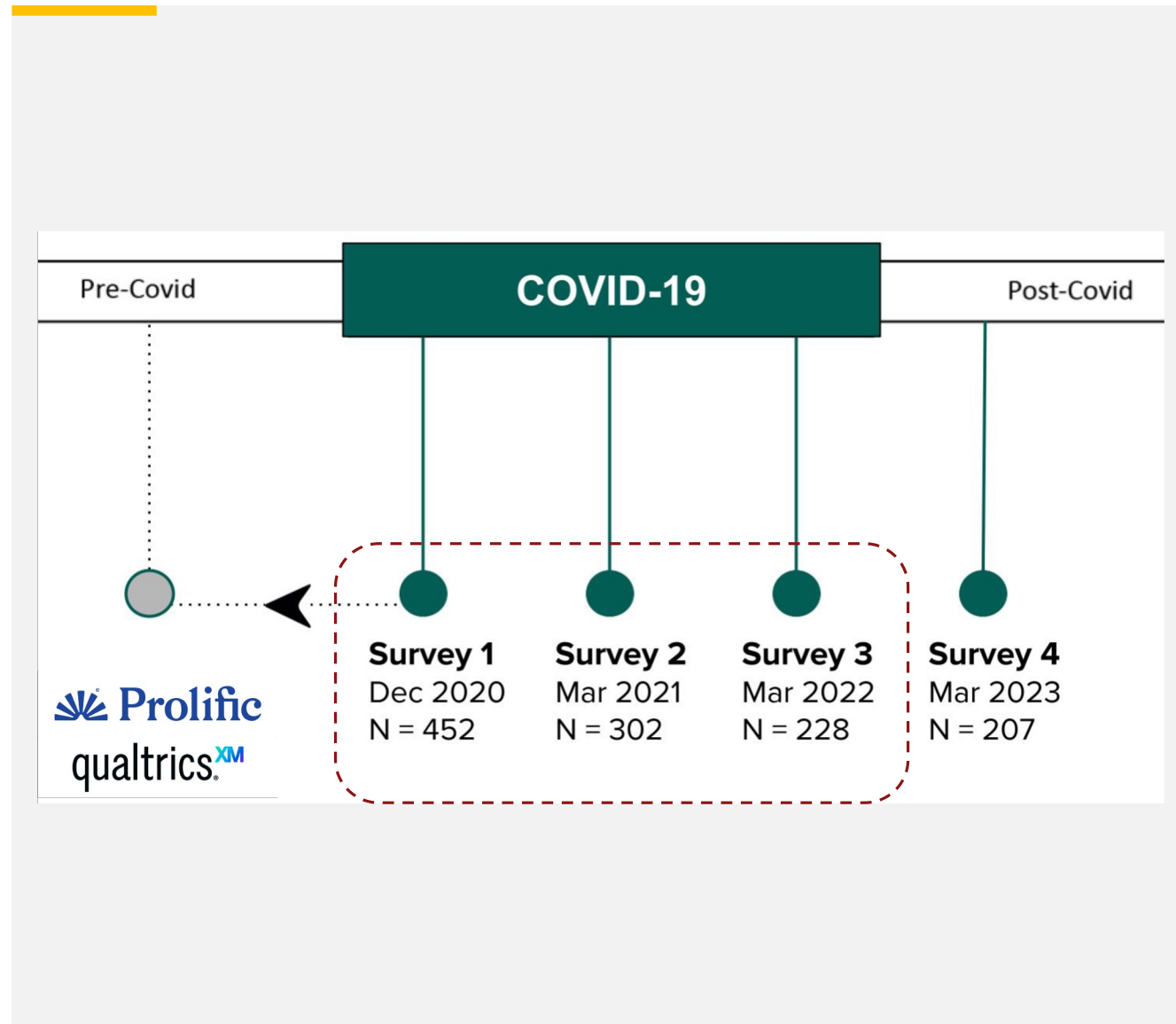
Approaches to measuring impact



Longitudinal Online Study

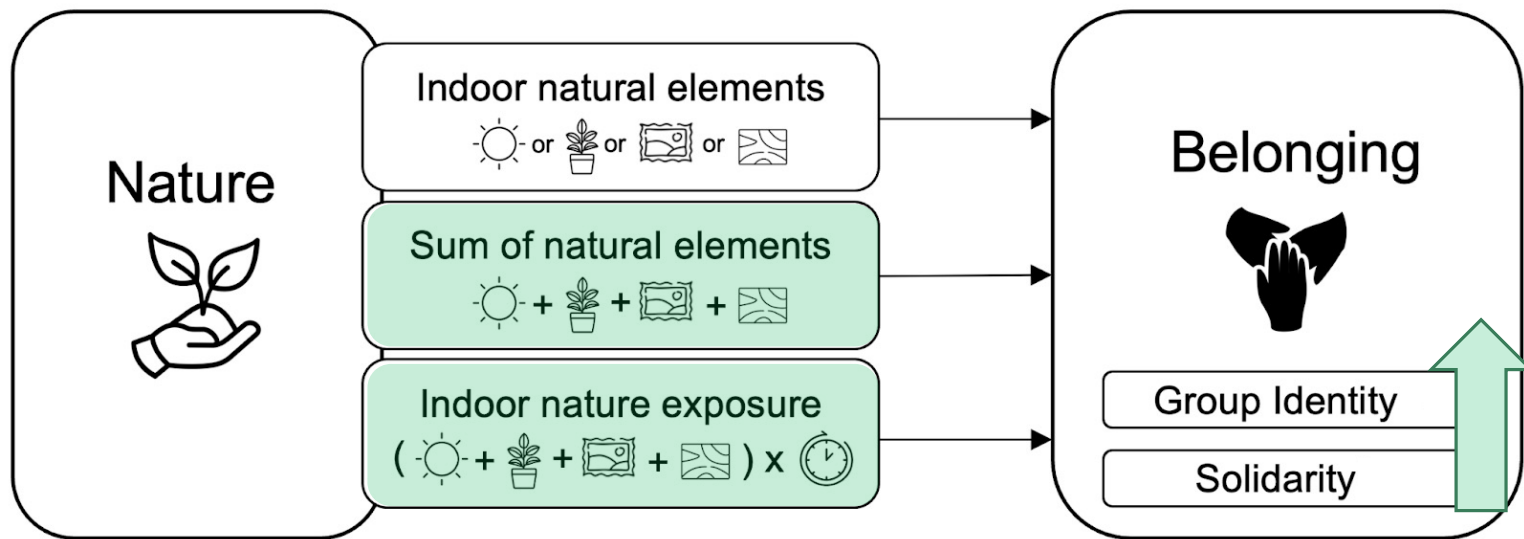
Impact of home office environments on:

- Time perception
- Stress
