# CollaboPlanner: Integrating Mobile Phones and Public Displays for Collaborative Travel Planning

**Nami Tokunaga**
FX Palo Alto Laboratory, Inc.
3174 Porter Drive, Palo Alto,
CA 94304, USA
tokunaga@fxpal.com

**Jennifer Marlow** [a]
Google, Inc.
1600 Amphitheatre Parkway,
Mountain View, CA 94043,
USA
jamarlow@google.com

**Scott Carter**
FX Palo Alto Laboratory, Inc.
3174 Porter Drive, Palo Alto,
CA 94304, USA
carter@fxpal.com

[a]This work was done while this author was at FX Palo Alto Laboratory, Inc.


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## Abstract
Searching collaboratively for places of interest is a common activity that frequently occurs on individual mobile phones, or on large tourist-information displays in public places such as visitor centers or train stations. We created a public display system for collaborative travel planning, as well as a mobile app that can augment the display. We tested them against third-party mobile apps in a simulated travel-search task to understand how the unique features of mobile phones and large displays might be leveraged together to improve collaborative travel planning experience.

## Author Keywords
Public display; Collaboration; Mobile devices; Tourism

## ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

## Introduction
Traveling and visiting new cities is often done in pairs or groups, yet prior work suggests that the technologies available to travelers prevent effective collaborative trip planning. Often planning is performed using a mobile phone, or sometimes a large public display in a visitor center or transportation hub. Mobile phones and public

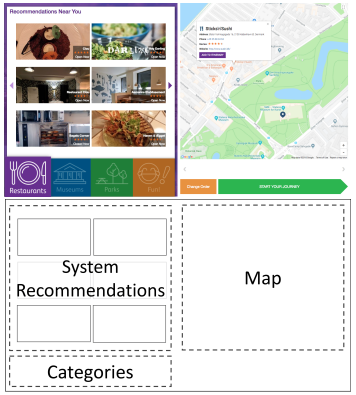


**Figure 1:** The main itinerary creation screen.

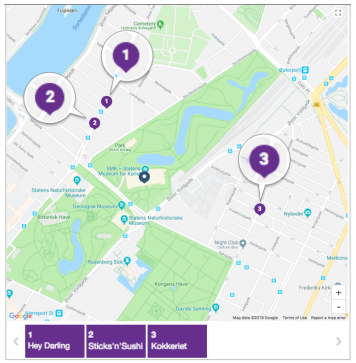


**Figure 2:** Users can compare destination locations on the map.

displays have different (and sometimes complementary) advantages in terms of supporting collaborative decision-making in the tourist context. To explore these issues, we designed and implemented CollaboPlanner, a collaborative itinerary planning application that combines mobile interaction with a public display. We compared three methods for a collaborative travel itinerary creation: using mobile phones, a public display, and our hybrid mobile and public display system.

## Related Work

Both collaborative mobile search and interactive public displays have been studied in a variety of settings, from civic participation [7, 6] to gaming [3]. In contrast, here we focus on applying both of these technological platforms in a single system, specifically for point-of-interest search in the context of tourism in an unknown (foreign) city. Some research has looked at the effects of combining mobile devices with a shared large public display in order to increase the amount of screen real estate available to nomadic users [4] and to disperse control and access across multiple users [5].

In the travel and tourism domain, other studies have looked at ways in which tablets and a shared large display could help with route creation using a map [2] by facilitating spatial awareness and awareness of others' search activities. While this work is focused on sharing map viewports in map-based search tasks, CollaboPlanner is focused on providing information about potential destinations. Brudy et al. found that groups using separate overview devices in addition to personal devices collaborated, shared, and discussed options more frequently [1], but it does not involve a large public display. CollaboPlanner, on the other hand, is designed for public displays and focused on tourists in a new city.

## System

We designed CollaboPlanner to support two scenarios: users creating travel itineraries with a public display application, and users creating travel itineraries with the public display and mobile applications combined.

