Tourgether: Exploring Tourists' Real-time Sharing of Experiences as a Means of Encouraging Point-of-Interest Exploration

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We developed Tourgether, an app that enables tourists' mutual sharing of their experiences via check-ins in real time, to enhance their awareness and exploration of various points of interest (POIs) in a tourism region. We conducted formative studies and a between-subjects field experiment to assess how tourists used Tourgether in their travels, and the influence of real-time experience-sharing on unplanned POI visits, respectively. The results of the formative studies indicated that seeing shared real-time experiences encouraged tourists to explore and make unplanned visits to less well-known POIs, and that their decisions to make unplanned POI visits were dependent on familiarity, worthiness, and convenience. The app also created a feeling of co-presence among tourists, boosting their desire to interact with others. Two strong motivators for tourists to check in on the app were identified: contributing to other tourists, and recording journeys. Our experimental results further showed that seeing shared real-time experiences prompted the participants to make more unplanned visits than would have been the case if they had not seen them. This influence was more prominent among tourists who planned more POI visits. Other differences in the usage and influence of Tourgether across these two groups will also be discussed.

CCS Concepts: • **Human-centered computing → Empirical studies in ubiquitous and mobile computing**.

Additional Key Words and Phrases: encourage exploration, real-time check-in, tourism

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1   INTRODUCTION

Today's tourists have an unprecedented range of sources of information about destinations within a given region, including but not limited to online maps, travel services, blog posts, and social-networking sites. As such, they are likely to know something about a variety of potential points of interest (POI) in a region, both popular and less popular, even before they visit it for the first time. However, like the tourist guidebooks of previous generations, new-media sites aimed at tourists tend to highlight well-known attractions and landmarks, arguably as a response to demand from tourists themselves [38]. Thus, if a tourist is highly satisfied with a destination, he or she is more likely to repeatedly visit it in the future [1, 25]; and this can result in a vicious circle whereby the most famous places receive many visits and re-visits, but less famous ones comparatively few, despite being equally worth visiting in an objective sense. While revisiting the same destinations will not necessarily lead to tourist dissatisfaction, novelty and the unexpected have been identified as important components of journeys that tourists deem pleasant or pleasurable [5, 31]. Novelty is also an important component of a positive memorable tourism experience (MTE), defined as a tourism experience positively remembered and recalled after the event has occurred [23]. Thus, as well as spreading tourist revenue more equitably across a given region, enhancing the novelty of tourist experiences via the exploration of unfamiliar locations and events has considerable potential for increasing tourist satisfaction.

In the field of human-computer interaction (HCI), numerous systems have been built to encourage exploration (e.g. [4, 24]). However, most provide a static list of place recommendations showing industry-generated information about potential POIs, rather than actual visitor experiences – despite findings that the latter triumphs over the former in terms of its perceived freshness and relatability [18]. Underlying such perceptions is a lessening of uncertainty: i.e., seeing POI-related content that has been produced by one's peers diminishes the sense that such content has been falsified or 'spun' for purposes of corporate gain. In addition, numerous studies have suggested that electronic word-of-mouth (eWOM), i.e., statements made on the Internet by former visitors and check-ins on social media, has a disproportionate impact on people's decisions about visiting a place [11, 13, 17, 18, 33, 44]. Real-time updates linked to places also have the advantage of boosting tourists' awareness of the current or most recent status of their surroundings and of specific POIs, potentially enabling them to make more informed decisions about their subsequent travel destinations. However, because check-ins on social-media sites such as Facebook, Foursquare and TripAdvisor are aggregations of content and not intended to be shared in real time by tourists, the place information they contain is not necessarily current; nor do any of these platforms' designs make it easy to extract and highlight their users' most recent experiences of specific places. Moreover, hardly any research has hitherto explored tourists' own use of social media for sharing their real-time POI experiences, or such sharing's influence on other tourists' destination decisions, despite the sharing of travel experiences via smartphones having become routine [43]. Smartphones are potentially suitable channels for tourists' recording and curating of real-time POI experiences, primarily as a public good for tourists in the same region, but also for the region itself, through the eventual achievement of a more equitable distribution of visitors and visitor revenue across it [21]. As such, we regard mutual sharing of travel experiences among tourists in a particular region as a promising approach to building tourist awareness of that region in general, and of the current status of its POIs in particular. The present paper explores the feasibility and effectiveness of this, with special attention to how tourists' learning about and visits to unfamiliar POIs may be driven by such real-time sharing.

To achieve this goal, we built Tourgether, a mobile application that allows tourists traveling within the same region to share their travel experiences via check-ins. Tourgether's check-ins differ from those provided by well-known social-media platforms such as Foursquare and Facebook, not merely in that they are focused on tourist POIs, but because they are shared in real time solely with other users traveling in the same region.

Tourgether's development followed an iterative design process across four successive formative studies, which included 9, 10, 26, and 30 tourists, respectively. All 75 of these participants were visiting Tamsui, a renowned tourism region in Taiwan. Then, the final version of Tourgether was used in a field experiment to examine whether real-time experience sharing increased the likelihood that tourists would visit places they had not previously planned to.

The results of the third and fourth formative studies, which comprised data from 56 members of 42 different tour groups, indicated that using Tourgether led each such group to visit an average of 5.38 POIs on an unplanned basis, representing 55.9% of all their POI visits. Moreover, those participants who checked in most often were more likely than others to visit POIs on an unplanned basis, irrespective of whether they were familiar or unfamiliar with Tamsui, or whether or not they intended to stick to a travel plan. From focus-group discussions, we learned that whether participants made unplanned visits to POIs after seeing check-ins from them depended on three factors: familiarity, worthiness, and convenience. We also identified two main motivators for checking in: helping the anonymous community learn about new POIs, and treating Tourgether as a travel journal for recording one's personal journey. In addition, we found that seeing travel experiences shared in real time created a feeling of co-presence among the participants while they were traveling. Meanwhile, it provoked participants' desire to interact with others in various ways, including through physically encountering them. Finally, results from the field experiment provided further evidence that participants' exposure in real time to the experiences of other tourists prompted more unplanned POI visits than online reviews did. This influence was especially apparent among those tourists who had planned relatively high numbers of POI visits – though this was just one of several ways in which this group's travel behaviors and Tourgether usage differed dramatically from those of their counterparts who planned to visit relatively few POIs.

The contributions of this paper to ubiquitous computing are as follows. First, it provides details of Tourgether, a new mobile socio-travel application featuring real-time travel-experience sharing among its users, with the wider aim of facilitating touristic exploration of POIs and boosting the total number of visits to a given region's lesser-known POIs. Second, its findings shed light on how the sharing of real-time travel experiences can affect tourists' travel decisions, as well as why they share such experiences through an app. Third, its field experiment provides evidence that seeing shared real-time travel experiences can encourage tourists to make more unplanned POI visits. And lastly, it shows that real-time experience-sharing can have a differential influence on tourists depending on how many POI visits they plan.

2 RELATED WORK

2.1 Systems that Encourage Exploration

Researchers have built various systems to help visitors and/or residents explore new sites in an area and learn about local events. One line of such research involves location- or context-aware systems that show and recommend places to those users who are detected as being within a certain range of a specific place (e.g., [6, 7, 20, 30, 34, 45]), and systems that go beyond mobile solutions, such as physical interactive devices that encourage exploration of public space [29, 36, 46] to encourage exploration.

Another focuses on the use of multi-modal or visualization techniques to enrich the presentation of POIs, notify visitors about nearby POIs, and/or help with navigation around an area (e.g., [4]). This approach can include audio recordings [3, 12, 15, 20, 24, 41], geo-tagged photos [39], augmented and mixed reality [2, 19, 31, 47], and 3D maps [26, 35, 37] that present visitors with content from pre-existing resources. Tourgether differs from such systems in that its content focuses on its users' own experiences, documented and shared with one another in real time.

A third line of research leverages passive location tracking to allow location and location-trace sharing with family, friends, and the local community: i.e., shows where the sharers are in a neighborhood and where they

have been. For example, MoveMeant was designed to raise local users' awareness of new places in their own communities [42]. Some researchers have built systems that allow users to document and log their own journeys, thus fostering interaction within a community. For example, Curated City lets people build their own personal guides to a city's neighborhoods, and let others to know how best to move from place to place and to learn about new places [10]. Its originators found that adding content to Curated City strengthened its users' sense of community. Similarly, Journey Notes, which helps users document their journeys, has been shown to support self-reflection about journeys, interactions with others, discovery of new places, and community building [9]. Though the current research shares some findings with both [10] and [9], it differs from them in that its context is travel and real-time sharing.

2.2 Social Media: Exploration, Motivations, and Community

Social media are widely considered to exhibit the qualities of "richness, unbiasedness and responsiveness for travelers", and are increasingly classified as smart-tourism technologies (STTs) that help tourists identify potential destinations, compare destination options, and plan their travel [16]. In particular, social-media sites are seen as crucial conduits for eWOM [14, 31, 48], which has been found to facilitate travel-information searches [28, 48] and to affect the formation of its users' perceptions of potential destinations [44]. Additionally, the always-on and always-connected nature of smartphones allows tourists to share their travel experiences easily [50], which increases the use of locative social media and check-ins. Users' intentions regarding their use of locative social media have been found to include meeting friends [8, 9, 13, 27], building reputations [13, 22], helping others [32], promoting viral communication [22], exploring new places [9, 13]. Unlike the prior studies cited in the previous sentence, this paper focuses on locative social media as tool exclusively for tourists rather than residents; yet, we will show that all of the above intentions also apply in travel contexts, among tourists sharing real-time experiences. Moreover, we found that an additional motivation – to help other tourists in the same region – was strong, due to users' perceptions that they and these other tourists shared the common goal of enjoying their travel; and such perceptions also tended to raise users' awareness of the co-presence of other tourists viewing their check-ins on Tourgether or checking in on it themselves, increasing their interest in interacting with them in various forms, including in-person encounters.

3 TOURGETHER: DESIGN AND DEVELOPMENT

In light of Tourgether's main aim – to help tourists explore novel POIs via peer sharing of real-time travel experiences – we scoped it as supporting pedestrian tourists in an area whose attractions can mostly be reached on foot within 30 minutes. In addition, because popular POIs are ipso facto already known and visited by large numbers of tourists, Tourgether is not designed to encourage its users to visit well-known POIs like other tourism websites or applications do. Instead, it presents users with all check-ins created by other tourists regardless of the popularity of the places those others are visiting, in the hope that if any lesser-known POIs are shared by a tourist on Tourgether, other users will become better informed about it. To evaluate the feasibility and effectiveness of such a design, we chose a well-known tourism region and created an interactive tourist map of it on Tourgether. Below, we first briefly introduce our target region and explain how we classified its POIs and created the map. Then, we explain the key revisions we made to our design over the course of the iterative development process.

3.1 The Target Tourism Region: Tamsui, Taipei

Located near Taipei, the capital of Taiwan, Tamsui features a dense but diverse array of attractions. Tamsui Old Street is renowned for its restaurants, cafés, shops, performers, and historic buildings. We chose this tourism region because it is easily accessible by day-trippers from Taipei (including tourists staying there), who frequent it especially during weekends. It has a variety of POIs, but only a few are listed on common tourist maps and

Fig. 1. Tourist map of Tamsui designed by the research team

websites (about which, more details will be provided in the next section), making it an ideal choice for examining whether Tourgether can encourage tourists, including both new visitors and re-visitors, to explore a region beyond its best-known POIs.