- Sense of belonging at work



Impact of Built Features on Sense of Belonging

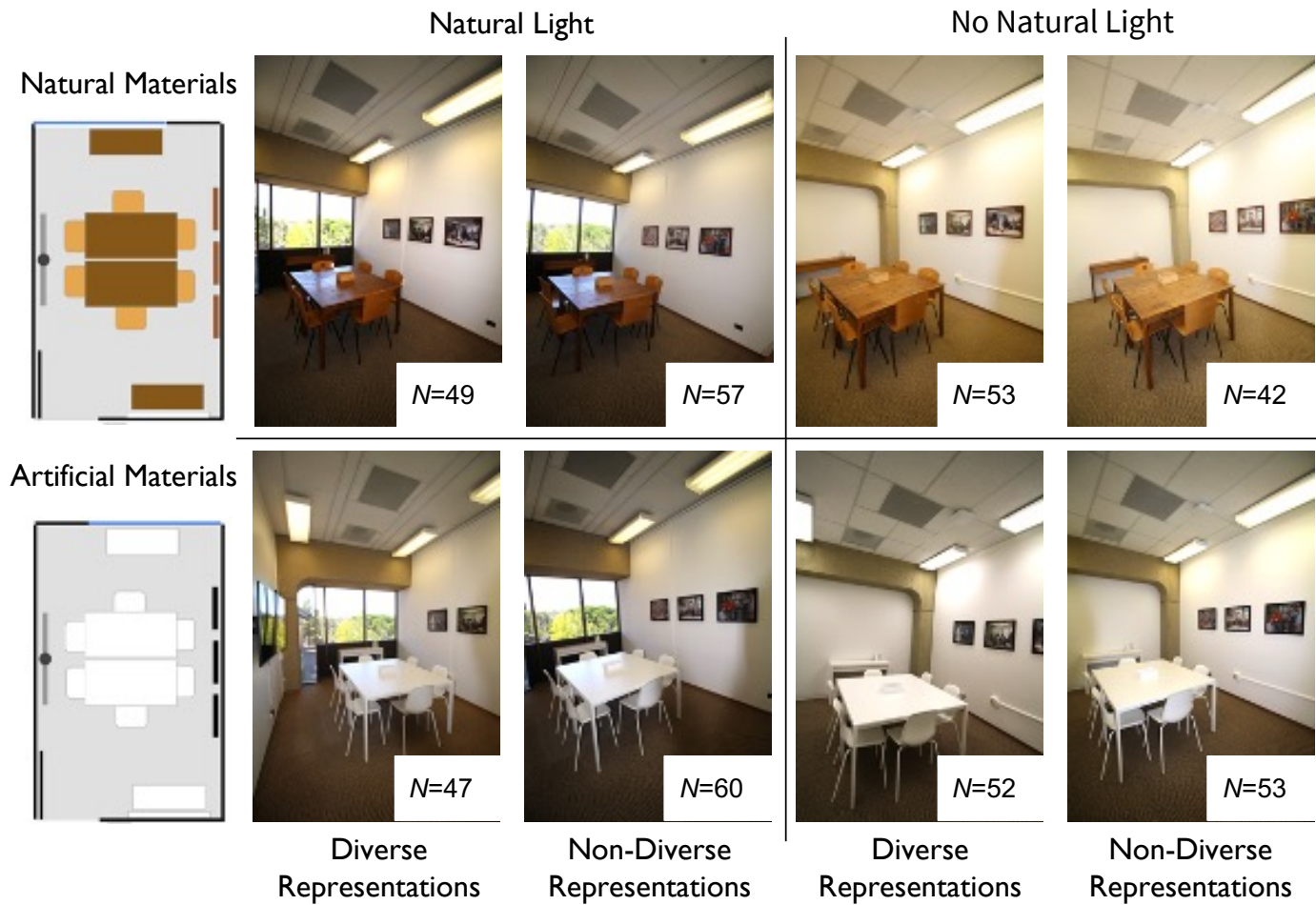
Sense of belonging at work increases with exposure to indoor nature at home office