*The public display system*

The public display system we created was designed to run on a large, touchscreen display. This system includes two core components: an itinerary creation web app and a simple, network-based messaging system to pass content between the display and mobiles. The core logic of the web app is implemented as a database-driven web server using Node.js and MongoDB. The main screen has three components: system recommendations, categories of interest, and a map showing the public display's location (Figure 1). Each recommendation includes a photograph, the destination's name, a rating, and text indicating whether it is currently open. Users can tap each picture to look at additional details such as more pictures, reviews from Yelp users, a distance, and a link to the destination's web page that the users can browse. We combined recommendations from two well-known rating apps APIs, Yelp APIs and Google Places APIs, to present a single set of system recommendations. Users tap a button to add a place to their current itinerary list below the map. Users can also click directly on destinations on the map and add them to the itinerary list. When destinations are added to the itinerary, they appear on the map as a numbered circle. Once a few locations are listed, users can compare them on the map (Figure 2).

*Hybrid public display and mobile application system*

When used in conjunction with the mobile application we built, the public display has space for mobile users' search results. Users can search for places and send selections

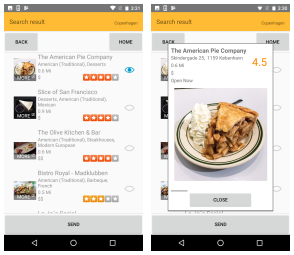

**Figure 3:** The mobile application allows users to peruse nearby destinations and upload them to the public display.

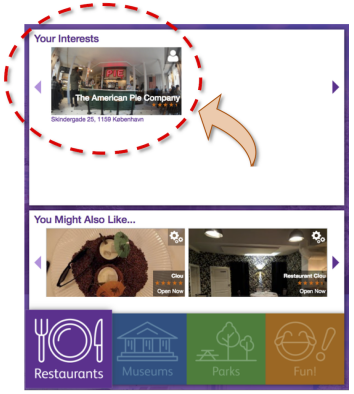


**Figure 4:** Destinations uploaded from the mobile app to the public display appear in the "Your Interests" panel on the public display.

to the public display using our mobile application (Figure 3). Our mobile app has two components: a place search component and a messaging system (the same one that the public display uses). We also used Yelp and Google Places APIs to aggregate information for search results. Users can also tap each picture to view details. Users tap the "SEND" button to upload selections to the public display: their selections appear in the "Your Interests" panel (Figure 4). The icons on the selections are colored according to the user that uploaded them. This allows users to see places that came from different mobiles on the same screen (Figure 5).

## System Evaluation

To evaluate the system, we conducted a lab study with eight people (four pairs of people who knew each other). Participants performed travel-search tasks under three conditions, including the two scenarios we described in the previous section (using our public display system and our hybrid public display and mobile app system) as well as an additional mobiles-only condition. The order of use of the three systems was counterbalanced for each pair. For each task, participants were assigned a foreign city (Yokohama, Japan; Copenhagen, Denmark; or Mexico City, Mexico). They were given a starting point and asked to find 1) a place to eat and 2) an additional location they would like to visit (museum, park, etc.). Following each of the three tasks, participants individually completed a questionnaire about the difficulty of the task, the degree to which they felt they contributed to the task, the ease of use of the system, and what they liked and disliked about the setup they used.

## Results

In the public display condition, participants explored a broader range of options, and did so more efficiently, than in the mobile only condition. But we also found that mobiles are perceived as being more convenient than public displays. The hybrid system may allow users to more easily explore a broader set of options.