3.2 Creating the Tourist Map and Classifying POIs

We chose to create our own tourist map (1) for Tourgether rather than embedding a detailed and standardized electronic one – e.g., from Google Maps – because our focus was strictly on POIs. Because prior research has shown that paper tourist maps are preferred by tourists over electronic ones, as being more useful in planning routes and choosing sites to visit [49], we created an interactive tourist map inspired by Hsu et al. [16] that resembles a typical paper tourist map but is able to show the user's GPS location.

To determine which POIs should be highlighted on our map, we began by making a list of places within Tamsui that were commonly mentioned and highlighted across various tourism resources. For this purpose, we mainly referred to TripAdvisor, Google Maps, and two official tourist maps of Tamsui, obtained from the New Taipei City Government and the Taipei Rapid Transit Corporation Metro Service, respectively. In addition, we examined a number of blog posts about traveling in Tamsui to obtain data on lesser-known POIs. To ascertain the top POIs in Tamsui on Google Maps, we searched for the word Tamsui on Google Maps using an Incognito Window, such that the search results were not personalized to any of the researchers. This resulted in the extraction of 55 POIs, which we then divided into five categories. These were 1) famous, POIs that appeared on at least three of the four main sources; 2) popular-both, POIs that appeared at least once on online resources and once on a paper tourist map; 3) popular-either, POIs that appeared on either online resources or on tourist maps, but not both; 4) less popular, POIs that appeared on only one of our four main data sources; and 5) least popular, POIs that did not appear on any of those four data sources, but which were nevertheless mentioned in travel-themed blog posts. We created graphical icons for the famous and popular-both POIs and placed them on our own tourist
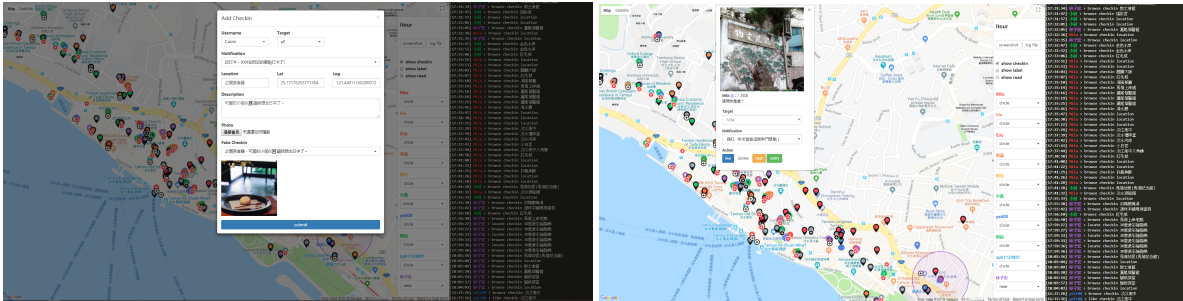
Fig. 2. Control panel for creating check-ins, delivery of notifications, monitoring of users' real-time GPS coordinates, and app usage log

map, whereas the popular-either and less popular POIs were identified only by their names. The names of the less-popular POIs could also be seen, but only when the map user zoomed in. Finally, the least-popular POIs were not shown on the map at all, in keeping with typical tourist-mapmaking practices.

3.3 The Iterative Design of Tourgether

The current Tourgether (V5) is the successor to four major iterations (V1-V4), each of which was revised according to feedback from a user study. We feel it is important to explain the evolution of the app's key features, as the process included important lessons both about user experiences and about tourists' needs more generally. The next two subsections summarize the revisions to two major features of Tourgether: check-ins and notifications. Most changes to V1 related to the former, whereas most changes to V2 through V5 involved the latter.

3.3.1 Content and Presentation of Check-ins. In V1, the check-in feature allowed tourists to combine text, pictures, and voice recordings. The voice-recording element was inspired by two prior projects [24, 30] that had used auditory cues to guide navigation. We conducted two formative user studies of V1 in Tamsui, one with four tourists and the other with five, to examine how individuals used and were affected by check-ins. Because of the small number of participants, the researchers adopted a Wizard of Oz method [40] to periodically create check-ins via a control panel (Fig. 2). From the first of these two initial studies, we learned that the participants preferred a combination of photos and textual descriptions, and this preference was further reflected in their own check-in posts, which mainly included the same two elements. As well as making few voice recordings, some of the participants said they felt uncomfortable doing so because they were unsure of what else might be captured by a recording. Therefore, we removed the voice-recording element and focused instead on refining the check-in feature's use of photos and text. In addition, we found that while most participants were enthusiastic about check-ins and active in creating them, they only infrequently looked at the other participants' check-ins because they were unsure when the information shared by others might be useful to them. This prompted us to devise a notification system to inform tourists of potentially interesting check-ins at certain moments.

3.3.2 Notification System. Our above-mentioned notification system aimed at enhancing tourists' awareness of others' check-ins that were likely to be useful and interesting to them was first introduced in V2, and there were subsequently four major changes to it over the course of the iterative process. Its initial version had two main notification types, popular check-in (i.e., one that tourists had 'liked' at least five times), and checking-in at novel places, each of which was subdivided into distant and nearby. Lastly, there were notifications called liking nearby check-ins, which notified tourists when check-ins near their own current locations were given likes. Thus, V2 had a total of five types of notifications. Its user study, with 10 tourists, used a control panel

to deliver notifications (Fig. 2, right) based on each participant's pre-study familiarity with specific POIs and the inclusion or not of those POIs in his/her travel plans. Specifically, such notifications were sent whenever a participant was within 100 meters of a checked-in place that he/she had not included in the current travel plan and had previously described as unfamiliar or unsure about. Feedback from that user study indicated that such notifications were effective at drawing participants' attention to check-ins right from the beginning of their use of the app, with some occurrences triggering awareness of and visits to novel checked-in POIs. In addition, many participants said that they preferred to see popular check-ins, followed by other check-ins nearby. By the same token, notifications about check-ins were generally considered less relevant the farther away the associated POIs were. Finally, the participants complained about the large number of notifications they received, and said that they did not have time to read them all.

In V3, we reduced the number of notifications by eliminating the liking nearby check-ins category. We kept the popular check-in notifications, but dropped the distinction between nearby and distant ones. Distant popular check-ins were retained because we wanted to examine their effect on travel decisions in a larger user study to be conducted at a later date. We also added an in-app notification center that allowed tourists to read notifications within Tourgether if they missed phone notifications. After these changes had been implemented, we conducted a larger user study with 26 members of 20 different travel groups, which will be discussed in more detail below. At this point, because many more tourists were now participating, the researchers stopped sending their own notifications using the control panel. Feedback from this user study suggested that the participants preferred to visit places that the largest numbers of other tourists had traveled to previously. Unfortunately, however, the number of notifications emitted by V3 was still described as overwhelming. Therefore, in V4 – the subject of the fourth user study, one week later – we further lowered the overall number of notifications by 1) omitting ones about distant check-ins, and 2) notifying users only about the latest check-in within the range, rather than all check-ins, at novel POIs nearby. To satisfy tourists' desire to know which POIs were the most popular, we added notifications about hot areas, i.e., those that had received five check-ins or more. Lastly, it should be noted that the participants in this user study indicated that they would also like to receive notifications when other participants liked or commented on their check-ins, because such notifications might remind them to respond to comments. Thus, in V5, which would go on to be used in the final field experiment, Tourgether notified participants when others commented on, liked or saved their check-ins.

3.3.3 Comments on Check-ins. In V1 through V3, 'liking' of check-ins was the only way Tourgether users could interact with one another. However, over the course of our user studies, we learned that the participants were interested in having a broader range of interaction types. Therefore, another important change in V4 was the addition of a commenting feature on check-in posts. V5 inherited this change.

3.4 Features of Tourgether V5

The current version of the Tourgether Android app, V5, has four main features for assisting tourists to explore novel POIs. These are: 1) a GPS-enabled interactive Tourist Map that displays popular POIs and check-ins shared by other Tourgether users; 2) a News Feed page that presents all check-in posts for the target tourism area of around 6 square km; 3) a Notification System that informs tourists of check-ins related to events of potential interest to them; and 4) a Personalized Tourist Map that displays the POIs that participants are planning to visit, and provides directions to them from the user's current location.

3.4.1 GPS-enabled Interactive Tourist Map. Tourgether's interactive Tourist Map (Fig. Fig. 3a) displays a total of 12 popular POIs, each of which is represented by a graphical icon. It also displays the names of lesser-known POIs. Inspired by Hsu et al.'s [15] approach, we mapped each pixel of the interactive map to a GPS coordinate, such that a tourist's current location can be projected to a position on the map in real time. Each tourist check-in
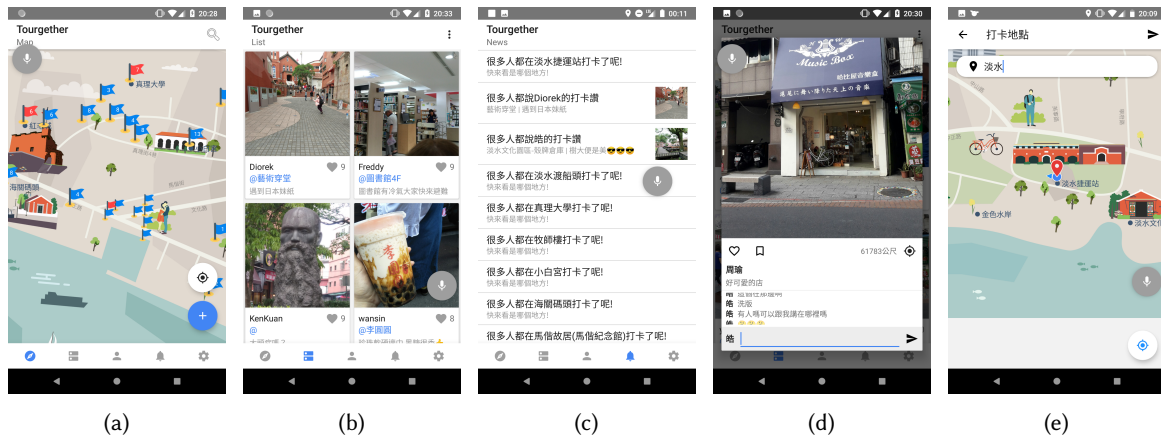
Fig. 3. System design of Tourgether, including (a) its GPS-enabled Tourist Map displaying graphics of important POIs and displaying check-ins with flag icons; (b) its News Feed page presenting all user check-ins; (c) all received notifications, divided into three categories, i.e., the most-liked current check-ins, the most checked-in areas, and newly checked-in POIs that the user has never visited; (d) its check-in post interface, with like, save and locate buttons below the image; and (e) its page for choosing a location when posting a check-in.

is represented by a flag icon, located at the position on the map corresponding to the GPS coordinate at which the tourist created it. Two colors are used to indicate the popularity of a check-in: with a blue flag being used for every check-in from its inception unless/until it receives more than five 'likes', at which point it becomes red for 30 minutes (i.e., 30 minutes after a blue flag becomes red, it changes back to blue). Blue flags stay on the map and do not disappear. As in other social media, a user is allowed to create multiple check-ins at the same place. Check-ins within a 100-meter radius of one another, or relating to the same POI, are represented by larger flags labeled with the number of check-ins in the area, or at that POI, as the case may be. When tourists zoom in to such an area, the large flag breaks up into standard-sized flags representing each individual check-in.