Longitudinal, online study
($N = 452, 302, 228$)

Bianchi et al., 2023

Impact of Built Features on Stress



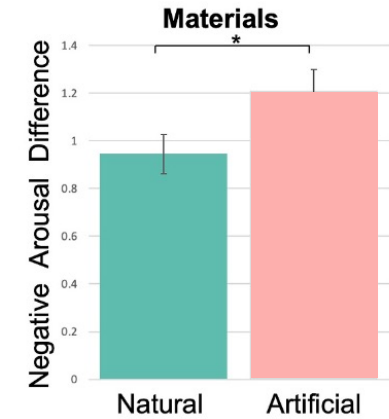
Douglas et al., (2022)

Impact of Built Features on Stress

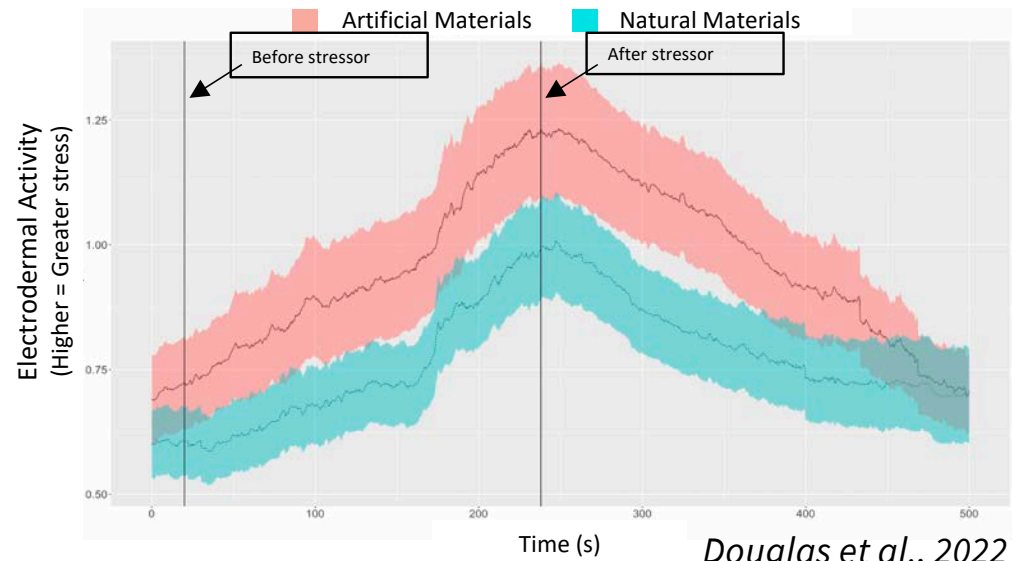
The presence of **natural materials** leads to **lower negative stress impacts** after an acute stressor task



Self-report
(N=412)



Physiological Measurement (Empatica watch)



Douglas et al., 2022

Measuring the Wellbeing Outcomes (Dependent Variables)

Belonging	Stress	Creativity	Pro-Environmental Behavior
Self-report Social and Academic Fit Scale	Self-report Stress Negative Arousal Positive Arousal Sensor Physiological Stress	Self-report Adjective Checklist Scored Remote Associates Task (<i>Convergent Creativity</i>) Brainstorming Task (<i>Divergent Creativity</i>)	Self-report Connectedness to Nature Scale Environmental Attitudes Inventory Behavior Charitable Donation

Douglas et al., (2022)

Can we replicate the results in Virtual Reality?

Virtual Reality

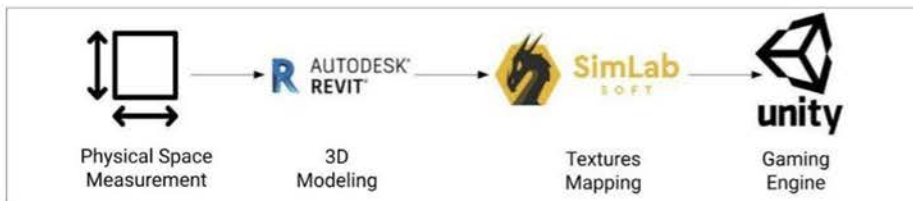


Lab



Can we replicate the results in Virtual Reality?

