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Factors that Influence Adoption and Use of Location-Sharing Social Media

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Information and Computer Science

by

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Dissertation Committee:
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DEDICATION

To

My husband and children
for their patience, helping me to stay active and balanced
but focused on my dissertation research.

My parents and brother for their support throughout
many years in school and various degrees.

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ABSTRACT OF THE DISSERTATION

Factors that Influence Adoption and Use of Location-Sharing Social Media

By

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Doctor of Philosophy in Information and Computer Science

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Professor Alfred Kobsa, Chair

This work aims to understand real-world factors shaping behaviors and attitudes towards location-sharing social networks (LSSN), especially as to why people avoid or abandon this technology, or limit their usage. Based on interview-based qualitative research and survey-based exploratory quantitative research, I hypothesize conceptual models describing factors that greatly impact how and whether people use location-sharing social networks. Through a series of nationwide surveys and structural equation modeling analysis, I operationalize, confirm, and refine these theories. To explore how these theories can be incorporated into the design of location-sharing social networks, I conduct a controlled experiment comparing user attitudes towards different designs.

This research leads to the following findings:

- People's attitudes about how their existing relationship boundaries will be preserved (Boundary Preservation Concern) or enhanced (Boundary Enhancement) when using LSSN are a root determinant of location-sharing privacy concerns, usage intention and actual usage frequency.

- The main driver of attitudes towards boundary preservation or enhancement stems from one's predisposition to communicate in a style I term "FYI" (For Your Information). FYI communicators like to infer availability and to keep in touch with others without having to interact with them, which is the predominant style in current LSSN.
- The effect of age, personality, and other demographic factors are completely mediated by the FYI communication style.
- There is a connection between value-related personality characteristics (such as propensity to lie), and privacy concerns as well as LSSN usage.

This dissertation presents an integrated theoretical framework of location-sharing attitudes and usage that shows the relationship between these factors.

Lastly, the validated framework is applied to system design. While certain designs prove more appealing than others, FYI communicators have a more positive evaluation of LSSN overall. This difference in attitudes can be traced back to differences between how high and low-FYI individuals perceive the same system design. Drawing on these disparities, certain features (such as those that help convey contextual cues) can be used to help narrow the attitude gap between high and low-FYI individuals. Based on these results, the thesis concludes with design suggestions for making location-sharing social media more appealing to a broader audience.

INTRODUCTION

Research shows that social media use can benefit existing relationships, build new ones, and lead to improved psychological well-being (Ellison, Steinfield, & Lampe, 2007). However, relatively little is known about who is and who is not using social media (Boyd & Ellison, 2007), and even among social media users, not all ways of using social media have been found to lead to the same benefits (Burke, Kraut, & Marlow, 2011). This dissertation focuses on understanding who is and is not using a specific type of social media, location-sharing social networks (LSSN).

LSSN such as Foursquare or Google Latitude allow individuals to share their location with family and friends. There are various ways of sharing location. Some systems continuously and automatically share the user's location. Other systems have the user to "check in" each time they want to share a snapshot of their location. Still others require the user to request their friends' location.

Describing one's location serves to convey more than just geography. Analysis of mobile phone conversations reveals that location disclosure plays a major role in creating social or process awareness, coordinating meetings, and in signaling availability, caring, or need for help (Bentley & Metcalf, 2008). Location-sharing social networks integrate location into social media as a way to facilitate interpersonal exchanges.

Recently, smartphones and location-based services have become widely available in developed countries (Tsai, Kelley, Cranor, & Sadeh, 2010a), enabling social location sharing. Almost half of U.S. adults now own a smart phone, yet only 10% have ever used social location-sharing services (A. Smith, 2012). Amongst smartphone users, 74% have used services such as location-based search, but only 18% have ever tried sharing location

with other people (Zickuhr, 2012). Researchers and the media attribute this to privacy concerns (Baldor, 2010; Tsai et al., 2010a) and point to how a majority of mobile users now avoid new apps because of privacy concerns (Boyles, Smith, & Madden, 2012). With many popular social media services now incorporating location-sharing features (e.g., Facebook, Twitter, Google+), it is important to understand any concerns surrounding location-sharing technologies and its impact on interpersonal interactions in social media.

There has been much location-sharing research in the fields of Human Computer Interaction (HCI), Computer Supported Cooperative Work (CSCW), and Ubiquitous Computing (UbiComp). However, for the most part studies have used hypothetical survey or lab scenarios, often in a pre-Facebook and pre-Twitter context (Consolvo et al., 2005; Iachello et al., 2005; Olson, Grudin, & Horvitz, 2005; Want, Hopper, Falcão, & Gibbons, 1992). More recent field studies often involve prototypes with willing participants (Barkhuus et al., 2008; Brown et al., 2007; Raento & Oulasvirta, 2008; Sadeh et al., 2009; Toch et al., 2010). While some researchers have studied early adopters of social location-sharing systems (Boesen, Rode, & Mancini, 2010; Humphreys, 2007), the recent proliferation of freely available location-sharing social networks allows us to turn to the question of *who is not using these services and why?* To understand the interactions enabled by social technologies, studying non-use is just as important as studying actual usage (Satchell & Dourish, 2009). Although some researchers are beginning to probe on the topic of abandoning social media (Baumer et al., 2013), there is still relatively little research on the topic of social media non-use, let alone on location-sharing social media non-use.

This work considers various types of users and non-users as a way to understand factors influencing adoption and usage of LSSN. Understanding people who are avoiding or

limiting their technology use and the reasons behind their adoption decisions lays the groundwork for researchers to anticipate and address underlying barriers and catalysts to using new systems. This dissertation also takes a first step into translating theory into practice by exploring how these factors can manifest in actual system design, and how that may affect ones' attitudes and usage of LSSN. By producing concrete design guidelines and insights, this research will assist designers in tailoring features to their target audience, and in avoiding alienating large segments of the population.

This work contributes to a larger research agenda of understanding social media adoption, avoidance and abandonment. Although I focus on location-sharing social media, my data suggests that similar influences or root causes may also be at play in the adoption and usage of other social media. Thus, this work can be a starting point for researching motivations and barriers to using social media in general.

CHAPTER 1: Motivation and Research Questions

A large body of the location-based services (LBS) literature emphasizes privacy concerns as a barrier to using location-sharing features and services with others. These privacy concerns range from informational (e.g., withholding or disclosing personal information) to psychological (e.g., self-presentation concerns about how one appears on a map) to interactional (e.g., being contacted when you do not want) to physical (e.g., physical intrusion) (Li & Chen, 2010a; Tang, Lin, Hong, Siewiorek, & Sadeh, 2010; Tsai et al., 2010a; Xu, Teo, Tan, & Agarwal, 2009). Many social media and other studies of online behavior have also emphasized privacy concerns as an impediment to technology use. Similarly, they focus on a diverse array of informational, psychological, interactional and physical privacy concerns (Binder, Howes, & Sutcliffe, 2009; Meeder, Tam, Kelley, & Cranor, 2010; H. J Smith & Rogers, 2003; Stutzman & Kramer-Duffield, 2010; Tufekci, 2008a).

However, research shows that online privacy attitudes and concerns often fail to predict actual online behavior (Spiekermann, Grossklags, & Berendt, 2001a). Indeed, scholars often point out many instances of over-sharing and other behavior that not only disregards privacy, but even puts them at risk of embarrassment, financial loss and threats to personal safety (Acquisti & Gross, 2006, 2009; Neuburger, 2008). This conundrum is widely recognized as the *privacy paradox* and has led some scholars to conclude that people are irrational in making privacy trade-offs (Acquisti & Grossklags, 2006) or that people are not really as privacy concerned as they maintain (Berendt, Günther, & Spiekermann, 2005; Spiekermann, Grossklags, & Berendt, 2001b; Norberg, Horne, & Horne, 2007). Other researchers work on improving existing privacy scales, asserting that the

literature has not yet measured the right constructs (Buchanan, Paine, Joinson, & Reips, 2007; Malhotra, Kim, & Agarwal, 2004; Pedersen, 1999).

Given the disagreement over what and how privacy concerns affect behavior, and given that there is still relatively little research on non-users and social media abandonment, this dissertation begins with an exploration of location-sharing social networks in the real world to study whether people really have concerns and the impact of those concerns. Namely, the research questions are as follows:

R1: What concerns do people really have?

R2: What causes these concerns?

R3: Are these concerns affecting adoption and usage?

R4: How do we remove these barriers to adoption and usage?

In answering these research questions, this work draws from and contributes to multiple bodies of literature including privacy, location-based services, social media, technology adoption, and human-computer interaction.

CHAPTER 2: Literature Survey

This dissertation spans multiple research areas. This chapter summarizes relevant work regarding location-sharing services, social media and privacy, as well as factors contributing to location-sharing attitudes and behaviors such as predispositions and personality traits. Lastly it surveys work on design of location-sharing systems.

Location-Sharing Services

Location-Based Services (LBS) use one's location to provide a number of services. Social location-sharing services are a subset of LBS that allows people to share their location with other individuals. The manner in which one shares location ranges from automatic, continuous, real-time location-sharing (e.g., Google Latitude) to manual check-ins (e.g., Foursquare, Gowalla), to authorized disclosures in response to requests (e.g., HeyWAY), to location tags (e.g., GPS coordinates appended to a Twitter tweet, or location tag on a Facebook post). From a technical standpoint, there are many different methods for determining the location of a mobile device: GPS, cell phone towers, wireless access points, and IP address.

Much location-tracking research emphasizes privacy concerns. They've probed on hypothetical scenarios via questionnaires (Lederer, Mankoff, & Dey, 2003; Olson et al., 2005; Xu, Gupta, & Shi, 2009), experiments (Lederer, Hong, Dey, & Landay, 2004; Lederer et al., 2003) and experience sampling methods (ESM) where people are prompted during their normal day-to-day activities on whether they would disclose current location if a particular person were to request it at that moment (Consolvo et al., 2005; Khalil & Connelly, 2006). Studies suggest location-tracking is useful for coordinating meetings and

checking on loved ones (Iachello et al., 2005). Researchers also posit that the primary determinants of location disclosure are *who* is requesting one's location, *when,* and *why* (Consolvo et al., 2005; Lederer et al., 2003; Olson et al., 2005). Recent research has also focused on other aspects of *who* and found that one's subjective perception of closeness is enough to predict disclosure in a given set of scenarios (Wiese et al., 2011). Other scholars have focused on weighing disclosure benefits versus risks (Culnan & Armstrong, 1999; Culnan, 1993; Knijnenburg, Kobsa, & Jin, 2013; Laufer & Wolfe, 1977; Tsai, Kelley, Cranor, & Sadeh, 2010b).

However, stated privacy attitudes often differ from actual behavior (Spiekermann et al., 2001a). Thus some scholars have studied location-tracking usage. Reno was a system prototype where location was disclosed or withheld in response to requests initiated by other participants (Iachello et al., 2005). Other systems used real-time disclosure within a limited group of socially connected participants such as a family, a group of friends, or co-workers (Barkhuus et al., 2008; Brown et al., 2007; Raento & Oulasvirta, 2008; Want et al., 1992). These studies showed that location-awareness can also be useful for being socially connected, coordinating day-to-day activities, and making sure loved ones are okay. In a household setting, location sharing also creates a moral component where family members have to account for their location and justify deviations (Brown et al., 2007). To avoid disclosing too much location information, many of these prototypes support nondisclosure, ambiguity, and varying level-of-detail.

Within the last decade, location-tracking services have become publically available such as those to track children or the elderly (Segan, 2006). Some researchers have studied these location-tracking services autonomously adopted by participants, i.e., adoption and

use within a real world context. This is important to understand what types of people would use the technology and for what purposes. Humphreys described how Dodgeball, a text-based application, helped people meet up at venues in the city (Humphreys, 2007). Boesen et al. studied domestic use of Google Latitude as a way of monitoring and making sure children were where they should be (Boesen et al., 2010). Boesen et al. point out that despite behavioral improvements, the ability to more easily detect lies undermined the perceived trust in their relationships. Lindqvist et al. catalog types of use that drive Foursquare users, finding that many users had Foursquare friends that they had never met (Lindqvist, Cranshaw, Wiese, Hong, & Zimmerman, 2011). Cramer et al. further investigate how check-ins are performative and the norms around appropriate check-in locations (Cramer, Rost, & Holmquist, 2011).

These studies take an initial step in understanding adopters of location-sharing services and the benefits of use. However, with the slow uptake of location-sharing services despite the recent explosion of location-sharing social media and proliferation of smartphones, it is also important to understand why many people are not using LSSN. My dissertation takes a step in this direction by studying adopters and non-adopters of publically available location-sharing services.

Usage and Adoption

There is much literature on technology adoption, usage and their antecedents. These subsections survey the most relevant literature in this area for the adoption of location-sharing social networks.

Social Media (Non) Adoption

Social Media studies have mostly focused on understanding social media *users* (see Boyd & Ellison, 2007 for an overview). However, a small number of scholars have studied how people may temporarily disengage, limit disclosure, or permanently leave a service (Baumer et al., 2013; Farnham & Churchill, 2011; Vitak, 2012). Some studies shed light on various external or situational motivations for social media abandonment (Baumer et al., 2013). Others concentrate on individual differences such as personal beliefs or personality (Tufekci, 2010). Still others show how usage patterns evolve over time and how technology does not adequately support these transitions (Birnholtz, 2010). Furthermore, although social media use is increasing among older adults, they still lag greatly behind younger users (Madden, 2010).

Overall, these studies suggest that non-users may be different from social media users in a number of aspects such as motivation, personality or life phase. These differences may also be connected to location-sharing social media use. Thus this research includes both social media users and non-users, and looks at similar factors that may be connected to non-use of location-sharing social networks.

Online Privacy Concerns

There are diverse conceptualizations of privacy (Solove, 2008). Some scholars and lawmakers view privacy as a fundamental human right (Iachello & Hong, 2007), while others take a commodity view and study how people are willing to trade their privacy for other benefits (Acquisti & Grossklags, 2006). Some attempt to classify information according to their privacy sensitivity (Ackerman, Cranor, & Reagle, 1999; Olson et al.,

2005), while others believe that what is private varies and is contextual defined (Nissenbaum, 2010) and still others focus on privacy practices rather than privacy as an abstract concept that can be compared across different situations (Dourish & Anderson, 2006). HCI scholars often study privacy in one of two camps: informational and data protection privacy which is often concerned with data collection and organizations (Smith, Dinev, & Xu, 2011), versus personal or social privacy which deals with managing privacy in interpersonal interactions (for an overview of work in this field, refer to Iachello & Hong, 2007).

Some prominent definitions of privacy used in HCI are Warren and Brandeis's "Right to be left alone" (Warren & Brandeis, 1890), Westin's "claim of individuals, groups, or institutions to determine for themselves when, how and to what extent information about them is communicated to others" (AF Westin, 1967), and Altman's "interpersonal boundary regulation" (Altman, 1975). These definitions depict privacy as the ability to regulate physical, informational or social access. Several scholars have created taxonomies to define these different types of privacy. Burgoon et al. distinguish between informational privacy (how, when and to what extent my information is released), physical privacy (degree to which one is physically accessible), and social/communicational privacy (controlling social contact) (Burgoon et al., 1989). DeCew uses slightly different categories of informational privacy, accessibility and expressive privacy (DeCew, 1997). Westin identifies solitude (being separate from the group), anonymity (not identifiable), intimacy (confide in small group) and reserve (psychological barrier against unwanted intrusion) as different types of privacy that can be used to achieve privacy functions such as personal autonomy, emotional release, self-evaluation, as well as limited and protected communication (AF

Westin, 1967). Marshall brings in environmental factors and extends Westin's privacy types to also include seclusion and no neighboring (Marshall, 1974). Pedersen also builds off of Westin's taxonomy but differentiates between intimacy with friends versus intimacy with family, and adds isolation as a separate state which emphasizes being geographically removed from and free of observation by others (Pedersen, 1999). Pedersen additionally extends Westin's privacy functions to include creativity.

There has also been work to develop scales and metrics for measuring privacy concerns, although much of the work has been concentrated in informational privacy and data protection from organizations rather than social privacy practices (Page, Tang, Stutzman, & Lampinen, 2013). One of the most often cited is the Westin segmentation which classifies people into privacy Fundamentalists (value privacy highly), Pragmatists (can see trade-off benefits in some situations), and Unconcerned (A. Westin, 1991). However, it's utility for predicting online behavior has been debated and some scholars have developed privacy scales for empirically evaluating online privacy attitudes. Smith et al. developed the Concern for Information Privacy scale which measured four dimensions of concern towards an organizations information practices: collection, unauthorized secondary use, improper access and errors (H. Jeff Smith, Milberg, & Burke, 1996). Malhotra et al. concentrated on other aspects of informational privacy – collection of personal information, control, and awareness of privacy practices (Malhotra et al., 2004). Attempting to improve on these scales, Buchanan et al. produced a 3 part scale that consists of a attitudinal measure of general privacy concern and two measures of privacy behavior, general caution and technical protection (Buchanan et al., 2007). Many of these privacy scales do not capture social privacy concerns such as impression management, accessibility

and self-realization. Thus, many HCI studies of social technologies continue to define their own set of privacy concerns and use study-specific measures that do not easily lend themselves to cross-study comparisons.

Research on location-sharing technologies deals with social privacy concerns and has identified a range of privacy concerns that users of such systems may harbor. Many studies focus on informational privacy and on sharing information with, or withholding it from, the appropriate people (Consolvo et al., 2005; Wiese et al., 2011; Xu, Gupta, et al., 2009). Some studies uncover user anxieties around not having control over how they are presented (Tang et al., 2010). Researchers have also found that people may be more concerned about disturbing and being disturbed by others than about the private nature of disclosure (Iachello et al., 2005). Tsai et al. surveyed people about perceived risks and found that fear of potential stalkers is one of the biggest barriers to adopting location-sharing services (Tsai et al., 2010a).

Researchers highlight similar concerns in other social media. Social network users are concerned about who sees what, often because of the various social spheres (e.g., family, work, friends) that intersect on their Facebook page (Binder et al., 2009). Users often limit who sees their profile to a defined audience (Li & Chen, 2010b; Meeder et al., 2010; Stutzman & Kramer-Duffield, 2010). Likewise, social media users worry about self-presentation and how others' postings will reflect on them (Tufekci, 2008b), sometimes getting annoyed or being overwhelmed by too much information from others (Ehrlich & Shami, 2010). Studies have also shown concerns for feeling compelled to interact with others online (Smith & Rogers, 2003).

On the other hand, researchers have also identified many counterexamples where privacy seems no concern. Trials of location-sharing systems in small, close-knit peer groups or families seem to promote connection rather than privacy fears (Barkhuus et al., 2008; Brown et al., 2007; Raento & Oulasvirta, 2008). Even within larger social networks, people continue to share tremendous amounts of personal information despite potential drawbacks including embarrassment, loss of employment, identity theft, and threats to personal safety (Acquisti & Gross, 2006, 2009; Neuburger, 2008). Nardi et al. observed how some people leave diary-like blogs open to the world (Nardi, Schiano, & Gumbrecht, 2004). In fact, some share intimate details with complete strangers when they will not even share those details with their closest relationships (Hasler & Ruthven, 2011). Moreover, people increasingly use location-based services such as OkCupid to connect with total strangers nearby (Rao, 2011).

Other research shows that online privacy regulation mirrors offline behavior, given that most social networking ties are with existing, offline relationships (Boyd & Ellison, 2007; Lampe, Ellison, & Steinfield, 2006). Drawing from Altman's theories of privacy in the offline world, Palen and Dourish describe how, just like in the real world, online privacy is a boundary regulation along the dimensions of identity, disclosure, and temporality (Palen & Dourish, 2003). Using this conception, privacy not only consists in withholding information or withdrawing from others, but it can also involve sharing information or being more accessible. People regulate their disclosure or accessibility to the desired level, and thus, seemingly overt online behavior may not be a privacy violation at all. Similarly, the framework of contextual integrity explains that context-relative informational norms define privacy expectations and appropriate information flows and so a disclosure in one

context (such as your doctor asking you for your personal medical details) may be perfectly appropriate in one context but not in another (such as your employer asking you for your personal medical details) (Nissenbaum, 2010).

This research explores whether and how privacy concerns impact location-sharing attitudes and behaviors. Better understanding what type of boundary regulation occurs and why will help in the design and evaluation of location-sharing and other social media.

Personality Traits

Some scholars have focused on individual differences that might explain variations in how people utilize social media (Correa, Hinsley, & de Zúñiga, 2010; Rosenberg & Egbert, 2011). A number of studies have investigated connections to one of the most widely used personality trait taxonomies, the Big Five personality traits (McCrae & Costa Jr., 1985a). The Big-5 consists of traits that are abstractions of the most common personality facets in various trait taxonomies throughout the literature (John & Srivastava, 1999). The traits are extraversion, agreeableness, conscientiousness, emotional stability, and openness to new experiences. Often more specific traits will be more useful for a specific context (e.g., shyness, communication style) but the Big-5 captures the broadest spectrum of personality traits.

Studies have found different Big-5 traits to have different effects on social media use, size of friend lists, disclosure, and other behaviors (Amichai-Hamburger & Vinitzky, 2010; Ross et al., 2009). Most commonly, studies have found a positive connection between social media use and extraversion (Correa et al., 2010; Rosen & Kluemper, 2008; Ryan & Xenos, 2011). Nonetheless, other studies have found no effect (Junglas & Spitzmuller, 2006)

or even that extraverts are less likely to disclose or spend time online (Burke et al., 2011). In light of these contradicting results, the literature does not give us clear direction as to the connection between personality traits and social media use.

Fewer studies have looked at the connection between personality traits and location-sharing adoption (Junglas & Spitzmuller, 2006). Rather, much of the media and research blame non adoption on privacy concerns (e.g., Tsai et al., 2010a). Thus, my research takes into account both privacy concerns and personality traits as possible factors affecting location-sharing adoption, attitudes and usage behavior.

Beyond the Big-5 personality traits, my research also looks at more specific individual predispositions that may be useful in explaining attitudes and behavior. The following subsections review the literature for two stable dispositions that emerged in the exploratory phase of my research.

Communication Style

In studies of offline communication attitudes and behaviors, communication styles are stable individual predispositions that have been linked to personality traits (Richmond & Roach, 1992). Willingness to use verbal communication has been used to predict attitudes and behaviors across a variety of situations such as likelihood of occupying leadership positions, initiating new relationships, and academic performance (Cho, Gay, Davidson, & Ingraffea, 2007; Richmond & Roach, 1992). Scholars have found that communication style traits can be more productive for understanding offline communication behavior than focusing on personality traits such as introversion (McCroskey, 1992; Richmond & Roach, 1992). Similarly, recent research explaining people's social media activity suggests that personality traits may be overshadowed by an individual's desire to

communicate (Ross et al., 2009). These insights from the literature suggest that a person's communication style could greatly influences whether and how that person uses social media such as location-sharing social networks.

Existing communication style constructs assume verbal or physical interaction (e.g., McCroskey, 1992). With the advent of social media, scholars have noted new ways of consuming and sharing information, and for learning about others without requiring real-time, verbal, or physical interaction (Burke et al., 2011; Spitzberg, 2006). Some theories highlight key differences between face-to-face (FtF) communication and computer-mediated communication (Kotlyar & Ariely, 2013; Mantovani, 1996; Riva, 2002). A common theme that emerges is that in FtF interaction, participants use many nonverbal cues to signal the true meaning of their message. In fact, nonverbal cues can in certain cases contribute more towards understanding than even the content of the message itself. Cues provide a context from which common understanding can occur in order to interpret a message. In FtF interaction, these nonverbal cues are enacted through the physical body (Cassell, 2000). However in online interactions, people must adopt new ways of signaling these cues, whether it is through features explicitly designed into the software (Snowdon & Munro, 2001) or through user-developed tactics to communicate these additional cues (J. B. Walther, 1992). Although signaling tactics are different online than off, they are able to compensate for cues that cannot be expressed online, and are even superior in some aspects (J. Walther & Parks, 2002).

Thus, those who prefer online interactions through social media may do so because they also prefer the type of signaling that is supported in computer mediated communication. Part of my research is to investigate this new communication style and

accompanying online signaling, and whether it may drive preference for using Location-sharing social networks.

Deception

Lying can be characterized as an act that "deliberately seeks to create a false belief" in the other person (J. Hancock et al., 2009). Lies may be enacted for self-interests (e.g., enhancing self-image, avoiding embarrassment) or told in the interest of helping another (DePaulo & Kashy, 1998). Some reasons for lying include interactional and relational goals, relieving role strain, achieving high-value outcomes or guarding against high-risk outcomes (Carlson, George, Burgoon, Adkins, & White, 2004). Studies estimate that one quarter to one third of all interpersonal interactions involve some sort of deception (Buller & Burgoon, 1996; J. T. Hancock, Thom-Santelli, & Ritchie, 2004). The vast majority of these lies are what researchers consider minor deceptions, such as pretending to agree with someone or making excuses to avoid interacting with someone (J. Hancock et al., 2009). In everyday life, many people lie about a diverse range of topics including their feelings, achievements or failures, plans, actions, and location (DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996). This is often for impression management reasons (e.g., a concept popularized by Goffman (Goffman, 1959) and further developed in subsequent empirical research by various scholars (Leary & Kowalski, 1990; Leary, Tchividijian, & Kraxberger, 1994)).

Lies can come in many forms including outright deception, equivocation, plausible deniability, and nondisclosure (O'Sullivan, 2000). Studies of SMS use have identified diverse ways of creating ambiguity such as using temporal, activity-based and location-based excuses (Birnholtz, Guillory, Hancock, & Bazarova, 2010). Many studies in ubiquitous

computing encourage systems to support white lies for plausible deniability (Hong & Landay, 2004; Lederer et al., 2004). Researchers have even addressed this in contexts where technology is always on (Bagüés, Zeidler, Valdivielso, & Matias, 2007).

Many scholars focus on how everyday lies are trivial and how they do not cause much distress (DePaulo et al., 1996). Some even emphasize how lying is essential to maintaining close relationships (O'Sullivan, 2000): partners may collaborate to maintain lies or use ambiguity rather than full disclosure (DePaulo & Kashy, 1998; Ekman & Friesen, 1969). However, other research shows how an act of deception and subsequent concealment may instill anxiety. Deceivers may experience apprehension associated with the fear of being caught, or guilt for violating social expectations (Buller & Burgoon, 1996). Lying to a partner can result in discomfort, less meaningful interactions, and can even cause the *liar* to trust their partner less (Birchmeier, Dietz-Uhler, & Stasser, 2011). Lying has even been connected to physiological indicators of stress, such as elevated heart rate (Burish & Houston, 1976), and lying tendency has been linked to survival rates for various forms of cancer (Ratcliffe, Dawson, & Walker, 1995). These studies suggest that lying, as a coping mechanism, can have negative physiological side effects.

Rather than being pre-planned, most lies unfold as a reaction during the course of an interaction (Caspi & Gorsky, 2006). Nonetheless, psychological research shows that people differ in their tendency to resort to lying in the face of a threat (Eysenck & Eysenck, 1991). In other words, although lying is triggered by a threatening situation, the *propensity* of a person to tell a lie in that situation is a disposition. Studies have also found that people's predisposition "to use their defensive maneuvers is somewhat independent of the nature of the threatening situation" (Burish & Houston, 1976). This may help explain why

people lie just as much offline as online (Birchmeier et al., 2011; Caspi & Gorsky, 2006; J. T. Hancock et al., 2004), and that the importance and content of lies (J. T. Hancock et al., 2004) and the motivations behind lies are similar across media (O'Sullivan, 2000).

However, the rates of lying vary across media, and researchers have different explanations for this. Some authors posit a Social Distance theory in which the liar chooses less rich media to put social distance between themselves and the recipient (DePaulo et al., 1996). Others subscribe to Media Richness theory which views lying as equivocal work that benefits from the richest medium so that the liar can personalize and closely monitor the interaction (J. T. Hancock et al., 2004). Hancock et al. criticized these theories for ignoring three aspects: synchronicity, the ability to record the interaction, and whether the communication partners are co-present (J. T. Hancock et al., 2004). They argue that since most lies are unplanned, lying is better carried out in media that are synchronous, hence increasing the opportunities for deception to occur. Moreover, media that can record an interaction allow people to review the content, which deters lying. Lastly, being physically co-present serves as a deterrent too, since one cannot lie about the shared physical environment.

Based on media richness theory, one would predict that liars do not prefer location-sharing social networks since it is a limited interaction that does not allow personalization. Furthermore, although real-time sharing in LSSN might offer more opportunities to lie, it supports a limited version of physical co-presence in that both parties can observe the physical location of the person, which deters lying about it. Ability to record is also a common feature of many LSSN and could deter lying. In all, it seems that for people with a

high propensity to lie, LSSN could be a contentious medium. It inhibits their natural coping mechanism, which impacts their ability to alleviate privacy concerns.

Although lie scales have been developed in prior literature, it is often to detect positive survey response bias, i.e., lying as a means for social conformity or impression management (Eysenck & Eysenck, 1991; Paulhus, 1984; Sackeim & Gur, 1979). Studies often focus on the (situation-specific) *act* of lying. Those measuring the (situation-independent) *propensity* of people to lie contend that existing scales confound multiple constructs (Francis, 1991; Paulhus, 1984). When applied to new contexts, some scales have even been shown to assign high lie scores to the most honest respondents since items wrongly assume universal truths (McCrae & Costa Jr., 1985b; Pearson & Francis, 1989).

My research focuses on people's lying *propensity* in context of *managing interactions*. This predisposition should have an impact on people's willingness to use LSSN since the ability to tell and detect lies could be greatly affected by location-sharing technology.

System Design

By understanding the factors impacting location-sharing adoption, attitudes, and usage, this research can help us better design location-sharing social networks. Current work in this area often concentrates on balancing utility against protecting privacy. Several researchers have worked on improving access control settings (Sadeh et al., 2009; Wiese et al., 2011). Some have characterized different sharing purposes that drive different sharing needs (Tang et al., 2010). Many concentrate on anonymity or other algorithms for spatial or temporal degradation (Krumm, 2009). Some scholars have taken a hybrid social and

technical approach by introducing accountability into the interface and allowing users to know who has viewed their location (Tsai et al. 2009). Others explore different representations such as visual map-based versus text-based location-sharing (Tang, Hong, & Siewiorek, 2011). Still others de-identify individuals while still preserving location fidelity (Tang, Keyani, Fogarty, & Hong, 2006). On the flip side, some scholars have abstracted location coordinates using activity or user-defined labels, or even aggregated user identities to concentrate on the community of users rather than single out individuals (Ding & Patterson, 2009; Patterson, Ding, & Noack, 2006).

However, designing based on personality or personal disposition is an area largely unexplored. This opens the way for personalized user design as has been done in other fields such as for websites or recommender systems (e.g., Kobsa, 2007). However, new challenges will likely arise since personalization in an interpersonal system may affect more than the user desiring the personalization. My research starts down this path by exploring whether individual personality traits are connected with preference for different interfaces and interaction designs. If so, future work could test whether a hybrid system that supports different personalized interfaces would improve or perhaps turn users away from using the system.

CHAPTER 3: Research Procedures

This dissertation consists of four research phases. This chapter outlines the research design and procedures for each phase. The findings presented in this dissertation are based on the results of these phases.