3.4.2 News Feed and Check-in Posts. As in other social media, Tourgether V4's News Feed page exists to facilitate real-time browsing of oher users' check-ins (Fig. 3b). Tourists can sort posts in the feed by either creation time (most recent first) or numbers of likes. Posts in the feed include a photo, the screen name of the tourist who created it, a place-name, and a description entered by the post's creator. Clicking through to the more detailed version of such a post reveals all of the same elements, plus comments left by other tourists, and opportunities to 'like' or comment on it oneself; to save it for future reference; or to be guided to its location on the Tourist Map (Fig. 3d). When creating their own check-ins, tourists can select from among existing POIs or add new ones (Fig. 3e).

3.4.3 Notification System. Tourgether V5's notification system notifies a tourist about 1) highly checked-in areas, 2) highly liked check-ins, and 3) nearby checked-in POIs that he/she is unfamiliar with and has never visited before. All such notifications are sent automatically as soon as one of these events is detected, in both of the following two formats: an Android notification, viewed in a notification drawer, and an in-app notification preserved in Tourgether's notification center (Fig. 3c). Notification types 1 and 2 are sent to all tourists in the same tourism region. Specifically, a highly checked-in area notification is sent to all the Tourgether users within a tourism region either when a POI has received five check-ins, or when any area within a 100-meter radius contains a total of five check-ins. Clicking on the latter type of such a notification directs tourists to the center of

the area on our interactive map. Highly liked check-ins notifications, on the other hand, are sent to all users in the region as soon as a check-in is 'liked' for the fifth time, and on the map, they direct tourists to the coordinates of the check-ins themselves. Lastly, by its nature, each nearby novel check-in notification must be tailored to a particular user, based on self-reported information about his/her prior travel history. Such a notification is triggered when a tourist is detected to be within 100 meters of a POI that meets the novelty criteria mentioned above, and gives that person a link to the most recent check-in at that POI, along with its exact distance away.

3.4.4 Personalized Tourist Map. Tourgether V5 added a personalized tourist map on which users can enter POIs they plan to visit. Then, within the map, they can review the places they included in their travel plans, as well as the check-ins they have created or have saved from other tourists' activity. The personalized tourist map features three types of POI icons: 1) plan-to-go icons, indicating POIs that the tourist plans to visit; 2) saved-check-ins icons, representing check-ins; and 3) already-visited icons, which replace plan-to-go and saved-check-ins icons once the tourist has actually been to a place. In addition, Tourgether V5's personalized tourist map provides POI information that integrates introductions to them with check-in posts associated with them. This feature was added to help tourists achieve a more in-depth understanding of POIs, and find associated check-ins more quickly.

4 FORMATIVE USER STUDIES

The main aim of our formative studies was to improve the user experience of Tourgether. This was achieved by observing whether and how study participants used Tourgether to share their travel experiences; whether exposing them in real time to the travel experiences of other tourists encouraged them to make unplanned visits to novel POIs; if so, what motivated them to do so; and how they perceived Tourgether as differing from other social-media platforms. We conducted in total four formative studies. The first two, small-scale studies were briefly discussed in Section 3.3, but the findings reported and discussed in the remainder of this paper are all derived from our third and fourth field studies, which were conducted on April 22, 2018 and April 29, 2018, respectively, and will be referred to hereafter as Study C and Study D.

A person traveling alone was defined as a tour group for the purposes hereof, and no tour group in either of these two studies consisted of more than four persons. Thus, Study C's 26 participants were deemed to be members of a total of 21 tour groups, and Study D's 30 participants, part of 21 such groups. Both user studies were conducted on Sunday afternoons in Tamsui and lasted approximately five hours, including an approximately four-hour field study, followed by an one-hour focus group. To help ensure that the insights we sought were forthcoming, the Study C and D participants were all invited to use Tourgether V4 alongside any other tool they wished. To obtain further data on users' in situ experiences and decision-making, we added a voice-message feature to Tourgether V3 and V4 that allowed them to report their decisions and feelings when heading to their next destinations. After their travel was concluded, all 56 of these participants were invited to participate in one of eight focus groups, with 27 also asked to attend one-on-one interviews.

4.1 Recruitment and Participants

To observe realistic use of Tourgether in the context of traveling, we invited people who wanted to travel in Tamsui to participate in Study C and Study D, via invitations and a sign-up questionnaire on a subject-pool Facebook group and on PTT, the largest local bulletin-board system in Taiwan. The sign-up questionnaire covered personal information, prior travel experience in Tamsui, self-perceived tendency to follow a travel plan, social-media usage, and intended travel companions, if any. From among the 112 people who responded, we selected those who were not inhabitants of Tamsui, but did not filter participants based on their familiarity with Tamsui. This was because, in the formative studies, we hoped to obtain insights into the diverse behaviors and needs of Tamsui visitors with varying levels of familiarity with the region. However, since Tamsui is a highly

popular tourism area close to Taipei, nearly four-fifths of the respondents (78%) reported that they visited Tamsui at least once a year, while only seven (13%) reported never having been there. All 56 of the participants we eventually recruited were familiar with Facebook, and several had also used location-based social media such as Foursquare and TripAdvisor. Study C and Study D were both gender-balanced, and their participants ranged in age from 20 to 39. Slightly under half (n=25) were students, and the others had varied occupations. Half (n=28) reported being unfamiliar with Tamsui, despite a much larger proportion (88%, n=49) saying they visited it at least once a year. Three reported having never been to Tamsui.

4.2 Study Procedure

A week prior to the study to which they had been assigned (either Study C or Study D), the participants were asked to fill out an online questionnaire regarding their familiarity with the 55 selected POIs in Tamsui. This information was collected for purposes of individually tailoring notifications about nearby novel check-ins, as described above. At this point, the participants also provided us with their travel plans for the day of the study, so that we could distinguish between planned and unplanned POI visits during data analysis.

On the day of the study they had been assigned to, the participants were given an overview of the study at Tamsui Station, their initial meeting point with the researchers. Then, they downloaded Tourgether on their phones and received a tutorial on how to use its main features, as well as the app's voice-message function, which we strongly encouraged them to use to share their en-route decision-making with us. Then, after informing them that they were free to use any other tool to support their travel, we told them that they would receive a phone call from us later to provide them with the location of their respective focus groups. In both studies, after an average of slightly under four hours touring in Tamsui, the participants were told to gather at the region's former British Merchant Warehouse, where they were divided into four focus groups comprising six to eight participants apiece, each led by a well-trained moderator. The same four moderators took part in both Study C and Study D. The topics discussed in the focus groups included 1) the participants' experience of exploring POIs that they had not planned to visit, with a focus on the triggers and motivations for such exploration; and 2) their overall experience with Tourgether, including their perceptions of its features and how it related to their exploration. Only those focus-group participants that the moderator found to have extensive and unique experience were invited a short interview to further elaborate such experience.

4.3 Data Analysis

Though our analysis primarily focused on whether and to what extent Tourgether led its users to visit POIs that were unfamiliar to them and that had not been included in their original travel plans, we were also interested in how much the app encouraged them to make unplanned visits to POIs that were rated as Less Popular and Least Popular. We used several means of establishing whether a POI was visited by a participant, including self-reports contained in voice messages, focus-group and interview responses, and GPS traces. The researchers carefully reviewed each participant's GPS traces using the Control Panel, and considered whether he/she 1) stayed at that place, and 2) had checked in at that place. An unplanned POI visit was defined as a POI being visited by a participant, but not included in his/her travel plan. Linear regression analysis was used to identify the effects on unplanned POI visits of two independent variables: that user's number of actions on Tourgether, and his/her number of planned POIs. Because multiple participants in both Study C and Study D participated as members of tour groups of between two and four persons, we conducted this part of the analysis only at the group level, i.e., assumed that the participants in a defined tour group had all visited a given POI if any one of them had. For purposes of qualitative analysis, the four focus-group moderators, including two of the authors, transcribed audio recordings that had been made of the focus groups and interviews with the participants' permission. The moderators organized the transcripts into themes, and the two authors independently coded them. Having agreed

to focus on travel decisions, motivation, and interaction on Tourgether, the researchers iteratively coded the transcripts and met weekly to discuss the codes and group them with larger themes emerging from the data.

4.4 Study Results and Findings

4.4.1 Quantitative Results. The participants in formative studies C and D made many unplanned visits to POIs while in Tamsui: on average, 5.38 per tour group (SD=3.28), representing 55.9% of all POI visits. Only one of the 56 participants did not make any unplanned POI visits. We also identified a negative main effect of the number of planned POIs on the number of unplanned POI visits (p<0.001), implying that the more sites a tour group intended to see, the fewer other sites they visited. However, this result is not unexpected, i.e., given that the number of POIs in the region was finite, the more POIs one included in a travel plan, the fewer others were available for unplanned visits.

Exploration by Plan-stickers and Experienced Re-visitors. Among 'explorers', defined as members of the 50% of the above-mentioned tour groups with the highest exploration rates, four individuals reported sticking to their travel plans, and two, not making any travel plan, while the remaining 21 stated that they made plans but did not always stick to them. Slightly over half (n=15) of the 27 explorers rated themselves as unfamiliar with Tamsui. Of the remainder, nine rated their familiarity with the area as average, and three as high. Thus, it was not only those tourists who were unfamiliar with Tamsui who changed their travel plans to explore novel POIs when using the Tourgether app, but also those who were familiar with the area.

App Actions' Effects on Unplanned and Unpopular POI Visits. We calculated within-tour-group averages of the numbers of check-ins created and browsed, and found that the quantity of check-ins a group created had a positive main effect on its number of unplanned POI visits (p<0.001), but its quantity of check-in browsing did not (p=0.97). On the other hand, we found main effects of both the number of check-ins created (p=0.02) and the amount of check-in browsing on the number of unplanned visits to POIs in the Less Popular and Least Popular categories (p=0.004). In other words, travel groups that produced and browsed more check-ins were also more likely to visit unpopular POIs on an unplanned basis. The most likely reason that unplanned visits to unpopular POIs were positively correlated with browsing was that such POIs were not displayed on the map.

Tourgether's Promotion of Unpopular POIs. A high proportion of Tourgether users' tour groups visited many places that were not highlighted (or in some cases even mentioned) in standard tourism resources. Among the 10 POIs that were visited the most on an unplanned basis, six were classified as Less Popular or Least Popular (see Fig. 4), i.e., appeared only once or did not appear on TripAdvisor, Google Maps, or the two sampled tourist maps. And since no POIs in these popularity categories were displayed on Tourgether's Tourist Map either, other users' check-ins would have been the only way participants obtained information about them from the app.