*Public displays encourage discussion*

Participants found it easy to browse multiple types of information about a place at the same time on the larger public display screen. We found that participants discussed more options in the display condition (23 total across all pairs) and public display with mobiles condition (27 total) versus the mobiles condition (12 total). Three people mentioned that it was helpful to see (relative) information about multiple candidates at once. Furthermore, participants found the display only condition somewhat easier than the others. Two people rated the display only condition as the easiest of all three conditions, while five rated it as the same as the mobile only condition. Specifically, two people said that it was easier to hold a conversation in the display only condition. P4 mentioned that *"[it is] easy to make sure we are on the same page."* Participants reported several issues with the mobiles only condition. Three people felt less equality of contribution in the mobiles only condition than the others. Participants also felt that mobile screens were too small to see all information at once, or to share information with a partner. Finally, we found that mobile devices were not used as much in the final decision making process as in the hybrid condition. All pairs made their final decision using the display.

*Mobiles are more convenient*

Still, there were some benefits to the mobiles. Participants found searching with mobiles easy, convenient, and comfortable. Six people mentioned that it was easy or convenient to use their phones for search, which they are


**Figure 5:** User selections are color-coded to indicate which mobile device uploaded them.

used to. Also, mobiles helped participants search independently. P5 said that *"we may want to look at different things."* Two people mentioned that they might hesitate to use the display long if someone is waiting.

*A hybrid system helps explore candidates and share findings*
Participants found that it could be efficient to have multiple options for search. Five people mentioned that in the hybrid condition it was useful to switch between the display and mobile depending on the task at hand. Participants also took advantage of the hybrid system to make it easier to explore more options. Three people mentioned that the hybrid system allowed them to find more potential destinations. P5 said that *"we could both be looking at different things and share them to go over together."* Three people noted that it was easier to share candidates using the hybrid system.

*Designing for collaborative tourist planning*
Our evaluation revealed that displays have many advantages over mobiles for making collaborative decisions, that mobiles still have some advantages, and that a hybrid display and mobiles system introduces some complications but may offer the best overall solution. A hybrid system affords users both the familiarity of their mobiles and the advantages of the display to more easily share candidates and make a decision among more options.

## Conclusions

We examined the role of large displays and mobiles in supporting collaborative destination search and found initial evidence that users can take advantage of public displays to help them collaboratively search unfamiliar environments. Specifically, we found that public displays have advantages above and beyond standard mobile applications, especially for collaborative scenarios.

## Acknowledgements

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## References

[1] Frederik Brudy, Joshua Kevin Budiman, Steven Houben, and Nicolai Marquardt. 2018. Investigating the Role of an Overview Device in Multi-Device Collaboration. In *CHI*. Paper 300, 13 pages.

[2] Kelvin Cheng, Liang He, Xiaojun Meng, David A. Shamma, Dung Nguyen, and Anbarasan Thangapalam. 2015. CozyMaps: Real-time Collaboration on a Shared Map with Multiple Displays. In *MobileHCI*. 46–51.

[3] Petri Luojus, Jarkko Koskela, Kimmo Ollila, Saku-Matti Mäki, Raffi Kulpa-Bogossia, Tommi Heikkinen, and Timo Ojala. 2013. Wordster: Collaborative Versus Competitive Gaming Using Interactive Public Displays and Mobile Phones. In *PerDis*. 109-114.

[4] Jörg Müller, Marc Jentsch, Christian Kray, and Antonio Krüger. 2008. Exploring factors that influence the combined use of mobile devices and public displays for pedestrian navigation. In *NordiCHI*. 308-317.

[5] Tim Paek, Maneesh Agrawala, Sumit Basu, Steve Drucker, Trausti Kristjansson, Ron Logan, Kentaro Toyama, and Andy Wilson. 2004. Toward Universal Mobile Interaction for Shared Displays. In *CSCW*. 266-269.

[6] Ronald Schroeter, Marcus Foth, and Christine Satchell. 2012. People, content, location: sweet spotting urban screens for situated engagement. In *DIS*. 146-155.

[7] Nina Valkanova, Robert Walter, Andrew Vande Moere, and Jörg Müller. 2014. MyPosition: Sparking Civic Discourse by a Public Interactive Poll Visualization. In *CSCW*. 1323-1332.