Exploratory Phase

Much location-sharing research is based on hypothetical scenarios through surveys, experience sampling and lab studies, or on prototypes deployed to willing participants (Barkhuus et al., 2008; Brown et al., 2007; Consolvo et al., 2005; Iachello et al., 2005; Khalil & Connelly, 2006; Lederer et al., 2004, 2003, 2003; Olson et al., 2005; Raento & Oulasvirta, 2008; Sadeh et al., 2009; Toch et al., 2010). However, in order to understand adoption and adoption barriers, it is important to study those who have chosen to reject or adopt location-sharing systems in the wild. Until more recently, commercially available location-tracking technologies were more narrowly focused in use. For example, services were targeted at tracking children or the elderly (Segan 2006), limited to a single service provider (Brown et al. 2007) or had a narrow following (Humphreys 2007). This narrow focus makes it difficult to get a clear picture of who would use location-tracking technology and how.

The release of Google Latitude in February 2009 presented an opportunity to conduct research of location-tracking adoption in a naturalistic environment and targeted for a more general population. Because of Google's large user-base (Siegler 2009), free services strategy, and brand name credibility, the technology had the potential to reach a much wider audience. The fact that Latitude was a real commercial product embeded its

adoption and use into the real world context of personal, social, market, and political dynamics. Furthermore, the product could be integrated within people's existing ecologies of key social and functional technologies (e.g., social networking sites, instant messaging, e-mail, blogs, and maps). Lastly, Google Latitude took greater strides in overcoming technical barriers of use between people by integrating with a wide variety of technology configurations. It supported various mobile phone platforms (e.g., Android, iPhone, Blackberry, Windows Mobile 5.0+, Nokia smartphones) as well as browser-based interactions on desktop, laptops and tablets or iPads. It could transmit location via a cellular network, wifi, or any internet access, and could calculate location based on the best source available whether it be cell tower triangulation, GPS, or wireless access point. This opened the way for studying how and if people connect with others when incompatible technology platform or cell phone service provider are less of a hindrance.

This phase consisted of interviewing Google Latitude users as well as those who explicitly chose not to use it. Understanding Latitude's reception and use could yield valuable insights into how these types of technologies could be better integrated into the everyday lives of larger segments of our population. In spring of 2009, 1 to 2 hour semi-structured interviews were conducted with 21 individuals. The interviews were held mostly one-on-one and face-to-face (participants beyond driving distance were phone interviewed, and a husband and wife pair was only available for a joint interview). Interview questions were informed by theories of innovation diffusion (Rogers, 2003), framing (Benford & Snow, 2000), privacy (Palen & Dourish, 2003), and trust (Bigley & Pearce, 1998). These open-ended questions asked about their experiences with Latitude, their feelings towards using it with various contacts and different contexts, and about

alternative ways in which they connected with others. The participants included 10 interviewees who had not used Latitude and 11 interviewees who had used. This made findings applicable both to the user population as well as those who choose not to use location-sharing social networks. Since Latitude was new and likely to have attracted the attention of those more technically inclined, participants were recruited through student discussion lists in Information and Computer Sciences at UC Irvine, through non-academic personal contacts from various locations in the United States, and through subsequent snowball sampling.

The interviewees consisted of 4 females and 17 males with ages ranging from early twenties to mid forties (averaging 28). Of the 10 interviewees who had not used Latitude, 7 had decided not to use it and 3 wanted to but did not own a supported device. Of the 11 interviewees who had used Latitude, 7 were still using it and 4 had abandoned it. This allowed us to study attitudes and privacy concerns that might impede adoption as well as those arising from usage after adoption. Each female represented one of the four user/non-user categories. In terms of other social technologies, all but one interviewee used Facebook or Orkut. Instant messenger was similarly popular, and about a third used Twitter. With regard to their relationship status, 13 were single, 2 living with a significant other, 1 in a long distance relationship, and 5 married with children. Their professions ranged from graduate student (some having previously worked in industry), software developer, product marketing manager, lawyer, and construction project manager, to housewife. 15 participants were either born in the United States or had lived here for five or more years. 6 participants were originally from Asia (mainly India) and had been here

one year or less. For the key findings, we did not find major differences between the International and the U.S. participants.

Analysis was performed using open-coding, purposeful sampling, and constant comparison to generate grounded theory from these interviews (for a description of grounded theory, refer to Glaser & Strauss, 1967).

Confirmatory Phase

Based on theories generated in the exploratory phase, several constructs were operationalized and developed into a survey. The survey was piloted to test for clarity and understandability. Two of the original interviewees (a non-user and a user) also participated in the pilot in order to probe for criterion validity of items. Minor clarifying changes were made to the survey and then it was advertised using Craigslist, a popular online site for jobs, services, and selling or buying goods. Craigslist sites are regional and so the survey was posted to the most active sites in each sub-region of each major geographic region (West, Mid West, South, North East), as defined by the U.S. census. To obtain a more representative sample, the survey was posted to additional sites for the least active regions (located in the Mid West and the South). In all, the survey was posted to 13 Craigslist sites (Los Angeles, San Francisco Bay Area, Seattle, Denver, New York City, Boston, Chicago, Minneapolis, Omaha, Atlanta, Miami, Louisville and Fort Worth) and collected 2039 responses over the course of a week in the spring of 2011. To make the sample more representative of the U.S. population, the answers were normalized from each of the four regions by their respective metropolitan population sizes. Participants were 18 and older and had resided in the U.S. for at least 5 years (to control for cultural assimilation (Khan &

Khan, 2007)). The online survey was anonymous in order to obtain a more representative sample since anonymity is known to elicit more honest responses (especially for deviant behavior such as lying) than methods where a researcher needs to be present (Hine, 2005). Location-sharing or other social media use was not a precondition for participation. This way, the results would be relevant for understanding both user and non-user attitudes.

The first 50 participants each received a $10 Amazon.com gift card and the first 1000 were entered into a raffle for two $100 gift cards. After removing surveys that failed two or more of seven quality checks (e.g., reverse-coded items, unrealistic completion times), and 1.7% who had lived in the U.S. for less than 5 years, there were 1532 valid responses. 24.0% of the respondents had tried location-sharing services, 79.0% used social media at least weekly, 54.0% owned smart phones, 59.7% had an unlimited data plan, 66.6% were female, the education level was in line with the U.S. Internet population, and the average age was 35.5 years (range 18-73).

The valid responses were randomly split into thirds. Initially, the first sample was used for exploratory theory construction, and the second sample for its validation. Later, further insights were validated on the third, fresh sample that had been held in reserve. In all of the analyses, results were cross-validated on two samples and only results that were significant in both samples are reported. This ensures the robustness of results.

Path analysis, factor analysis, and structural equation modeling techniques were used to test and validate theories generated from the exploratory phase. Common model fit indices, and more importantly the significance of modeled effects, were used to evaluate the appropriateness of the model. This includes Chi-squared, CFI, RMSEA, WRMSR. For more details on these techniques, refer to (R.B. Kline, 2004). For structural equation

modeling, weighted least squares estimator (WLSMV) with ordered categorical indicators was used as the estimation method for all analyses.[1] This technique does not assume normality of outcome variables. The data was checked for outliers (+/-3 standard deviations) and bivariate scatterplots were used to check for homoscedasticity. All data was within normal ranges.

The remaining chapters in this dissertation will describe the subset of questionnaire items from this data set that were pertinent to the presented analyses. Additionally, the following demographics and control variables were included: age, gender, education, geographical region, smartphone ownership, having an unlimited data plan, marital/relationship status, and parental status.

Initially, LSS users were modeled separately from non-users to see if their attitudes and concerns differ. No difference was found and hence the data was combined for our analysis. Thus, a single model accounts for both users and non-users.

Refinement Phase

In this phase, the constructs from the validated theories were refined to create more robust measures and test related hypotheses. The survey was administered to 180 (valid) participants from Amazon Mechanical Turk. Requirements to participate were the same as in the previous study and similar quality checks were implemented (only a handful were eliminated as a result of invalid responses). 88.3% of respondents used social media at least weekly, 76.7% owned smartphones, 41.7% were female, education levels were in line with the U.S. Internet population, and the average age was in the 30-34 years old age

[1] Mplus uses probit regression to estimate ordered categorical outcomes.

bucket (range 18-69). Possible age buckets were 18-24, 25-29, 30-34, 35-39, 40-44, 45-49,…, 70 and above. The same types of analysis were used as in the previous phase.

This phase led to the creation of robust scales more amenable to future use in research, while validating that they still support the theories confirmed in the previous phase. The theories were also tested against existing hypotheses in the literature.

System Design Phase

The previous phases identified stable individual predispositions as the predominant determinants of whether and to what extent people use location-sharing social networks. The final phase of this dissertation explores how to apply these findings to actual system design. It focuses on the question: *Do individuals of different dispositions and personality types prefer different types of system design?* Being able to map technical features to social, interactional, or psychological preferences can help researchers understand why certain people may prefer certain types of systems. Since the previous phases show that certain demographics are also associated with higher or lower prevalence of a given dispositional trait, findings from this phase could be very useful for understanding how to support a target audience. Finding a connection between certain designs and dispositional traits also opens the way to exploring how to support multiple dispositions in a system. Whereas user personalization on e-commerce and various other websites can tailor to a given individual without much impact on other people, this may be much more difficult for systems facilitating interpersonal interactions and collaborations. Understanding whether and what preferences users may have is an initial step towards studying how or if one system can match multiple types of users.

The final phase maps technology features to predispositions by conducting an online factorial experiment. The experiment was deployed online and advertised through Craigslist in fall of 2013 using similar sampling and recruitment methods as in the confirmatory phase, in order to maintain a more representative population. The experiment was posted to the four most populated metropolitan areas based on 2012 statistics (New York City NY, Los Angeles CA, Chicago IL, Dallas TX), which drew responses from each geographic region. It was posted to additional high-traffic Craigslist sites (Philadelphia PA, Washington D.C., Atlanta GA, Boston MA, San Francisco CA, Orange County CA, Phoenix AZ, Seattle WA, St. Louis MO, Columbus OH, Louisville KY, Raleigh NC) to cover all geographic subregions. Three-quarters of the craigslist sites were in the top 15 most populated metropolitan areas, but all were in the top 50.

Over the course of a month, 577 valid and complete responses were collected after removing those who failed more than 1 of 5 quality checks in the survey portions, and those who failed more than 3 of 8 comprehension checks in the interactive prototype portion of the experiment. Failing a comprehension question leads to the participant being retaught the principle until he or she answers correctly. Thus, we allowed up to 3 failed checks, but kept a control variable to see whether there is a difference in results for those who failed more often. The control variable did not prove to be significant. Of the valid responses, 20.3% used location-sharing services (includes both active and occasional users), 89.9% used social media at least weekly, 86.3% owned smart phones, 70.5% were female, the education level was in line with the U.S. Internet population, and the median age bucket was 30-34 years old (range from 18 to over 70).

To lower technical barriers to participation, the experiment was an interactive web-based prototype rather than an application download. It was developed over multiple design iterations and piloting, which progressed from paper prototypes and wizard of oz interactions, to PowerPoint click-throughs, to online interactive prototypes. The experiment was piloted for understandability, ease-of-use, and timing to ensure that participants could complete it within a 10-15 minute time range. This was essential for recruiting enough participants for robust statistical results.

Participants were randomly assigned to one of 3x2 conditions that represent different interaction designs for a location-sharing social network. The designs vary along theoretical dimensions that distinguish between design elements preferred by people with different dispositional traits. To test user preference for different designs, participants first answered questions about their predispositions and other relevant factors using the survey items developed in the previous phases. Then, participants use the prototype for their assigned condition in order to learn about the design and the types of interactions it would enable. Immersing users in realistic tasks that they perform hands-on is a way of teaching them the system and having them realize the social implications (positive or negative) that come with using the interface. As users finish each task, they are prompted to choose to use either the location-sharing system or a phone call to accomplish the task for a similar situation in their own lives. These decision points are a measure of how the person received the features presented in the tutorial, gauging how they feel about that design. Eight quality checks dispersed throughout the tasks test participants' understanding of the key features of the system. Upon completing the tasks, a post survey measures participants' attitudes towards the system.

The analysis consisted of structural equation modeling to validate that the theory can be applied to system design. For example, checking if someone scoring high on a given predisposition prefers a corresponding design more than someone scoring lower (and vice versa). Similar to the previous phases, common fit indices are used to check goodness of fit.

CHAPTER 4: What Concerns Do People Have?

Interview data from the exploratory phase reveals many of the same privacy concerns found across the location-sharing and social media literature, such as information overload (Iachello et al. 2005), impression management (Tang et al. 2010), and disclosing location to the wrong people (Wiese et al. 2011, Tsai et al. 2010). However, grounded theory analysis of the interview transcripts sheds light on the *source* of these concerns. Privacy concerns are actually symptoms of a desire for *boundary preservation*: An online social interaction manifests as a privacy issue if it renegotiates relationship boundaries with the other person. For example, one interviewee signed up for Google Latitude in the presence of someone she was dating. She did not add him since it "would be weird…[It] could potentially turn into kind of a stalking situation with someone you're dating." Her companion seemed similarly cautious about changing their current dating relationship boundaries: "I think there was a mutual understanding that we didn't want to know where each other were all the time. Like we weren't in that phase of our relationship." Location-sharing would have made it difficult to preserve their offline relationship boundaries. They thus opted out of sharing with each other at this point in their relationship.

Many researchers have focused on *who* can see one's location as the origin of a number of privacy concerns (e.g., Consolvo et al. 2005). However, it is more nuanced than that – there are several examples where *who* sees one's location was not the main determinant of privacy concerns. For instance, in relating his location-sharing experiences to Facebook, one interviewee explained how he turned off his Facebook wall to keep his coworkers from seeing unprofessional communications. This preserved his professional relationship boundaries. At a later point in time though, he "got over it" and turned the

wall back on: “It’s fine now. I don’t really care [if they see it]…I’m not there anymore, I quit the job.” In this example, his ex-coworkers are still on Facebook with him, but his relationship with them has changed. In other words, the *who* is constant, but the *relationship* has changed from coworker to ex-coworker. This transition dispelled privacy concerns since he no longer had a professional relationship boundary to maintain.

This chapter draws on examples from the exploratory phase interviews to illustrate how boundary preservation is at the root of common privacy concerns. It then presents results of the confirmatory phase survey that confirms this finding and uncovers a hierarchical relation between lower-level privacy concerns and the high-level desire for boundary preservation. Lastly, it draws from the refinement phase survey to further develop the concept of boundary preservation and make an important distinction between boundary preservation concern and boundary enhancement desire.

Privacy Concern Catalog

Open-coding of interview data produced a catalog of privacy concerns (expressed by both location-sharing users and non-users alike). Based on the insight that boundary preservation is a driving factor behind these concerns, a closed coding analysis was performed. Each privacy concern had a code (C1-C8), as well as an opposite code to represent each corresponding *non-concern*. Other codes were also introduced in order to investigate the influence of relationship management through boundary preservation: the *relationship* type (R), acts of boundary preservation (BP), and indications of privacy concerns arising when boundary preservation fails (BPC). These codes are used to annotate the findings in this section.

What consistently predicted the absence or presence of privacy concerns turned out not to be the relationship type itself. Rather, it was whether or not the situation would change existing offline relationship boundaries. However, boundaries (and thus the ensuing activities) change when the associated relationships change, even when the 'who' stays the same: when acquaintances become good friends sharing may increase, while sharing may slowly decrease when relationships dry up. In turn, what was once a privacy concern may no longer be, and new concerns may appear where they were absent. This was even the case for potentially negative relationships such as stalkers and strangers: people were not necessarily concerned about their privacy unless they anticipated a change in relationship with the stalker or stranger.

In other words, people preserved their offline relationships and boundaries in the online environment by engaging in a specific type of online boundary regulation, namely *boundary preservation*. This section illustrates how the concern of boundary preservation manifests for each of the privacy issues most commonly found in the data. Many examples are drawn from other social media, since interviewees often expressed location-sharing concerns by using examples from their ecology of social technologies.

C1. Bothered by Information

Many interviewees complained about information filtering and information overload problems. This ranged from status updates or tweets about "the most inane things about their life" to Latitude location updates that "clutter up my phone." On the other hand, many found it useful to keep in touch with friends or family about everyday activities such as knowing when a spouse was on their way home.

What made the difference between information being an annoyance versus being helpful was the relationship between sender and receiver. An interviewee illustrates this by explaining his disinclination to use Twitter: "Somehow my older sister calls my mom 18 thousand times a day… seemingly every 5 minutes (R)." They "would enjoy [Twitter], cause I think that's the level of communication they might have… That's their relationship (R)." Twitter would bother him since he has a different relationship with them (BPC). Several interviewees also pointed to how they wanted less detailed status (BP) from friends as they moved away and grew apart (R). They often asserted that online communications should reflect existing offline practices (BP).

C2. Bothering Others with Information

For some relationships, interviewees were also sensitive to bombarding others with information: "I work so hard to maintain my relationships with my colleagues (R) … I don't want to encumber them by spending too much time with them (BP). [Also] I don't want to encumber them with the extra data about me (BPC)." Nonetheless, many of these same interviewees emphasized sharing in their family relationships: "More information is always important to the other person (R)…I would love them to know where I am right now (BP)" in order to feel "connected to my family always even if I'm not able to talk to them." Others had a different family relationship where sharing would be superfluous: "I don't tell them what I do every day, and I never have (BP). We just don't have that type of relationship, even though it's very close (R). That's how I'd want it online as well (BP)."

C3. Sharing with More People than Intended

Quite a few interviewees had bad experiences disclosing to more people than they had intended. Even when the information was not private, if they intended to share it with a certain relationship type, it could invite too much attention from other relationship types:

> I even have this problem with my status. I used to just put my status to say *In <lab name>* and that on its own would often just lead to random people, well not random, but my buddies (R) IM-ing me and saying, 'Hey, what's <lab name>?' out of curiosity. And it would just be this, not pointless, I'm glad to explain what I'm doing, but at some points it would be just irritating (BPC)…"

There is no clear boundary (BP) telling his IM contacts that this status is meant for work relationships (R). Similarly, the interviewee who turned off his Facebook wall (see earlier example) had unprofessionally "abusive language" between him and his good friend "that started coming onto Facebook" from their offline relationship (R). He turned off the wall (BP) to keep his professional contacts from witnessing it (BPC). However, when he left his job, they no longer had a professional relationship (R) and so it didn't matter anymore to him whether they saw it (BP).

C4. Compelled to Interact Online

A common concern was feeling compelled to interact with others on social media, ranging from having to respond to too many instant messages, texts, or Facebook wall posts, to having to interact in person because of location sharing:

> [If] I'm in the neighborhood [and] enough of them calls me at once, 'Drop by', it doesn't seem nice to say 'Ok, I can't' to everyone (BPC). I'm kind of an old fashioned guy. I'll probably get in touch with [friends] (R) I need to on a cell phone. And I expect them to do the same (BP)… I like to be pretty much in control of my own life rather than people directing me how to go about it (BPC).

In contrast, this same interviewee did not have the same concerns about being compelled to meet his extended family (R): "You have your own schedule and if it's on the way and you have some spare time, why not. But if you are kind of busy, you just say, 'I'll try, but maybe sometime later (BP).'" Saying no upsets the relationship boundary with his friends but not with his family.

Similar privacy concerns can arise with old acquaintances (R) with whom one used to interact regularly (BP). One interviewee worried about acquaintances who, years after they've lost contact (R), reengage and try to advance their relationship online: If "I felt like I had to respond and keep this thing up… that would be annoying (BPC)."

C5. Others' Actions Reflecting Badly on Me

Others' online activity was also a source of anxiety, especially when this activity could hurt the image that interviewees maintained towards people with whom they had a different kind of relationship. Even a profile picture could trigger concerns: "I just don't need my neighbor's mom (R) knowing who I hung out with last night… or even just my list of friends (BP). Like if I have a friend whose profile picture is a little more scandalous, I feel like that would reflect upon me somehow (BPC)." This interviewee kept the "older generation" (R) out of her friend list in order to maintain the relationship boundaries that she has spent her "whole entire life" upholding (BP). Other interviewees would delete or untag (BP) problematic posts and photos of them uploaded by others (BPC).

C6. Unknown Social Etiquette

Social etiquette includes knowing "which level friends" are appropriate to add, and expectations around how others would use one's disclosed information and vice versa. Not

knowing the etiquette makes it difficult to anticipate which relationships will be affected and how. Some interviewees explained how this concern is mitigated in intimate relationships: "Only with my partner (R) could I have those conversations where I'm like, 'you will never do this because it upsets me.' (BP)" However, unless a relationship reaches that point of intimacy, "it's too private having that conversation (BPC) with a friend (R)" or to say to a supervisor (R), "I don't like that you use Google Latitude and used it to say… 'You're in the lab. Cool, you're available for me to ask to do some task.' I can't say to my advisor (R), 'Don't do that!' (BPC)." This illustrates how negotiating social etiquette may be within the boundaries of intimate relationships, but crosses the line for other relationships and leads to privacy concerns.

C7. Controlling Who Sees My Location

Interviewees were often concerned about controlling who can see their location. Sometimes they wanted to manage the impression they made on others. Other times they focused on being caught in a lie. One interviewee complained that he would be "in trouble" if his girlfriend (R) saw him hanging out with his best friends who were a "bad influence" (BPC). Once their relationship ended, his concerns disappeared because he was no longer accountable to her for his actions (R).

Surprisingly, only a handful of interviewees expressed safety concerns about making their location public. Most interviewees explained that strangers would not be interested in their location: "I would treat [it] as anyone not online in real life (R). You won't just go and talk to anyone. You'll say hi, or whatever, but that's just it, right? (BP) Even if you broadcast your location, your name, … that doesn't mean everyone will come

and talk to you (BPC)." One interviewee even asserted that Latitude would not change his relationship with a girl who had been stalking him (R) since she already knew how to find him anyway (BP). Even when it comes to strangers and stalkers, location-sharing does not necessary violate relationship boundaries.

C8. Others Joining Me Unexpectedly

Sometimes interviewees worried that others would join them at an inopportune time. This too seemed to be influenced by the type of relationship they had with the other person. Several participants worried about how to deal with relationships (R) where just showing up was not a problem initially (BP), but as the relationship changed (R), it became a problem (BPC). This included acquaintances who seemed interesting at first (R), but less so over time (R). One example was a student who did not have concerns about sharing his location yet:

> Because right now I'm just a student (R), but next quarter I'm going to be a TA [Teaching Assistant]. Cause I know if I'm going to TA in a class where a lot of people want to grab me (R)… I can say, "Bother me in these hours" (BP)… but I'd feel really guilty and probably help them (BPC)… I've had friends that have their students (R) try to pull all their attention and try to get their help a lot… to do all the work for them (BPC).

Right now there is no reason for the students to want to find him, so he is not concerned about them dropping in on him. As a TA, his relationship will change so that he expects to be accessible during office hours. However, the interviewee is concerned that students will violate the boundaries of that new relationship.

Generalizing and Validating the Theory

The examples in the previous section illustrate how people defend existing relationship boundaries. They are concerned if they suspect that others may cross that

boundary, changing the nature of their relationships. In several examples, the *who* stayed constant while the *relationship* changed. To validate these results, a nation-wide survey was administered to find out whether these privacy concerns are widespread and in fact motivated by the desire for preserving relationship boundaries.

In the exploratory phase, people's attitudes towards location-sharing did not necessarily align with actual usage: Reluctant users dreaded an inevitable wave of friends and acquaintances joining the service, and enthusiastic non-users wished they owned a supported smart phone, or that their friends were on it. Thus, the confirmatory phase survey focused on privacy concerns and attitudes. It also did not require survey respondents to use location-sharing technology in order to capture the concerns of non-adopters and not just of people who are already users.

BPC	I'm worried LSS will change my relationship with others.
C1	I am bothered that others share so much information with me.
C2	I am concerned that if I share too much information, I would bother others.
C3	I worry that I might share information with more people than I intend to.
C4	I worry about feeling compelled to interact with others online.
C5	I worry that what my friends share will reflect badly on me.
C6	I'm worried about knowing the social etiquette of using LSS (e.g., who to friend, what to share, etc.).
C7	I'm concerned about being able to control who sees my location.
C8	I'm worried others would join me at an inappropriate time if I share my location.

Table 1: Questionnaire items considered in the confirmatory phase analysis

Table 1 lists the items used in the survey for boundary preservation concern (BPC) and the eight frequent privacy concerns (C1-C8) uncovered in the qualitative study. Participants evaluated the items on 7-point scales whose values are -3 (Disagree Strongly), -2

(Disagree Moderately), -1 (Disagree Slightly), 0 (Neutral), +1 (Agree Slightly), +2 (Agree Moderately) and +3 (Agree Strongly).

Additionally, participants were asked how frequently they used five popular types of social media commonly mentioned in the qualitative interviews (Facebook, MySpace, Twitter, Instant Messaging, Social Media Games) using 6-point scales: 0=Not Applicable, 1=Less than once a week, 2=Once a week, 3=Several times a week, 4=Once a day, 5=More than once a day. A composite of the individual social media items (including an "other" category) was used for analysis to represent the total amount of social media use. Also collected were demographics (age, gender, education, geographical location) and controls (smart phone ownership, data plan).

Many location-sharing concerns were so intertwined with people's attitudes and concerns towards social media in general that items C1-C5 probed on the respondent's current social media behavior or attitudes. Those items were only shown to the 75.8% of respondents who indicated that they use some sort of social media beyond instant messaging at least once a week.

Boundary Preservation Model

An exploratory sample (N=510) was drawn out of the total 1532 valid responses (refer to chapter 3 for a detailed description of the research procedures). To check whether privacy concerns C1-C8 could be treated as one or more privacy concern factors, an exploratory factor analysis (EFA) was performed. The items did not constitute a well-fitting factor model since the average inter-item correlation was 0.26, whereas 0.30 is a minimal requirement for factorization (Kline 2004). Furthermore, the average variance extracted

(AVE) was 0.311, below the 0.5 cut-off for factor creation (Kline 2004). These results indicate that there is a relationship between the items, but that the correlation is too low for the items to form a robust measurement scale. In fact, all inter-item correlations were low except C7,C8 (r=0.647) and C3,C5 (r=0.516)[2] and these pairs lacked face validity to be considered as a construct. Therefore, items C1-C8 are treated as separate, but correlated, indicators.[3]

Next, the sample was used to model several possible relationships between boundary preservation and the other concerns, controlling for social media use. The modeling explored the possibility that the other concerns are hierarchically at the same level as boundary preservation, or that concerns are unrelated to social media use, or even that the concerns affect social media use. However, the model that had the best fit (lowest AIC and BIC)[4] and the most explanatory power was the hypothesized model, in which boundary preservation causes all other measured privacy concerns.

[2] Correlation of < 0.4 is considered low, 0.4 to < 0.7 is medium, and > 0.7 is high

[3] Our modeling tool, Mplus, treats single indicators as single-item latent factors.

[4] The Akaike information criterion (AIC) and Bayesian information criterion (BIC) are statistics for comparing the fit of non-nested models.

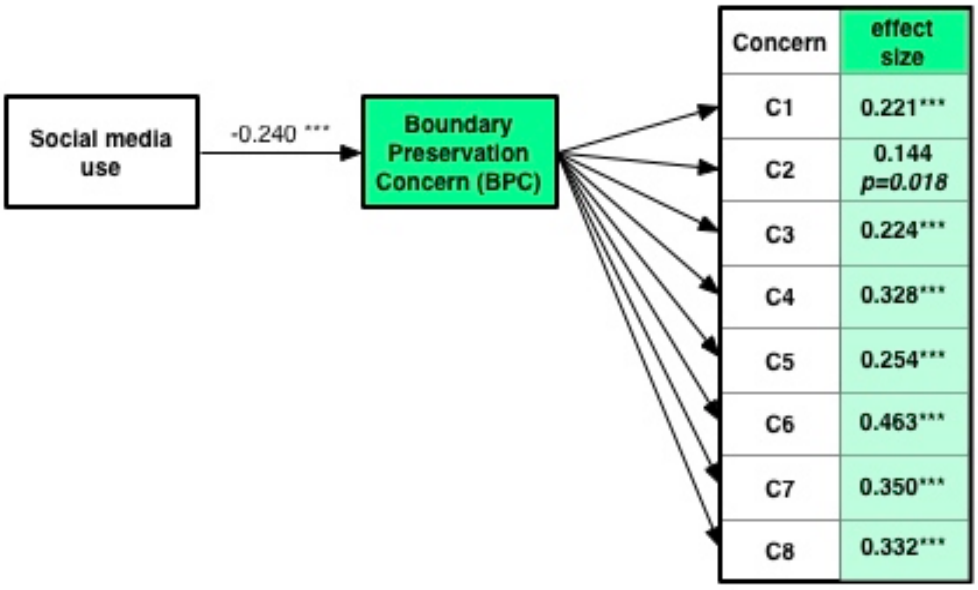


Figure 1: The path model, in which boundary preservation concern (BPC) serves as a cause of the other privacy concerns (C1-C8). Effect sizes are standardized; * indicates a significance level of $p < 0.001$.**

This final path model was estimated using Weighted Least Squares estimation with categorical indicators for the concerns (Figure 1). The model had excellent fit indices ($\chi^2(8) = 9.428$, $p = .3075$; $CFI = 0.999$; $RMSEA = 0.019$ [0.000, 0.057]; $WRMSR = 0.291$).[5] More importantly, all modeled effects are highly significant.

Figure 1 shows that social media use decreases concerns about boundary preservation. As hypothesized, boundary preservation concern has a sizeable, significant, positive direct effect on all other location-sharing privacy concerns (Figure 1 shows the standardized effect sizes). Moreover, the effect of social media use on the lower-level concerns is fully mediated by boundary preservation concerns.

[5] The "non-significant" Chi-square indicates that the model has no significant misfit. Accepted cut-off values for the other fit statistics are: $CFI > 0.96$, $RMSEA < 0.05$ (within (0.00, 0.10)), $WRMSR < 0.95$.

This model was subsequently validated on a separate confirmatory sample (N=511), which found that the effects from boundary preservation concerns to the lower-level concerns were consistent in size and significance. Most prominently, the effect on C2 was even larger in the confirmatory model (0.231, $p < .001$). This model also indicated that aside from social media use, other demographic variables (i.e., age, gender, education, smart phone, data plan, and geographic region) did not have a consistent influence on either boundary preservation or the lower-level concerns.

Model Interpretation

The model supports the hypothesis that boundary preservation is a main source of location-sharing privacy concerns. This insight allows researchers to causally explain the various concerns of location-sharing system users that prior research has identified: When people are concerned about boundary preservation (i.e., they are concerned that location-sharing services will change their relationships with others), this will increase their various other concerns, such as worrying about being compelled to interact with others, or being overloaded by information from others. Conversely, when people are *not* concerned about boundary preservation, they are also less likely to have these other privacy concerns.

In the analysis, the only consistent causal influence on boundary preservation concerns was social media use: frequent social media users are less concerned about boundary preservation. Other influences may exist, but cross-validating the results between the exploratory (N=511) and confirmatory samples (also N=511) ruled out consistent influences of age, gender, education, smart phone ownership, data plan, and geographic region.

Refining the Boundary Preservation Construct

Because a single item indicator was used to represent boundary preservation concern in the confirmatory phase, in the refinement phase a more robust measure of BPC was developed. Multiple items were introduced to measure the construct. Although concern for boundary preservation was emphasized in the previous phase as a root cause of privacy concerns, both positive and negative sentiment towards relationship boundary change was represented in the refinement phase. Interviewees often expressed positive boundary change sentiments when they hoped that LSSN would be beneficial to their relationships. The items were developed to reflect various types of change commonly emphasized in the interview data. Table 2 lists all of the initial items and Table 3 describes the type of change described by each item.