4.4.2 Factors Affecting Users' Decisions to Visit and Check-in at POIs Not on Their Itineraries. From our eight focus groups, we learned that many of the Study C and Study D participants had been influenced by the real-time travel information provided by other tour groups. There was considerable individual variation, both in how often they looked at check-ins, and in whether they were motivated to visit POIs on an unplanned basis. However, a pattern emerged in the factors that affected participants' decisions to make or not make such unplanned visits after receiving a notification or after browsing check-ins on their own. These factors included the user's familiarity with the POI, and his or her perceptions of its worthiness and the convenience of physically going to it.

Regarding familiarity, participants frequently mentioned being interested in visiting POIs that they had neither been to nor heard of before. Also, some who reported that they were familiar with Tamsui felt surprised at seeing check-ins from POIs that were unknown to them. Upon first learning about one of these novel POIs, the participants tended to decide whether or not to go to it based on its perceived worthiness and convenience only. Three main elements attracted participants to physically visit a novel POI: 1) its popularity, 2) its promise of fulfilling their specific needs, and 3) its visual and/or topical appeal.

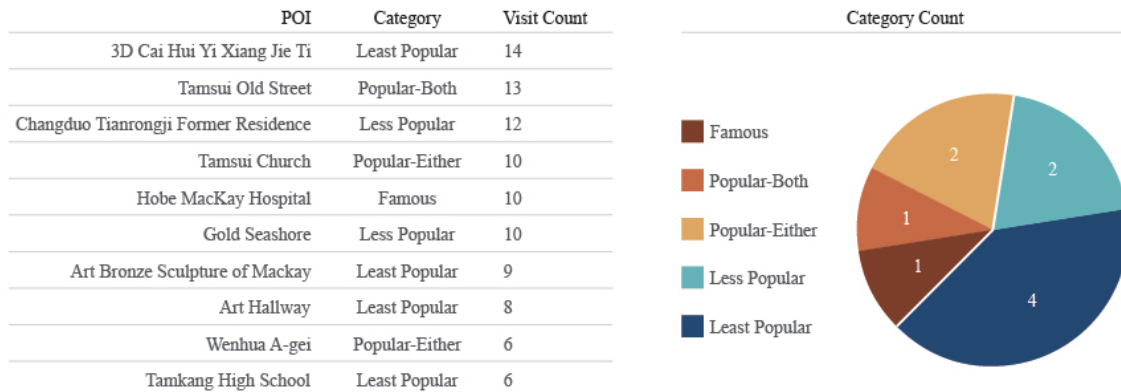| POI	Category	Visit Count
3D Cai Hui Yi Xiang Jie Ti	Least Popular	14
Tamsui Old Street	Popular-Both	13
Changduo Tianrongji Former Residence	Less Popular	12
Tamsui Church	Popular-Either	10
Hobe MacKay Hospital	Famous	10
Gold Seashore	Less Popular	10
Art Bronze Sculpture of Mackay	Least Popular	9
Art Hallway	Least Popular	8
Wenhua A-gei	Popular-Either	6
Tamkang High School	Least Popular	6

Fig. 4. Tourist map of Tamsui designed by the research team

In the case of popularity, many participants said that they wanted to visit and to obtain more information about POIs that other participants had just visited, some by browsing the News Feed, and others by checking the app's interactive Tourist Map. As P22 explained, *"I first checked where all the flags were. [...] I'd see where everyone was going to decide where I can probably go later."* Some other participants said they would mostly check the red flags that indicated recent highly-liked check-ins; as P55 put it, *"people were probably discussing that [red-flagged] check-in. I was curious about what everyone would be talking about."*

Sometimes participants decided to visit a POI without having planned to because it fulfilled their needs of the moment, such as allaying hunger, thirst, or discomfort. P18 said, *"I saw someone mention a library with an air conditioner, then I started to figure out how to get to that library."* Upon seeing a post about brown-sugar bubble milk tea, P11 said, "it looked so delicious. I really wanted to check it out." Many other participants also had the idea of making an unplanned visit to a POI during their travel because they were attracted by a photo in a check-in: *"I saw people posting photos of that place, and the scene looked quite nice. Then I was just thinking, 'maybe I could go to that place later'"*, P23 said. But conversely, a few participants decided against going to POIs they had planned to visit because of check-ins they had seen. One such was P10, who said, *"That temple was part of my plan. But I didn't go because I saw photos in the check-ins and no longer felt very interested."*

POIs' convenience was crucially important. P39 said, *"Besides reading check-ins on News Feed, I'd pay attention to the check-ins around me. I mean the notifications that'd tell me what was nearby."* Similarly, P41 said, *"We referenced the Map and the News Feed to decide where to go. But we first checked those that are close."* As well as proximity, however, we found that participants considered not only whether a POI was close, but also whether it was on the way to their planned destination, or on the way back; and whether going to a particular place would enable them to visit several POIs in a short period of time. As such, a holistic consideration of convenience, as opposed to simple distance, suggests that notifications from distant check-ins were still worth delivering. As P25 said, *"If I see the flags grouped together, I think that's a place that's worthwhile to go to. Because that means I can go to three places at once."* In short, our qualitative as well as quantitative data reveal that many participants were triggered to make unplanned visits to POIs because they had seen other tourists' experiences shared in real time.

4.4.3 Motivations for Checking In. The Study C and Study D participants created an average of 9.31 check-ins apiece (SD=5.86, MD=7), with the least-active 50% of users checking in an average 4.78 times, and the most-active

50%, 13.85 times. Qualitative analysis revealed that two strong motivators for actively checking in transcended any perceived obligation to check in because of the research-study context. Each is dealt with in its own subsection below.

An Anonymous Community. The first motivator involved the sense of community that Tourgether engendered, without violating users' privacy. Many participants who actively checked in said that they wanted to recommend places and thus contribute to other tourists' positive experiences. Among these users, checking-in was Tourgether's most-used feature. A focus-group discussion involving P5 and P6 was illustrative of this point. P6: *"I most often used check-ins. When I got somewhere [. . .] if I thought it was worth sharing, I'd check-in."* P5: *"I also used check-in most. When I saw a nice place, I shared it with everyone."*

Many participants noted that, although they rarely checked in on Facebook, they felt motivated to do so on Tourgether. They said this was because checking in on other social-media platforms made them feel their activity was being tracked by people who knew them, and might incur their critiques and judgments. This chimed with prior research findings that privacy concerns had a negative impact on the frequency of check-ins on Facebook [22]. A consistent reason cited by the participants for not feeling the same way about Tourgether was that its real-time audience consisted entirely of tourists currently within the same region, who shared the common goal of enjoying their travel and thus were more likely to appreciate check-in content than a more disparate group would have. As P19 said, *"I don't really like checking in normally. But here, no one knows me. I can check-in a lot."* Other participants also emphasized that anonymity was key to making them feel comfortable about sharing their travel experiences, because they perceived the audience reading their check-ins as mainly looking for places to go themselves, rather than engaging in surveillance of their friendship networks. As P34 commented, *"I think anonymity is crucial. [...] I worry that without it, someone would just say, 'Oh you're there! [...] I'll go and meet you' or 'Oh you're here! Why are you so free? What about your job?'"* Similarly, P11 said, *"I don't check in on Facebook because I added some acquaintances whom I met only once. And there are other relatives, friends and so on that I don't want to know where I go or what I'm doing. But in this app, it's like playing a game. I'm quite enjoying sharing what I'm doing with everyone. Because they don't know me!"*

Anonymity also helped the participants feel less worried about polishing and refining a post as they would on their personal social-media pages. As P10 put it, *I would not check in on Facebook at every spot I go to. I'd just post one or two. [... Together] is a travel tool, so I don't really care if I have to take a great photo or have to apply a filter or something. If I post on Facebook I have to care about these details. But in this app, I would just authentically share and present what I see to everyone. If it's not too far from them, they would want to take a look. Just like I also check if there are places nearby."* It is also worth noting that a few of the participants regarded checking in as a competition. P55 commented of her travel partner, *"He was trying to win. He'd say, 'Hey, no one has checked in there. Let's go and be the first one!'"* Similarly, P34 said, *"I definitely feel a sense of accomplishment. [. . .] that I found something that no-one else knows about!"*

Tourgether as a Travel-journal Tool The second of our participants' two strong motivators for checking in was Tourgether's affordance as a travel-journal tool. A number of them mentioned that they were motivated to check in by a desire to record their footprint during the travel, and that Tourgether fulfilled this need. For example, P10 stated, *"I checked in more than usual. [...] I want to know where exactly I went to, and how long it took me to visit these places. [...] [C]heck-ins can help me record this, and to remember these places. But I would not check in on Facebook or Instagram, because I think people would just skim it, because there are too many check-ins there."* Another participant, P7, liked seeing her check-in history on the Tourist Map, as this type of journey-recording tool was not available on other social-media platforms: *"I think what's different from Facebook is that this app has a map, and your check-ins are on the map. For me, this is like a travel trace log. Although Facebook also has check-ins, it doesn't have a map. So it's merely like a journal. But with this app, if I review it someday, I'd feel more like I actually walked here."*

These findings were unexpected, because we had not designed Tourgether as a journey-recording tool. Moreover, because this type of usage was not anticipated, Tourgether lacked various features that could have supported it. Several participants suggested improvements for Tourgether that were related to enriching check-ins, such as support for the uploading of multiple photos and videos, and adding more details about a POI. A few participants also mentioned that reviewing other participants' check-ins had made them want to visit a place specifically to make a record of it. For example, P10 said, *"I know I'd pass by [the POI]. But I didn't take a photo of it. But after I saw his post, I really wanted to go back and take a photo."* This suggests that systems like Tourgether that rely on tourists to generate content should embrace travel-journal usage, not least as a means of keeping their users motivated to check in frequently.

4.4.4 Desires for Various Forms of Interaction with Other Tourists. As briefly mentioned above, an important revision to the Tourgether app that occurred between Study C and Study D was the addition of a commenting feature on check-ins. We added it because, in the first three user studies, the participants had expressed a desire to interact more with other app users. For example, P2 stated, *"I think what it lacks is the feeling of interaction. I feel that it would be better to have someone respond to your post. I feel quite lonely when I just check in there without any interaction."* In Study D, i.e., after the commenting feature had been added, the participants left 48 comments, while the number of likes remained broadly the same across Study C and Study D (313 vs. 304). In fact, the participants expressed desires for various additional forms of interaction beyond commenting, including 'following' specific other users on the platform; being notified when their own posts were liked; sending direct messages; tagging other tourists in check-ins; becoming more closely acquainted with those tourists who liked their posts; and even co-traveling. In one focus group, P18 and P19 discussed this. P18: *"On one post, I got two likes! I guess that might be a slip [laughs]. But I checked if they took them back. They didn't, so I got more excited about checking in, and I started to like other people's check-ins."* P19: *"Yeah, I also wanted to know who liked my posts. And I'd like to meet them, and make friends."*

More interestingly, like P19, a number of participants mentioned an interest in physically encountering other Tourgether users. P4 said, *"Pressing a like doesn't make me feel like I'm interacting. Is there any way to get in touch with people nearby? Maybe we can even walk together if we get along well."* Similarly, P25 said: *"I was thinking if I happened to meet other users on the way, we could probably become friends. I'd be more willing to use this than other dating apps because there's somehow a sense that we are closer, you'd know each other better. Of course, this is not happening yet. But I just feel that when I see other people using this same app, I'd like to approach them and talk to them. I think you ought to add this social element to it."*

Some participants mentioned experiencing feelings of co-presence when using Tourgether, rooted in their perceptions that other app users were traveling in the same tourism region and interchanging real-time travel experiences with them, and in some cases, visiting the same place based on one another's check-in information. Indeed, some participants speculated that they had seen other participants checking in; and a few mentioned that knowing many other tourists were nearby motivated them to visit more places in the region. For example, P21 said, *"You know everyone is around here; if a place is nearby I'm more willing to visit it. And I feel more connected to them."* We found it interesting that, although Tourgether was designed to encourage exploration, it also motivated many participants to connect physically and to have a tour together. Conceivably, such a desire might have not only been spurred by the app's real-time experience-sharing features, but also by its anonymity, which could have fostered a sense of mystery, and hence curiosity about, its other users.