A) Virtual Environment Modeling



D) Data Collection



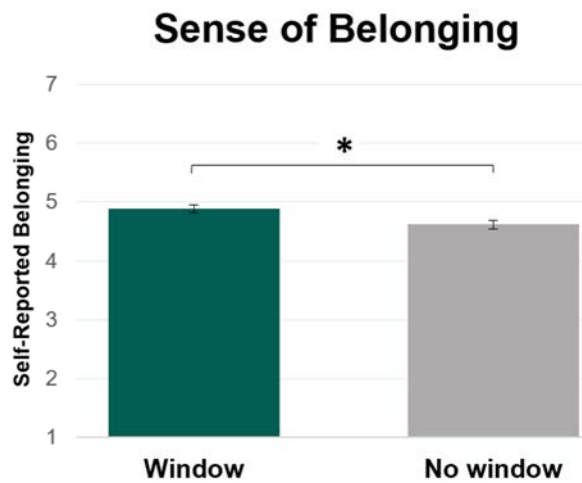
B) Experimental Setup



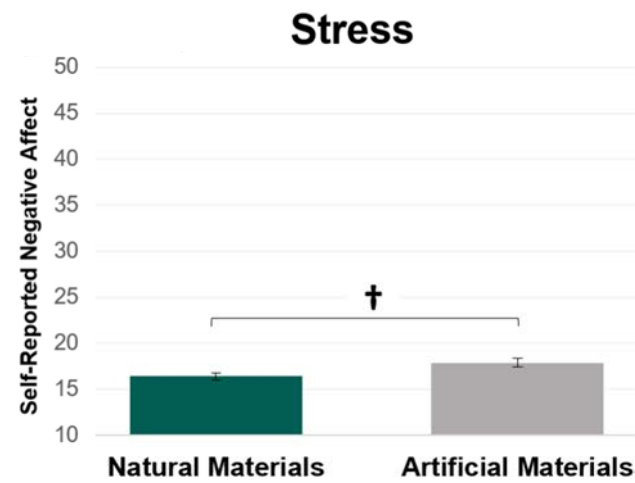
C) Virtual Environment



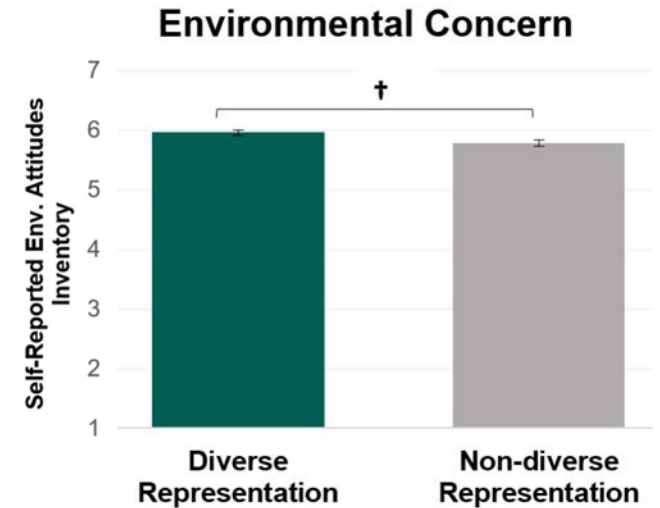
Wellbeing outcomes in VR with significant findings