	Initial items to measure Boundary Preservation Concern construct
BC1	Others will use LSSN in a way that is out of line with our relationship.
BC2	Inevitably, I will use LSSN in a way that others feel is unsuitable for our relationship. – *dropped*
BC3	LSSN exposes information that will negatively affect my relationship with others.
BC4	Using LSSN will upset my relationships by triggering changes in behavior.
BC5	It is certain that using LSSN will negatively impact my relationships with others.
BE1	Others will use LSSN in a manner fitting for our relationship. – *dropped*
BE2	I am confident that I will use LSSN appropriately for my relationships with others. – *dropped*
BE3	Using LSSN enhances my relationships with others by keeping us better informed.
BE4	LSSN supports new behaviors that will improve my relationships.
BE5	Using LSSN will improve my relationships with others.

Table 2: Initial items for measuring Boundary Preservation Concerns. Grey cells were subsequently dropped.

Items	Type of Change	Example
BC1, BE1	How ***others*** will use LSSN	Positive: Sometimes I get delayed at work and it keeps taking another fifteen minutes. My girlfriend drives me crazy calling every fifteen minutes to check if I'm coming home yet. This way she can just see when I am coming home. Negative: When I was back East for a wedding, I would have felt bad if my friends saw I was in town since I didn't get to see them.
BC2, BE2	How ***I*** will use LSSN	Positive: I check my friend's location before I IM her. It makes for a more intelligent opening line and I don't want to forget something important. Negative: I don't want to walk in on my friend while he's having a family reunion.
BC3, BE3	***Informational*** changes from LSSN use	Positive: My sister can know I was at the lab late without me telling her. Just so she has an idea of what is going on in my life. Negative: I don't need to know you're at the movies with your son. Status update does not mean I want to know everything that you are doing.
BC4, BE4	***Behavioral*** changes from LSSN use	Positive: When I see my friend in town, I know he is visiting since he is usually up north and so I know I can call him. Negative: Having LSSN will mean that my partner will want to hyper-plan our day. Oh, you're here so you can drop this off.
BC5, BE5	General	*catch-all for changes that don't fall into the previous categories*

Table 3: Type of change being measured by each relationship boundary construct

Through exploratory and then confirmatory factor analysis, it became apparent that these items represent two highly correlated yet distinct constructs: Boundary Preservation Concern (BPC) and Boundary Enhancement (BE). Both concepts have to do with expecting a relationship boundary change. Boundary Preservation Concern captures concerns that the changes will negatively affect relationships. Boundary Enhancement captures the expectation that changes will positively affect relationships.

Items BC2, BE1, and BE2 were dropped due to poor loadings. This may be due to the wording on all of these items, which emphasized suitability and appropriateness. Those concepts are related but slightly different from the concept of relationship change. The final Boundary Preservation Concern construct consisted of B1, B3, B4, and B5 with an AVE[6] of 0.593 indicating an acceptable level of convergent validity. The Boundary Enhancement construct consisted of BE3, BE4, and BE5 with an AVE of 0.718 also indicating acceptable convergent validity. All factor loadings were significant at the $p < 0.001$ level. The high correlation (-0.770) between BPC and BE suggests that these two constructs often go hand in hand and that one or the other may be used when modeling boundary change attitudes, positive or negative.

Summary

This chapter explored the privacy concerns that people have about location-sharing social networks. Based on grounded theory, boundary preservation concern was identified as being a root cause of individual privacy concerns. The privacy concerns are symptoms of this higher-level concern. By identifying and verifying that boundary preservation is a major driving force behind privacy concerns, this work lays the foundation for future research to alleviate this cause of user concerns. Rather than address privacy concerns (symptoms of boundary preservation concerns) they can strike to the heart of the problem – worries about preserving offline relationship boundaries.

This theory was generalized and validated on a larger scale nationwide sample. Additionally, the model showed that heavier social media users have fewer boundary

[6] Accepted minimum value for the Average Variance Extracted (AVE) is 0.5

preservation concerns and that the effect on individual privacy concerns is completely mediated by boundary preservation concern. Subsequently, the construct was refined and expanded for robustness, which led to the identification of two boundary change constructs that are highly correlated: Boundary Preservation Concern and Boundary Enhancement.

CHAPTER 5: What Drives these Concerns?

The previous chapter identifies boundary preservation concern as a root cause of privacy concerns. In the exploratory phase, several non-adopters and reluctant users expressed great concern about LSSN as an instrument for infringing on their relationship boundaries. However, other LSSN users were more confident that this would not happen and were open to sharing location with others. This begs the question, *What causes someone to have boundary preservation concerns?*

The grounded theory identified two key factors that affect boundary preservation concern and the highly related concept of boundary enhancement. The first has to do with *value*-based personal characteristics, and the second with *communication style*. To test hypotheses about these constructs, the two samples used in the construction of the boundary preservation model in the previous chapter were combined to create a new exploratory sample (N=1021). For both of these constructs, initial modeling was conducted using this sample. The third, untouched sample (N=511) was used for validation of the models (refer to chapter 3 for a detailed description of the research procedures). Effects that were not significant in either of the two samples were removed and the resulting model ran on the full sample (N=1532).

Values and Privacy Practices

One's values can greatly impact one's social interactions, including privacy management practices. One practice that stood out in the exploratory phase analysis is that some people admitted that they would use *lying* as a routine privacy management tactic. Lying occurred in face-to-face as well as online interactions as a way to maintain relation-

ship boundaries. Lies were often used to hide information or to avoid going out with someone in favor of going out with others.

Some interviewees were confident that they could get away with such lies, even when sharing their location: "I probably don't have anything to hide [about my location], but even if I do, I can just cover it up…Just make up some story." On the other hand, more interviewees expressed concern about being caught in their offline lies if their location were known: "[If] I'm calling in sick...to go somewhere like a three day trip, [I'll say I'm] sick Friday [and] sick Monday to make it more plausible [be]cause no one gets better over the weekend… I don't think I'd ever want to reveal my location to my coworkers or my boss." Here, coworkers would question whether this interviewee is really sick if they could see that he is out of town rather than at home. A quarter of the interviewees brought up similar situations in which they had misled someone as to their whereabouts and feared being caught lying.

Examples like these led to the question of whether one's propensity to lie also plays a role in shaping one's location-sharing privacy concerns. On the one hand, people may be less privacy concerned if they feel they can count on lying to facilitate interactions. Indeed, much research characterizes lying as a common practice used to facilitate daily social interactions and to maintain relationship boundaries (e.g., DePaulo et al., 1996). Studies of deception in computer-mediated interactions show that lying also occurs as a boundary management tactic in various mediated communications (J. Hancock et al., 2009). On the other hand, people with a propensity to lie may be more privacy concerned for fear of being caught at some point. Moreover, the medium of communication affects one's ability to tell and detect lies (which may explain why the rates of lying vary across media (J. T.

Hancock et al., 2004)). In LSS, which typically give an unbiased view of one's location, these fears and concerns of seasoned liars may thus be aggravated.

Not all interviewees who lie may have admitted it during in-person interviews. Thus, to probe on whether or not one's propensity to lie affects location-sharing boundary preservation and privacy concerns, a nationwide anonymous survey was administered in the confirmatory phase.

Propensity to Lie Factor

Because lying is a sensitive topic, propensity to lie was represented with a latent factor measured by multiple indicators. For content validity, types of lying found from the exploratory phase analysis were used to create the indicator items. Those who spoke of lying often discussed two or more of the following forms of lying: 1) I lie, 2) Everyone lies, and 3) Technology Lie (e.g., pretending to have a bad network connection as an excuse for not answering or not being visible in a location-sharing service). Table 4 shows the items developed to represent each form of lying. The development of each item is described in detail below.

Respondents rated the three lying items on the same 7-point scale used for privacy concern items: -3 (Disagree Strongly), -2 (Disagree Moderately), -1 (Disagree Slightly), 0 (Neutral), +1 (Agree Slightly), +2 (Agree Moderately) and +3 (Agree Strongly). The reliability and validity of the Propensity to Lie factor was established to be consistent in both the exploratory and the reserved sample and so the statistics for the full sample are reported (N=1532). The factor loadings are significant at the $p < 0.001$ level and had the following values: Everyone Lies (L1) = 0.647, I Lie (L2) = 0.883, Technology Lie (L3) =

0.700. The Cronbach's alpha of 0.74 indicates a satisfactory level of internal reliability. The Average variance extracted (AVE) of 0.565 indicates acceptable convergent validity.[7]

	Propensity to Lie
L1	Everyone lies to get out of doing something.
L2	Sometimes I tell a lie to avoid something (e.g., I tell someone I don't have time to go out, but then go out with someone else).
L3	Sometimes I use technical difficulties as an excuse (e.g., I pretend I had bad cell phone reception).

Table 4: Questionnaire items for Propensity to Lie factor

Everyone Lies (L1). Several interviewees thought of lying as a typical behavior used by everyone. One interviewee elaborated on how he hid his actions by removing tags that identified him in Facebook pictures: "I don't know if my friends [remove tags]. I mean, no one wants to get caught in a lie. I'm sure they must do it." Asserting that others must untag pictures to avoid getting caught in a lie betrays an underlying assumption: Others are lying as well. Because others are lying, they inevitably will run into similar situations. Consequently, L1 reflect the belief that others also lie. This item also had a purpose beyond being an indicator for propensity to lie: It was displayed before the other lying items in order to frame the behavior of lying as commonplace. Framing is a common technique to increase the likelihood that respondents will be comfortable admitting to what could be perceived as deviant behavior (Singleton & Straits, 2005).

I Lie (L2). Several interviewees mentioned lying as an offline privacy management tactic to avoid going out with someone: "I do tell somebody [I'm] not available for some-

[7] A loading > 0.7 is considered high, and a loading > 0.4 is considered medium. Accepted cutoff values for the reliability indices: Cronbach's alpha > 0.7, AVE > 0.5.

thing. I tell them that I'm not feeling too good – I can't come out. But I'm actually going out with another group of people that they don't necessarily get along with." This is an example of the most common lie among the interviewees. Namely, lying to avoid going out with or being around someone. In general, people used lying as an avoidance strategy, whether it be avoiding people in the physical space or avoiding having to converse online. This is in line with other studies that have found that people lie as a way to guard against unwelcome conversations (Vanden Abeele & Roe, 2008) or to extract themselves from an ongoing interaction (J. Hancock et al., 2009). This item therefore probes how much one lies as an avoidance strategy. This and other items are purposefully framed in the context of avoidance motives rather than just asking about lying in general. This was in line with motivations described by interviewees and also increased the social acceptability of the questions.

Technology Lie (L3). As a cover up, people often accused faulty technology. An interviewee explained how he could blame technology if location-sharing ever displayed him as being at an unsavory location: "Oh, there's a library across the street. Latitude must have been a few feet off." Making excuses by blaming technology may be a more socially acceptable type of lie since it exploits a sense of ambiguity. This is consistent with past research indicating that technology is a common scapegoat to create plausible deniability (Aoki & Woodruff, 2005; Bagüés et al., 2007; Birnholtz et al., 2010; Hong & Landay, 2004; Lederer et al., 2004). Several interviewees were not comfortable lying outright, but content to allege faulty technology. To capture this form of lying, L3 focused on blaming technology.

Lying Leads to Privacy Concerns

In the previous chapter, boundary preservation concern (BPC) was a root cause of eight identified privacy concerns (C1-C8). To test whether participants' propensity to lie could also be seen as a root cause of these eight concerns, a structural equation model was created in which propensity to lie (Lie) causes these concerns. This model had a good fit (χ^2 (12) = 50.151, $p < .001$; *CFI* = 0.991; *RMSEA* = 0.046, 90% CI: [0.033, 0.059]; *WRMSR* = 0.558). Table 5 summarizes the effects in this model.

Concern	Effect of Lie → C1-8
I am bothered that others share so much information with me. (C1)	0.183***
I am concerned that if I share too much information, I would bother others. (C2)	*no effect*
I worry that I might share information with more people than I intend to. (C3)	0.215***
I worry about feeling compelled to interact with others online. (C4)	0.235***
I worry that what my friends share will reflect badly on me. (C5)	0.259***
I'm worried about knowing the social etiquette of using LSS (e.g., who to friend, what to share, etc.). (C6)	*no effect*
I'm concerned about being able to control who sees my location. (C7)	0.116***
I'm worried others would join me at an inappropriate time if I share my location. (C8)	0.161***

Table 5: Standardized effects of Propensity to Lie on privacy concerns (C1-C8). * indicates p<0.001**

There is an effect of lying propensity on all concerns except C2 and C6. Conceptually, one can quickly see why this may be so. C2 captures the concern for *bothering others* with too much information. The Propensity to Lie factor emphasizes lying as an avoidance tactic for *self-interested* goals. Thus, it is aimed at limiting communication for the benefit of the liar. This, in turn, does not necessarily result in sharing too much information, nor concern for others.

C6 represents the concern for not knowing the social etiquette of LSS. Upon closer inspection, it becomes clear that all of the concerns, except C6, are tangible outcomes that can result from lying. Knowing social etiquette (e.g., who to friend, what to share, etc.) has to do with defining what is considered an infraction or problem in the first place, and this may not be affected by one's lies.

Lying Integrated with Boundary Preservation Model

Next, Propensity to Lie was integrated into the established boundary preservation structural model, in which social media use decreases boundary preservation concern, and in turn boundary preservation concern increases all eight of the other concerns (refer to previous chapter for a more detailed description of this model). Specifically, Propensity to Lie was modeled as a cause of both boundary preservation concerns (BPC) and the eight individual privacy concerns (C1-C8).

Although it is possible to conceive a model in which boundary preservation concern causes an increase in the *acts* of lying, research has shown that the *propensity* to lie can be considered a stable predisposition (Burish & Houston, 1976; Francis, 1991) rather than a situation-dependent activity. This warrants choosing the causal direction "Lie → BPC".

Would the effect of propensity to lie on boundary preservation concerns be positive or negative? First of all, the results of Lie → C1-C8 suggest that propensity to lie will increase concerns. This is in line with research results that lying can cause significant physiological and mental stress or anxiety (Buller & Burgoon, 1996; Burish & Houston, 1976); this stress could manifest itself as boundary preservation concerns and privacy concerns in social media. On the other hand, lying can facilitate maintaining relationship

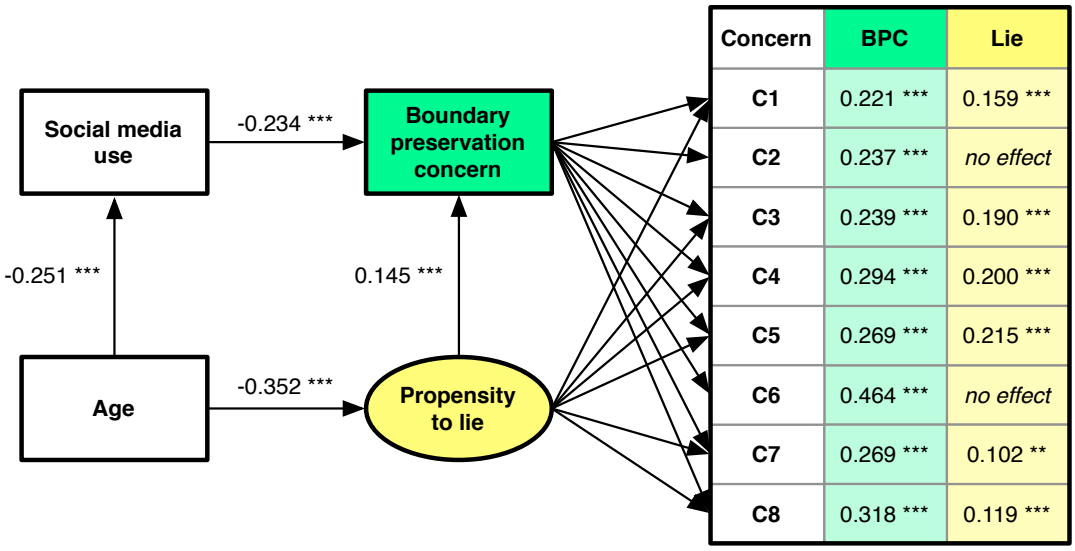
boundaries (O'Sullivan, 2000), which would mean that propensity to lie decreases boundary preservation concerns.

Testing the integrated model on both the exploratory and the confirmatory samples validated that the model is consistent between the two samples. It also showed that age has a consistent negative effect on the propensity to lie, as well as on social media use. The model has an acceptable fit ($\chi^2(42) = 175.059$, $p < .001$; *CFI* = 0.976; *RMSEA* = 0.046, 90% CI: [0.039, 0.053]; *WRMSR* = 0.989). Moreover, all effects in the model are highly significant (see Figure 2).

The model shows that lying propensity increases not only various online privacy concerns (C1-C8), but also concerns that location sharing will affect one's ability to preserve relationship boundaries (BPC). This makes boundary preservation concern a partial mediator that amplifies the effect of lying on privacy concerns.

The resulting model also shows that there is a direct effect of age on social media use and propensity to lie. Interestingly, the indirect effects of age on boundary preservation through social media use and propensity to lie are of similar magnitude but in opposite directions and hence end up canceling each other out. The final outcome is that there is no total effect of age on boundary preservation concerns ($p = 0.617$). Consequently, age only affects the eight privacy concerns through Propensity to Lie.

As an aside, this study did not find any effects of lying on social media use or vice versa.



Concern	BPC	Lie
C1	0.221 ***	0.159 ***
C2	0.237 ***	*no effect*
C3	0.239 ***	0.190 ***
C4	0.294 ***	0.200 ***
C5	0.269 ***	0.215 ***
C6	0.464 ***	*no effect*
C7	0.269 ***	0.102 **
C8	0.318 ***	0.119 ***

Figure 2: Propensity to lie and boundary preservation concern (BPC) are root causes of online privacy concerns. Effects of Lie and BPC on C1-8 are tabulated, e.g., the effect of BPC on C1 is 0.221* (standardized effect sizes, *** indicates $p < 0.001$, ** $p < 0.01$)**

Refining the Propensity to Lie construct

A single factor was used to represent the Propensity to Lie. However, the qualitative data showed evidence that there may be a difference in the type of lying people were comfortable invoking. Some interviewees were perfectly content to make untrue statements to avoid people or cover up a sticky situation. Others would not deliberately make an untrue statement, but were comfortable using vague statements, indirect excuses, or omissions to avoid telling the truth. For instance, one interviewee wasn't ready to tell his parents about a new girlfriend. He wouldn't lie to his parents and so, instead, omitted key details to avoid telling them that he was flying out to see her: "I would visit her but wouldn't tell my parents. I'd say I'm going to Atlanta… I *did* fly to Atlanta, but it was a lay over on the way to another place." When asked about his feelings towards expanding his Latitude friend list to include his parents, the interviewee expressed that he wished he could "manually set it to *break*" in situations like that. This was despite the fact that he

knew Latitude offered features to manually specify his location so that he could hide his true location. This interviewee was just one of several who did not entertain direct lying as a viable option to smooth interactions; Instead, ambiguity was the answer.

	Initial items to measure Direct and Ambiguous Lying Propensity constructs
AL1	I often use technology as a way to avoid addressing something (e.g., I say that I did not see a message).
AL2	To avoid disclosing the truth, sometimes I leave out specific details.
AL3	When I want to avoid talking about something, I use ambiguous language.
AL4	I am always forthright in what I say even when it is not comfortable. (R) – *dropped*
DL1	At some point, everyone runs into a situation where they have to lie to get out of doing something.
DL2	I often tell a white lie to make an interaction go smoothly.
DL3	Sometimes I tell a small lie to avoid something (e.g., I tell someone I can't go out, but then go out with someone else).
DL4	I always tell the truth even when it isn't convenient. (R)

Table 6: Initial items for measuring Direct and Ambiguous Lying Propensity. "(R)" indicates reverse-coding. Grey cells were subsequently dropped

The original Propensity to Lie factor did not differentiate between types of lying. In the refinement phase, multiple indicator items were developed to reflect these different categories of lies. Table 6 lists the original items, one of which was subsequently dropped due to poor loading. The factor analysis confirmed that these items form two constructs with a high level correlation (0.704): a Direct Lie (DL1-4) and an Ambiguous Lie (AL1-3) factor. Direct lying items represent telling an untruth (or truth for the reverse coded item). Ambiguous lying items avoid explicitly having to make a true or untrue statement by utilizing vagueness or acts of omission. The reverse-coded item for ambiguous lying loaded poorly and was dropped. This may be because it addresses being "forthright" rather than

ambiguous, but fails to state the goal of being misleading. The final Direct Lying construct has an AVE of 0.556, the Ambiguous Lying construct an AVE of 0.625, and all factor loadings are significant at the $p < 0.001$ level.

Next, these factors were used to create a structural equation model to see if they have an impact on the refined boundary preservation concern or boundary enhancement factors. It turned out that only Ambiguous Lying has an impact. Furthermore, when both boundary constructs are represented in the model, the effect is on Boundary Preservation Concern rather than Boundary Enhancement. Figure 3 illustrates the model. The fit indices were $\chi^2(60) = 87.944$, $p = .0109$; $CFI = 0.988$; $RMSEA = 0.051$ [0.025, 0.073]; $WRMSR = 0.604$. Although the RMSEA is a tad above the recommended cut-off, 0.05, the confidence interval is well within range, [0.00,0.10].

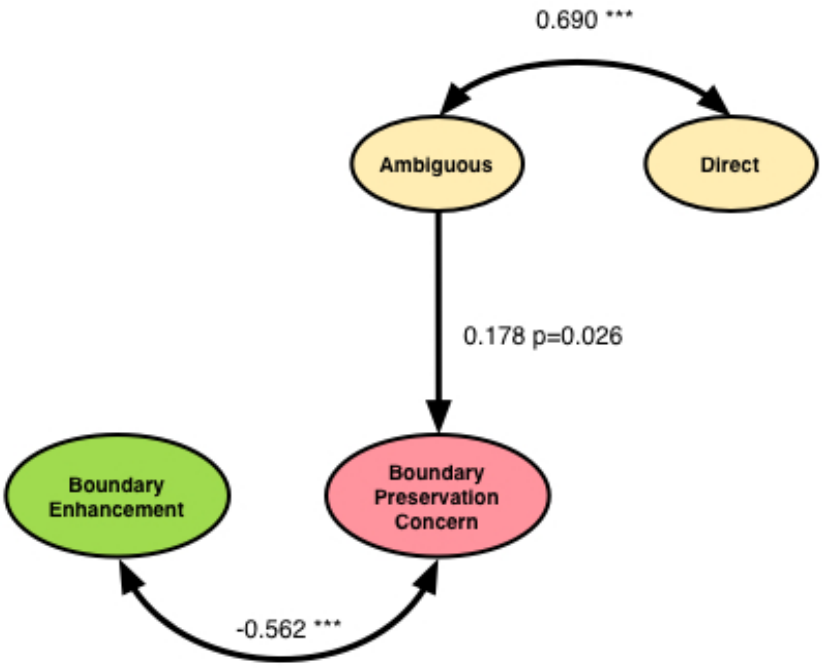


Figure 3: Structural equation model showing that Ambiguous Lying Propensity has an effect on Boundary Preservation Concern. Effect sizes are standardized.

Summary

The research presented in this chapter establishes that Propensity to Lie has a significant effect on a large majority of privacy concerns. Interestingly, these effects are all *positive*: one's propensity to lie *increases* one's privacy concerns. Integrating Propensity to Lie into the boundary preservation model (identified in the previous chapter) demonstrates that part of this effect is mediated by boundary preservation concerns (BPC). In other words, Propensity to Lie increases concerns about preserving one's relationship boundaries in location-sharing social media, and this in turn causes one to be more privacy-concerned. Thus, lying propensity is a cause for more boundary preservation concerns. These findings indicate that the privacy management tactic of lying tends to *backfire* in location-sharing social media.

The Propensity to Lie construct can be further subdivided into different types of lying: Ambiguous and Direct. Modeling the effects of these deception constructs onto the refined Boundary Preservation Concern and the Boundary Enhancement factors, one can see that it is actually Ambiguous Lying Propensity that increases boundary preservation concern. Direct lying does not lead to increased concern. This may be because LSSN removes ambiguity when it shares location, and those who won't tell a direct lie to repair the situation will be more concerned. Interestingly, neither types of lying have an effect on Boundary Enhancement.

Although location-sharing social networks may make it more difficult to pull off a lie, it does not mean location-sharing services should rush to provide ways of lying and obscuring one's location. The qualitative data shows that individuals on the other end of the spectrum avoid current location-sharing technologies that support falsifying location.

In part, this is because they consider hiding their location from someone a deceptive act. Some refuse to use a service where friends could set a fake location. This suggests a need for value-based "honest" technology design. Overall, these findings suggest that when researchers and designers introduce new technology, they should consider value-based characteristics such as lying propensity that may lead to more concerns.

Communication Style

Grounded theory analysis of the interview data revealed that the most active users had a preferred *communication style* that will be referred to as *FYI* (a common abbreviation of "for your information"). FYI communicators preferred to learn others' whereabouts, availability, or recent activity by reading updates on social media; they avoided phone calls and direct interaction with the other person. It stood to reason that these individuals would be less concerned about boundary preservation. This hypothesis was tested with survey data in both the confirmatory and refinement phases.

F.Y.I. (For Your Information) Communication

FYI communicators wanted to find out how others were doing and what their current status was, but did not want to ask them directly. They asserted that sharing location "is better; [it's knowing] without calling and disturbing [others]" (P3). Conversely, these interviewees also did not want others to initiate interactions: "I'd rather just share with them, 'Hey, here's where I am'. I could share without them actually calling me." (P2) Consequently, LSSN provided a wealth of information that allowed these interviewees to make inferences without verbal interaction. They welcomed a flood of information in support of this: "How is more information a bad thing?" (P4) These sentiments appeared to

drive positive evaluations of LSSN, and often also applied to other social media such as Facebook and Twitter. FYI communicators generally wanted others to know their status without having to tell them: "I think it's neat for them to see that [I'm] working late tonight. I don't tell them, 'Hey, by the way, I'm staying late.'" (P1)

At the other end of the spectrum, many interviewees did not like the FYI communication style. They were bothered by—and did not want to bother others with—too much information: "I think people abuse Twitter and Facebook…status update doesn't mean I want to know exactly what you're doing at all times of every day…it's too much information." These individuals clearly preferred calling others or otherwise interacting with them directly, rather than passively reading about them on social media: "I know some people use [Facebook] to go to people's profiles and just check them out… I don't do that at all." They viewed LSSN as a less desirable way to communicate: "Isn't all this a case of you're trying to invent some fancy tool when really a much simpler tool solves the problem, right? Which is [to] give her a call."

	FYI
F1	I want others to know how I'm doing without having to tell them.
F2	I want others to know where I am without them having to bother me by asking.
F3	I want to know where others are without having to bother them by asking.
F4	More information is always good.

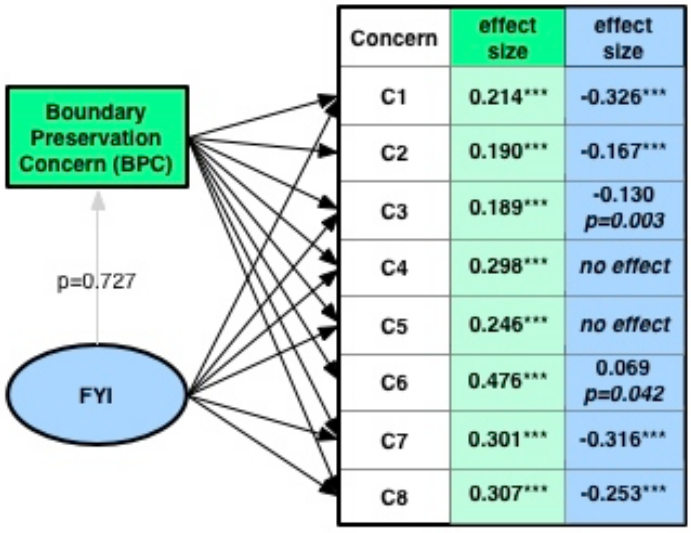
Table 7: Questionnaire items for the FYI factor

Based on these insights, a measurement model was constructed for FYI communication. Table 7 lists the survey items, which represent the most commonly observed FYI attitudes (labeled F1-F4). These items were rated on a 7-point scale (Disagree

strongly, Disagree moderately, Disagree slightly, Neutral, Agree slightly, Agree moderately, Agree strongly). The reliability and validity of the measurement model was checked using confirmatory factor analysis. All factor loadings are significant at the $p < .001$ level and the Average Variance Extracted (AVE) was 0.50, which indicates a satisfactory level of convergent validity. Cronbach's alpha was 0.80, which indicates good internal reliability.

Communication Style Integrated with Boundary Preservation Model

Next, the FYI construct is integrated into the boundary preservation model to see if it has an effect on boundary preservation concern. Figure 4 illustrates the model whose fit indices are $\chi^2(27) = 109.471$, $p = .0000$; *CFI* = 0.988; *RMSEA* = 0.055, 90% CI: [0.044, 0.066]; *WRMSR* = 0.673. The slight misfit is due to the fact that the FYI construct does not have a significant effect on boundary preservation concern. Removing the insignificant effect results in fit indices within acceptable cut-off ranges ($\chi^2(28) = 89.026$, $p = .0000$; *CFI* = 0.991; *RMSEA* = 0.046, 90% CI: [0.036, 0.057]; *WRMSR* = 0.652).



Concern	effect size	effect size
C1	0.214***	-0.326***
C2	0.190***	-0.167***
C3	0.189***	-0.130 p=0.003
C4	0.298***	no effect
C5	0.246***	no effect
C6	0.476***	0.069 p=0.042
C7	0.301***	-0.316***
C8	0.307***	-0.253***

Figure 4: This model shows that FYI does not have a significant effect on boundary preservation concern; (standardized effect sizes, * indicates p < 0.001)**

If FYI does not have an impact on boundary preservation concern, why was the FYI communication style so prevalent amongst active users in our grounded theory? To answer this question, we further explore the relationship between FYI and BPC in the refinement phase of research.

Refining the FYI construct

In the previous chapter, the boundary preservation concern item was expanded and found to consist of two related but separate constructs: Boundary Preservation Concern and Boundary Enhancement. Perhaps the effect of FYI can be better captured using these improved measures. Moreover, the FYI construct just barely met the criteria for acceptable construct validity with its AVE of 0.5. So a refined version of the FYI construct was also created using a larger catalog of items probing on different theoretical dimensions of FYI: control over when location is shared (FYI1-4), effort required to obtain location (FYI5-8), preference for sharing with a subset of individuals (FYI9-12), and whether it is my location or someone else's location being shared (bold). Table 8 lists these initial items.

	Initial items to measure FYI construct
FYI1	Others should be able to get **my location** when they feel they need it.
FYI2	I want others to know **my location** only when I allow them to. – *dropped*
FYI3	Rather than wait for others to tell me **where they are**, I would like a way to know someone's location whenever I need it.
FYI4	I should not know **someone else's location** without them explicitly giving it to me. – *dropped*
FYI5	I prefer to interact with others to find out **where they are.** – *dropped*
FYI6	I want to know **where others are** without having to bother them by asking.
FYI7	If others want to know **where I am**, I want them to ask me directly. – *dropped*
FYI8	I want others to know **where I am** without my having to bother to tell them.
FYI9	I would prefer to share **my location** with everyone in case anyone wants it.
FYI10	I would prefer to give **my location** to specific individuals who I think should have it. – *dropped*
FYI11	It would be useful to me if others would make **their location** available to everyone.
FYI12	If others want to tell me where they are, I would prefer that they share **their location** explicitly with me rather than with everyone. – *dropped*

Table 8: Initial items for measuring FYI. They measure when location is shared (FYI1-4), with how much effort (FYI5-8), audience (FYI9-12), and whose location (bold). Grey cells were subsequently dropped.