5 FIELD EXPERIMENT

After the formative studies, we conducted a field experiment that replicated Studies C and D, to examine the influence of Tourgether on unplanned POI visits. More specifically, the objective of the field experiment was to examine whether seeing real-time experiences shared by other tour groups (referred to as the real-time condition)

led to more unplanned POI visits than not seeing them (referred to as the baseline condition). As mentioned earlier, V5 was an improved version of V4, with better usability and the wider range of features described in Section 3.4. In the baseline condition, tour groups used Tourgether V5 without any check-in features, i.e., without seeing any check-ins or being able to check in. Instead, their variant of Tourgether V5 showed POIs with reviews downloaded from Google Maps. Another change to the study setting was that Tourgether did not notify participants only the POIs novel to them. This decision was made to enable fair notification delivery to the participants, regardless their familiarity with Tamsui. Another reason was that unplanned visits, and not the novelty of POIs, was the field experiment's focus. It should also be noted that, in this final experiment, we needed to let participants have as much control of their travel routes and destinations as possible, to render the participants' travel behavior natural and normal and the results ecologically valid. Inevitably, this aim was not entirely achievable, as simply by its existence the study probably affected tour groups' travel routes and destinations somewhat. Nevertheless, we regarded it as important to allow the participants in the field study to feel, to the greatest extent possible, that they were really traveling.

5.1 Recruitment and Participants

We followed the same general recruitment procedure we used for Studies C and D, with several adjustments. First, we additionally recruited participants from several Facebook groups with the theme of travel in Taiwan. Second, we excluded any respondents who self-identified as being familiar with Tamsui, as we were concerned that familiarity with the region could have confounded the findings of the previous studies, particularly with regard to destination choices. In all, 162 individuals signed up for the study, of whom 81 passed our screening process and formed 81 tour groups. Again, all participants reported whether they had previously visited any POIs on the predetermined list, although this time, an option of "unsure" was included. We balanced the number of tour groups across the two experimental conditions, and randomly assigned each group to one condition or the other. Three tour groups dropped out prior to the day of experiment, leaving 78 tour groups (comprising 101 individuals) to participate in it. However, P47's data were removed because P47 claimed to be very familiar with Tamsui, but had not been excluded from the experiment initially. Thus, the final dataset included 77 focal participants and 22 touring companions. The sample was gender-balanced (50 females, 48 males, 1 unwilling to reveal), and ranged in age from 20 to 65 (M=29.8, SD=10.2), with a wide range of occupations. Among the 77 focal participants – i.e., those who filled in the screening questionnaire – 46 reported being somewhat familiar with Tamsui, and 31, unfamiliar with it, including four who had never been there. Again, despite this high level of professed unfamiliarity, two-thirds of the participants (n=67) reported visiting Tamsui at least once a year. The average number of our 55 POIs that they said they had never visited was 29.2 (SD=12.0), with 78 individuals (79%) reporting never having seen 20 or more of the POIs, and only half (n=49) that they had visited more than 10.

5.2 Field Experiment Study Procedure

As noted above, our field study broadly replicated Studies C and D. Therefore, this section only discusses a few adjustments we made to those prior studies' procedures. First, the participants were asked to gather at a different initial meeting point, simply because their larger numbers required more space. The new meeting point was the British Merchant Warehouse, which was retained as the site of the post-study meeting; and it was there that we divided the participants into the two experimental conditions. The participants in each such condition received different tutorials on Tourgether, separately; and the tour groups in each condition did not know how the features of Tourgether differed in the other condition. In addition to the main features of Tourgether, we instructed the field-study participants to use a new Report function whenever they considered themselves to be visiting a place during the study, to help us distinguish between visit and non-visit. However, they were not required to report a visit if they chose to check in at one of the pre-determined POIs; this policy was intended

to reduce the burden on the participants that would have been created by having to both check-in and report the same visit. After the tutorial, as well as informing them that they were free to use any other tool to support their travel, we made them aware that they were not required to use Tourgether to obtain compensation for their participation. Unlike in Studies C and D, because the field experiment's focus was on quantitatively comparing unplanned POI visits across two conditions, we did not conduct a focus group for all tour groups. Instead, we invited 20 tour groups from the real-time condition to one of eight group interviews.

The goal of these interviews was to obtain additional insights that we might have missed in the previous formative studies. We invited 11 tour groups that had made many unplanned visits to POIs, and nine that had made only a few such visits. We also invited three tour groups from the baseline condition to review Tourgether, and asked them to imagine how their experience might have differed if they had been assigned to the real-time condition instead.

5.3 Field Experiment Data Analysis

As in Studies C and D, we analyzed POI visits only at the group level, i.e., assumed that participants in the same tour group had all visited a given POI if any one of them had. However, unlike in Studies C and D, where the research team had decided whether a given POI visit had occurred, the field experiment relied on the report button described above. To examine whether the check-in feature led to more unplanned POI visits by tour groups, we included condition (baseline vs. real-time) as a main effect in a linear regression model. In addition, because tour groups had quite diverse numbers of planned POIs (M=13.5, SD=9.4, Med=11), and because we observed sharp distinctions in numbers of POI visits and usage of Tourgether between those tour groups who planned to visit many POIs and those who planned to visit only a few, we included another main effect, of group travel plan. This was a binary categorical variable divided into an upper half and a lower half according to how many POIs were included in a given group's travel plan, i.e., 11 or more, or 10 or fewer, with 11 being the median number of planned POIs of all 77 tour groups. This resulted in 40 tour groups being placed in the lower half category, and 37 in the upper half. Two dependent variables were examined: number of unplanned POI visits and ratio of unplanned POI visits to all POI visits. Unfortunately, both of these dependent variables could be affected by a given tour group's total number of POI visits, which varied widely and depended on many factors, as mentioned in Section 4.4.2. However, this was unavoidable once we had decided against controlling the field-experiment participants' travel routes and destinations, to make the study setting as naturalistic as possible. To account for the variance caused by this confounding factor, total number of POI visits was included as a random variable in mixed-effects linear regression, so that we could focus on the effects of experimental condition and group travel plan on the dependent variables.

In the qualitative data, we mainly looked for 1) recurrent patterns of how real-time travel experience affected tour groups' destination choices, and 2) their attitudes toward a) seeing real-time travel experiences and b) sharing their own travel experiences with others.

5.4 Study Results and Findings

The tour groups named a total of 1,052 places in their travel plans, among which 89% (n=937) were POIs about which they had reported their prior visit experience: i.e., as visited (30.7%), not visited (51.8%), or unsure if they had visited (17.5%).

5.4.1 Seeing Real-Time Experience Sharing Lead to More Unplanned POI Visits. In the field experiment, tour groups self-reported visits as having occurred, regardless of whether its site was one of our pre-determined POIs. In this phase of our analysis, however, we only focused on the pre-determined POIs because tour groups in the baseline condition could only see reviews of those POIs. This allowed us to examine whether seeing real-time experience sharing led to more unplanned POIs than seeing online reviews downloaded from online
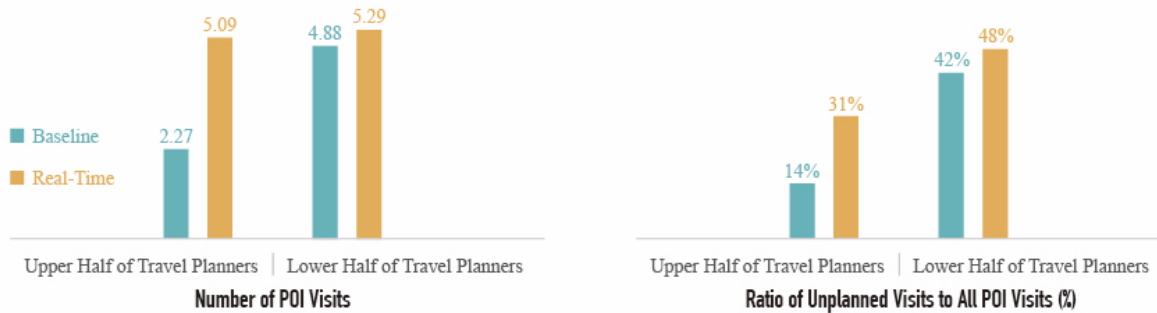
Fig. 5. Tour groups in the field experiment were divided into an upper half, based on having included more than 11 POIs in their travel plans, and a lower half, which planned to visit a maximum of 11. Tour groups using the real-time sharing feature (i.e., in the real-time condition) made more unplanned POI visits than those in the baseline condition. The impact of real-time sharing on upper-half tour groups was particularly high, leading to twice as many unplanned POI visits in the real-time condition as in the baseline condition.

maps. On average, the 77 tour groups in the two experimental conditions made 4.56 unplanned POI visits apiece (SD=3.94), representing 33% of all POI visits. However, the tour groups in the real-time condition made nearly one more unplanned visit each (M=5.18, SD=3.97, 37% of all POI visits) than those in the baseline condition did (M=3.92, SD=3.87, 29% of all POI visits). The regression results showed a positive main effect of experimental condition on both the number of unplanned POI visits (t(58)=2.3, p=0.03) and on the ratio of unplanned POI visits to all POI visits (t(74)=2.1, p=0.04). These results suggest that although tour groups in both conditions tended to make multiple unplanned visits spontaneously, seeing real-time experience increased the numbers of such visits. This finding was further supported by the fact that nearly one-fifth (18.8%) of all unplanned POI visits were preceded by the relevant tour group viewing check-ins associated with those POIs, with 37.7% of check-in views of unplanned POIs being converted into actual visits. Although some of these unplanned visits could be attributed to serendipity, a considerable portion of them appear to have resulted from seeing check-ins shared by other Tourgether users.