Similar to online studies



Similar to in-person lab study



Similar to online studies

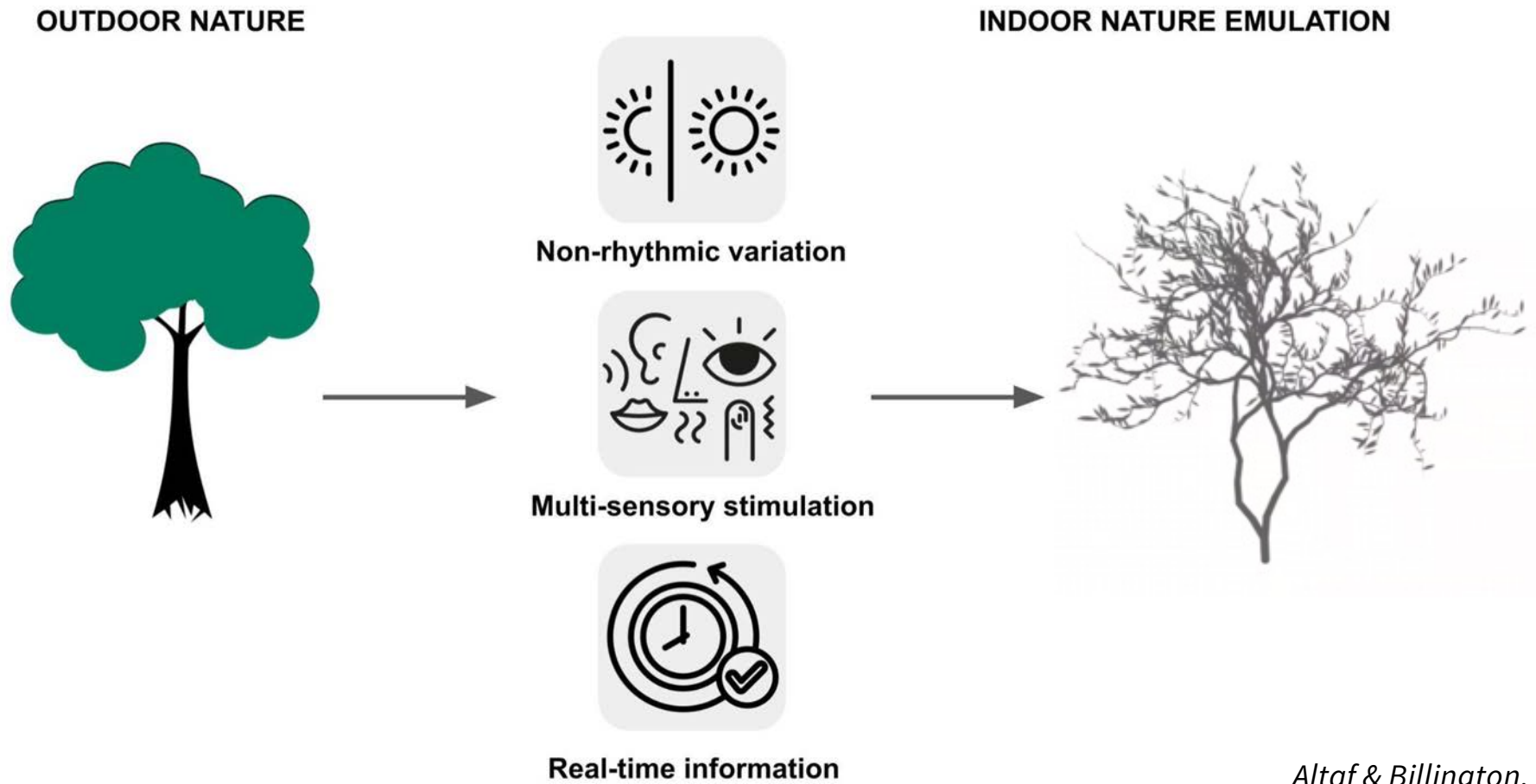
Error bars are standard error

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.1$

How can we increase access to nature to support wellbeing?

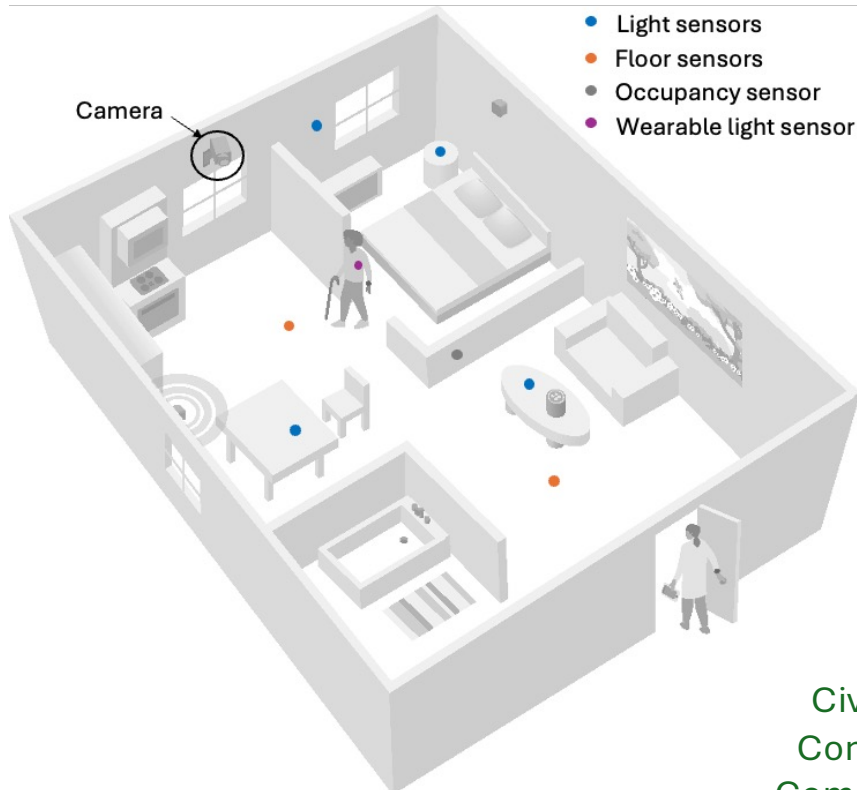


Biophilic illusions: connection to nature in windowless spaces



Altaf & Billington, 2024

Hybrid Physical + Digital Spaces for Aging in Place & Upskilling Health Aides



Continuous monitoring allows us to give the right care at the right time

Civil Engineering
Communications
Computer Science
Medicine/Geriatrics
Psychiatry



Our Current Projects



**Hybrid physical
+ digital spaces**



**Affordable
Housing**



**Biophilic
Design**



**Ethical Supply
Chains**



Public Perceptions of Affordable Housing

California study

How do the labels *affordable*, *historic*, and *sustainable* impact California residents' support of housing?