Half the items were dropped because of poor loadings (grey cells). What is striking about all of those items is that they are the items designed to represent non-FYI preferences. This factor analysis makes it apparent that an FYI attitude can be captured, but whether there is a single non-FYI attitude is unclear. In the end, two well-fitting FYI constructs were identified, each consisting of items from every theoretical dimension. They distinguish attitudes towards sharing my location (FYImy) from attitudes towards learning others' locations (FYIother). The factors are highly correlated (0.785) but are distinct, which points to how people have slightly different preferences for sharing their own location than for finding out others' location. FYImy consists of FYI1, FYI8, FYI9, has a

Cronbach's alpha of 0.76 and an AVE of 0.601. FYIother consists of FYI3, FYI6, FYI11, has a Cronbach's alpha of 0.81 and has an AVE of 0.655. All factor loadings are significant at the p < 0.001 level.

	FYImy
FYI1	Others should be able to get **my location** when they feel they need it.
FYI8	I want others to know **where I am** without my having to bother to tell them.
FYI9	I would prefer to share **my location** with everyone in case anyone wants it.

Table 9: Final factor for an FYI attitude towards sharing my location (FYImy).

	FYIother
FYI3	Rather than wait for others to tell me **where they are**, I would like a way to know someone's location whenever I need it.
FYI6	I want to know **where others are** without having to bother them by asking.
FYI11	It would be useful to me if others would make **their location** available to everyone.

Table 10: Final factor for an FYI attitude towards finding out others' location (FYIother).

Having validated measurement models for the two FYI constructs, the next step was to build a structural equation model to test the effect of FYI on boundary preservation concern and boundary enhancement. Figure 5 depicts the model which had the following fit indices $\chi^2(50) = 95.177$, $p = .0001$; *CFI* = 0.982; *RMSEA* = 0.071 [0.049, 0.092]; *WRMSR* = 0.628. Although the RMSEA index is a bit high, the confidence interval is within range.

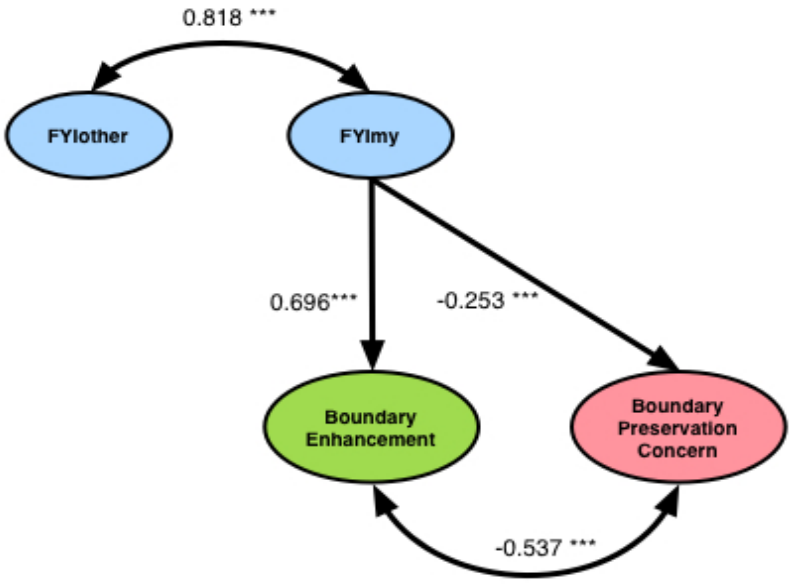


Figure 5: FYImy has a significant effect on both boundary preservation concern and boundary enhancement. Effect sizes are standardized.

As the figure illustrates, FYImy has a significant impact on both boundary constructs. It has a particularly substantial impact on boundary enhancement. That is, those who like to communicate their own location in an FYI style, are much more likely to feel that location-sharing social networks can enhance their relationship boundaries. They are also likely to have fewer concerns about preserving their relationship boundaries, but the standardized coefficient shows that it is only about a third the effect size. It is noteworthy that when both FYI constructs are included in the model, the influence comes from FYImy, and not FYIother. This suggests that attitudes about sharing one's own location are the determinant of attitudes towards relationship boundaries.

Combining FYI Communication Style and Lying Propensity

The previous section shows that Ambiguous Lying has a significant effect on boundary preservation concern. A model was created to check that the effects of both FYI

and Lying Propensity persist when they are both present. Figure 6 shows the combined model and confirms that the effects of both FYImy and Ambiguous remain significant. The model fit indices are $\chi^2(142) = 222.538$, $p = .0000$; $CFI = 0.976$; $RMSEA = 0.056$ [0.041, 0.070]; $WRMSR = 0.628$. Given that the RMSEA was a little high in both previous models, unsurprisingly it is also a tad high in this combined model, but within the confidence interval range.

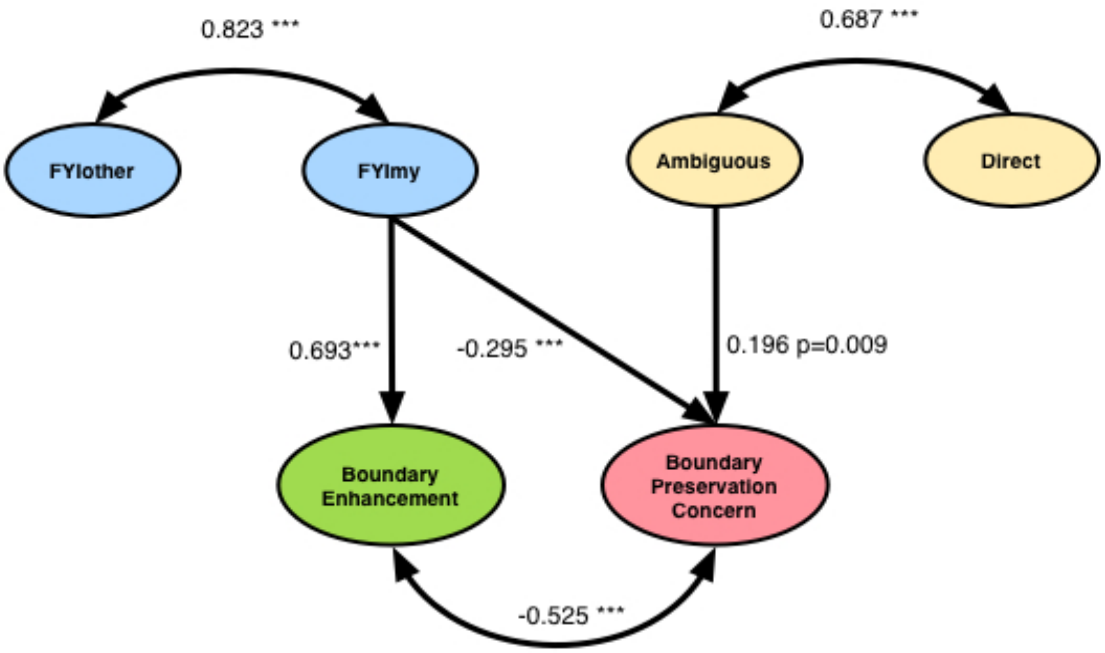


Figure 6: This model shows that, even when combined, the effects of FYImy and Ambiguous Lying Propensity on the relationship boundary constructs persist. Effect sizes are standardized, *** p < 0.001

Summary

From the qualitative analysis, a communication style termed FYI was found to be common among active LSSN users. Initial tests to see if it has an impact on boundary preservation concern did not find an effect. However, refining both the boundary

preservation concept and FYI construct led to a model where preference for FYI communication of one's own location had a significant impact on boundary preservation concerns. Furthermore, this effect paled in comparison to the effect of FYImy on Boundary Enhancement.

Based on these results, it would seem that FYImy has a strong connection with a positive evaluation of location-sharing social networks and ability to enhance relationships. Because so many active location-sharing social network users preferred FYI communication, one might hypothesize that this positive view of relationship boundary changes drives adoption and usage of LSSN more than negative fears of boundary changes impede usage. The next chapter proceeds to test this conjecture.

CHAPTER 6: What Predicts Adoption and Usage?

The previous chapter detailed how an FYI communication style and Propensity to Lie can both increase boundary preservation concerns, a root cause of privacy concerns. However, do these constructs predict actual adoption and usage behavior? As described in chapters 2 and 3, privacy concerns are notorious for their inability to predict behavior. Perhaps the higher-level boundary-preservation concern can do a better job at predicting adoption? However, the grounded theory analysis points to FYI communicators being the most active users. The previous chapter shows how FYI has a significant effect on boundary preservation concern, but a much greater effect on its counterpart, boundary enhancement. Could it be that boundary enhancement and boundary preservation concern work together as catalyst and deterrent, respectively, for LSSN adoption? And furthermore, as the prevalence of FYI communication style amongst active users would suggest, that the power of boundary enhancement attitudes to drive LSSN adoption is greater than the concern for boundary preservation for slowing adoption?

This chapter tackles these questions in two steps. First, it tests whether FYI communicators really do use LSSN more. Next, it tests the relationship between FYI and the boundary preservation and enhancement constructs, as well as their impact on adoption and usage.

Effects of FYI on LSSN Adoption and Usage

Exploratory phase interviews revealed that preference for FYI communication was associated with using location-sharing social media. Those high in FYI also were more actively engaged and more comfortable sharing on various social media beyond LSSN.

Those low on FYI were either avoiding these media, or reluctantly using social media but drastically limiting their sharing and activities. Another observation was that FYI communicators were commonly the youngest interviewees. An opposite, more interactive communication style, such as calling others directly, was more common as age increased. Overall, this FYI communication style was the strongest predictor of LSSN adoption as well as disclosure behavior.

These theories were tested and refined via two rounds of surveys and analysis. The following subsections describe each of these iterations.

Confirming the effects of FYI and age

The confirmatory phase survey tested the hypothesis that preference for FYI communication leads to increased LSSN usage. It also tested whether younger people prefer FYI communication and thus, FYI mediates the effect of age on LSSN use (i.e., age –> FYI –> LSSN use). In addition to answering the 4-item preference for FYI (see Table 7, previous chapter), respondents indicated whether they use LSSN and how often (More than once a day, Once a day, Several times a week, Once a week, Less than once a week, Never/Not applicable). To capture usage attitudes that hadn't been carried out due to platform constraints, controls were administered. This included a question about smartphone ownership, data plan, and intention to use LSSN ("If you are offered the opportunity to use a new location-sharing service, please indicate the extent to which you agree or disagree with the following: 'I will use the location-sharing service'"). Moreover, because FYI communicators would rather not call others, especially in regards to locating them, we included the item: "To find out where someone is, I would rather call them than

use a location-sharing service." This and the intention to use item both used the same 7-point scale as the FYI factor. The demographic and control variables were also included in the analysis (refer to chapter 3 for a full list).

A structural equation model was created using age, FYI, Intention to use LSSN and actual LSSN usage (collectively referred to as LSSN), preference for calling rather than using LSSN, and smartphone ownership. Control variable effects were also included. The model was validated on an initial exploratory sample (N=510) and a second confirmatory sample (N=511) and the results of the combined samples are reported. Fit indices are within accepted cut-off values (χ^2 (28) =75.933, $p < 0.001$; *CFI* = 0.993; *RMSEA* = 0.041 [0.030 0.053]; *WRMSR* = 0.740). More importantly, all modeled effects are highly significant.

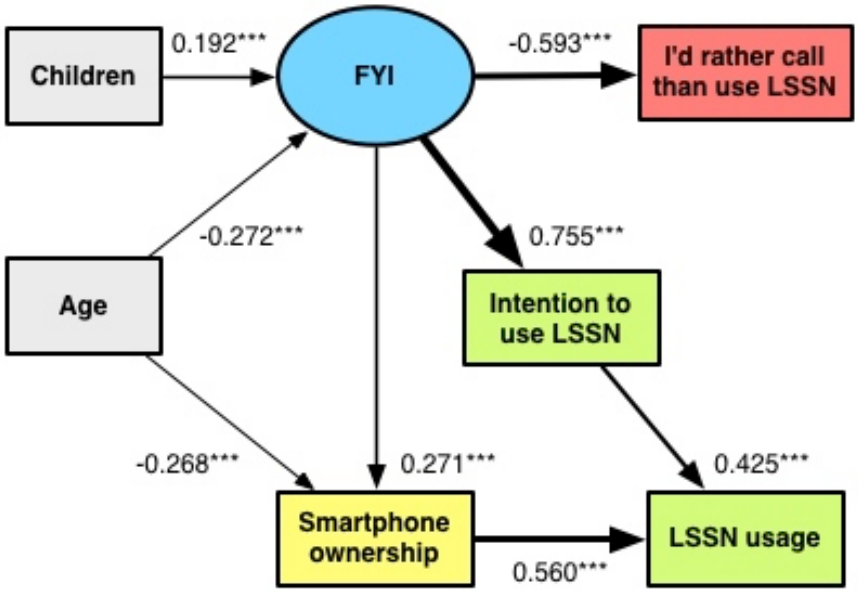


Figure 7: FYI mediates the effect of Age and Parental status on Intention to use LSSN. Standardized effect sizes, * indicates p < 0.001**

The final model (Figure 7) shows that FYI has a significant effect on Intention to use LSSN (it explains 57% of the variance in LSSN usage intentions). Intention, in turn, has a large impact on actual usage (intention fully mediates the effect of FYI on actual usage). FYI also has a big effect on desire to call others, but in the negative direction.

The model further shows that age has a negative effect on FYI and that the effect of age on LSSN is fully mediated by this communication style. Similarly, the effect of being a parent on LSSN is also fully mediated by FYI, but in the positive direction; respondents who have children are more likely to be FYI communicators.

Lastly, the model shows that the use of location-sharing social networks is greatly influenced by smartphone ownership. This is a reminder that, perhaps unlike other web-based social media, platform constraints are still a major adoption barrier for location-sharing social networks. Furthermore, older adults are doubly unlikely to use location-sharing social media. This is because they are not inclined to use the FYI communication style and less likely to own the smartphone necessary to use LSSN.

Further Exploration of FYI Effects

To further explore the FYI communication style, another survey was launched in the Refinement Phase. This study replicated the previous study: it included the same measures, but with some improvements. The first improvement was the construction of a more robust measurement of the FYI construct, as described in the previous chapter. This showed that the FYI communication style actually consisted of two (highly correlated) sub-constructs: usage of the FYI-style by *me* to communicate *my* location (FYImy), and

appreciation of the FYI style when used by *others* to communicate *their* location (FYIother). Refer to tables 9 and 10 for the measurement models.

A measurement criterion was introduced to test the external validity of the FYI constructs. It was hypothesized that users who prefer the FYI communication style would be more adept at "*signaling*" the contextual cues needed to understand an online communication (this serves the function that nonverbal cues do in offline communication) (Riva, 2002). In turn, signaling leads to greater participation and disclosure in social media.

Qualitative insights from phase one support this hypothesis. Active LSSN users often expressed confidence in using social media to convey their availability and current activities, describing various tactics for doing so. Signaling could be achieved by engaging with FYI style features (e.g., broadcast status updates, type in a status field). Conversely, those who were concerned about others misunderstanding their status or current activities often limited their social media activity and shared very little (i.e., they would have *Limited Participation* and less *Involved Participation*). These three constructs were measured with the following indicators (all 7-point scales):

	Signaling factor
S1	I find that posting updates about myself is an effective way to keep others informed.
S2	Others get a good idea of whether I am free or busy using my online posts or status.
S3	Social Media poorly captures how or what I am doing. (R)

Table 11: Extent to which one signals context such as availability and activity. (R) indicates reverse coding

	Limited Participation factor
L1	I limit how I use social media because I worry about what others will do.
L2	I limit my activity on social media to keep others from interacting with me.

Table 12: Extent to which one limits social media engagement.

	Involved Participation factor
I1	I share everything on social media because I am not worried about who will see it.
I2	I never hold back on what I say or do with others online.

Table 13: Extent to which one freely engages in social media.

The reliability and validity of the measurement models were acceptable for all of the factors. Signaling has a Cronbach's alpha of 0.77 and an AVE of 0.549. Limited Participation has a Cronbach's alpha of 0.74 and an AVE of 0.655. Involved Participation has a Cronbach's alpha of 0.74 and an AVE of 0.703. All factor loadings are significant at the $p < 0.001$ level.

Additionally, an improvement was made to the measurement of a users' intention to use LSSN. Rather than a single item indicator, four 7-point scale items were introduced that probed on different types of location-sharing social networks. They converged as the same factor and were treated as a single Intention to Use construct with Cronbach's alpha of 0.92 and an AVE of 0.868. Table 14 lists the indicator items.

	Intention to Use LSSN
T1	In the next year, I see myself using a location-sharing social network (LSSN).
T2	In the next year, I see myself using a LSSN that uses continuous, real-time location-sharing (i.e., look up where someone is in real time).
T3	In the next year, I see myself using a LSSN that uses check-ins to share my location (i.e., user shares location each time they decide to check in).
T4	In the next year, I see myself using a LSSN that uses request-based location sharing (i.e., location is only shared when someone responds to a request).

Table 14: Items for Intention to Use Location-sharing Social Networks construct.

Finally, many scholars have focused on individual differences that might explain variations in how people utilize social media (Correa et al., 2010; Rosenberg & Egbert, 2011). A number of studies have investigated connections to personality traits (McCrae & Costa Jr., 1985a) such as the Big Five. However, not all studies find an effect of personality, and those that do seem to disagree as to which personality traits have an effect on which behaviors (Amichai-Hamburger & Vinitzky, 2010; Rosen & Kluemper, 2008; Ross et al., 2009; Ryan & Xenos, 2011). Thus, to test the relationship of personality to communication style and LSSN adoption, a measure of the Big-5 personality traits (extroversion, neuroticism, agreeableness, conscientiousness, openness) was included. Gosling's 10-item version of the Big-5 personality scale was used in which participants judge on a 7-point scale to what extent pairs of personality traits applied to them (Gosling, Rentfrow, & Swann, 2003).

Refined Model of FYI Communication and LSSN Adoption

A structural equation model was created using the Big Five personality constructs, FYI (both for my location and others' location), LSSN intention to use, actual LSSN usage, preference to call rather than use LSSN, smartphone ownership and control variables. Signaling was also included as an outcome of FYI, and Involved and Limited Participation as outcomes of Signaling. To ensure robust results, this model used the same structure as the previous study for the replicated constructs. After pruning non-significant effects from the model, the resulting model is presented in Figure 8. The resulting fit indices are within accepted cut-off values, with the exception of RMSEA, which is still well within the bounds of an acceptable confidence interval (χ^2 (191) =323.77, $p < 0.001$; *CFI* = 0.975; *RMSEA* =

0.062 [0.050 0.074]; *WRMSR* = 0.924). More importantly, all modeled effects are highly significant.

The final model (Figure 8) confirms the same basic structure as the previous model (Figure 7). Namely, FYI communication style drives LSSN usage. It has a positive effect on Intention to use LSSN and smartphone ownership, but a negative effect on Calling rather than using LSSN. Intention and owning a smartphone both lead to LSSN usage. Additionally, this model shows a negative effect of Intention to use LSSN on Calling rather than using LSSN. This effect makes theoretical sense; LSSN users do not have to call other users to learn their location.

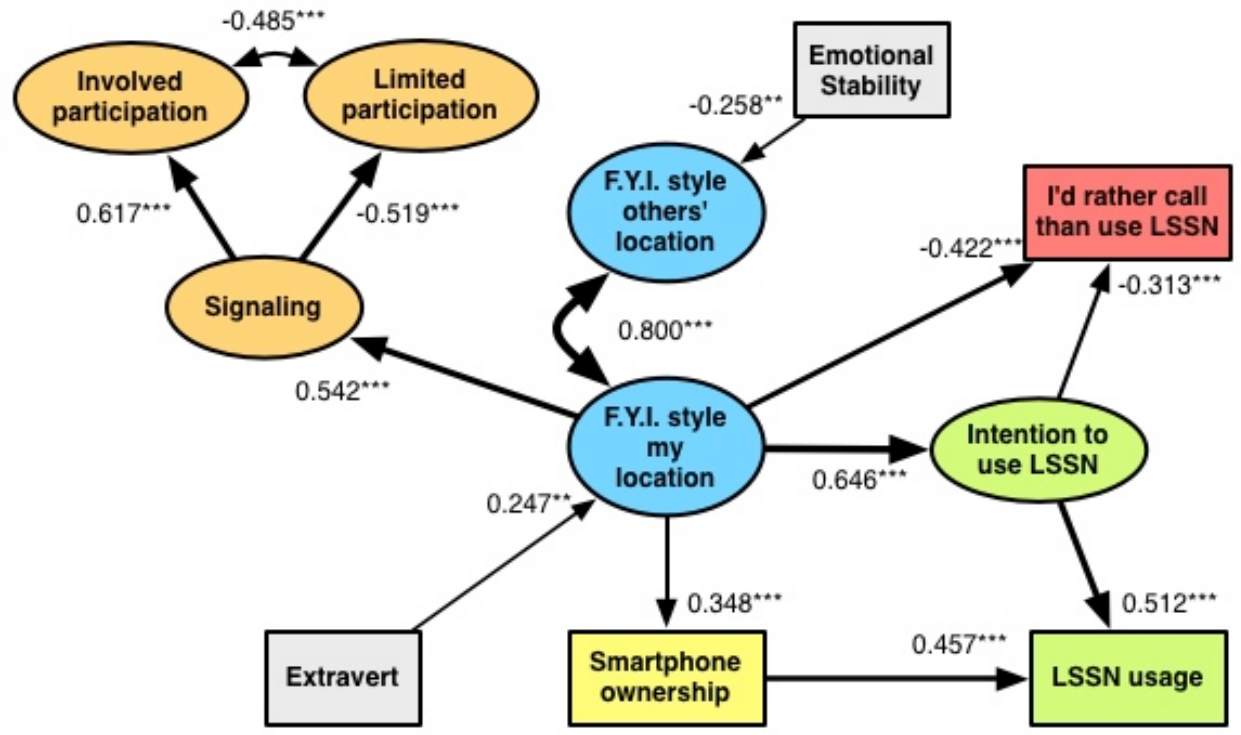


Figure 8: This model confirms the model of the previous study that shows FYI has a significant and large effect on Intention to use LSSN. It also shows that those who are high on Neuroticism (the opposite of Emotional Stability) prefer FYI style communication to learn others' location. Extroverts prefer a FYI communication style to share their own location. Moreover, those who have an FYI communication style are more likely to use Signaling in social media, which leads to more Involvement rather than Limited participation. (standardized effect sizes, * indicates p < 0.001, ** p < 0.01)**

As hypothesized, FYI increases Signaling (it explains 29.4% of the variance in Signaling), which in turn increases Involved Participation and decreases Limited Participation. The model also shows that the Emotionally Stable personality trait ("Calm, emotionally stable" and not "Anxious, easily upset", in other words the opposite of Neuroticism) is negatively related to the appreciation of the FYI style for others' location. However, the Extravert personality trait ("Extraverted, enthusiastic" and not "Reserved, Quiet") is positively related to the usage of the FYI style for sharing one's own location. What's more, FYI fully mediates the effect of personality on LSSN use intention and signaling behavior.

Finally, note that all effects are driven by the usage of the FYI style for *my* location. Although the appreciation of the FYI style for others' location is highly correlated with using FYI for my location, it does not have its own effect on Signaling, intention to use LSSN, and smartphone ownership.

Integrated Model

The previous section validates that, indeed, FYI is a main determinant of LSSN usage. What remains to be tested is the effect of FYI on boundary preservation concern and boundary enhancement, and the effect of the boundary items on LSSN usage. Using the survey data from the refinement phase, a model was constructed that includes all of the refined constructs. It tests the effect of the relationship boundary constructs on Intention to Use, and the effect of FYI and Lying Propensity on boundary preservation concern as well as on Intention to Use. The resulting model is depicted in Figure 9 and has acceptable fit

indices (χ^2 (240) =347.220, $p < 0.000$; *CFI* = 0.973; *RMSEA* = 0.050 [0.038 0.061]; *WRMSR* = 0.821).

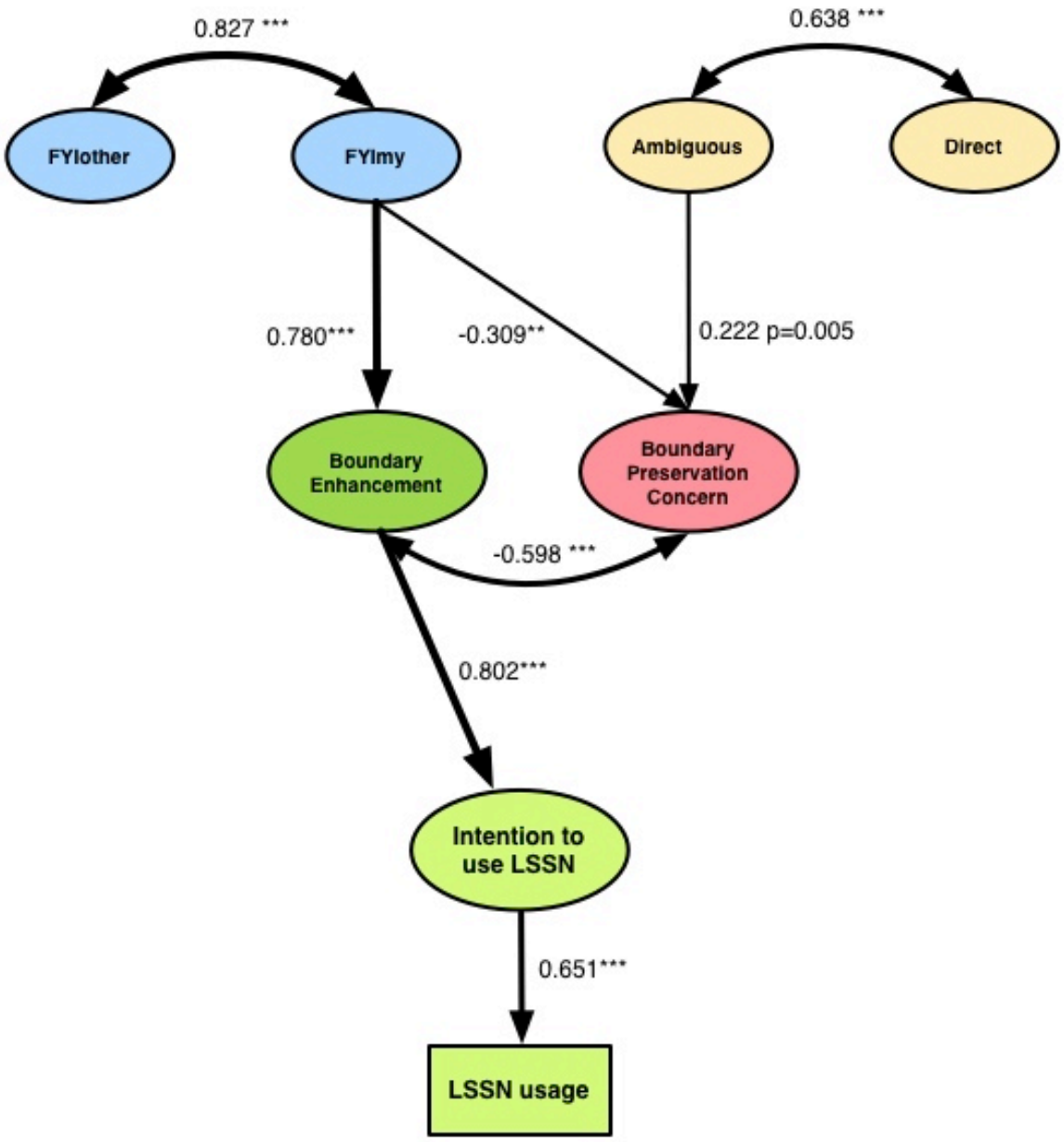


Figure 9: Usage Intention is driven by Boundary Enhancement beliefs, which are driven by a preference for FYI communication to share my location. Boundary Preservation Concern is likewise influenced by FYImy, but also by Propensity to tell Ambiguous Lies. Standardized effect sizes, * indicates p < 0.001**

The model shows that Intention to use location-sharing social networks is driven by perceptions of Boundary Enhancement. The driver of Boundary Enhancement is being a

FYI communicator for sharing my location. Boundary Preservation Concern is correlated with Boundary Enhancement, but does not have any additional effect on Intention. Propensity to tell Ambiguous Lies and FYI for sharing my location both have significant effects on Boundary Preservation Concern.

Summary

This chapter shows how FYI indeed has a substantial positive effect on use of LSSN. FYI also fully mediates the effect of age, personality, and parental status on LSSN use. This may explain inconsistent effects of personality found throughout the literature, or why other researchers have also observed a preference for making phone calls as age increases (Thomas et al., forthcoming). The complete mediation through FYI indicates that this is due to differences in communication style.

Combining all of the refined constructs into a single model, it becomes clear that Boundary Enhancement drives LSSN usage. Boundary Enhancement is in turn driven by an FYI communication style. The next chapter translates these theories into system design and tests this model.

CHAPTER 7: Translating Theory into Specific Designs

Having identified a model for adoption of location-sharing social networks (see previous chapter, Figure 9), what can we do to lower barriers to adoption and usage? The model shows that an individual predisposition, namely communication style, is the predominant determinant of whether and to what extent people use LSSN. The final phase of this dissertation is an initial exploration of how this theory can be applied to system design. The research question that it focuses on is, *How does communication style affect user preference for a given LSSN system design?* Answering this question can help researchers and designers see how certain design elements may affect users preferences differently based on communication style.

Experimental Design

To test how an LSSN system design is perceived by users of differing communication styles, design dimensions were chosen based on the theoretical dimensions represented in the FYI trait (refer to chapter 5 for a detailed description of the FYI constructs):

1) **When**: Control over *when* location is shared
2) **Effort**: *Effort* required to obtain location
3) **Who**: Preference for choosing a subset of individuals with *whom* to share, as opposed to letting everyone on my friend list access the information

FYI communicators prefer one end of the spectrum for each of these dimensions. Low-FYI communicators are on the opposite end of that spectrum. Table 15 lists these dimensions and the preferred design for each FYI trait. This phase of research starts with the

hypothesis that participants will prefer an interface with design dimensions matching their communication style.

	When location is shared		**Effort to share location**		**Who can see location**	
	I control	*Others control*	*Higher*	*Lower*	*Specific individuals*	*Any friend*
High-FYI		✔		✔		✔
Low-FYI	✔		✔		✔	

Table 15: Shows design preferences for high and low-FYI communicators

Longitude Version	**Description**	**When location is shared**		**Effort to share location**		**Who can see location**	
		I control	*Others control*	*Higher*	*Lower*	*Specific Indiv.*	*Any friend*
Continuous	Caters to high-FYI: Continuous, automatic, real-time location sharing with all of your Longitude friends.		✔		✔		✔
Check-in	Uses popular LSSN model: Each time you want your Longitude friends to know where you are, you "check in" to share a snapshot of your current location.	✔					✔
Request	Caters to low-FYI: Send request to a specific person and, if they accept, you can see a snapshot of their current location. Must send new request each time you want to see their location.	✔		✔		✔	

Table 16: The three versions of Longitude and their design dimensions

The design dimensions in Table 15 were incorporated into the design of a hypothetical location-sharing social network, Longitude. Three versions of Longitude were created for the experiment. One version catered to high-FYI communicators and is closest

to the design of Google Latitude (i.e., others get my location when they want, low effort for sharing location, any of my Longitude friends can see my location). Another version was tailored to low-FYI communicators (i.e., I share my location when I want to, it takes some effort to share, only specific individuals see my location). A third version of Longitude represented a hybrid interaction, check-in location-sharing (i.e., I share my location when I want to, it takes moderate effort to share, any of my Longitude friends can see my location). This is a mode of interaction used in several popular LSSN, such as Foursquare. Table 16 maps the features of each Longitude version to the design dimensions they represent.