Interestingly, we found that the influence of real-time experience sharing was more apparent in the tour groups that included 12 or more POIs in their travel plans (i.e., the upper half) than those that included 11 or fewer (i.e., the lower half). As shown in Fig 5, among the upper-half groups, those in the real-time condition made an average of 5.09 unplanned POI visits (SD=4.57), representing 31% of all their POI visits, whereas those in the baseline condition only made 2.27 (SD=2.0), or 14% of all their POI visits. However, the difference between the two conditions was less noticeable in the lower half, within which tour groups in the real-time condition made an average of 5.29 unplanned POI visits (SD=3.16), representing 48% of all their POI visits, whereas those in the baseline condition made 4.88 (SD=4.37), or 42% of all their POI visits. Our regression results showed a negative main effect of travel-plan group on the number of unplanned POI visits (t(69)=-2.1, p=0.02) and on the ratio of unplanned to all POI visits (t(74)=-3.3, p=0.002), which was consistent with the results of the formative studies, i.e., that the number of planned POI visits was negatively correlated with the number of unplanned ones. The same pattern was also observable in the number of unplanned POI visits made after viewing check-ins. That is, whereas just 11.1% of the unplanned POI visits made by the lower-half tour groups were preceded by viewing check-ins from these POIs, 25% of the upper half's unplanned POI visits were preceded by such viewing. These results suggest that, while exposing tourists to real-time experience increased their numbers of unplanned POI
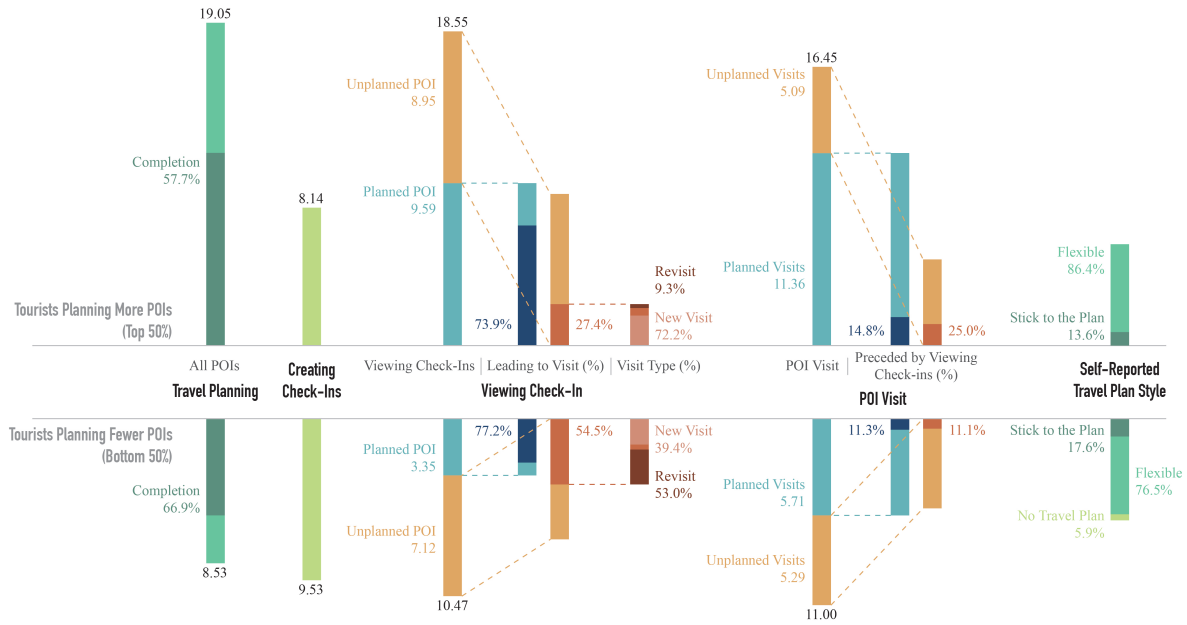
Fig. 6. Compared to those tour groups that included fewer POIs (i.e., 1-11) in their travel plans, those that planned more (i.e., 12+) created fewer check-ins, viewed more check-ins, and made more visits. However, while a larger portion of the former group's unplanned POI visits were preceded by viewing check-ins from those POIs, their check-in views were less often converted into actual visits, while revisits were especially rare.

visits, this influence was more than twice as strong among those who planned relatively large numbers of POI visits than among those who planned relatively few.

5.4.2 Differences in Travel Behavior and Tourgether Influence, by Planned POI Visit Quantity. The differential influence of Tourgether we observed across the upper-half and lower-half tour groups could have been a consequence of their essentially different travel behaviors, which in turn led to different usage of Tourgether. Fig 6 depicts contrasts between these two groups in terms of their travel planning, viewing of check-ins, and POI visits. However, we only included tour groups in the real-time condition in the next phase of our analysis, because those in the baseline condition could not check in or view check-ins. It can be observed that tour groups in the upper half, as well as including more POIs in their plans, viewed more check-ins and made more POI visits. On the other hand, probably due to the greater length of their lists of planned visits, their travel-plan completion rates were lower than those of their lower-half counterparts. Interestingly, while 25% of the upper half's unplanned visits were preceded by viewing check-ins from the relevant POIs, they had a significantly low conversion rate of check-in views to actual unplanned visits: 27.4%.

Furthermore, among those unplanned visits that occurred after viewing check-ins from the same POIs, between 72% and 90.7% were new visits (depending on whether "unsure" responses were included), while only 9.3% were definitely revisits. The facts that upper-half users' conversion rate of check-in views to visits was low, and that the majority of the resulting unplanned visits were new visits, further suggest that others' real-time experiences of non-novel POIs barely affected their travel plans at all. In strong contrast to this, the lower-half participants –

possibly due to being more flexible about their plans – made more unplanned visits that were not preceded by viewing check-ins, while their conversion rate was almost twice as high, at 54.5%. Unexpectedly, however, the resulting POI visits included 53% revisits, i.e., nearly six times more than for the upper half, and just 39.4% new visits (or 47% if "unsure" responses are included). This implies that, as compared to their upper-half counterparts, these tour groups did not focus strongly on sticking to their their travel plans; were more receptive to other tourists' check-ins; and were more willing to revisit places they had been to previously. Taken together, these results indicate that Tourgether exerted two distinct types of influence on its users, which might be ascribable to their different travel behaviors and preferences, and different purposes in using it. Interestingly, 86.4% of the upper-half tour groups self-reported being flexible about their travel plans.

5.4.3 Field Experiment Qualitative Results. Similar to the qualitative findings of Studies C and D, among those who were in the field experiment's real-time condition and were invited to participate in group interviews, most (17) interviewees reported that real-time check-ins had been useful to them, by increasing their awareness of nearby POIs and/or positively influencing their travel experience in some other way. These interviewees included members who were familiar and unfamiliar with Tamsui, and a mix of experienced re-visitors and new visitors. This echoes our formative-study results, that tourists who made more unplanned visits had diverse levels of familiarity with and prior experience of Tamsui. For example, P18, who self-identified as somewhat familiar with Tamsui and as visiting it once a year, commented, *"You can see where other people have visited, and take that as a reference. Compared to photos of products or shops provided by official websites, these are more akin to what normal people would see."* P44, who also self-identified as somewhat familiar with Tamsui, but as visiting it once every three months, said, *"[Y]ou can see the recent status of other places. If I want to go there I check the check-ins there. And you can avoid visiting stores that are not open."* P12, who self-reported as unfamiliar with Tamsui but as visiting it twice per year, said, *"[M]any places, taking Tamsui for example [...] we have visited many times. But still, there is always something new that you don't necessarily know. But I can be more likely to know if the information comes from somebody."* Finally, P30, who self-identified as unfamiliar with Tamsui and as visiting it less than once a year, also commented: *"There were some places I knew I would like, and places I knew I'd feel bored. But the real-time [check-in] made me realize that [the latter places] are actually pretty good to try. It changed my impression and decision [...]. So we have a lot, actually more than half, of places, which were those we suddenly decided to go on the spur of the moment."* Like this participant, some others mentioned that Tourgether helped change their pre-existing impressions of places that they initially did not include in their travel plans, but later determined to visit due to seeing others' check-ins.

Additionally, among the nine tour groups who were invited to interviews because they had made few or no unplanned visits, seven mentioned that although they mainly followed their own plans, they liked seeing other tourists' real-time experience. P34, for example, commented, *"I like this kind of feeling, being able to see what other tourists are doing. [...] It's like everyone is doing the same thing, making me want to see it more."* P81, who made no unplanned visits at all, also regarded seeing others' real-time experiences as helpful, but said he would have liked to see more assessment associated with check-ins: *"I might have a lack experience of these places. [...] I'd hope the app can also allow people to share, like good or bad experience. [...]. It can help me avoid visiting some bad places, reducing these kind of mistakes."* All members of three of the interviewed tour groups from the baseline condition also mentioned that they wished they had been able to see other groups' check-ins and to check in themselves. As one of them explained, *"I wanted to have more places to visit!"* Another said, *"I want to know more about the place, and also let other people know."*

Three interviewees took a more neutral attitude toward the helpfulness of real-time sharing. Two said they thought it did not help because they did not utilize it: P53 because he could not view photos in the app, and P61 because he simply did not want to. P63, on the other hand, found seeing others' experiences to be "good", yet expressed concerns about how he would be "affected" by it: *"I like to just walk around. If I see a check-in and then*

want to visit the place, it's like my journey was being constrained, not as free as I'd like it to be. I feel I was influenced by seeing other people's check-ins." Taken together, these interview data suggest that participants in the field experiment, though not all were invited to the interviews, generally thought seeing the real-time experiences of other tour groups had a positive influence on their travel. However, the feeling of being influenced by these experiences was not always welcome. Additionally, a majority of the participants in the real-time condition considered providing other tourists with their own experiences had a positive impact. As P12 commented, *"If other people learn about new places and good food because of my sharing, of course I think it's good to help people."* Similarly, P25 noted, *"Seeing this kind of real-time sharing makes me feel like everyone is contributing. Kind of warm"*, and P34 said, *"I like the feeling of sharing information with other people to help them."*

6 DISCUSSION

Our quantitative and qualitative results both support the idea that seeing experiences shared by other tourists could facilitate increases in Tourgether users' unplanned POI visits, and thereby their knowledge of new places, regardless of their levels of familiarity with or prior experience of an area. Some participants also reported that seeing these shared experiences changed their impressions of certain places that had previously been established via viewing online photos, and thus triggered their curiosity. On the other hand, their motivation for exploring POIs on an unplanned basis was driven solely by curiosity, but also to fulfill needs. Although many of the unplanned visits were made spontaneously, some would not have occurred if users had not been exposed to real-time experiences shared by others. A considerable number of check-in views were converted into unplanned visits to the same places. This is particularly interesting in light of the findings of a recent survey-based study, which reported that Facebook use had an impact on people's frequency of travel, itinerary planning, and social sharing, but no impact on their travel planning during the destination-selection stage [18]. This could have been because information received via Facebook was not perceived as being in real time, and/or perceived as incorporating no fast or easy way to access other users' experiences of physically proximate POIs. The tour groups in our study, in contrast, recognized that the travel experiences they saw were being shared by other tourists in real time, and therefore could represent the current or the most recent condition of the places being discussed, thus enabling better-informed decisions about whether to stick with or modify their original travel plans.