**Dr. Isabella
Douglas**



**Draper
Dayton**
UG researcher



**Prof. Arash
Tavakoli**
Villanova Univ.

Set of four affordable housing developments

Medium-Sized Developments

Large-Sized Developments

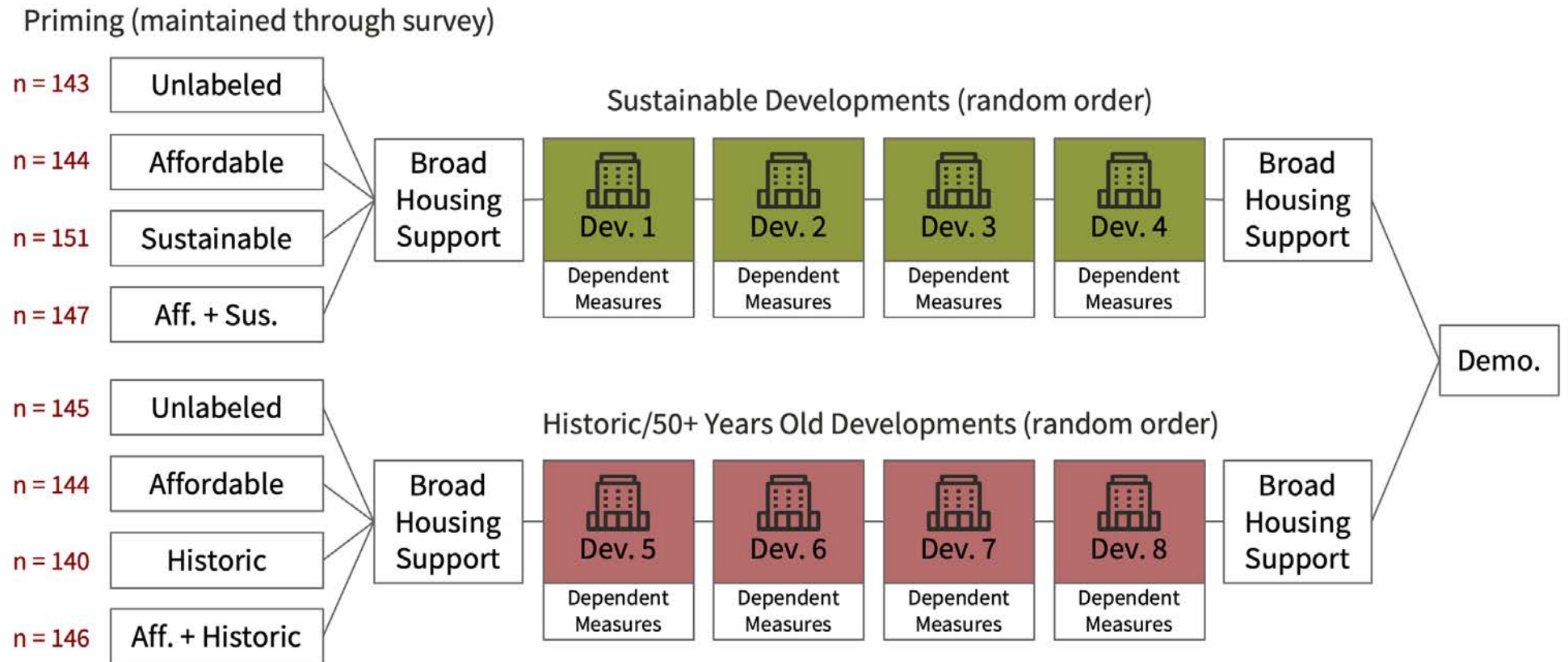
Suburban



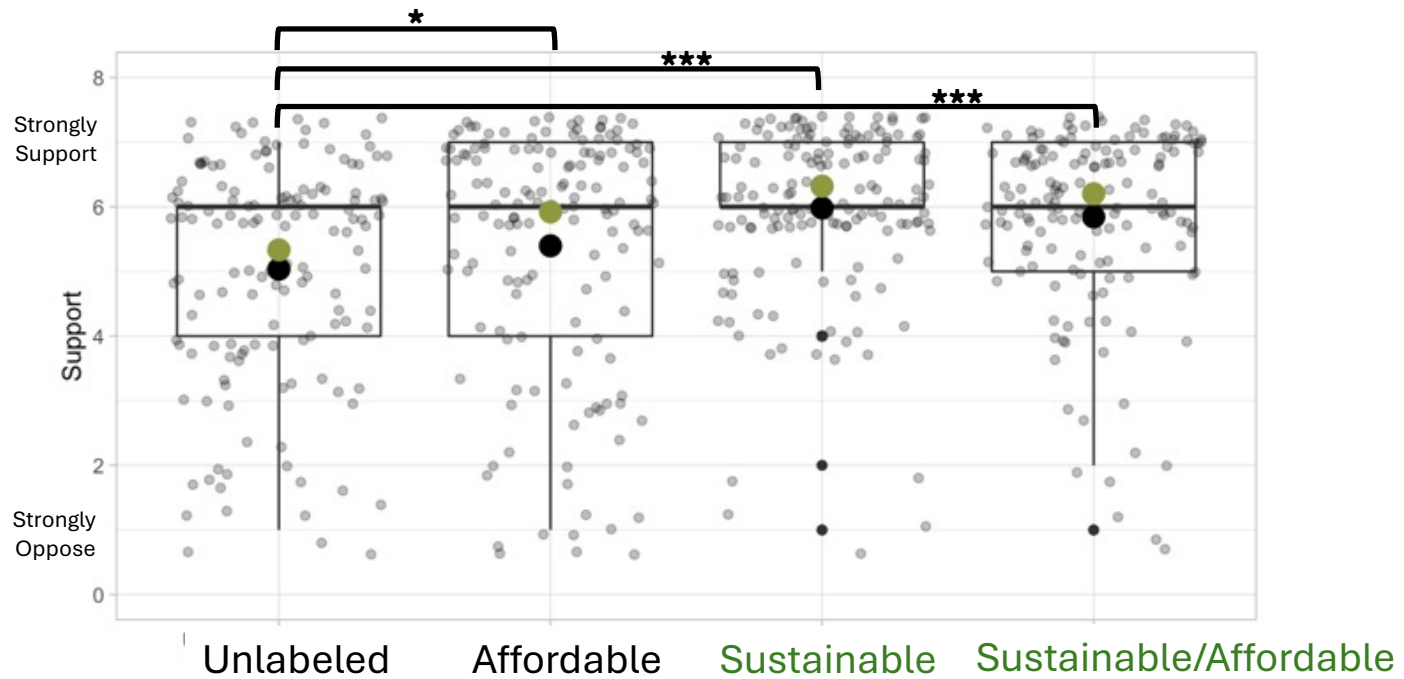
Urban



We deployed a between- and within-subject online study (N=1,160)



Broad support for additional housing in neighborhood increased with labels