The check-in version of Longitude is a mix of design dimensions and so hypothesized to rank between the other two more extreme designs in terms of user preference. That is, it is hypothesized that high-FYI communicators will prefer the designs in this descending order: Continuous, Check-in, Request. Low-FYI communicators will prefer the designs in the exact opposite order. This preference should manifest as lower boundary preservation concerns and higher boundary enhancement expectations, which ultimately affect intention to use Longitude. However, this interaction effect may not be large enough to overcome the main effect of FYI communication style – high-FYI communicators may still prefer any version of Longitude over calling someone to find out their location (and vice versa).

The FYI communication style was measured using a very slightly refined version of the constructs developed in the previous phase (Tables 9 and 10). Pilot feedback revealed that being specific about the scope of "everyone" and "others" in some items is useful for reminding respondents that this includes only their Longitude friends and not strangers. Thus, the items in tables 17 and 18 were used and proved to have acceptable convergent

validity with AVE well above 0.5 and all loadings significant at the $p < 0.001$ level. *Boundary Preservation Concerns*, *Boundary Enhancement Expectations* and *Intention to use*, are measured by the measurement models in tables 19-21. They are adapted to Longitude from the constructs validated in the refinement phase. AVE was also greater than 0.5 for these factors and all loadings were significant at the $p < 0.001$ level. Unless otherwise noted, all items (here and for the rest of the chapter) were rated on a 7-point scale whose values are -3 (Disagree Strongly), -2 (Disagree Moderately), -1 (Disagree Slightly), 0 (Neutral), +1 (Agree Slightly), +2 (Agree Moderately) and +3 (Agree Strongly).

	FYImyR: Revised FYI for sharing my location
FYImyR1	The people I know should be able to get my location whenever they feel they need it.
FYImyR2	I want the people I know to be aware of my location, without having to bother to tell them.
FYImyR3	I would prefer to make my location available to the people I know, so that they can see it whenever they need it.

Table 17: Revised factor for an FYI attitude towards sharing my location (FYImyR).

	FYIothR: Revised FYI for learning others' location
FYIothR1	I would like a way to know someone's location whenever I need it, without waiting for them to tell me.
FYIothR2	I want to know where others are without having to bother them by asking.
FYIothR3	I would prefer if everyone I know would make their location available to me.
FYIothR4	It would be useful to me if others would make their location available to everyone.

Table 18: Revised factor for an FYI attitude towards finding out others' location (FYIothR). The last item is one of the original items, included because it has a semantically different meaning from the revised items.

	BCL: Boundary Preservation Concern for Longitude
BCL1	Using Longitude will ***damage*** my relationships with others.
BCL2	Others will ***misuse*** Longitude in a way that is out of line with our relationship.
BCL3	What Longitude shares with others will ***hurt*** my relationships with them.
BCL4	Others will use Longitude to do something that ***hurts*** my relationships.

Table 19: These are adapted to using Longitude from the refined Boundary Preservation Concern construct.

	BEL: Boundary Enhancement Expectation for Longitude
BEL1	Using Longitude will ***improve*** my relationships with others.
BEL2	Longitude lets me take actions that ***help*** my relationships.
BEL3	Longitude ***improves*** my relationships with others by keeping all of us better informed.

Table 20: These are adapted to using Longitude from the refined Boundary Enhancement construct.

	TL: Intention to Use Longitude
TL1	Within the next 6 months, I see myself using Longitude regularly.
TL2	Within the next 12 months, I see myself using Longitude regularly.
TL3	Eventually, I see myself using Longitude regularly.

Table 21: The original Intention to use LSSN construct prompts about intention to use in a given timeline, as well as intention to use different designs. This revised construct only prompts about timeline.

Technology adoption studies often draw on the TAM model (Davis, 1993; Venkatesh, Morris, Gordon B. Davis, & Davis, 2003) to predict adoption. The basic model posits that precursors to adoption all funnel through Usefulness and Ease of Use. Thus, items representing these constructs were administered. The items were developed based on measures that have shown to have predictive power in prior studies (Knijnenburg & Kobsa, 2012; Knijnenburg, Willemsen, Gantner, Soncu, & Newell, 2012). Tables 22 and 23 show the items.

	Usefulness
U1	Longitude would be useful to me.
U2	Using Longitude would be annoying. (R)
U3	Using Longitude would make me happy.
U4	I would recommend Longitude to others.
U5	I would quickly abandon using Longitude. (R)
U6	Using Longitude would be convenient.
U7	Overall, I would be satisfied with Longitude.

Table 22: Measure of Longitude's usefulness. (R) indicates reverse coding.

	EOU: Ease of Use (Effort)
EOU1	Longitude would be easy to use.
EOU2	I would have to put a lot of effort into using Longitude. (R)
EOU3	It takes too many steps to use Longitude. (R)
EOU4	Using Longitude would take too much time. (R)

Table 23: Ease of Use construct. Also used as manipulation check questions for the *Effort* design dimension. (R) indicates reverse coding.

Furthermore, the communication style model in the previous chapter shows that FYI communicators are more likely to use signaling features to convey context about their activity. This leads to more involved participation. This finding suggests that additional features to help convey contextual cues should improve user satisfaction of the interface. However, it is unclear whether this would be true for all conditions, and whether for both high- and low-FYI communicators. It could be that signaling context is only useful for those high in FYI, or it could be useful only in the sharing design condition favored by the given FYI type. The design of this experiment makes it possible to test whether context signaling features are helpful, for whom, and with which version of Longitude.

To test the effect of signaling context, an additional design condition was introduced that supports the ability to convey context. This condition is called signaling and allows the user to type a free-form message to go along with a location-sharing event (for Check-in and Request) or a continuously displayed status field (for Continuous). Hence, each of the three versions of Longitude was available in both a signaling version and a non-signaling version. Overall, signaling context is expected to increase usage intention by lowering boundary preservation concerns and increasing boundary enhancement expectations.

The signaling context feature makes this a 3x2 factorial experiment design which yields 6 possible design conditions: Continuous No Signaling (CntNS), Continuous Signaling (CntSig), Check-in No Signaling (ChkNS), Check-in Signaling (ChkSig), Request No Signaling (ReqNS), Request Signaling (ReqSig). Participants were randomly assigned to one of these conditions and performed tasks with the interface. Comprehension check questions not only checked for understanding, but taught the interface to participants if they answered incorrectly. Participants who answered a third or more of the questions incorrectly where automatically eliminated. The percent correct variable also served as a control for the remaining participants (which proved to be insignificant). Figures 10-12 illustrate each of these design conditions. For the full interactive prototypes, refer to appendix A.

Figure 10: Continuous condition design, Signaling supported (No signaling has no status messages).

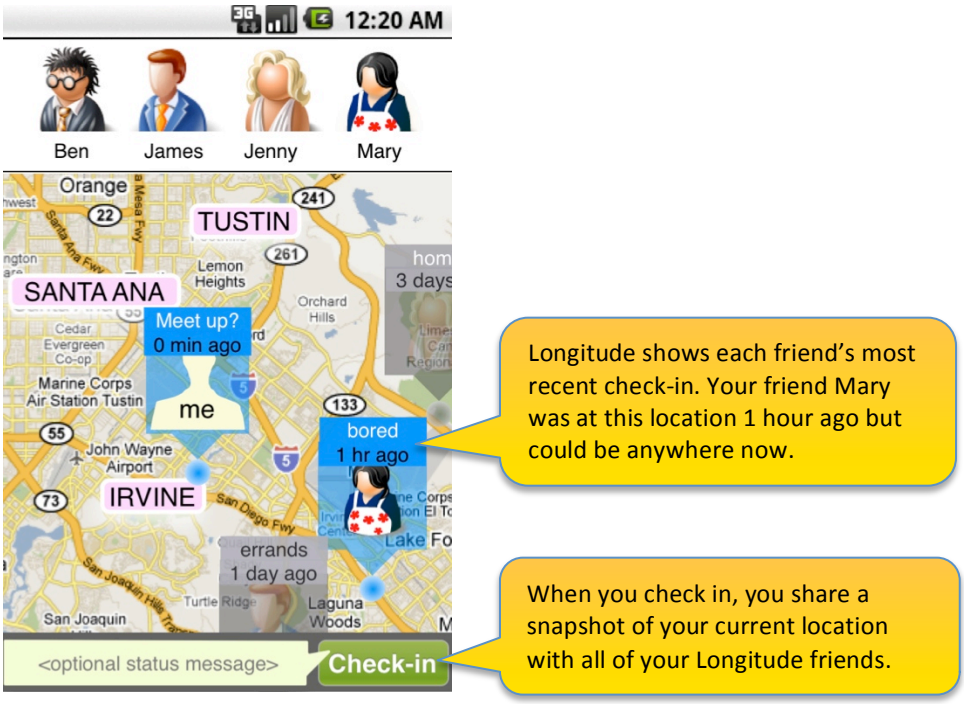


Figure 11: Check-in condition design, Signaling supported (No signaling has no status messages).

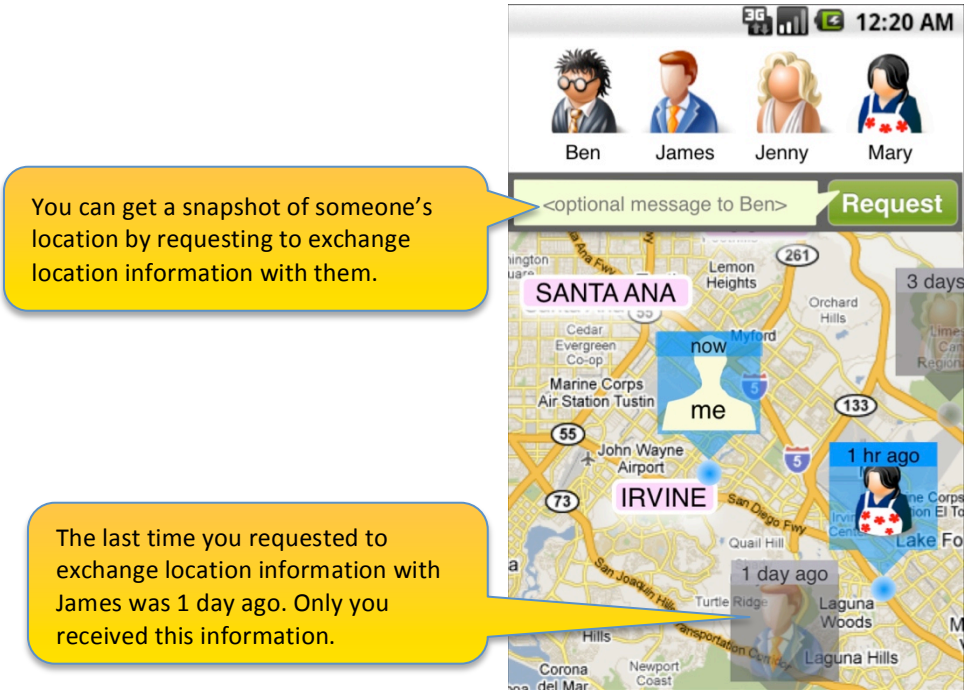


Figure 12: Request condition design, Signaling supported (No signaling has no message accompanying request).

To check that the design conditions reflect the conceptual dimensions for which they are supposed to differentiate (when, effort, who, signal), manipulation check questions were included to check that users *perceive* that Longitude supports the correct design dimensions. The Effort dimension is represented by the previously described Ease of Use measure (Table 23). Tables 24-26 list the when, who, and signal manipulations checks, which each formed an acceptable factor with loadings at the $p < 0.001$ level and AVE above 0.5. The manipulation checks also served to isolate each design element so that each individual dimension can be analyzed for its impact on user preferences.

	When location is shared: Share Discrete Events
MCDiscrete1	It is simple to share my location with only one person.
MCDiscrete2	It is hard to share my location with a specific person and no one else. (R)
MCDiscrete3	I can choose exactly which Longitude friends can see my location and which cannot.
MCDiscrete4	It is impossible to share my location with only a subset of my Longitude friends. (R)
MCDiscrete5	I am always able to control with which Longitude friends I do and do not share my location.

Table 24: Manipulation Check questions for *When* design dimension. Ranges from ability to share continuously, to sharing at discrete moments in time. (R) indicates reverse coding.

	Who can see location: Share with Subset
MCSubset1	I can choose at which discrete moments to share my location rather than continuously share.
MCSubset2	When Longitude is on, I must constantly share my location. (R)
MCSubset3	It is hard to limit my location sharing to discrete moments. (R)
MCSubset4	I can easily share my location at discrete moments rather than continuously.

Table 25: Manipulation Check questions for *Who* design dimension. Ranges from selectively sharing with certain individuals, to undifferentiated sharing with one's Longitude friends. (R) indicates reverse coding.

	Signaling: Signal Context
MCSignal1	Beyond my location, Longitude gives others an accurate picture of what I am doing.
MCSignal2	Others can use Longitude to tell me where they are, but not what they are doing. (R)
MCSignal3	Beyond their location, longitude keeps me aware of others' activities.
MCSignal4	Longitude tells others my location, but nothing about my activity. (R)

Table 26: Manipulation Check questions for *Signal* design dimension. Ranges from providing context about one's activities, to providing none. (R) indicates reverse coding.

Additionally, as participants performed tasks, they were prompted to relate that task to their own lives and make a choice between using Longitude, calling on the phone, or some combination for accomplishing the task. The tasks and prompts were designed to have them think more deeply about using Longitude to share their location, or get others'

location, for different audiences (specific vs. multiple individuals), and purposes. Although they probe on different scenarios, participant answers were so similar across all four prompts that the items ended up forming a single well-fitting factor. This is not surprising for the attitudes towards my versus other's location considering FYImy and FYIother attitudes have been found to be so similar. However, it does offer new insight that attitudes toward communicating with a specific individual versus multiple individuals may be similar, as well as for planned versus serendipitous encounters.

	Choose Phone: Decision to use Longitude or call someone on the phone			
Share…	*…whose location…*	*…with Individual v. Multiple…*	*…for planned v. Chance meet-up*	*Prompt*
CP1	Other	Individual	Planned	When you **have already agreed** to meet with someone (like you did with Ben) how would you prefer to learn if **they are now ready to meet up**?
CP2	My	Individual	Planned	When you **have already agreed** to meet with someone (like you did with Ben) how would you prefer that they learn **you are now ready to meet up**?
CP3	My	Multiple	Chance	If your contacts are **looking to meet up with you** (like Mary was), how would you prefer that they find out **if you are around now**?
CP4	Other	Multiple	Chance	If you are **looking to meet up with others** (like you were with Jenny and James), how would you prefer to find out **who can meet up now**?

Table 27: Longitude decision point prompts that appear in the interactive prototype. To limit the amount of time it takes to complete our experiment, we limited to 4 prompts and scenarios.

This factor (called "Choose Phone") provided an additional behavioral measure of how the interface tasks and tutorial were influencing attitudes. Thus, Choose Phone is an outcome of perceived ease of use and usefulness, but a precursor to longer-term intention

to use Longitude. Table 27 lists the four prompts and theoretical dimensions they probe. Respondents selected one of four choices, listed in decreasing order of reliance on Longitude to learn about availability and whereabouts: *Use Longitude* (0), *First use Longitude, then follow up with a call* (1), *First call, then follow up using Longitude* (2), *Just call* (3).

Theorized Model

Figure 13 combines the validated theoretical model from the refinement phase with the design dimensions and constructs described in the previous section. Going into the design experiment, Figure 13 illustrates the expected model structure. Interaction effects of FYI with a factor is represented by having both a high-FYI coefficient (Hfyi) and a low-FYI coefficient (Lfyi) on the arrow of that factor. "+" indicates an expected positive effect, "-" a negative effect, and "0" indicates no effect. For instance, the arrow from Signal Context to Boundary Enhancement indicates that a positive effect is expected for high-FYI, but no effect is expected for low-FYI communicators.

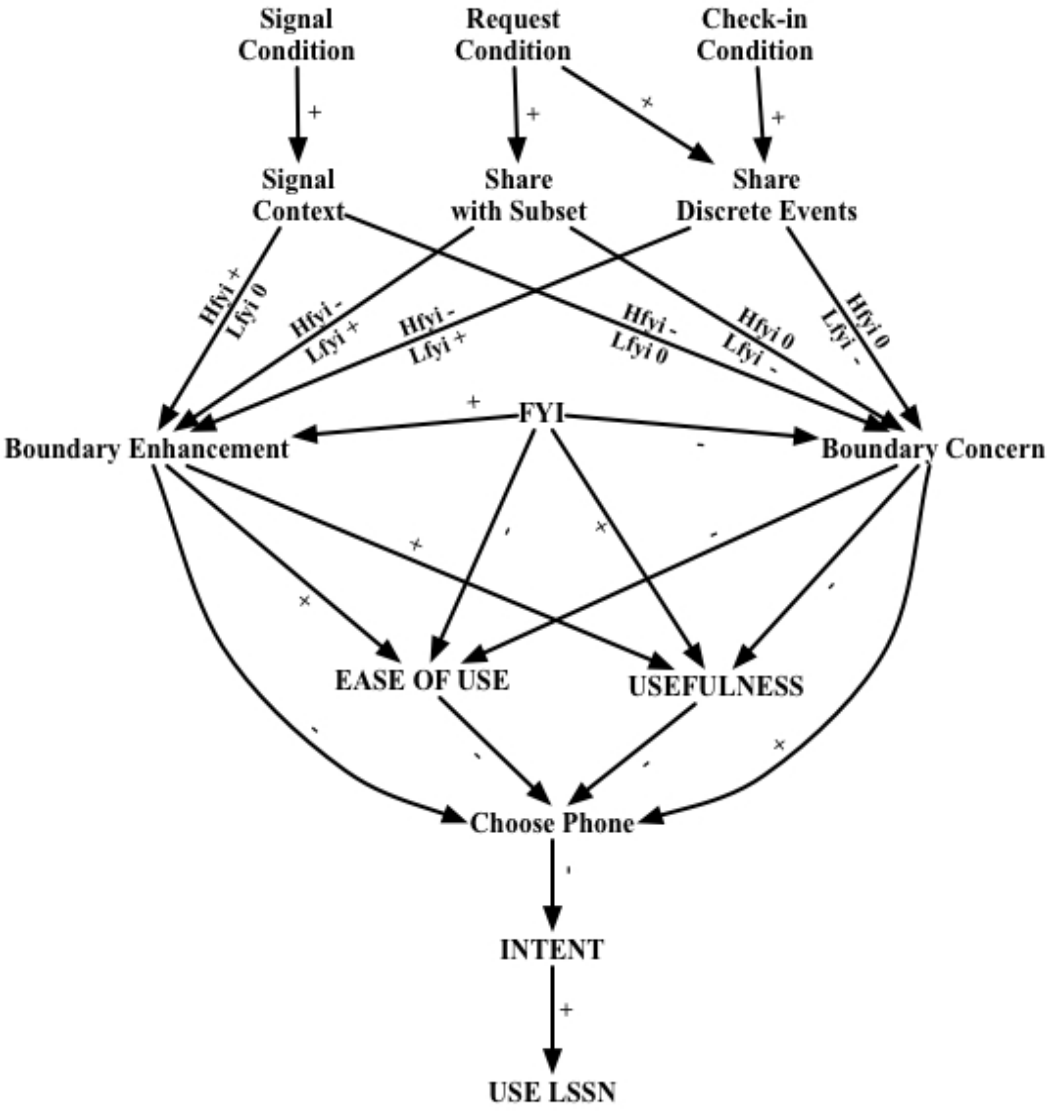


Figure 13: Theoretical model hypothesized

The model shows that the design condition leads users to perceive support for a given design dimension (e.g., ability to signal context). That perception influences boundary preservation concern as well as boundary enhancement expectations. However, perceptions have a different influence for high-FYI communicators than for a low-FYI, as indicated in the model. Attitudes about how Longitude affects relationship boundaries, in turn, impact perceived ease of use and usefulness. Because relationship boundary attitudes

are a measure of social impact that is different from ease of use or usefulness, they also have a direct effect on whether someone chooses to use Longitude during the experiment. Someone's choice during the experiment should be a strong predictor of intention to use, which leads to use.

Throughout the model, the effects of FYI communication style should have an impact. FYI communicators should perceive more boundary enhancement and have lower boundary concerns. High-FYI communicators are also adverse to putting in too much effort for using LSSN, perceiving the same interaction as requiring more effort than a low-FYI communicator. Furthermore, low-FYI communicators should have more positive feelings towards Longitude if the design supports the ability to share location at discrete moments in time, or to share selectively with individuals. The constructed model tested all of these effects. In fact, it started with a saturated model (i.e., it also included all other non pictured paths from top to bottom) and also tested interaction effects of FYI with design conditions, and interactions between design conditions. The final model is pruned to paths significant at the $p < 0.01$ level (refer to Rex B. Kline, 2004 for a detailed description of starting with a saturated model and the pruning procedure).

Results

Figure 14 shows the final model and all significant effects with excellent fit indices (χ^2 (364) =474.507, $p < 0.001$; *CFI* = 0.997; *RMSEA* = 0.023 [0.017 0.029]; *WRMSR* = 0.902). An important note about the structure is that the Usefulness and Intent to Use constructs had such a high correlation (.928) that they could not be included in the same model for reasons of multicollinearity. Thus, Intent to Use was kept in the model since that is the

theoretically most interesting construct for understanding adoption of location-sharing services. Although Usefulness is not in the final model, the high correlation with Intent lends external validity to the Intent construct. Because of the size of the model, the following subsections discuss each dependent variable, and its significant explanatory variables, separately.

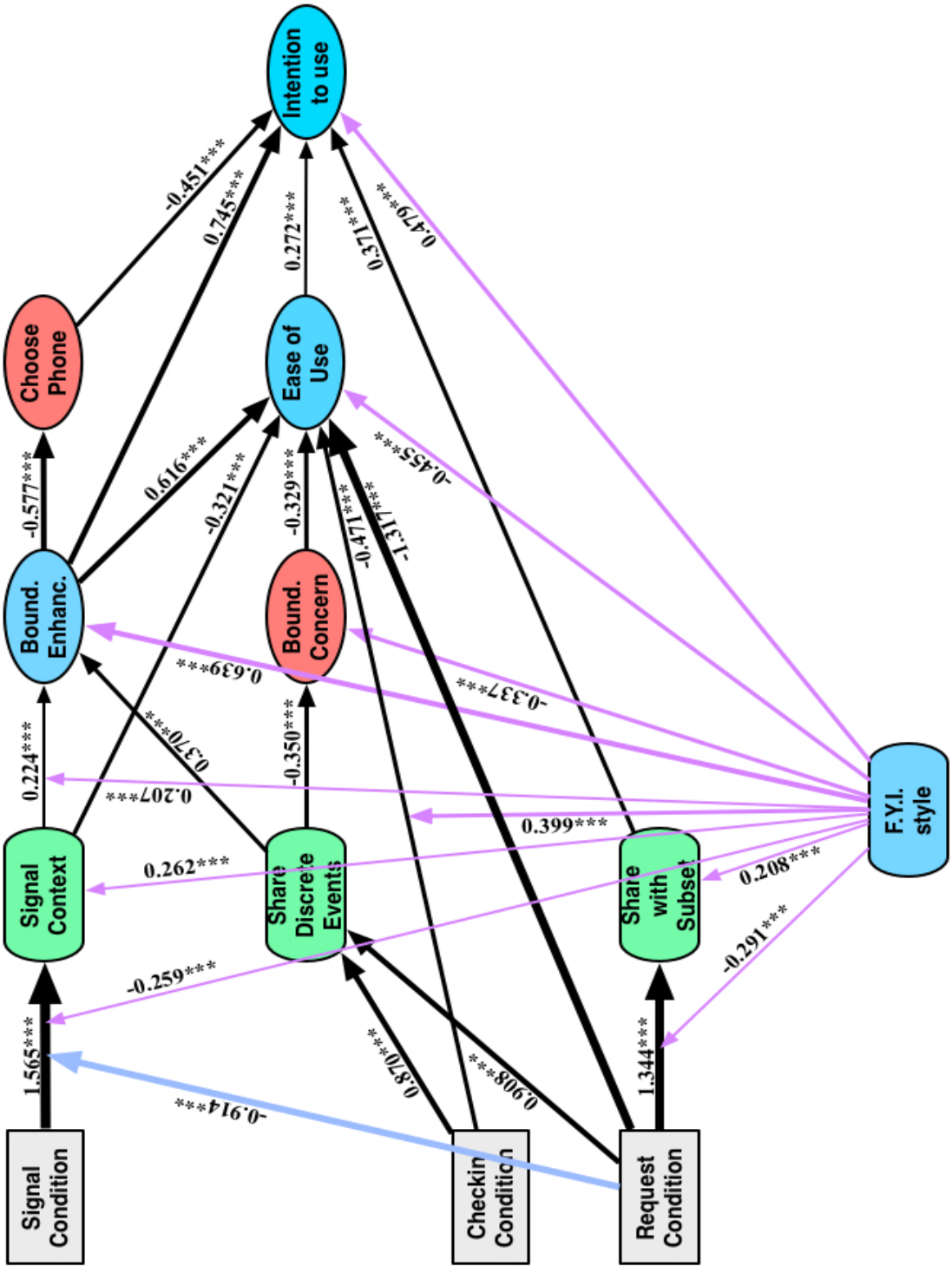


Figure 14: Final model. Standardized effect sizes for factors, unstandardized for design conditions.

Intention to Use

As Figure 15 highlights, several factors influence one's Intention to use Longitude. One's expectation of Boundary Enhancement is the greatest determinant of intent to use. Having a FYI communication style also has a fairly large positive effect and a design that allows one to share with a subset of Longitude friends has a medium sized impact. Surprisingly, ease of use has the smallest effect, but still does increase intention. On the other hand, if the participant indicates that they would more often choose to call someone on the phone, they are much less likely to use Longitude.

Notably, boundary preservation concern does not have a significant direct effect on intention to use longitude. This is in line with findings from the previous phases that show boundary enhancement is the determinant when both constructs are accounted for in the model. Ability to signal context or share location at discrete moments in time (rather than continuously) also did not have a direct effect on Intention.

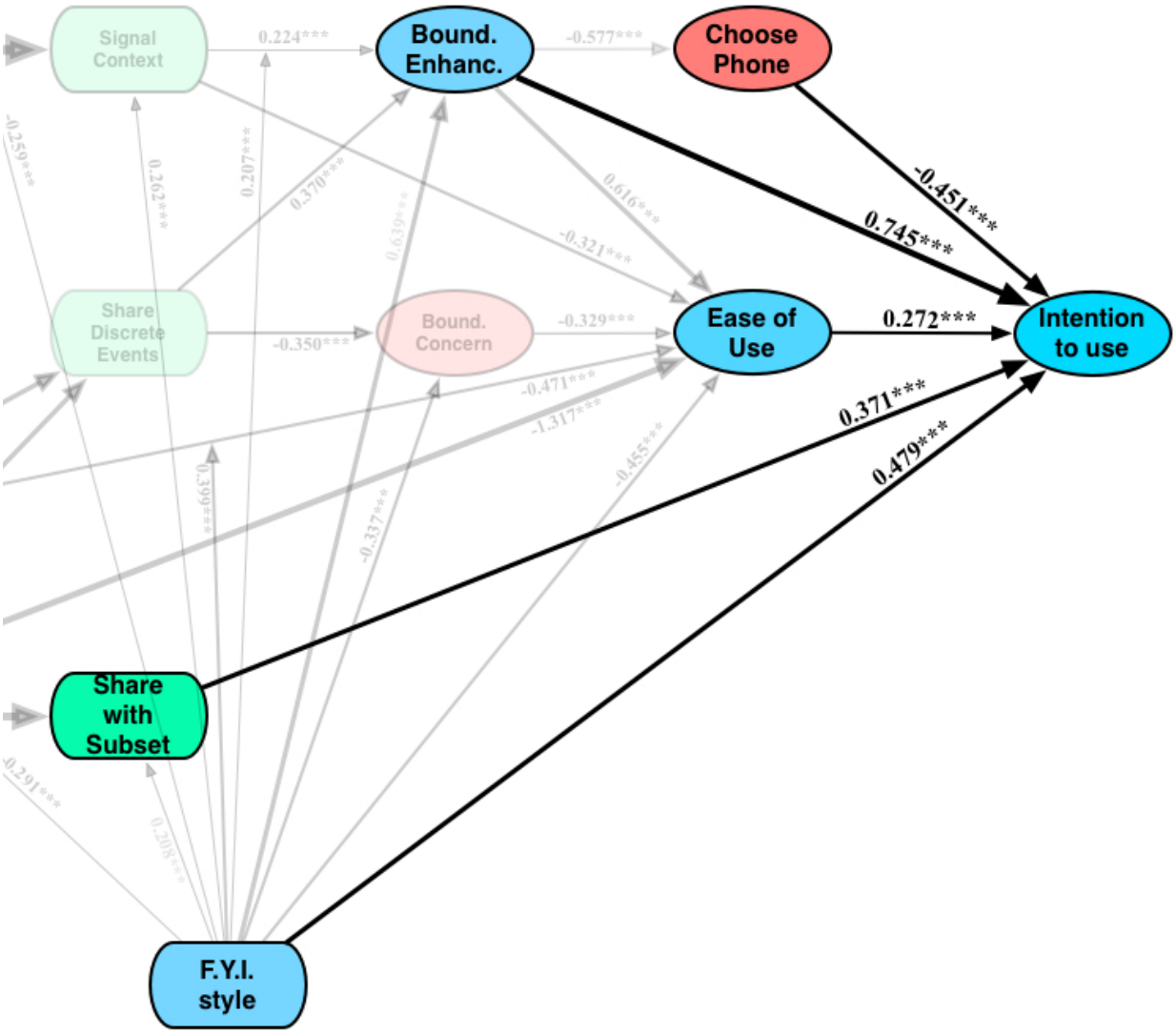


Figure 15: This portion of the model shows factors with a significant effect on Intention to use Longitude.

Ease of Use

Figure 16 shows that there are several influences on perceived ease of use. Noticeably, the Request and Check-in designs are both perceived as harder to use. This is in line with expectations since the conditions were designed to be that way. Interestingly, there is an interaction effect of FYI and the Check-in condition. The effect size is close to the magnitude of the main effect of Check-in, but in the positive direction. This means that FYI

communicators think the check-in interaction is much easier to use than low-FYI communicators. Specifically, high-FYI people (+1 standard deviation) find the Check-in condition just as easy to use as the Continuous condition, while for low-FYI people (-1 standard deviation) the ease of use of the check-in condition is even lower (around -0.870). Despite this interaction effect, there is a large main effect of FYI communication which indicates that in general, FYI communicators tend to think the Longitude service is harder to use than low-FYI communicators do.

