From Simple Labels to Time-Use Integrations: Supporting the Spectrum of Qualitative Travel Behavior Data

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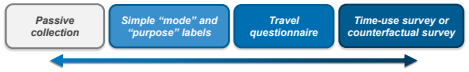
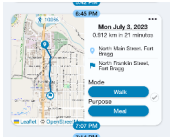
INTRODUCTION & MOTIVATION

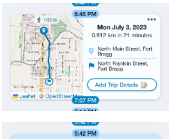
In transportation research, applications of travel behavior data collection are context-specific. While passive data collection may be sufficient in some use cases, others may benefit from qualitative input from participants. These inputs can be viewed as spanning a spectrum of user burden and data quality, from simple trip labels to complex time-use surveys.

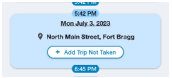
Trade-off: user burden vs. richness of data

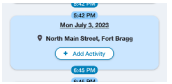


We will demonstrate that any or all of these can be collected by a smartphone travel diary app that collects both location data and input from users.









Mode and Purpose Labels

- Prompt users to label the modes and purposes of their trips.
- Options presented in a drop-down menu or in multiple-choice format.
- Used in program evaluation, where the goal is to evaluate the impact of a particular mode versus another.[1,2]

Classic Travel Questionnaire

- Per-trip or per-place questionnaire that can provide more detailed information.
- May prompt for mode and purpose, as well as cost, party size, and more.
- Used in research contexts where a deeper understanding of travel patterns and choices is desired.

Counterfactual "Trips Not Taken" Survey

- Travel diary apps could also prompt users to record "missed trips" or "trips not taken" in a travel diary app.
- Insight into latent demand and barriers to mobility for low-income, elderly, and disabled populations.

Time-Use Survey

- Time-use data tell us how people allocate their time among different activities.
- Sheds light on work-from-home behavior, online shopping habits, and immobility rates, all impacting travel demand and transportation planning.

RELATED WORK

A review of the existing literature and other travel diary apps revealed that while there have been many smartphone-based travel diary solutions, most of them do not cover the full spectrum of use cases.

Based on the publicly available information about various travel diary platforms, we evaluated their capability to support multiple use cases.

	license	sense	label	questionnaire	time	App last updated
rMove	closed	Y	?	Y	?	2022 (Google Play)
MotionTag Catch-My-Day	closed	Y	Y	N	N	2023 (Google Play)
TimeUse+	closed	Y	N	N	Y	2022 (App Store)
Atlas II	closed	Y	Y	Y	?	2019 (Google Play)
City Logger	closed	Y	Y	N	N	2017, not in stores
Daynamica	closed	Y	Y	Y	Y	2023 (App Store)
Ilinerum	open	Y	Y	N*	N?	2018 (Github)
MEILI	open	Y	Y	N	N	2017 (Github)
ohmage	open	Y	N	Y	?	2015 (Github)
Statistics Netherlands TABI	open	Y	Y	Y**	N	2020 (Gitlab)

*Ilinerum allows the configuration of which pre-defined prompts to show, but does not document a way to include fully custom questionnaires

**TABI supports day-level questionnaires, but support for trip-level or place-level questionnaires could not be verified

license: open-source platforms have their code publicly visible in a Git repository; closed-source platforms are proprietary or otherwise not public.
sense: support for continuous collection—i.e., background sensing.
label: support for mode and purpose labels.
questionnaire: support for a detailed travel questionnaire, which may prompt for a variety of qualitative inputs.
time: support for time-based survey prompts, which may be used to record activities performed (time-use survey) or that might have been performed under some other circumstance (counterfactual survey).

Information on the reviewed closed-source projects was limited, particularly with reference to the level of configurability they support. Since the details of the architectures underlying these platforms are not publicly available, we based our findings on screenshots of the apps, promotional descriptions of app features, and literature describing how the apps were used in research contexts.

The open-source projects on this list generally had more public information, including documentation, describing their functionality. However, many of these projects have unfortunately become obsolete due to a lack of active maintenance.

This suggests a compelling need for a universal, open-source travel diary platform that supports a broad range of use cases while also outlining a clear path to customization for each of its applications.

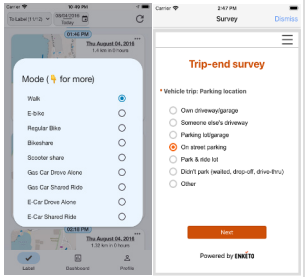
IMPLEMENTATION: NREL Open Platform for Agile Trip Heuristics (NREL OpenPATH)

We expanded NREL OpenPATH to support a dynamically configurable in-app survey mechanism. This means that each deployment of the app has its own set of options and its own surveys, but all deployments benefit from the same shared architecture.

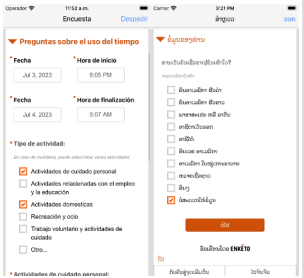
We also outline a streamlined process for the app to be deployed for a particular use case. Thus, the app can be easily customized without changing the code.

Each program or study has its own configuration file specifying which surveys will be used.

The survey questions themselves can be created and edited with a web builder (pictured) or a spreadsheet file.

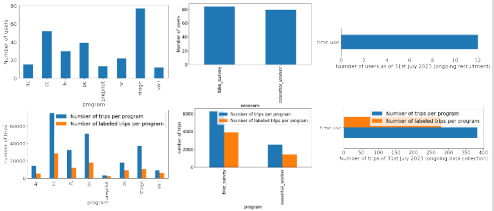


Mode and Purpose Labels *Trip Questionnaire*



Time-Use Survey (in Spanish) *Demographics Survey (in Lao)*

EVALUATION (Deployment Results)



NREL OpenPATH has already been deployed across several use cases, including:

- The CanBikeCO e-bike program[1,2] ("mode," "purpose," and "replaced mode" labels)
- "Essential Worker" and "Bike" surveys (trip questionnaire)
- Chicago Time-Use Study (time-use survey, still ongoing).

CONCLUSIONS AND FUTURE WORK

Our work suggests that:

- A single, open-source platform can be used for a multitude of data collection and analysis scenarios in transportation research.
- The research community could benefit from a more unified effort in developing and refining the tools supporting the research; by collaborating and pooling resources, the community can collectively advance the field much more rapidly.
- Smartphone app-based travel diary data collection possesses distinct characteristics and abilities compared to traditional methods, and the scale and duration at which collection can occur is much greater.

We look forward to working with the community to explore novel use cases and refining the implementation of our tools.

REFERENCES

1. Shankari, K., A. Duvall, and L. Boyce. 2021. "The CanBikeCO Mini Pilot: Procedure and Preliminary Results."
2. Akcicek, C., Z. Aemmer, K. Shankari, and A. Duvall. 2023. *Freewheeling: What Six Locations, 61,000 Trips, and 242,000 Miles in Colorado Reveal About How E-Bikes Improve Mobility Options*. Golden, CO: National Renewable Energy Laboratory.

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