However, the value of real-time travel experience sharing was not merely that it kept tourists updated with the current status of POIs; additionally, it informed them of ad hoc events nearby that they would have not foreseen or been aware of otherwise. Even tour groups that only made a few unplanned visits appreciated the opportunity to "watch" other tourists collaborating and helping each other in the same region. It is noteworthy that, during our first three formative studies, only a few of the participating tourists felt that their awareness was enhanced by Tourgether, because they had turned off its (overwhelming) notifications. After several iterations of the notification system, however, we started to observe tourists being able to learn about their whereabouts via its notifications, and to hear them talking about their experiences and opinions of seeing other tourists' real-time experiences. Nevertheless, we did not specifically observe or inquire about whether they preferred to be passively notified about check-ins or to view them actively. Many mentioned that they browsed check-ins during break-points, mainly when they were resting, and that they rarely used Tourgether when actually moving. Nevertheless, it is unclear whether these moments were opportune ones for sending check-in notifications, because convenience was also rated as a key factor in tourists' decisions to make extra unplanned visits; and late notifications were likely to let tourists pass by POIs they might have wanted to visit if notified sooner. Thus, calculations of the most opportune moments for sending such notifications will require taking account of proximity, route, and break-points during travel: topics that are underexplored in ubicomp, but worth examining in future work.

It is also interesting to observe that the influence of seeing others' real-time experiences differed between tourists who included more vs. fewer POIs in their travel plans. Though this result was not conclusive, it seemed that such differences arose from these two groups' divergent travel behaviors and preferences. That is, tourists who planned more were mainly following their respective long lists of travel plans, and making only a small number/proportion of unplanned visits, despite viewing many check-ins. In particular, they seemed less willing to revisit POIs they had viewed check-from than POIs they had not visited before; thus, most of the unplanned visits this subset of participants made were to novel POIs. Nevertheless, exposure to real-time information still increased their overall quantity of unplanned visits, to double that of the baseline condition. In strong contrast to this, tourists who planned less seemed to be more flexible during their travel: making, in either experimental condition, many unplanned POI visits, a smaller proportion of which was associated with check-in viewing. Consequently, despite being statistically significant, the increase in this participant subset's number of unplanned visits caused by seeing real-time experience was small. On the other hand, its check-in views more often resulted in actual visits; and the majority of the resulting unplanned visits were revisits. This shows that the value of Tourgether to these users was not merely getting to know new places, but also updating their knowledge of places they had visited before.

Interestingly, the majority of the tour groups in both the upper half and lower half self-reported being flexible in their travel plans. Perhaps the flexibility referred to by the former consistsed of being "flexible within the travel plan", as opposed to open to making changes to the plan itself. In any case, it would be difficult to conclude that real-time travel experience sharing was more useful to or influential upon one of these subsets or the other, given that the wide differences in the kind of benefit tourists wanted to gain from Tourgether, the times at which they wanted such benefit, and how they preferred to travel, might all have determined how they used the app and its various features. Consequently, instead of assuming that tourists played a passive role of being influenced by other tourists' experiences, one should interpret our results in light of the possibility that they played an active one: i.e., deciding what kind of information and value they expected to obtain from others' check-ins and related real-time activity. Accordingly, we believe it would be worthwhile to conduct further research into how travel styles and preferences moderate the influence of real-time experience sharing.

Another key observation we made was that tourists who engaged in more unplanned visits also shared more. In focus groups, many participants who reported wanting to help the Tourgether community learn about new places also said they wanted to see other tourists' check-ins for the purpose of learning about and visiting new places. It seems likely that these individuals saw sharing travel experiences as adding value to one another's travel. Be that as it may, thanks to the high proportion of users who actively checked in, numerous tourists were able to learn about and visit novel places; and this process, in turn, raised a number of POIs with minimal or zero exposure on other travel apps to the status of top-10 most-visited POIs on ours. However, once a high number of check-ins had been created, a new issue emerged: how to filter for the "most relevant" or "most appealing" ones. Moreover, while most users appreciated the benefit of being aware of the current status of nearby POIs, one raised a concern about being unduly influenced by such awareness. Thus, while this research has provided evidence that exposing tourists to shared real-time experiences was 1) possible and 2) an effective means of enhancing their awareness of potentially interesting and novel POIs, questions remain about how to manage and regulate this feature, if it starts to overwhelm users or lead to other undesirable outcomes (e.g., replicating the current problem of tourist regions having a handful of ultra-popular, dominant POIs, albeit with different POIs).

Finally, it is interesting that anonymity emerged as a key driver of participants' check-in activity on the Tourgether app. In the absence of any worry about being tracked and questioned by relatives and friends (or "friends"), Tourgether users felt less pressure around refining and polishing their posts, and they reported that this increased the overall number of posts that they created. In other words, instead of being seen as an aspect of managing one's personal image, like typical social-media check-ins, Tourgether check-ins were perceived as geared toward helping others to enjoy themselves in the real world. Prior research [13] categorized Foursquare

users into four groups: those who wanted to make new friends; those who checked in everywhere for gaming; "explorers" who used it mostly to find new locations; and people who wanted to log their lives. We observed a similar patterning among the tourists in the present study, albeit with less sharp demarcation among the four groups – probably because members of all four perceived themselves 1) as co-present with other tourists in the same region, and 2) as sharing the goal of enjoying travel collectively, rather than using the app for normal social networking or standard travel-information gathering. Interestingly, the feeling of co-presence combined with anonymity created a sense of mystery among our participants, provoking their curiosity about one another and their desire to engage in more kinds of interaction with one another, including physically encounters and even friendship. On the flipside, such desire to physically interact might not be expected, reciprocated, or welcomed by tourists who are sharing; and the fact that check-ins reveal their creators' current locations could, at worst, facilitate disruptive and undesirable physical encounters, which would undoubtedly diminish users' willingness to sustain their contributions to the community. Finally, despite the fact that we did not intend or foresee such usage, Tourgether's role as a travel journal did drive check-ins, and thus indirectly served the app's main purpose of facilitating mutual help among all its users. Such usage should be anticipated and supported in any future versions.

7 STUDY LIMITATIONS

The above results were derived from a sample of tourists from Taiwan, all of whom were already familiar with social media and mobile electronic maps. As such, the results may not be generalizable to populations with less experience of such technology or members of other cultures. In addition, as mentioned earlier, we intentionally chose Tamsui as our study region because it is a popular place to revisit among residents of Taipei City. This choice allowed us to invite both new visitors and re-visitors to the study, as both these types of travelers are major target populations for Tourgether. As a result, most of the participants recruited for all five of our studies had visited Tamsui before, with the majority self-reporting that they visited the area more frequently than once a year. However, perhaps because Tamsui contains many POIs that these participants had never been to before (exceeding in number the POIs that they had been to previously), many of them made unplanned visits to novel POIs; and of course, if we had not included any re-visitors in our sample, we would not have been able to observe whether Together could encourage revisiting. Nevertheless, it must be acknowledged that the results we obtained from our participants were still biased toward re-visitors and should therefore not be generalized to tourism scenarios where the majority of visitors are new to the area. Unfortunately, we were not able to make clear comparisons between the data from new visitors and re-visitors, since many of the latter claimed that they were still unfamiliar with the region and/or that they had only visited a few places in it before. To investigate how familiarity with and visit experience of a region may moderate the influence of real-time sharing on unplanned visits will therefore require a more controlled experiment, which we regard as the next step in this line of our work. Also, given that Tourgether was initially aimed at supporting pedestrian tourists, the present paper's results might not be generalizable to larger tourism regions in which traveling from one POIs to another requires more travel time and/or different modes of transportation such as driving or taking public transit. In light of our qualitative findings that convenience was a critically important factor in the making of unplanned visits, it is possible that the influence of real-time sharing will be lower in areas where moving between POIs takes more effort. We allowed the participants a free choice of traveling companions. On the positive side, this represented a realistic approximation of their normal travel practices; however, it also prevented us from conducting data analysis on an individual level, as a given POI visit might easily be associated with several group members who had differing levels of familiarity with Tamsui and/or different travel preferences.

Also, though we assumed that four hours would be sufficient to experience Tamsui, the time actually needed might vary sharply from one user to another, and some probably tried to optimize their routes due to feelings of

time pressure. Given that the participants were traveling freely within the tourist region and not observed by the researchers, we were able to glean only limited data on how their travel decisions were made; and many participants did not leave us any voice messages, presumably because it was not required. In most cases, we could only rely on post-travel self-reports for such information, and it was impossible for us to ascertain the reason for every POI visit. As such, some POI visits were undoubtedly the result of serendipity, rather than directly caused by seeing Tourgether posts.

Lastly, travel decisions could have been the outcomes of face-to-face within-group discussions, and/or separated from the viewing of the relevant post by an hour or more, due to our experiments' realistic travel contexts. By the same token, however, it would be infeasible to conduct a fully controlled experiment. In fact, our first two initial small-scale formative studies were intended as controlled experiments, and thus we used a control panel to deliver mocked-up notifications of check-ins and to monitor participants' movement after these notifications were delivered. We learned from these two studies, however, that such manipulation was obvious to the participants, meaning that we remained – at that stage – unable to learn about how they would use our system and what they needed from it to support their travel. Thus, given the characteristics of the quantitative data we have, we cannot draw any firm conclusions about causal relationships between the viewing of check-ins and actual POI-visiting behavior, but only about general trends and associations between the two. Nevertheless, such insights have shed light on the features that future versions of this socio-travel tool, and others like it, ought to have.

8 CONCLUSION

The findings of our field test of Tourgether, a socio-travel app that allows users to mutually share their travel experiences via check-ins in real time, suggest that tourists can benefit from such sharing in several ways. On a practical level, Tourgether not only allowed our particpants to discover places they would not have known about without such a tool, but enhanced their awareness of current condition of such places, and helped them determine their imminent travel destinations. We also observed that the influence of Tourgether on its users seemed to differ according to their travel preferences: notably, whether they preferred planning to see many POIs and executing their travel plan more or less exactly, vs. planning less and enjoying serendipity more. These two broad types of tourists used Tourgether differently, resulting in different conversion rates of check-in viewing to actual POI visits. On an emotional level, many of our participants reported a desire to contribute to other tourists' enjoyment of the same region, and/or to utilize Tourgether as a tool for recording their own journeys. Even more interestingly, users of the app experienced a feeling of co-presence when seeing real-time posts shared by other users in Tamsui, provoking their interest in more direct contact with those individuals, including messaging, "friending", and even physically encountering them during travel. Taken together, these results imply that a tool like Tourgether, which allows users to see shared real-time experience, has promising applications for the tourism industry. That being said, we believe that the potential of real-time experience sharing by and for travelers has not been fully captured by this research, and that further studies are still needed. For example, it would be interesting to observe how people would use Tourgether or a similar app in connection with their non-touristic travel, or how locals in a tourism region could play a role on such a platform to enhance tourists' experience of it.

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REFERENCES

[1] Joaquín Alegre and Magdalena Cladera. 2009. Analysing the effect of satisfaction and previous visits on tourist intentions to return. *European Journal of Marketing* 43, 5/6 (2009), 670–685.

[2] Salvatore Andolina, Dario Pirrone, Giuseppe Russo, Salvatore Sorce, and Antonio Gentile. 2012. Exploitation of mobile access to context-based information in cultural heritage fruition. In *2012 Seventh International Conference on Broadband, Wireless Computing, Communication and Applications*. IEEE, 322–328.