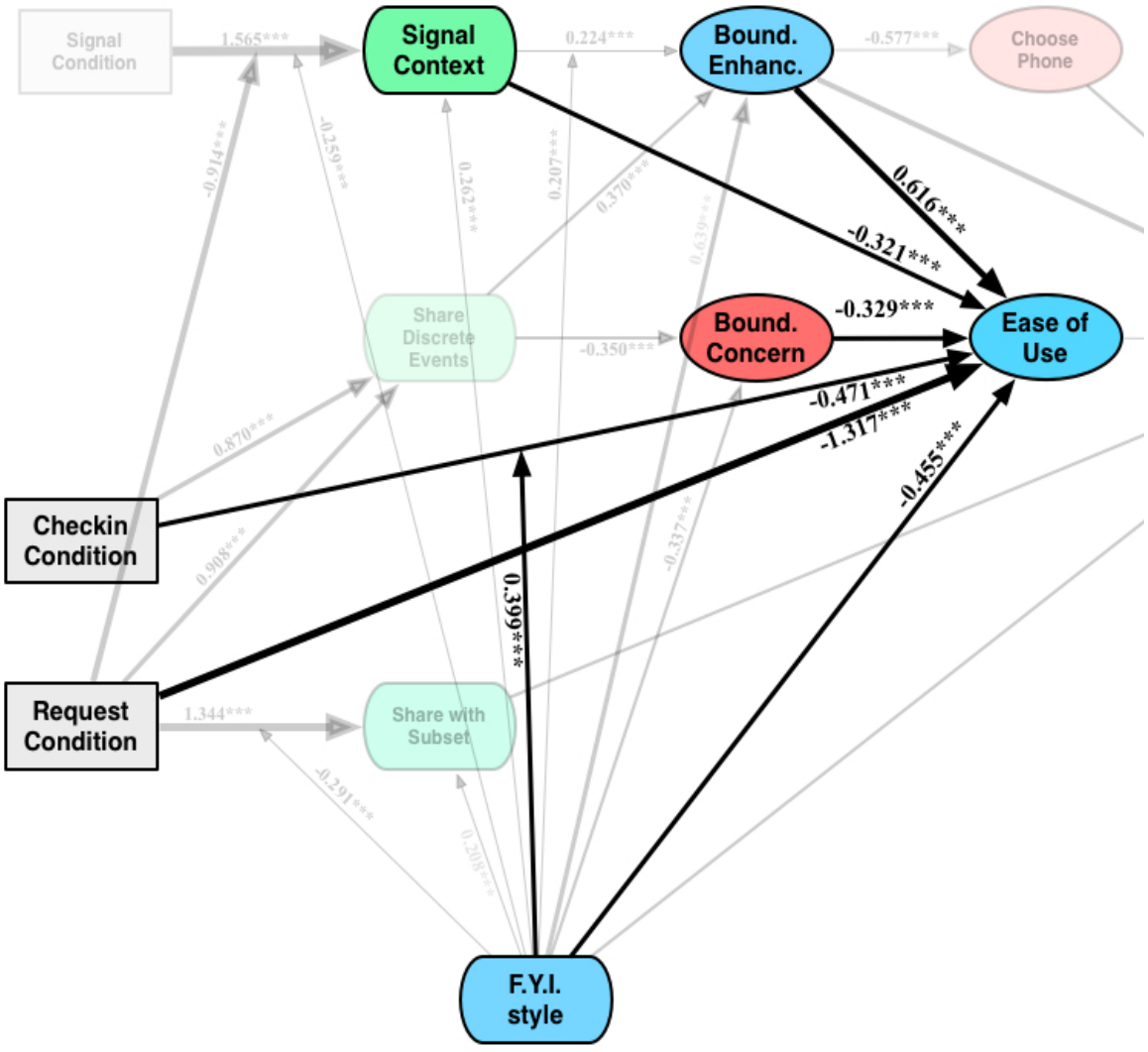


Figure 16: Portion of the model that shows influences on Ease of Use for Longitude.

Designs that support signaling context are also perceived as harder to use. This is understandable since it takes additional effort to set a status field or to enter a message when one shares location. Boundary preservation concerns also lower perceived ease of use while Boundary Enhancement greatly increases perceived ease of use. One possible reason could be that those who do not worry about boundary preservation (or who find the system in line with their expected boundaries) feel they need to expend less effort to make the system do what they want. Conversely, those concerned about being able to preserve relationship boundaries may feel that they need to put more effort into protecting those boundaries.

Boundary Enhancement

Boundary Enhancement has been shown to have a sizeable impact on Ease of Use and Intention to use Longitude. So what drives expectations of boundary enhancement? Figure 17 shows that an FYI communication style increases expectations of boundary enhancement. It is further amplified by LSSN design that allows sharing location at discrete moments in time, and design that supports signaling contextual information. What's more, FYI has an interaction effect with signaling context; a high-FYI communicator (+1 standard deviation) feels that signaling context enhances relationship boundaries twice as much as a low-FYI person (-1 standard deviation).

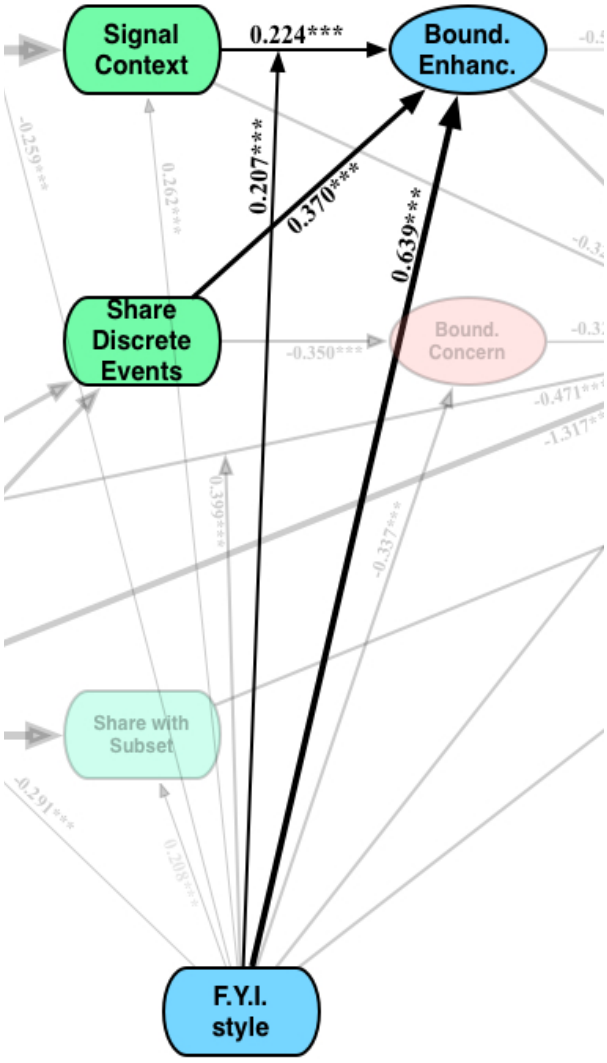


Figure 17: Factors that increase expectations of Boundary Enhancement.

Boundary Preservation Concern

The FYI communication style was shown to decrease boundary preservation concerns. However, Figure 18 shows that the ability to share location at discrete moments in time can decrease boundary preservation concern a similar amount. No other design elements were found to have an affect on boundary preservation concern.

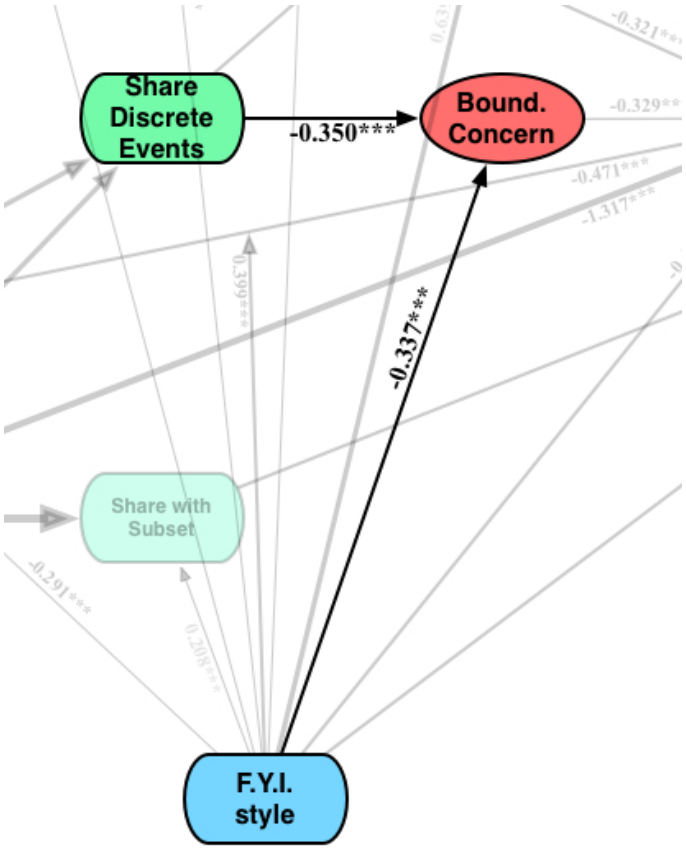


Figure 18: An FYI style and certain design elements can lower boundary preservation concerns.

Share Discrete Events

Figure 19 shows that only the design conditions impact perceptions that a user can share location at discrete moments in time. Both the request and check-in conditions do so. This is in line with the intended effect of those design conditions – that they are high on the *when* dimension (refer back to Table 16). This shows that the design manipulation worked.

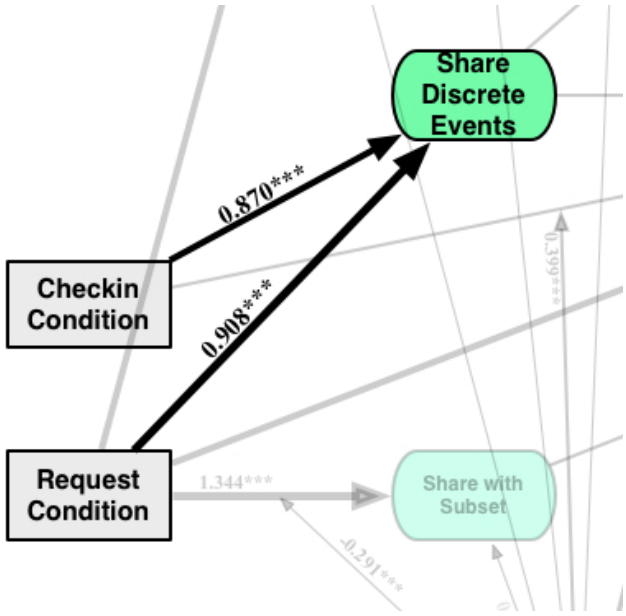


Figure 19: Designs shape the perception that location can be shared as discrete moments in time.

Signal Context

The signal condition successfully conveyed to users the ability to Signal Context along with their location sharing, as was the original design intention. FYI communicators feel generally more able to communicate the context of their location sharing, but at the same time they feel that the signal condition (i.e., the option to add a status message to the location sharing) contributes less to this ability. In contrast, low-FYI communicators fully rely on the status message to communicate context. In fact, the status message overcomes the difference between low- and high-FYI communicators. Also, the signaling design in the request condition was perceived to support signaling much less than for other conditions. These interactions show that signal ability is necessary for low-FYI people to convey context, and may be most effective in the Check-in and Continuous conditions.

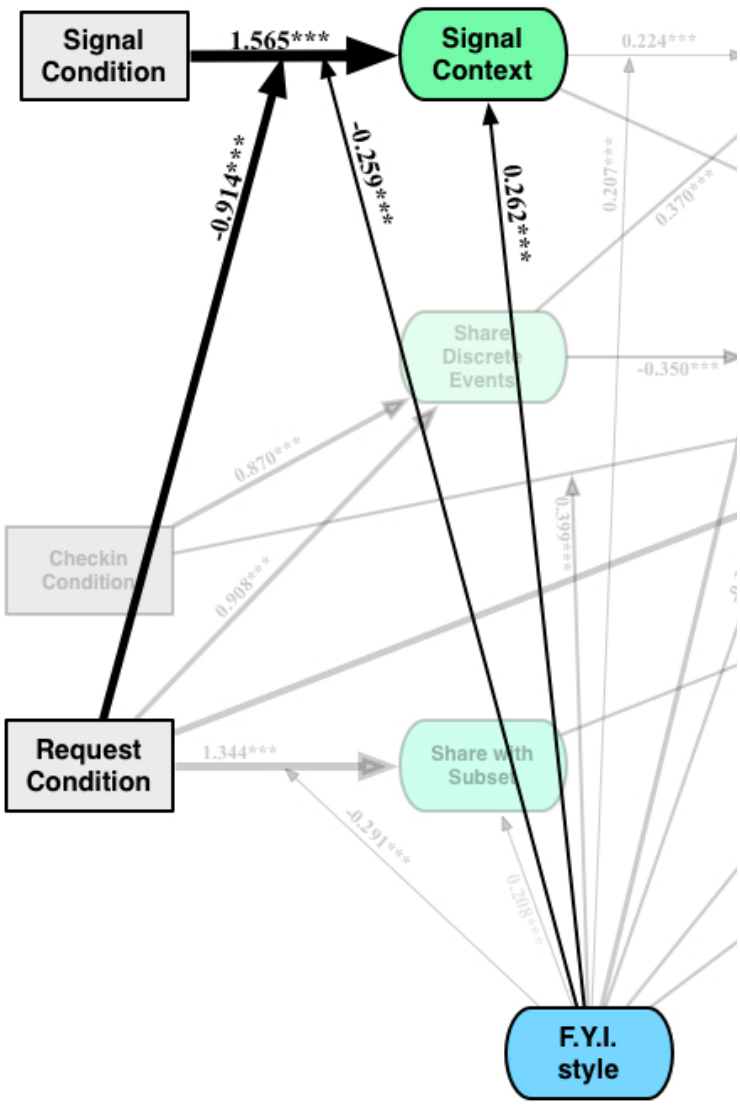


Figure 20: A number of interaction effects shape perceptions that contextual cues can be conveyed.

Share with Subset

The request design condition is the only one that allowed users to specify exactly with which individuals to share location. Accordingly, it is the condition with a large effect on the perception that the user can share with a subset of friends. However, Figure 21 makes it clear that the FYI communication style affects Share with Subset in multiple ways.

FYI communicators are more likely to feel like they can selectively share location in Longitude in the continuous and check-in designs. However, the request design can offset this difference for low-FYI individuals.

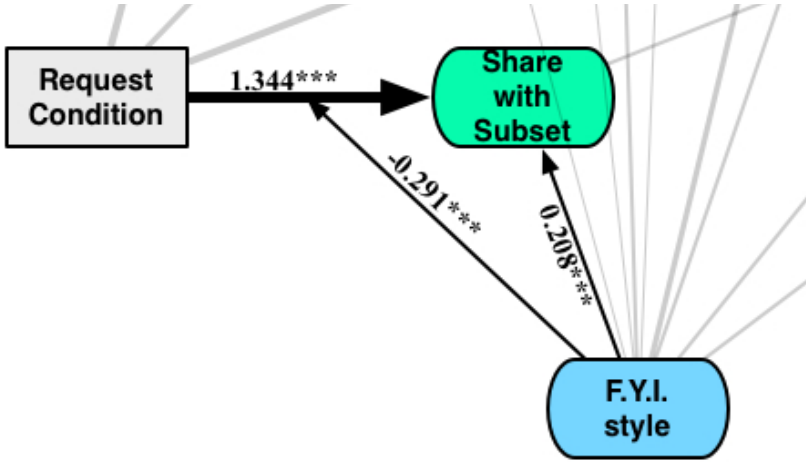


Figure 21: FYI communicators perceive the ability to share with a subset of individuals more than low-FYI individuals. The appropriate design can help low-FYI communicators overcome this difference.

Effects of Design Conditions

The model has many factors influencing intention to use Longitude. Just by looking at the model, it is difficult to see how much of an impact a given design can have. Figures 22-30 and Tables 28-36 show the total effects of different design conditions on the outcome variables.[8] A discussion of the effects precedes each figure. These total effects graphs are in harmony with the marginal effects graphs (see appendix B).[9] However, for the Intention to Use graph, the marginal effects show a noticeable 3-way interaction that is

[8] All total effects are graphed since the total effects are derived by taking only model paths, which are all highly significant. The table of regression coefficients highlights which total effects proved to be significant.
[9] Marginal effects graphs are a rough summary of the raw data. Graphing all of the effects on an outcome variable, even the insignificant effects, produces a rough visualization of the data.

unexplained. The model presented in the previous section is slightly simplified in this respect and does not contain that interaction. Causes for this discrepancy remain to be explored in future research. Figure 23 shows the marginal effects graph for Intention.

In the graphs below, the x-axis is the FYI score (in standard deviations) and the y-axis is the outcome variable (e.g., Intention to use LSSN). Thus, in the first graph, one can see that a fairly low-FYI scorer at -1 on the x-axis (representing 1 standard deviation below the mean) has much lower Intention to use LSSN scores for all 6 design conditions than for a relatively high-FYI scorer at +1 on the x-axis (representing 1 standard deviation above the mean). Refer to the legend on the right of each graph for the color- and pattern-coded design conditions.

Intention to use Longitude. One can see that FYI communication style has a large total effect on Intention to Use Longitude. However, using a request-based or check-in design can also increase people's willingness to use. Including signaling features will also give usage intention a boost, but a bit less of a boost for FYI communicators. Also, the signaling feature in the request design is slightly less helpful than in the other design conditions, but somewhat helpful nonetheless.

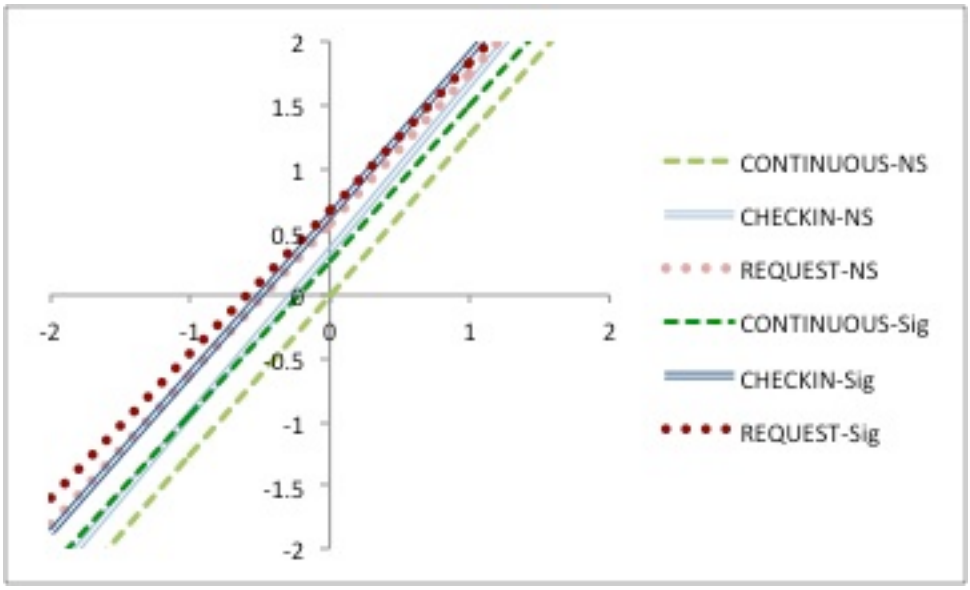


Figure 22: Total effects of design conditions on Intention to Use Longitude

Variable	Beta	S.E.	p-value
FYI style	**1.258**	**0.179**	**0.000**
Is Check-in Condition	**0.365**	**0.134**	**0.006**
Is Request Condition	**0.566**	**0.175**	**0.001**
Is Signal Condition	**0.275**	**0.116**	**0.018**
FYI X Check-in	0.049	0.064	0.441
FYI X Request	-0.068	0.066	0.302
FYI X Signal	**-0.046**	**0.022**	**0.043**
Check-in X Signal	-0.002	0.031	0.944
Request X Signal	**-0.16**	**0.075**	**0.033**

Table 28: Regression Coefficients for Total effects on Intention to Use Longitude

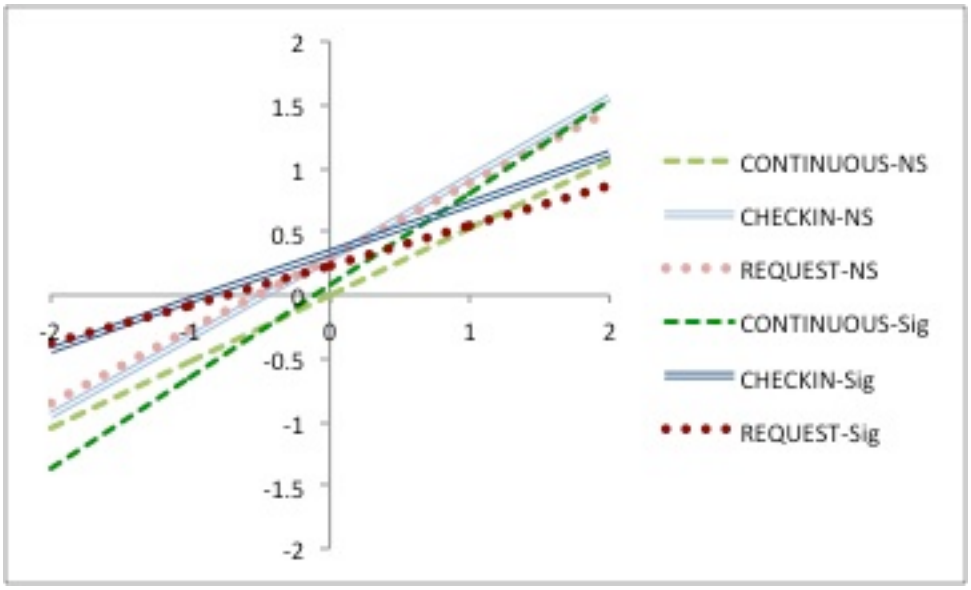


Figure 23: Marginal effects of design conditions on Intention to Use Longitude. There is a 3-way interaction effect of FYI x Check-in x Signal, and FYI x Active x Signal that is not accounted for in the model.

Variable	Beta	S.E.	p-value
FYI style	**0.525**	**0.091**	**0.000**
Is Check-in Condition	0.301	0.156	0.053
Is Request Condition	**0.298**	**0.145**	**0.039**
Is Signal Condition	0.077	0.158	0.628
FYI X Check-in	0.104	0.159	0.511
FYI X Request	0.051	0.151	0.736
FYI X Signal	0.200	0.154	0.195
Check-in X Signal	-0.040	0.228	0.860
Request X Signal	-0.138	0.224	0.539
FYI X Check-in X Sig	**-0.442**	**0.223**	**0.048**
FYI X Request X Sig	**-0.465**	**0.230**	**0.043**

Table 29: Regression Coefficients for Marginal effects on Intention to Use Longitude. Graphing all of these all effects above, even insignificant effects, produces a rough visualization of the raw data.

The marginal effects regression coefficients further reveal that there may be two three-way interactions that are significant at the $p < 0.05$ level. Namely, high-FYI communicators are much less likely to want to use Longitude in the Check-in and Request-based signaling conditions than in any other condition. Because these are direct effects on Intention, they are not due to ease of use, boundary enhancement or concern, nor any of

the other factors in the model. Further research will be required to understand why those two conditions affect intention for FYI communicators.

Choose Phone. The model shows that the only factor influencing a user's choice is boundary enhancement. The total effects graph shows the effect of factors upstream of boundary enhancement: FYI communication style makes it less likely the participant will choose to call instead of use Longitude. However, the check-in design entices people to choose Longitude, and the Request-based design does so even more. Combine this with signaling features and people are even more likely to choose Longitude. The signaling feature helps low-FYI individuals choose to use Longitude more than it helps FYI communicators (who already feel they can convey context without such a feature, see *Signal Context* section below). Although signaling in the Request-based design still helps somewhat, it is not as effective as in the other designs.

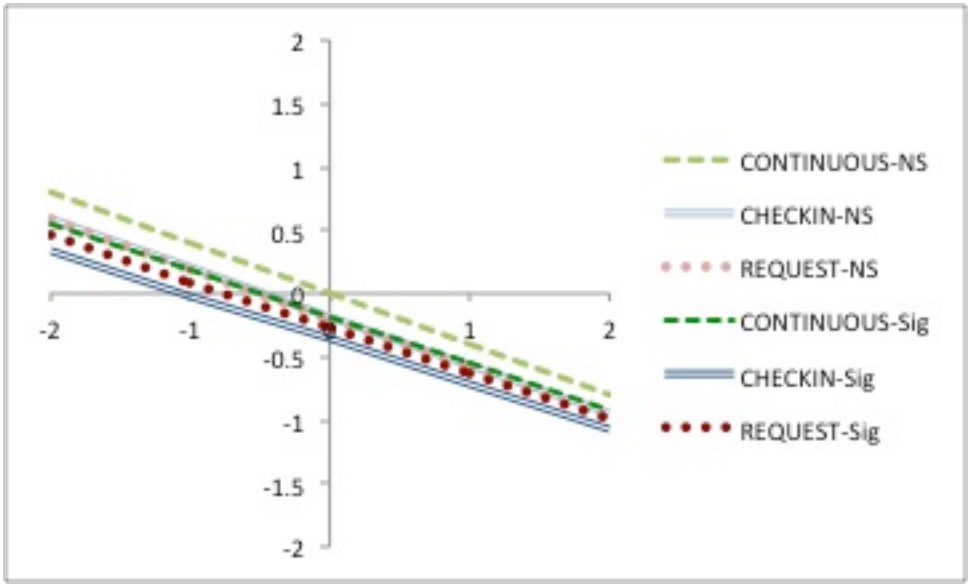


Figure 24: Total effects of design conditions on Choose Phone

Variable	Beta	S.E.	p-value
FYI style	**-0.402**	**0.062**	**0.000**
Is Check-in Condition	**-0.182**	**0.050**	**0.000**
Is Request Condition	**-0.196**	**0.051**	**0.000**
Is Signal Condition	**-0.202**	**0.059**	**0.001**
FYI X Check-in	0.015	0.011	0.176
FYI X Request	0.005	0.011	0.596
FYI X Signal	**0.034**	**0.013**	**0.010**
Check-in X Signal	0.002	0.023	0.944
Request X Signal	**0.118**	**0.041**	**0.004**

Table 30: Regression Coefficients for Total effects on Choose Phone

Ease of Use. The model shows that there is a significant decrease in ease of use resulting from the signaling design condition, and even more of a decrease when it occurs in the request condition. Nonetheless, FYI communicators find signaling context features a little easier to use than low-FYI do. Overall, request-based design is much harder to use than the others. However, the ordering for continuous and check-in designs flip flops between low and high-FYI communicators; low-FYI view continuous as easier to use than check-in while hi-FYI have the opposite view. This may be because high-FYI are more likely to be already using a location-sharing system. The most popular location-sharing paradigm is the check-in model, and thus they may be more familiar with that interface.

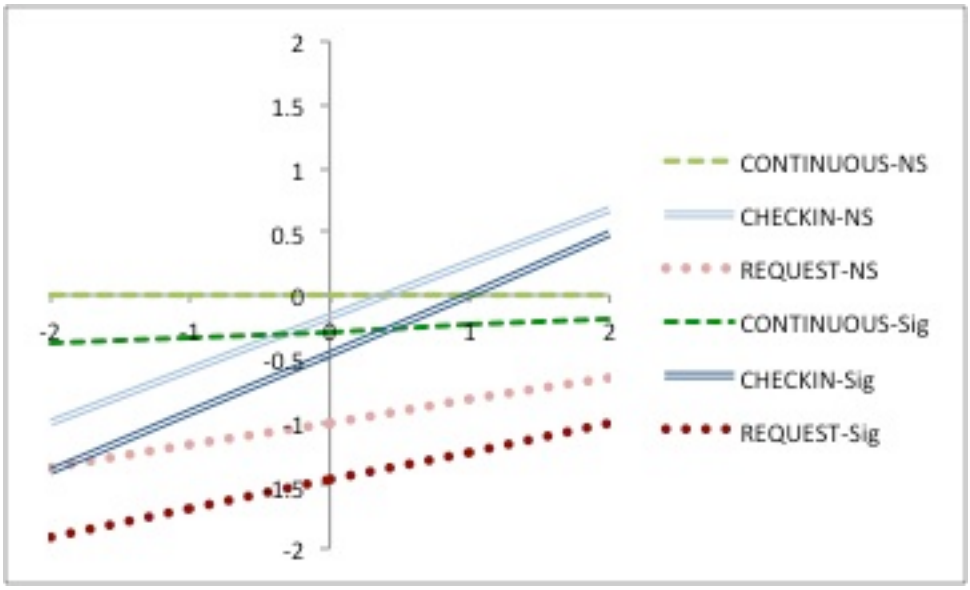


Figure 25: Total effects of design conditions on Ease of Use

Variable	Beta	S.E.	p-value
FYI style	-0.001	0.094	0.988
Is Check-in Condition	-0.167	0.201	0.406
Is Request Condition	**-1.008**	**0.197**	**0.000**
Is Signal Condition	**-0.287**	**0.105**	**0.006**
FYI X Check-in	**0.42**	**0.133**	**0.002**
FYI X Request	0.178	0.141	0.209
FYI X Signal	**0.047**	**0.022**	**0.031**
Check-in X Signal	-0.002	0.032	0.944
Request X Signal	**-0.167**	**0.067**	**0.012**

Table 31: Regression Coefficients for Total effects on Ease of Use

Boundary Enhancement. Having a FYI communication style greatly determines one's expectations of boundary enhancement. Additionally, a request or check-in design increases it even more. Signaling also has a positive effect but less so for FYI communicators. Signaling in the request condition has a much smaller impact than in the other conditions, as can be seen in Figure 26.

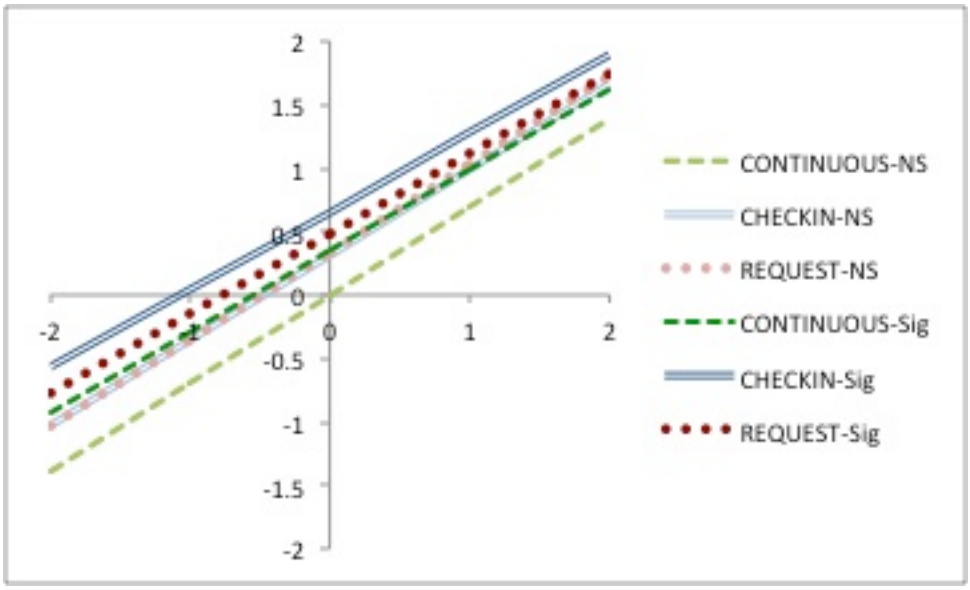


Figure 26: Total effects of design conditions on Boundary Enhancement

Variable	Beta	S.E.	p-value
FYI style	**0.697**	**0.094**	**0.000**
Is Check-in Condition	**0.315**	**0.083**	**0.000**
Is Request Condition	**0.34**	**0.084**	**0.000**
Is Signal Condition	**0.351**	**0.101**	**0.000**
FYI X Check-in	-0.026	0.019	0.174
FYI X Request	-0.009	0.016	0.595
FYI X Signal	**-0.058**	**0.022**	**0.010**
Check-in X Signal	-0.003	0.039	0.944
Request X Signal	**-0.205**	**0.070**	**0.004**

Table 32: Regression Coefficients for Total effects on Boundary Enhancement

Boundary Preservation Concern. FYI communicators have significantly fewer boundary preservation concerns, as depicted in Figure 27. Changes in design can help offset that advantage for low-FYI individuals. Both check-in and request conditions lower concerns, but as Table 33 shows, signaling does not have any effect.