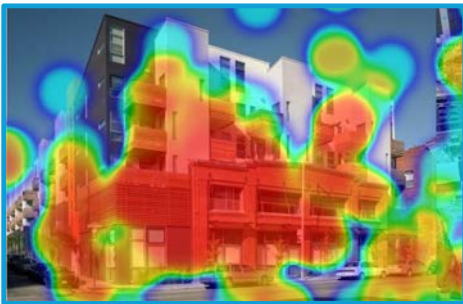


p-value ≤ 0.10 †, p-value ≤ 0.05 ††, p-value ≤ 0.01 †††, p-value ≤ 0.001 ††††

Public Perceptions of Affordable Housing & Neighborhood Condition

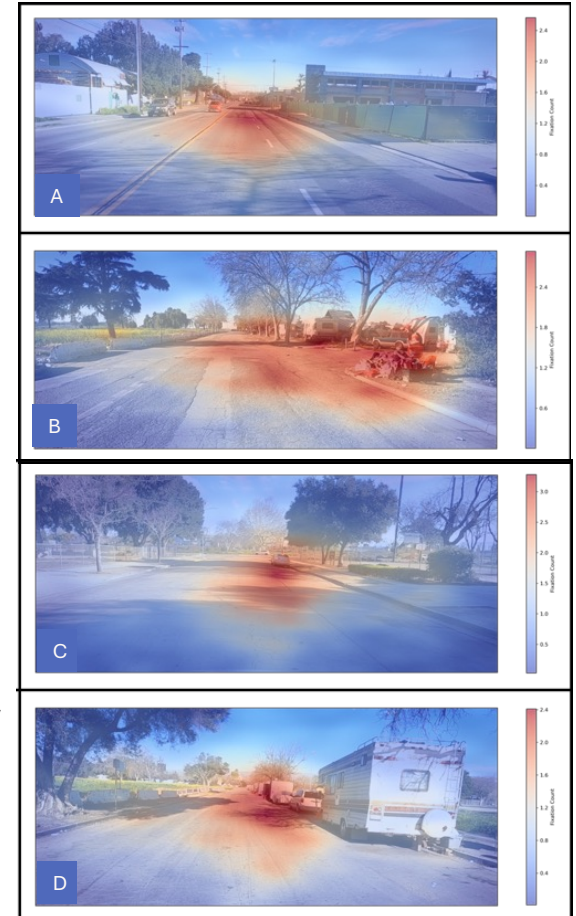


Eye-tracking



We are repeating the housing study with eye-tracking

We found that neighborhood scenes with **trash** are possibly observed in a more **conscious** way than scenes with RVs, construction, or parks (Tavakoli et al., 2024)