[3] Anupriya Ankolekar, Thomas Sandholm, and Louis Yu. 2013. Play it by ear: a case for serendipitous discovery of places with musicons. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2959–2968.

[4] Ben Bedwell, Holger Schnädelbach, Steve Benford, Tom Rodden, and Boriana Koleva. 2009. In support of city exploration. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1171–1180.

[5] Daniel C Bello and Michael J Etzel. 1985. The role of novelty in the pleasure travel experience. *Journal of Travel Research* 24, 1 (1985), 20–26.

[6] Victoria Bellotti, Bo Begole, Ed H Chi, Nicolas Ducheneaut, Ji Fang, Ellen Isaacs, Tracy King, Mark W Newman, Kurt Partridge, Bob Price, et al. 2008. Activity-based serendipitous recommendations with the Magitti mobile leisure guide. In *Proceedings of the sigchi conference on human factors in computing systems*. ACM, 1157–1166.

[7] Keith Cheverst, Nigel Davies, Keith Mitchell, and Adrian Friday. 2000. Experiences of developing and deploying a context-aware tourist guide: the GUIDE project. In *Proceedings of the 6th annual international conference on Mobile computing and networking*. ACM, 20–31.

[8] Henriette Cramer, Mattias Rost, and Lars Erik Holmquist. 2011. Performing a check-in: emerging practices, norms and'conflicts' in location-sharing using foursquare. In *Proceedings of the 13th international conference on human computer interaction with mobile devices and services*. ACM, 57–66.

[9] Justin Cranshaw, Andrés Monroy-Hernández, and SA Needham. 2016. Journeys & notes: Designing social computing for non-places. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 4722–4733.

[10] Justin B Cranshaw, Kurt Luther, Patrick Gage Kelley, and Norman Sadeh. 2014. Curated city: capturing individual city guides through social curation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 3249–3258.

[11] Loredana Di Pietro, Francesca Di Virgilio, and Eleonora Pantano. 2012. Social network for the choice of tourist destination: attitude and behavioural intention. *Journal of Hospitality and Tourism Technology* 3, 1 (2012), 60–76.

[12] Steven Dow, Jaemin Lee, Christopher Oezbek, Blair MacIntyre, Jay David Bolter, and Maribeth Gandy. 2005. Exploring spatial narratives and mixed reality experiences in Oakland Cemetery. In *Proceedings of the 2005 ACM SIGCHI International Conference on Advances in computer entertainment technology*. ACM, 51–60.

[13] Jordan Frith. 2014. Communicating through location: The understood meaning of the Foursquare check-in. *Journal of Computer-Mediated Communication* 19, 4 (2014), 890–905.

[14] Thorsten Hennig-Thurau, Kevin P Gwinner, Gianfranco Walsh, and Dwayne D Gremler. 2004. Electronic word-of-mouth via consumer-opinion platforms: what motivates consumers to articulate themselves on the internet? *Journal of interactive marketing* 18, 1 (2004), 38–52.

[15] Simon Holland, David R Morse, and Henrik Gedenryd. 2002. AudioGPS: Spatial audio navigation with a minimal attention interface. *Personal and Ubiquitous computing* 6, 4 (2002), 253–259.

[16] Chih-Hsiang Hsu, Chia-Lun Ku, Yung-Ju Chang, Yu-Shuen Wang, Uyn-Dinh Trân, Wen-Hao Cheng, Chu-Yuan Yang, Ching-Yu Hsieh, and Chun-Cheng Lin. 2018. iTour: Making Tourist Maps GPS-Enabled. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 4 (2018), 139.

[17] Jens Kr Steen Jacobsen and Ana María Munar. 2012. Tourist information search and destination choice in a digital age. *Tourism management perspectives* 1 (2012), 39–47.

[18] Veena Jadhav, Seetha Raman, Nitin Patwa, Krishna Moorthy, and John Pathrose. 2018. Impact of Facebook on leisure travel behavior of Singapore residents. *International Journal of Tourism Cities* 4, 2 (2018), 157–178.

[19] Hyungeun Jo, Sungjae Hwang, Hyunwoo Park, and Jung-hee Ryu. 2011. Aroundplot: Focus+ context interface for off-screen objects in 3D environments. *Computers & Graphics* 35, 4 (2011), 841–853.

[20] Antti Jylhä, Yi-Ta Hsieh, Valeria Orso, Salvatore Andolina, Luciano Gamberini, and Giulio Jacucci. 2015. A wearable multimodal interface for exploring urban points of interest. In *Proceedings of the 2015 ACM on International Conference on Multimodal Interaction*. ACM, 175–182.

[21] Stephen Kaplan. 1991. Beyond rationality: Clarity-based decision making. *Environment, Cognition, and Action: An Integrative Multidisciplinary Approach* (1991), 171–90.

[22] Hyang-Sook Kim. 2016. What drives you to check in on Facebook? Motivations, privacy concerns, and mobile phone involvement for location-based information sharing. *Computers in Human Behavior* 54 (2016), 397–406.

[23] Jong-Hyeong Kim, JR Brent Ritchie, and Bryan McCormick. 2012. Development of a scale to measure memorable tourism experiences. *Journal of Travel Research* 51, 1 (2012), 12–25.

[24] Andreas Komninos, Peter Barrie, Vassilios Stefanis, and Athanasios Plessas. 2012. Urban exploration using audio scents. In *Proceedings of the 14th international conference on Human-computer interaction with mobile devices and services*. ACM, 349–358.

[25] Metin Kozak, Enrique Bigné, and Luisa Andreu. 2005. Satisfaction and destination loyalty: A comparison between non-repeat and repeat tourists. *Journal of Quality Assurance in Hospitality & Tourism* 5, 1 (2005), 43–59.

[26] Ville Lehtinen, Antti Nurminen, and Antti Oulasvirta. 2012. Integrating spatial sensing to an interactive mobile 3D map. In *2012 IEEE Symposium on 3D User Interfaces (3DUI)*. IEEE, 11–14.

[27] Janne Lindqvist, Justin Cranshaw, Jason Wiese, Jason Hong, and John Zimmerman. 2011. I'm the mayor of my house: examining why people use foursquare-a social-driven location sharing application. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 2409–2418.

[28] Stephen W Litvin, Ronald E Goldsmith, and Bing Pan. 2008. Electronic word-of-mouth in hospitality and tourism management. *Tourism management* 29, 3 (2008), 458–468.

[29] Can Liu, Ben Bengler, Danilo Di Cuia, Katie Seaborn, Giovanna Nunes Vilaza, Sarah Gallacher, Licia Capra, and Yvonne Rogers. 2018. Pinsight: A Novel Way of Creating and Sharing Digital Content Through'Things' in the Wild. In *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, 1169–1181.

[30] David Mcgookin, Stephen Brewster, and Pablo Priego. 2009. Audio bubbles: Employing non-speech audio to support tourist wayfinding. In *International Conference on Haptic and Audio Interaction Design*. Springer, 41–50.

[31] Anubhav Mishra and SM Satish. 2016. eWOM: Extant research review and future research avenues. *Vikalpa* 41, 3 (2016), 222–233.

[32] Ana María Munar and Jens Kr Steen Jacobsen. 2014. Motivations for sharing tourism experiences through social media. *Tourism management* 43 (2014), 46–54.

[33] Hossein Nezakati, Asra Amidi, Yusmadi Yah Jusoh, Shayesteh Moghadas, Yuhanis Abdul Aziz, and Roghayeh Sohrabinezhadtalemi. 2015. Review of social media potential on knowledge sharing and collaboration in tourism industry. *Procedia-social and behavioral sciences* 172 (2015), 120–125.

[34] Per M Nielsen, Jeni Paay, Jon Pearce, and Jesper Kjeldskov. 2015. Exploring Urban Events with Transitory Search on Mobiles. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct*. ACM, 712–719.

[35] Antti Nurminen. 2006. m-LOMA-a mobile 3D city map. In *Proceedings of the eleventh international conference on 3D web technology*. ACM, 7–18.

[36] Timo Ojala, Hannu Kukka, Tomas Lindén, Tommi Heikkinen, Marko Jurmu, Simo Hosio, and Fabio Kruger. 2010. UBI-hotspot 1.0: Large-scale long-term deployment of interactive public displays in a city center. In *2010 Fifth International Conference on Internet and Web Applications and Services*. IEEE, 285–294.

[37] Antti Oulasvirta, Sara Estlander, and Antti Nurminen. 2009. Embodied interaction with a 3D versus 2D mobile map. *Personal and Ubiquitous Computing* 13, 4 (2009), 303–320.

[38] Stanley Plog. 2001. Why destination areas rise and fall in popularity: An update of a Cornell Quarterly classic. *Cornell hotel and restaurant administration quarterly* 42, 3 (2001), 13–24.

[39] Mattias Rost, Henriette Cramer, and Lars Erik Holmquist. 2012. Mobile exploration of geotagged photographs. *Personal and Ubiquitous Computing* 16, 6 (2012), 665–676.

[40] Aaron Steinfeld, Odest Chadwicke Jenkins, and Brian Scassellati. 2009. The oz of wizard: simulating the human for interaction research. In *Proceedings of the 4th ACM/IEEE international conference on Human robot interaction*. ACM, 101–108.

[41] Steven Strachan, Parisa Eslambolchilar, Roderick Murray-Smith, Stephen Hughes, and Sile O'Modhrain. 2005. GpsTunes: controlling navigation via audio feedback. In *Proceedings of the 7th international conference on Human computer interaction with mobile devices & services*. ACM, 275–278.

[42] Emily Sun, Ross McLachlan, and Mor Naaman. 2017. MoveMeant: Anonymously Building Community Through Shared Location Histories. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 4284–4289.

[43] Wee-Kheng Tan. 2017. The relationship between smartphone usage, tourist experience and trip satisfaction in the context of a nature-based destination. *Telematics and Informatics* 34, 2 (2017), 614–627.

[44] Aaron Tham, Glen Croy, and Judith Mair. 2013. Social media in destination choice: Distinctive electronic word-of-mouth dimensions. *Journal of Travel & Tourism Marketing* 30, 1-2 (2013), 144–155.

[45] Mark Van Setten, Stanislav Pokraev, and Johan Koolwaaij. 2004. Context-aware recommendations in the mobile tourist application COMPASS. In *International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems*. Springer, 235–244.

[46] Giovanna Nunes Vilaza, Can Liu, Ben Bengler, Licia Capra, and Yvonne Rogers. 2018. Here, this and next: evaluating public engagement with multiple, distributed and interlinked devices. In *Proceedings of the 10th Nordic Conference on Human-Computer Interaction*. ACM, 524–536.

[47] Daniel Wagner and Dieter Schmalstieg. 2003. First steps towards handheld augmented reality. In *Seventh IEEE International Symposium on Wearable Computers, 2003. Proceedings*. IEEE, 127–135.

[48] Zheng Xiang and Ulrike Gretzel. 2010. Role of social media in online travel information search. *Tourism management* 31, 2 (2010), 179–188.

[49] Libo Yan and Maria Younghee Lee. 2015. Are tourists satisfied with the map at hand? *Current Issues in Tourism* 18, 11 (2015), 1048–1058.