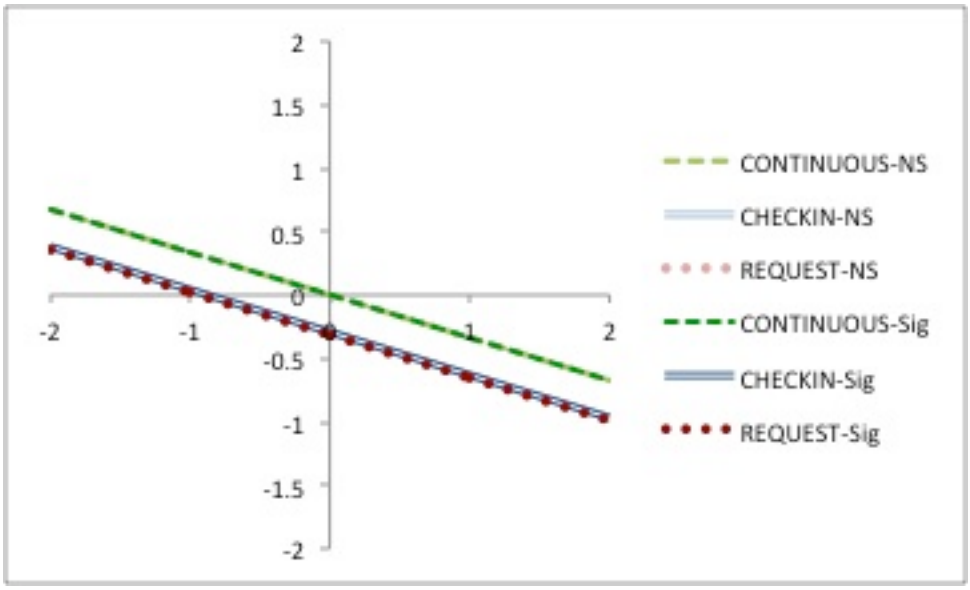


Figure 27: Total effects of design conditions on Boundary Preservation Concerns

Variable	Beta	S.E.	p-value
FYI style	**-0.337**	**0.090**	**0.000**
Is Check-in Condition	**-0.304**	**0.077**	**0.000**
Is Request Condition	**-0.318**	**0.074**	**0.000**
Is Signal Condition	0.000	0.000	0.000
FYI X Check-in	0.000	0.000	0.000
FYI X Request	0.000	0.000	0.000
FYI X Signal	0.000	0.000	0.000
Check-in X Signal	0.000	0.000	0.000
Request X Signal	0.000	0.000	0.000

Table 33: Regression Coefficients for Total effects on Boundary Preservation Concerns

Signal Context. The large effect of the signal condition indicates that signal features are perceived to convey contextual cues about one's current activities. This confirms that people perceived the signal interaction to support the design dimension it was meant to support. Furthermore, FYI communicators perceive more context signaling capability regardless of design. However, signaling features reduce this difference between low- and high-FYI communicators. In the request condition, signaling helps a lot less for everyone.

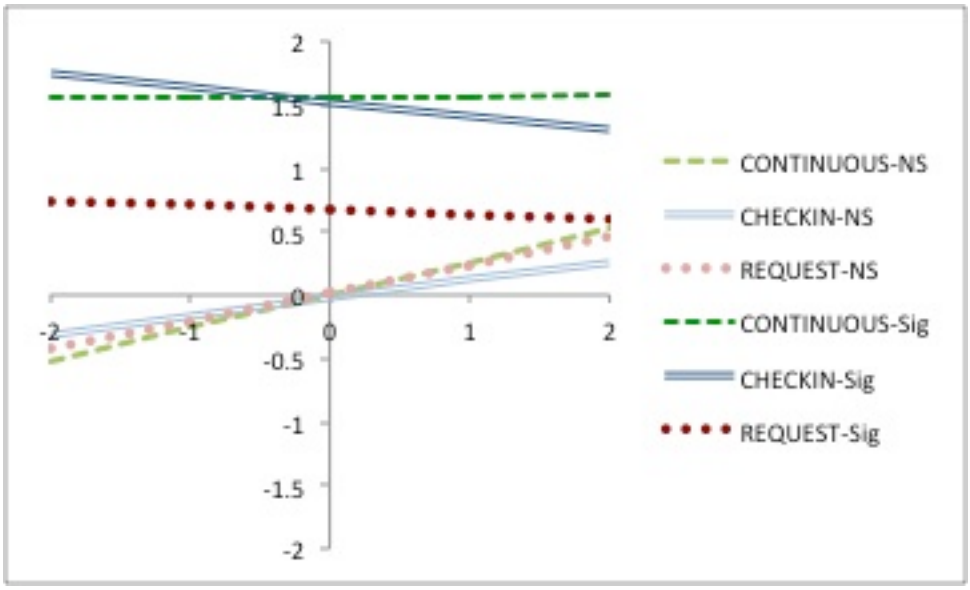


Figure 28: Total effects of design conditions on perceived ability to signal context

Variable	Beta	S.E.	p-value
FYI style	**0.262**	**0.050**	**0000**
Is Check-in Condition	-0.029	0.106	0.788
Is Request Condition	0.019	0.105	0.858
Is Signal Condition	**1.565**	**0.104**	**0000**
FYI X Check-in	-0.117	0.083	0.158
FYI X Request	-0.039	0.073	0.595
FYI X Signal	**-0.259**	**0.071**	**0000**
Check-in X Signal	-0.012	0.173	0.944
Request X Signal	**-0.914**	**0.149**	**0000**

Table 34: Regression Coefficients for Total effects on perceived ability to signal context

Share Discrete Events. Perceptions of controlling when one shares location is the only factor not influenced by the FYI trait. Rather, it is shaped by design. Both check-in and request conditions greatly increase the perception that one can share discrete events rather than share location continuously. This confirms that those design conditions support the capabilities they should. Figure 29 illustrates the effect.

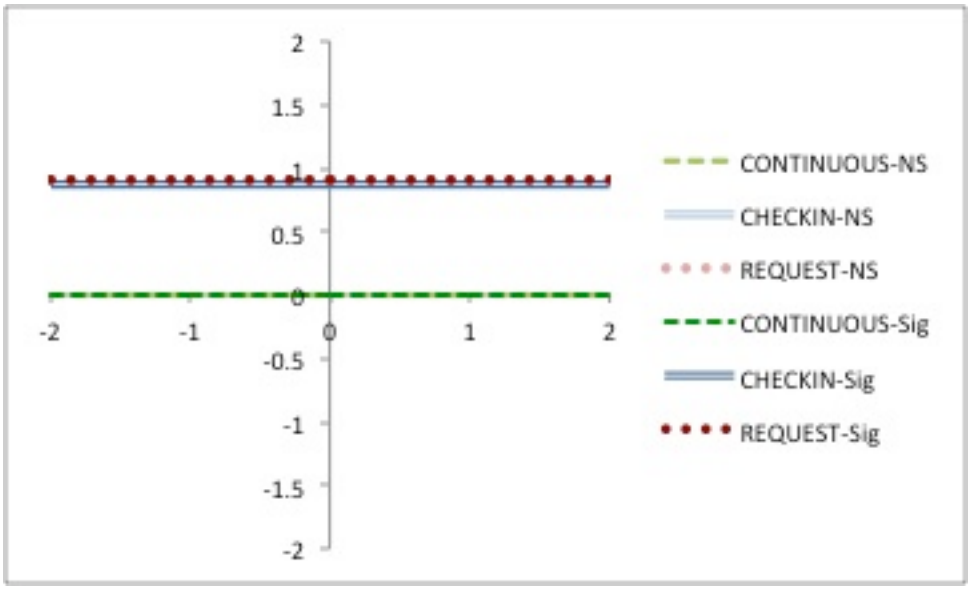


Figure 29: Total effects of design conditions on ability to share discrete events

Variable	Beta	S.E.	p-value
FYI style	0.000	0.000	0.007
Is Check-in Condition	**0.870**	**0.172**	**0.000**
Is Request Condition	**0.908**	**0.153**	**0.000**
Is Signal Condition	0.000	0.000	0.000
FYI X Check-in	0.000	0.000	1.000
FYI X Request	0.000	0.000	1.000
FYI X Signal	0.000	0.000	0.103
Check-in X Signal	0.000	0.000	1.000
Request X Signal	0.000	0.000	0.048

Table 35: Regression Coefficients for Total effects on ability to share discrete events

Share with Subset. Figure 30 reveals an interesting trend. The request-based condition makes a design more amenable to sharing with select individuals. Even the check-in design does so to a minor extent. However, high-FYI individuals already feel that any given design supports that ability more so than low-FYI. However, in the request design, this is not so – the request condition brings low-FYI communicators to the same level as high-FYI communicators.

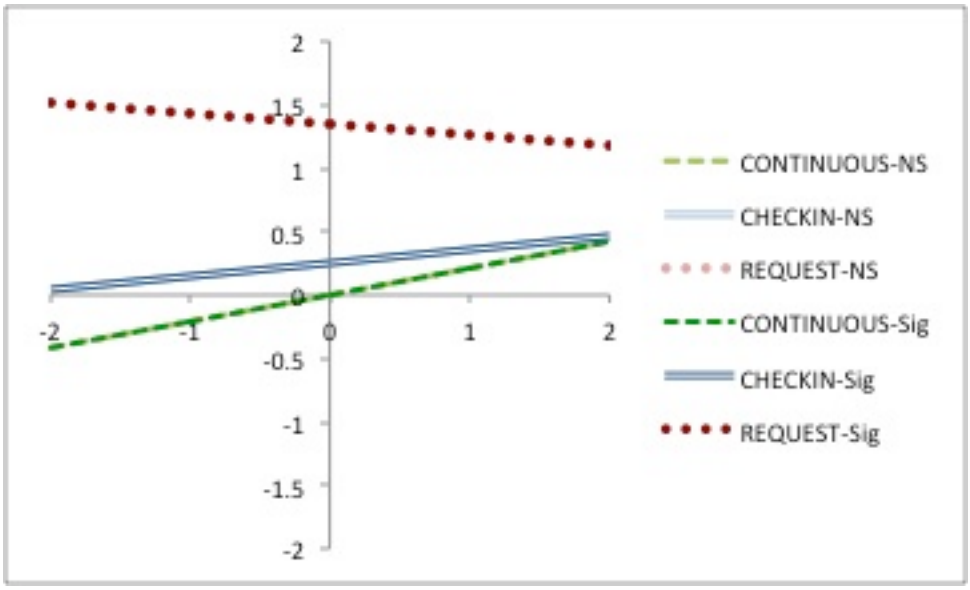


Figure 30: Total effects of design conditions on perceived ability to share with a subset of friends

Variable	Beta	S.E.	p-value
FYI style	**0.208**	**0.058**	**0.000**
Is Check-in Condition	**0.251**	**0.105**	**0.017**
Is Request Condition	**1.344**	**0.114**	**0.000**
Is Signal Condition	0.000	0.000	0.003
FYI X Check-in	-0.104	0.078	0.182
FYI X Request	**-0.291**	**0.087**	**0.001**
FYI X Signal	0.000	0.000	0.020
Check-in X Signal	0.000	0.000	0.990
Request X Signal	0.000	0.000	0.047

Table 36: Regression Coefficients for Total effects on perceived ability to share with a subset of friends

Design Implications

The model shows a number of factors that influence intention to use Longitude. As anticipated, boundary enhancement, boundary concern, ease of use, FYI communication style, and the design elements all have either a direct or indirect effect on intention. The design conditions check-in and request generally do influence attitudes and intention in the positive direction. What's more, this experiment contributes a better understanding of how a FYI communication style influences perceptions of those design elements, and ultimately

the system. The model allows one to observe several differences in how FYI communicators perceive the exact same design elements. Designers should take heed of these insights:

- Given any design, FYI communicators perceive a higher ability to convey contextual cues. However, the signaling design can overcome this advantage since it helps low-FYI individuals more than FYI communicators. This is especially true for the continuous and check-in designs. This would indirectly have a positive effect on intention. A note of caution: The marginal effects graph for Intention shows that there may be a 3-way interaction of FYI, Signaling, and the check-in or request designs. Signaling may hurt FYI communicators in those two design conditions for a reason not accounted for by the model.
- Given any design, FYI communicators perceive a greater ability to selectively share location with a subset of individuals. A request type design can help overcome this perception difference for low-FYI communicators. This can have an especially noticeable impact since MC select has a direct effect on intention. Interestingly, a check-in design can also increase the perception that users can control when they share location. This is true regardless of one's communication style
- Although the model seems to suggest that FYI communicators find designs harder to use than low-FYI communicators, the total effects reveal that, all factors considered, this is not so. In fact, they are more likely to find check-in interactions and signaling features easy to use (perhaps due to familiarity).

> Designers should be aware that low-FYI communicators will find check-in and signaling designs harder to use. Also, signaling in the request condition decreases ease of use even more than in the other design conditions.

These design elements can all contribute to making LSSN more acceptable for low-FYI communicators. Overall, the best design for low-FYI communicators appears to be the request-based design combined with signaling context. According to the model, this does not hinder high-FYI communicators but gives a boost to low-FYI individuals.

However, designers must keep in mind that FYI communication style also has a large direct effect on intention that may not be completely overcome through these design elements. The total effects graphs give insight into how much the different Longitude designs can compensate for the influence of FYI style. Future research will need to be undertaken to understand what additional influences might be shaping user intention since the current model shows a somewhat simplified explanation of the outcome. Other design elements and methods of accommodating a non-FYI communication style should also be investigated. This experiment is a first step in the exploration of design influences on attitudes and intention to use location-sharing social networks.

Conclusions

This dissertation undertook to explain the various influences driving usage and adoption of location-sharing social networks. It uncovered a number of key social influences that play a large role in user perceptions and behavior. Privacy concerns are often blamed, but seldom shown to affect LSSN adoption. This work shows that the higher-level concept of relationship boundaries is more useful for understanding concerns and behavior. Concerns stem from an expected breach of those boundaries, while positive evaluations of LSSN arise from expectations of boundary enhancements. This concept of relationship boundaries was shown to predict behaviors such as LSSN usage, extent of participation in social media as well as use of features that signal contextual cues to others.

Furthermore, this research uncovered how individual predispositions are the main driver behind expectations around the effects of using LSSN on one's relationship boundaries. The greatest determinant is a communication style trait termed "FYI". This communication style preference shapes everything from expectations of how a design supports various capabilities, to how those capabilities impact relationship boundaries, ease of use, or intention to adopt LSSN. Other personality-trait type dispositions, especially privacy management tactics such as disposition to lie, can also play a role in affecting attitudes towards relationship boundaries.

This chapter discusses the main findings, their implications, and areas for future research.

Relationship Boundaries

Recognizing that boundary preservation is a main source of many common privacy concerns, leads to design suggestions for more effective privacy management. Google+ takes a step in the right direction by grouping contacts into circles and allowing users to interact within a circle. Google+ also supports the concept of *relationship* rather than just *who* by permitting a contact to be in multiple circles. The next step for system designers is providing users with a way to defend the boundaries of these circles by focusing on how their technology alters or maintains the relationship boundaries observed in the real world.

One direction would be to help people see and perhaps even shape the etiquette around location-sharing use. Since social privacy revolves around social norms (Solove 2008), establishing shared expectations around how these technologies will mediate social interactions allows people to use the service in a way harmonious with their offline relationships. For example, LinkedIn realizes that professional connections usually emerge out of a pre-existing relationship: the other person is a friend, colleague, business partner, etc. By requiring this information when adding someone to your professional network, LinkedIn effectively mirrors the social etiquette present in creating offline professional networks (i.e., requiring a certain relationship before being able to connect). Future research should investigate how to support location-sharing etiquette in more depth.

Another area for designers to investigate is lowering the odds that someone will show up at an inopportune time. This concern had a rather high correlation with the concern about controlling who can see my location ($r = 0.647$). This also came across in interviews when several people were worried that, just by virtue of sharing their location,

they had invited others to join them. System designers should consider how various online actions are interpreted by users, and should find ways to avoid misunderstandings.

For instance, Google+ allows the user to choose with whom to share her location, making it easier to share with only certain circles. However, there can still be ambiguity about whether the user is open to others stopping by and to what extent. In real life, a party host may tell his closest friend to stop by and to spread the word to others from their shared circle of friends. Online, the host may broadcast to that same circle of friends, but the less close friends may show up to hang out regardless of whether the close friend goes—something the host may not intend (see also Kelley et al. 2011). The offline relationship reflects an implicit structure of the one close friend bridging the relationship between the host and the others. Either the close friend comes alone, the close friend brings others along if she is inclined, or nobody goes at all. With circles, the relationship structure is flattened and the explicit action of broadcasting makes it an equal invitation to everyone. This may be why many users in this and other studies refrain from participating or disclosing anything at all. It is difficult to use social mechanisms, such as plausible deniability, that are commonly used in offline relationships to smooth social interactions (Hancock et al. 2009, Nardi et al. 2000).

The boundary preservation concern model produced in the exploratory phase of study (see Chapter 4, Boundary Preservation Model) showed that social media use counteracts concerns about boundary protection, and has no direct effect on the symptoms. This suggests that as people use social media more, they learn to navigate them in ways that do not impact their relationships negatively. Understanding how existing boundaries

are preserved in online social media may provide insights into how to support boundary preservation processes for location sharing.

On the other hand, the highly correlated and closely related construct of boundary enhancement expectations is a good predictor of LSSN adoption. In fact, it mediates the effect of many other factors. This suggests that to entice people to use location-sharing services with others, designers should focus on ways to help them improve their relationships. Some vendors and location-sharing apps focus more on gaming or offering services and vendor-customer interactions (Halegoua, 2011). Cultivating people's offline relationships could be a way to encourage people to participate in these location-sharing services whose current focus is less on friends and social circles.

Designers must be careful, though, in mixing people's existing social networks with commercial interests. Recently, both Facebook and Google have started associating user profiles with advertisements, page recommendations and product endorsements shown to their friends (Rodriguez, 2013). This can be informative but also can cause boundary preservation problems. Privacy concerns can arise if the topic matter is inconsistent with the friend's expectations of that person. Even when that isn't the case, the presentation can make it seem as if the individual is endorsing the product. Even if the topic matter is uncontroversial, having Facebook position the user as pushing a certain product or article can be inconsistent with how they normally interact. The wrong presentation can be offensive and damage a relationship if the viewer believes their friend is pushing something in a salesperson-like way. These examples illustrate how enhancing relationship boundaries must go hand in hand with not violating those boundaries.

This research lays the groundwork for further exploring the relationship between privacy concerns, social media use, intention to adopt location-sharing services, and actual adoption and usage behavior. Understanding that boundary preservation or enhancement is a major source of concern or positive expectations in location-sharing is a major stepping stone towards predicting adoption.

Values

Values shape how one behaves in social interactions, including privacy management practices. Lying is the breach of one such value (honesty). It is often depicted as a common privacy management tactic in offline relationships. Lying mitigates concerns and maintains relationship boundaries. Although the propensity to lie might alleviate boundary preservation concerns in other online technologies (Birnholtz et al., 2010; J. Hancock et al., 2009), this research shows that in location-sharing social media, lying is likely to *backfire* and to actually increase privacy concerns. These concerns arise directly from Propensity to Lie, but also from liars' increased concerns about preserving relationship boundaries. Several interviewees recognized the risks in mixing lying with location-sharing social media:

> I don't want to tell someone, "I can't go out with you – I'm at home," and then I go out. That's dangerous. [There have] been situations where I tell someone I'm not going out tonight and then photos will be posted of me going out… One of my friends was just caught. At happy hour, she told one of her friends she wasn't going to go out. And we went out and that friend happened to show up at the same restaurant.

Location-sharing services change the premise for carrying out these lies by erasing the physical barriers and making location easily accessible.

Some location-sharing services can be used to increase the plausibility of a lie because they allow people to set an incorrect location. However, the qualitative data suggests that this can be problematic as well. Many interviewees would not consider using software to lie, and were disturbed by others who did. One interviewee forsakes using technology with friends who are not sharing their true location:

> So the point about Latitude is to know where your friends are… And so if I see a person toy with an application, I just won't pay attention to them on it. So it's like my confidence in how well they use it.… And so my confidence in the way [person's name] uses this application…was [broken]. So from now I just won't pay attention to where he is.

Another interviewee explained how he wasn't interested in Google Latitude because it allows people to set or type an incorrect location:

> People can just say they're wherever they want to say they are… It changes my perception of using Latitude as opposed to showing your accurate location all the time no matter what the users wanted…[It] becomes this unreliable source of information, becomes this messy thing.

Similarly, some interviewees even perceived the practice of blocking others from seeing location to be a deceptive act. A number of these interviewees avoided location-sharing technology and minimized participation in social media in order to keep themselves from falling into situations where lying would be a tempting solution. Several seemed to take an ethical stance against lying. These interviewees serve as a reminder that features to support lying will not appeal to everyone and could even drive users away. A value-based approach (Knobel & Bowker, 2011) would help designers understand core values such as honesty that should be supported in their design.

For those individuals motivated to avoid bad situations (rather than by ethics), several studies conclude that location-sharing technology should support plausible denia-bility by obscuring or hiding location (Aoki & Woodruff, 2005; Bagüés et al., 2007; Iachello

et al., 2005). Interviewees who would not tell an untruth, nor use technology to do so, often used ambiguity and omissions to avoid an awkward situation. However, it is questionable whether this is possible. Obscuring location or ignoring location requests at certain moments or for certain lengths of time may violate relationship boundary expectations. For example, an employee who calls in sick for four days and whose location is unavailable the entire period might raise suspicions. Worse yet, even honest instances of being offline can then be mistaken as deception. Furthermore, as location-sharing services become more accurate and connectivity improves, and as users learn the available features, blaming technology becomes less of an option. Designers will have to better understand offline relationship dynamics in order to understand what constitutes acceptable interactions online.

This research did not find any relationship between overall social media use and lying. This suggests that Propensity to Lie does not affect frequency of social media use in general, or vice versa. However, lying propensity does seem to affect concerns towards specific social media. In location-sharing we find that lying propensity increases concerns, but studies suggest that in other technologies it might decrease concerns. For instance, Hancock et al. describe the benefits of butler lies in an instant messaging system (Hancock et al., 2009). Social media researchers should investigate how this value, and others, can affect adoption for various other social technologies.

In contrast to prior deception studies that focused on more homogenous samples (e.g., Birnholtz et al., 2010; Hancock et al., 2009), this work found that the propensity to lie significantly decreases with age. This in turn causes older participants to have lower privacy concerns. One can see this play out in some of the interviews. One man explained

how, as a youth, he would be especially anxious to control what his parents could see but "not so much anymore" because he is not lying to his parents about where he is. Despite common conceptions that teenagers don't care about privacy, research has shown that they actually are privacy concerned, especially in social media context (Lenhart & Madden, 2007). These findings shed light on one reason younger users could be more concerned: they tend to lie more.

The model results were consistent with the hypothesis that lying propensity impacts boundary preservation concern. This direction of causality is also in line with existing theory (Burish & Houston, 1976). Yet, because this is based on a descriptive study, it is conceivable that there is a mutual effect between lying propensity and boundary preservation concerns and thus, boundary preservation concerns could affect lying propensity over time. However, reversing the direction of causality in the model does not yield significant results. Hence, this research is unable to claim a mutual effect, and leaves the question to future research.

This dissertation further uncovered that employing ambiguity as a deception tactic had an impact on concerns, while telling direct untruths did not. This makes sense since Location-sharing social media removes the ambiguity of one's location. However, if someone is willing to tell an outright false statement, they may not have to be worried about what the location-sharing service conveys about them. Future analysis could be conducted to further refine these constructs since deception and lying are complex values with many conceptualizations. Ambiguous and Direct lying are only two possible factors.

There also may be other traditional social practices that can be in conflict with modern location-sharing social media. This work is an initial exploration of the interplay

between location-sharing social media, our social practices, and our social relationships. Longitudinal studies could also shed light on how privacy-preserving social practices manifest and evolve over time.

These findings bring to the forefront Sir Walter Scott's admonition, "Oh! What a tangled web we weave when first we practice to deceive!" The results indicate that lying may complicate matters even more in the online social world. This begs the question: Should technology pave the way to more transparent interactions by making it more difficult to lie? Would this force people to tell the truth, or would people avoid the technology? Or on the other extreme, should technology provide fertile grounds for facilitating lies and aim at reducing people's resulting concerns? In the middle of describing a detailed feature idea making it "convenient" to lie, one interviewee stopped himself and acknowledged this powerful, and perhaps disturbing, influence of technology: "There are applications which force people to lie, force people to do wrong things. And I may want to take my words back. If you're writing it down, just don't write it down because I don't want to be the reason for such a bad feature."

Technology can influence social dynamics by facilitating certain practices and inhibiting others (Latour, 1992). If one regards lying as undesirable, do designers have an obligation to protect people from their own propensity to lie? The answer to this may depend on one's ethical viewpoint. This research recommends that technology designers and researchers think about and study the social and moral impact their technology will have once it is deployed. Technological changes can affect social practice whether one designs for it or not (Orlikowski & Robey, 1991). Understanding how social practices are evolving around technology can at least ensure that the social and moral impacts of new

technology do not have to go completely unchecked. In the realm of privacy concerns, this dissertation provides a first step in that direction.

Communication Style

This dissertation has shown that the FYI communication style is a main determinant of LSSN usage. Conversely, this suggests that one of the reasons why location-sharing social networks do not attract certain people is that they do not support more proactive communication styles. FYI fully mediates the effect of personality, age, and parental status on LSSN use intention and signaling behavior. Researchers should therefore investigate whether behavioral differences associated with other demographics can also be explained in terms of communication style differences. Moreover, LSSN researchers and designers should identify the communication style preferences of their target users: studies of college students or young professionals may produce very different results than studies with forty-somethings or retirees. This is especially important because research shows that age and major life transitions (e.g., becoming a parent) can trigger changes in personality traits such as communication style (Heinstrom, 2003). For example, parents may exhibit a higher level of FYI than those without children because they try to keep up with their offspring (Madden, 2010).

The Big-5 personality traits are high-level constructs under which more specific dispositions are subsumed (John & Srivastava, 1999). In the case of location-sharing social media, it seems that communication style is one of these more specific dispositional measures. Researchers focusing on individual differences in LSSN usage may consider communication style as a more direct predictor than more general personality traits. This

is in line with offline communication studies that find it more fruitful to use communication style dispositions rather than high-level personality traits such as extraversion (McCroskey, 1992; Richmond & Roach, 1992). This may also explain the inconsistent effects of personality traits found in the literature. Various studies that link extraversion to social media use (Amichai-Hamburger & Vinitzky, 2010; Rosen & Kluemper, 2008; Ross et al., 2009; Ryan & Xenos, 2011) can be reevaluated in light of the findings that the effect of extraversion is fully mediated by communication style. Perhaps for a number of these studies, communication style may indeed be a mediator.

The negative effect of FYI on phone communication implies that FYI communicators oppose more interactive and verbal communication. This may explain why young people, who are more likely to be FYI communicators, are calling their friends less as social media use is on the rise (Lenhart, 2012). Conversely, it suggests that low-FYI communicators are much better supported by the telephone than LSSN. The qualitative data suggests that several low-FYI communicators sought to gain the benefits of online social connections, but were turned off by the style of interaction. To reach out to this group, LSSN designers could support more interactive location-sharing features rather than supporting one-way broadcasts as the predominant mode of "communication". For example, the Longitude design for request-based location-sharing allows someone to send a location disclosure, which only reveals location if the friend engages. This makes the interaction a mutual activity rather than a one-way broadcast (where it is uncertain whether and how others are engaging).

The communication style model (Chapter 6, Figure 8) also shows that FYI communicators are able to signal cues to help others understand context and availability,

and this leads to much more uninhibited participation and disclosure. Signaling context is much like using nonverbal cues in face-to-face interactions that give context to help others interpret a message (Mantovani, 1996; Riva, 2002). Going back to the interview data, one can see that individuals would signal in a variety of ways, including signing on or off to indicate availability, or utilizing status updates and fields to give context to their current activities. These are ways of conveying contextual cues without having to interact, in line with an FYI way of communicating. Another noteworthy observation was that many who drastically limited their social media participation opposed using status updates or status fields for signaling availability and context. These individuals were low on FYI and preferred a more interactive co-construction of context between communicators. They did not like the prospect of misinterpretation or annoying others with a status update. This suggests that along with more interactive features, interactive communicators also need more interactive signaling features. Rather than signaling by sending status updates or by setting status fields, active communicators may prefer to integrate signaling features into directed communications, as happens in face-to-face interactions.

To support low-FYI communicators, designers could extend the idea of interactively sharing location via a location request and include context as to the purpose of the request (e.g., to meet up). Designers should then also include a way to negotiate and co-construct that context. For example, the recipient could negotiate that context by countering with a different purpose (e.g., I'm not free to meet up now, but will be when I leave work). By providing a more interactive way of conveying the context of a given request, designers empower low-FYI communicators to understand and shape the meaning of the offer. A design such as the Longitude version that supports signaling and request-based location

sharing would achieve these goals. Furthermore, that design was experimentally shown to increase usage intention for low-FYI communicators.

The refinement phase model demonstrates that there is a slight difference in preference for FYI communication when it comes to sharing my own location versus learning others' location (Chapter 6, Figure 8). The high correlation between these two constructs shows that people tend to expect or prefer the same communication style regardless of whether it is for their own or others' location. Nonetheless, it is attitude towards sharing one's own location that actually drives usage and signaling behavior. Researchers thus may not necessarily need to measure a user's attitudes towards learning others' information, especially since FYI style for my location may serve as a good proxy. In general, designers *should* support the same communication style for sharing one's own location and learning others' location, because users are likely to prefer the same style for both actions.

Much work in Computer-Mediated Communications considers the *circumstances* in which different types of media are useful or appropriate (J. B. Walther, 1996). This work suggests that it is equally important to determine *for whom* those media are appropriate. Personal characteristics such as communication style may transcend situational considerations. Future research could shed further light on the topic by investigating how much *circumstance* influences behavior, as apposed to one's predispositions.

Moreover, studying additional populations could lead to a better understanding of media choice and online user behaviors. Cross-comparisons of studies and populations would allow researchers to understand to what extent FYI communication style mediates the effects of other factors that are said to influence social media usage and adoption. In

this research, FYI is already shown to fully mediate the effects of age, parental status, and personality.

Although the literature shows that many personality traits can change with age (Heinstrom, 2003), future studies would have to confirm how much of a change in FYI preference is due to aging, and how much may be attributed to generational differences (where the younger "digital" generation may continue to have a stable preference for FYI). The latter would imply the need to support FYI-style interactions more broadly in the future. Longitudinal research would be needed to investigate this topic.

Future research should further investigate whether communication style preferences are indeed prevalent in the use of other social media. In the qualitative data, there appears to be a positive association of FYI with using various other social media. This suggests that there is likely a higher-level generic FYI factor (not related to a particular social medium), as well as potential FYI factors for various specific types of social media. Like the LSSN-specific FYI factor used in this dissertation, these FYI factors could help explain differences in preferences for various social media for different demographics and personalities. These communication style preferences may even explain differences between populations and cultures.

In summary, this research finds that one reason why younger people and extraverts are more inclined to adopt location-sharing social networks is because they have a preference for FYI communication: they would rather infer availability and social information about others from social media than interact with them in person. This preference explains their usage intention for location-sharing social networks, as well as their disinclination to communicate through phone calls. It can also explain why heavy LSSN and

social media users are more effective at signaling their availability and activity, which leads them to engage more fully and share more freely.