Our current projects



**Hybrid physical
+ digital spaces**



**Affordable
Housing**



**Biophilic
Design**



**Ethical Supply
Chains**



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Thank you



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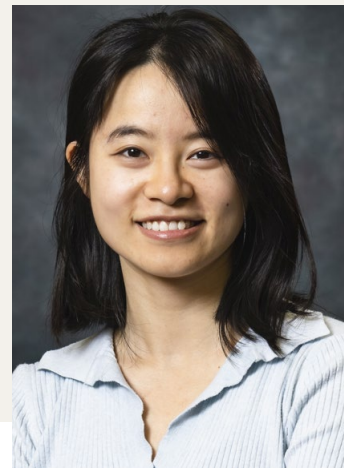
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November 19, 2024

TRB Webinar: Rural Accessibility to
Economic Opportunities and
Education

November 20, 2024

TRB Webinar: Intermodal Passenger
Facility Trends in Technology and
User Experience



[https://www.nationalacademies.org/trb/
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*January 5 – 9, 2025
Washington, D.C.*

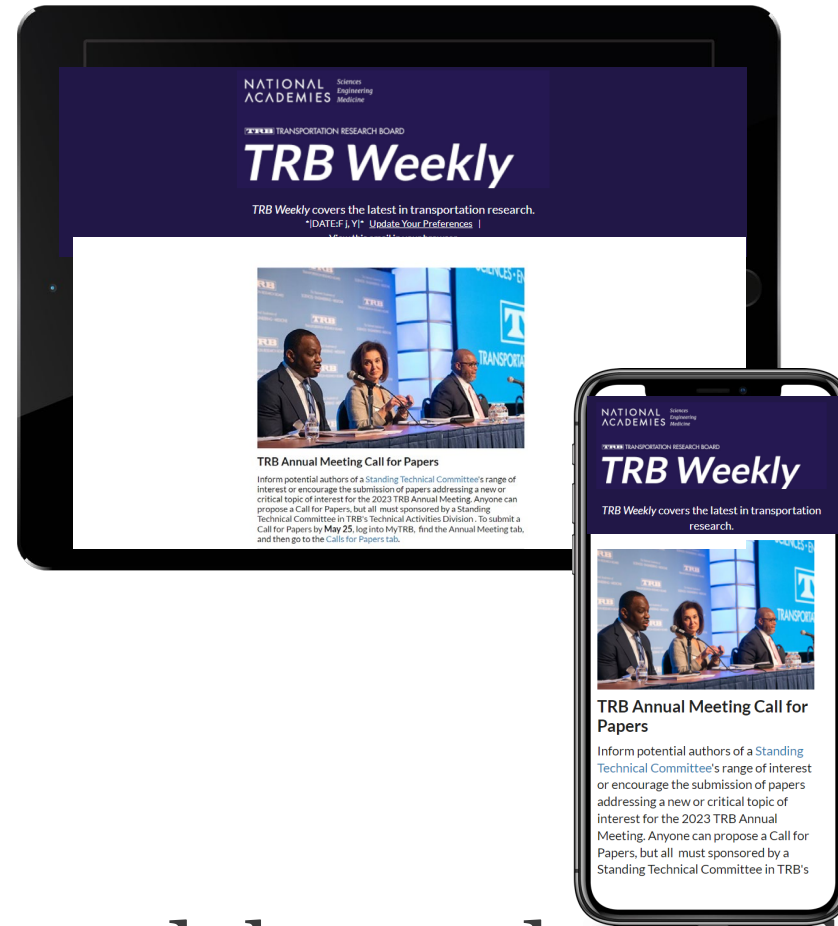


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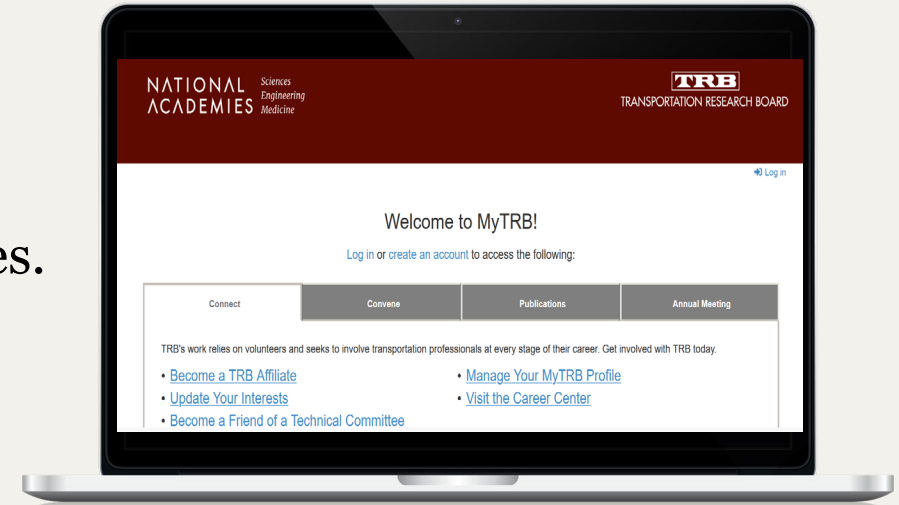


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