By identifying this communication style disposition as a major determinant of adoption and usage patterns, this work highlights the type of people who are benefiting from social media such as location-sharing social networks. At the same time, it also distinguishes the people who are being left out. Older individuals, introverts, and others who are not FYI communicators will be left behind if social media features continue to emphasize FYI style communication. Given that over half the variance of LSSN usage intention can be explained by the FYI communication style (see Chapter 6, Confirming the effects of FYI and age) this is *the* key factor that social media scholars should focus on in addressing adoption and level of participation. By studying location-sharing social networks, this study takes an initial step towards understanding the impact of communication style on people's social media use.

System Design

The FYI style is supported, and perhaps even encouraged, by many social media such as LSSN. To create systems that appeal to a broader audience, LSSN designers should support a wider variety of communication styles. The last phase of this dissertation explored what types of technological features support and conflict with the high- and low-FYI communication styles. It experimentally tests the theory that boundary concerns and enhancement attitudes, and ultimately intention, can be affected by different location-sharing system designs.

Originally, the design conditions were created with the hypothesis that FYI communicators prefer different types of interactions along the dimensions of *who* sees location, *when* location is shared, and *effort* to share (see Chapter 7, Table 15). However, there was no interaction effect between FYI and any of the variables that measure user's perception of whether that design dimension is supported (i.e., Share with Subset, Share Discrete Events, Ease of Use). An interaction would have occurred if FYI communicators differed in their desire to be able to share with a subset of individuals, or to share at discrete moments in time, or to put as much effort into using the app. In fact, only the *signal context* feature proved to have a different effect on relationship boundaries for FYI communicators. This means that high-FYI individuals feel that conveying contextual cues enhances relationship boundaries to a greater extent. However, FYI communicators appreciate the ability to share selectively and at discrete moments just as much as low-FYI communicators.

The surprising finding is that many of the differences actually come at the level of perception; there are several differences between how high and low-FYI communicators perceive the same design. This occurred for a number of designs and outcomes: high-FYI communicators perceive check-in designs as easier to use than continuous designs, while low-FYI felt just the opposite. Also, low-FYI individuals felt less able to share location with a subset of friends using the check-in and continuous designs.

However, the experiment also reveals that the gap between perceptions can be reduced through system design. Signaling and request-based design is less helpful for FYI communicators, but can help make up the difference for low-FYI communicators. In fact, request-based design is so much more helpful to low-FYI individuals that it increases the

Share with Subset perception to more than the amount increase due to an FYI style. This does not translate to an equal level of usage intention since the effect of that perception is one of several influencing factors, but it does close the gap in perception.

This experiment is a preliminary exploration of how design elements and communication style can affect location-sharing adoption and usage. As the marginal effects in Figure 23 reveal, there are likely further influences not accounted for by the model. Future research should investigate other design elements that may be able to further narrow the gap in perception between different communication styles. Also for future investigation is researching additional factors and design dimensions that affect preferences for a given system design. An even bigger challenge will be to help people of different dispositions communicate and maintain their social relationships despite different interface and interaction preferences.

Additional areas for future research

This research focused on the U.S. population, and more specifically, urban users of Craigslist. Because privacy is culturally influenced, research should expand beyond the United States. Future research should also study if and how concerns evolve with technology use over time, and with a more ubiquitous adoption of location-sharing technology.

Although this dissertation focuses on location-sharing technology, it is likely that the findings extend to other social media. The qualitative data suggests that the location-sharing concerns are intertwined with and similar to those found in other social media (Page & Kobsa, 2009). Future research should investigate whether boundary preservation

concerns, boundary enhancement expectations, and FYI type communication styles can be adapted and applied to social media in general.

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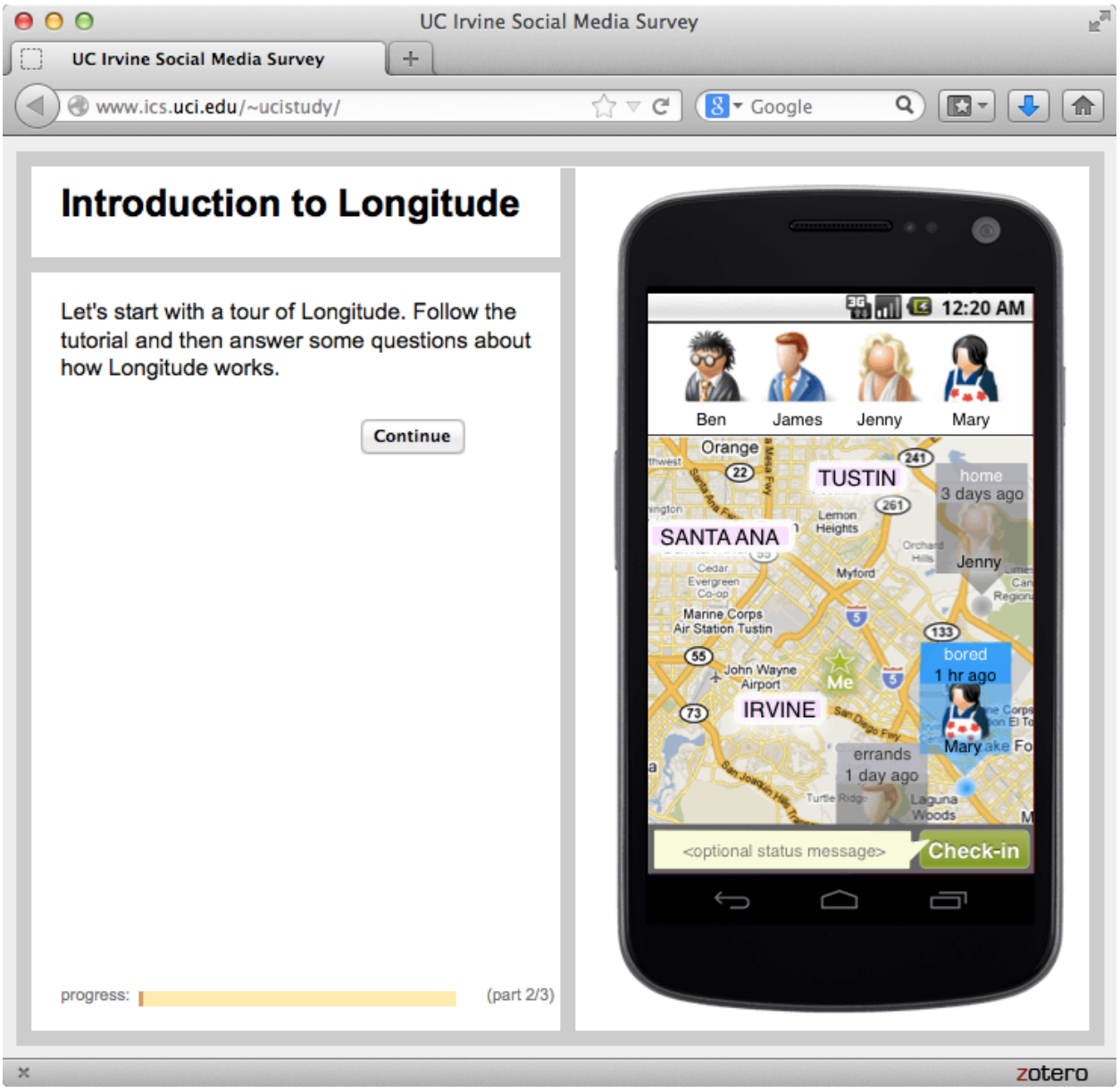
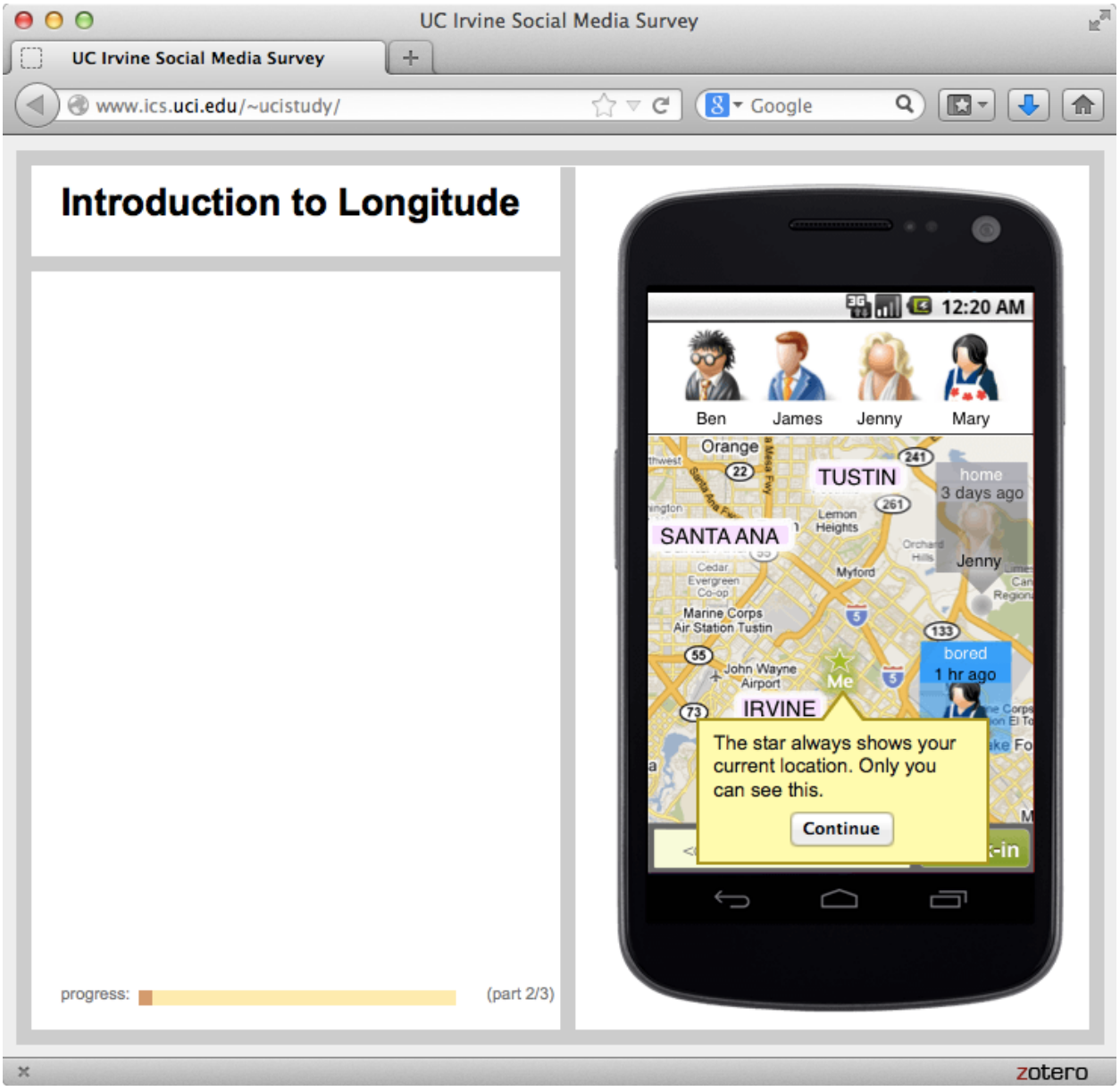
APPENDIX A: Design Prototypes

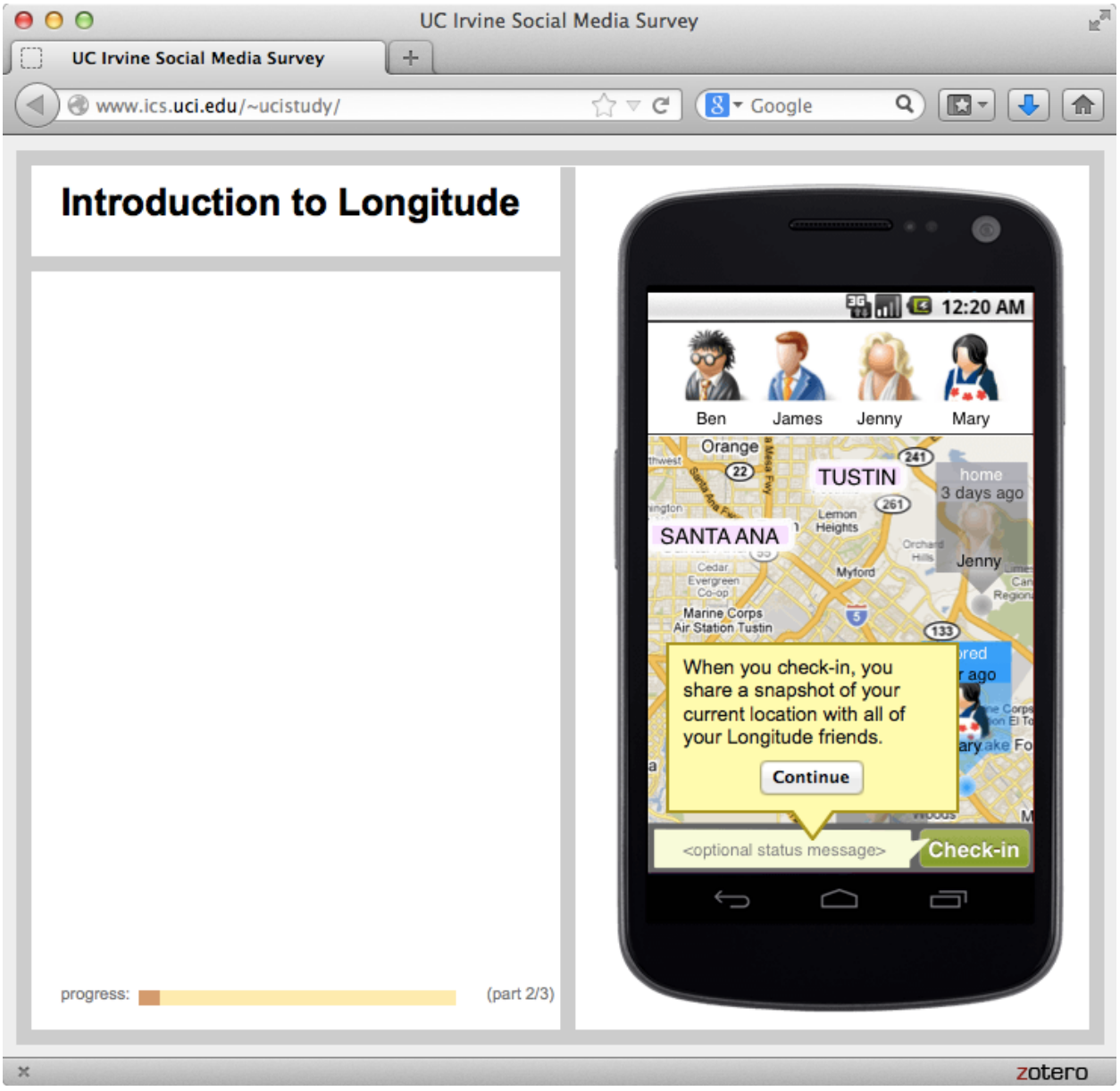
This appendix shows the screenshots of the interactive prototype for each experimental condition. The 3x2 factorial design gives 6 conditions: Continuous sharing without Signaling (reference group), Continuous sharing with signaling, Check-in sharing without Signaling, Check-in sharing with signaling, Request-based sharing without Signaling, Request-based sharing with signaling.

The user tasks, scenarios and questions are kept constant across conditions. The only difference is in how the user accomplishes the task (e.g., seeing someone's location requires sending a request in the Request-based condition, but no action in the other conditions) and the corresponding user interface differences to accommodate the different interactions. Thus, this appendix shows the complete interaction for one condition, and then shows enough representative screen shots for the other conditions to be able to understand where they differ.

Check-in sharing with Signaling (Complete Sequence)




UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
Lemon Heights
Myford
Cedar Evergreen Co-op
Marine Corps Air Station Tustin
John Wayne Airport
IRVINE
Me
home
3 days ago
Jenny
bored
1 hr ago
The star always shows your current location. Only you can see this.
Continue
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
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Introduction to Longitude
progress:
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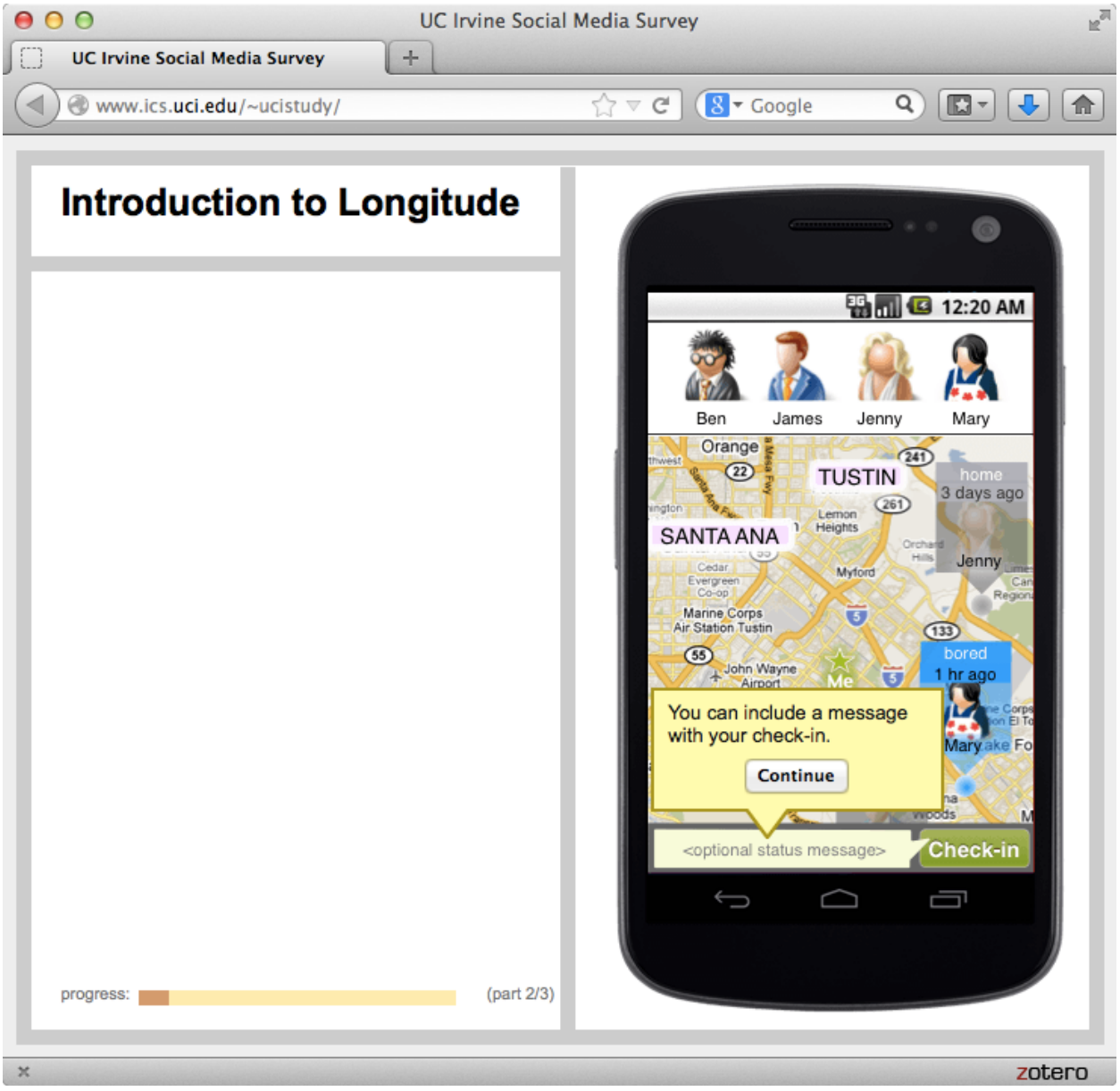
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
Lemon Heights
Myford
Marine Corps Air Station Tustin
home
3 days ago
Jenny
When you check-in, you share a snapshot of your current location with all of your Longitude friends.
Continue
<optional status message>
Check-in
zotero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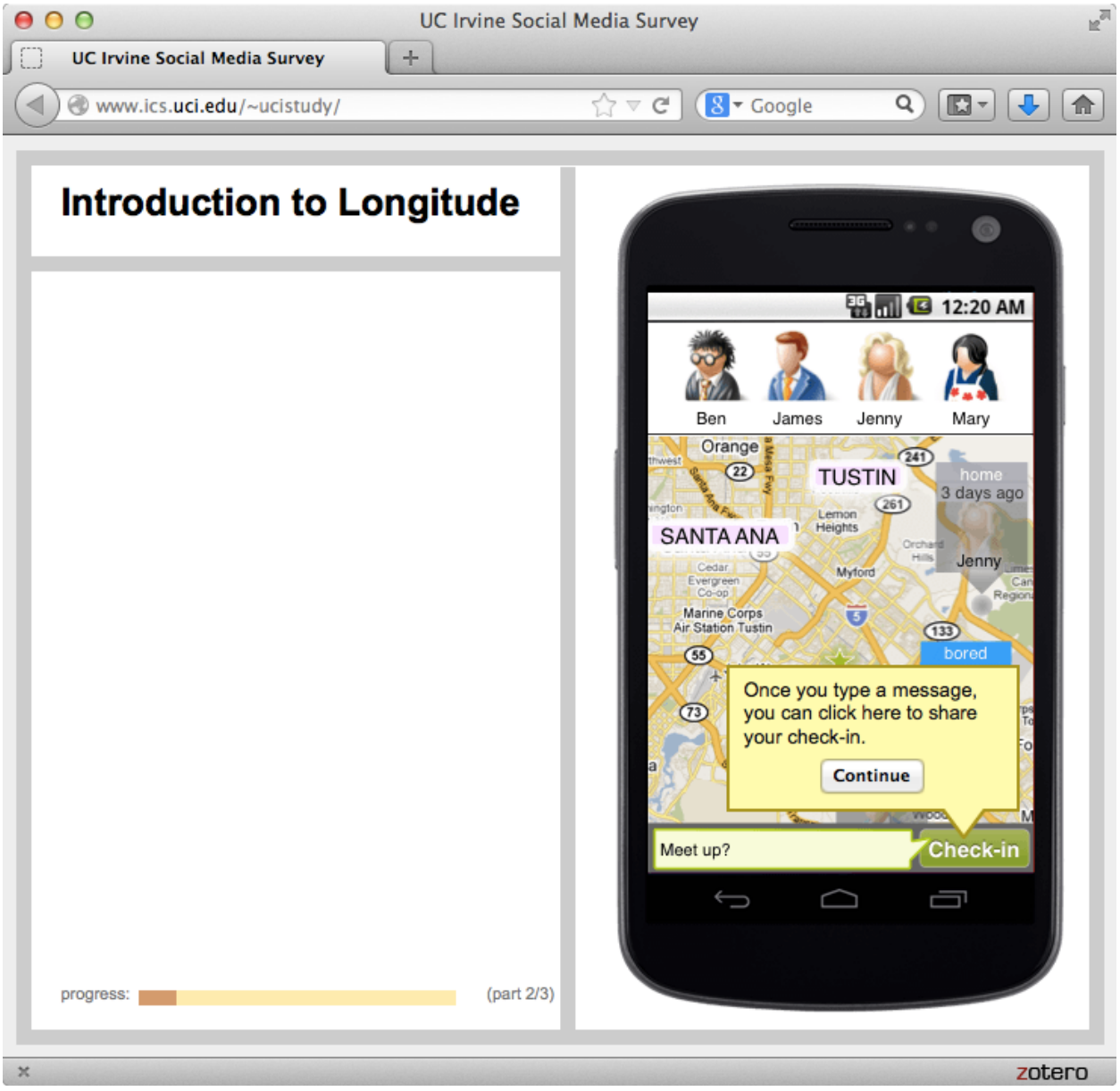
Lemon Heights
Myford
Cedar Evergreen Co-op
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
You can include a message with your check-in.
Continue
<optional status message>
Check-in
zotero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Mary
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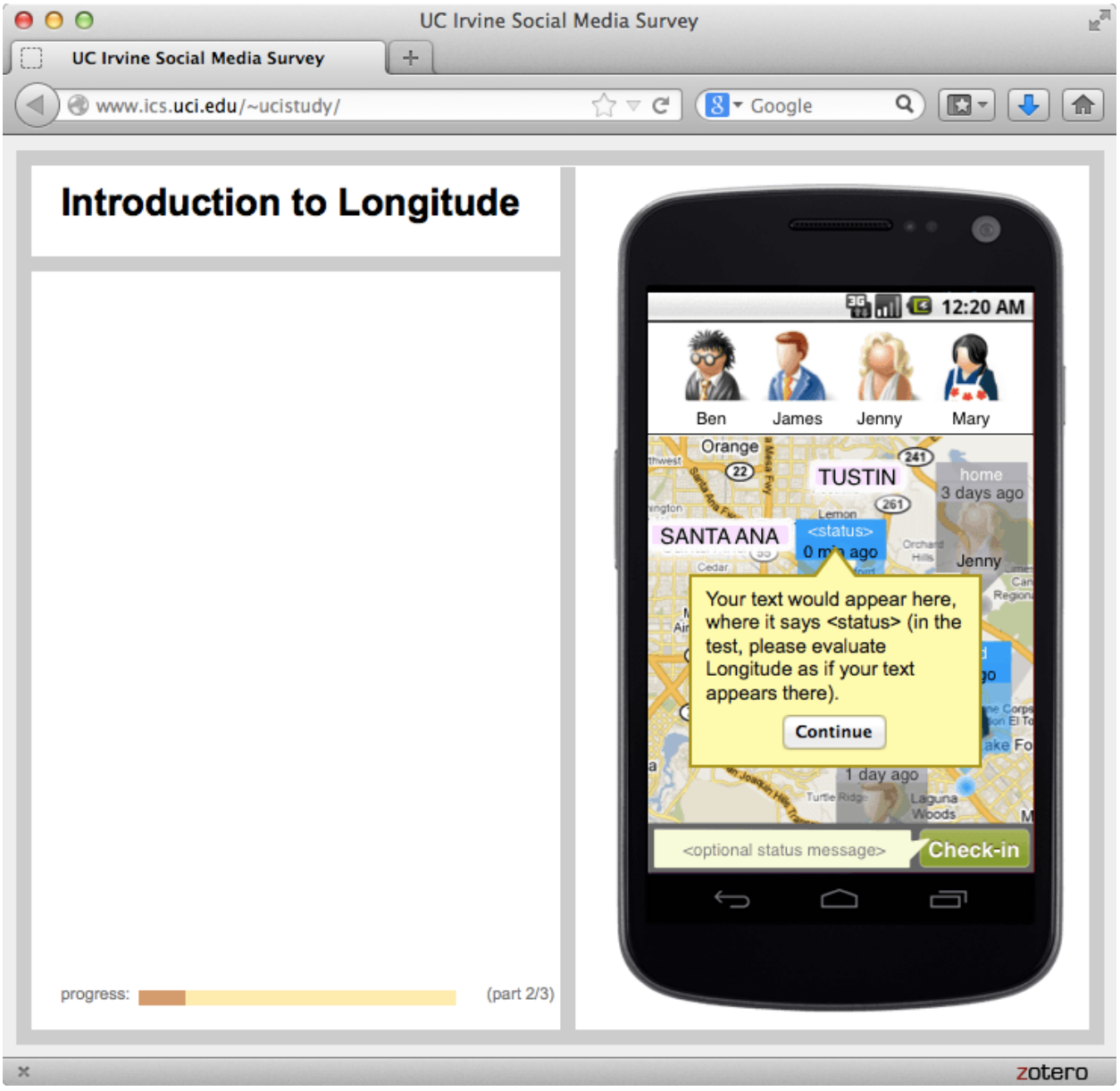
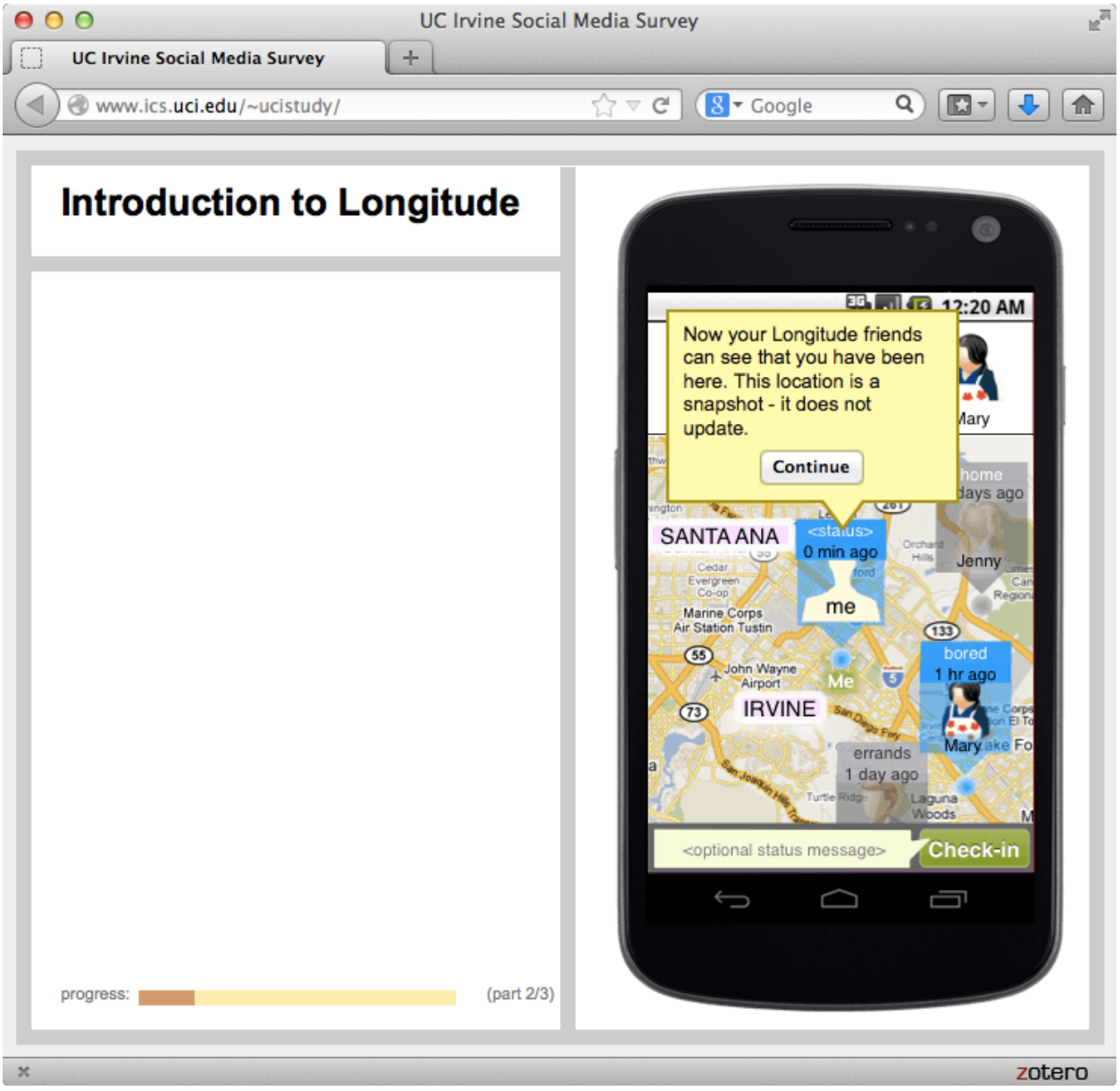
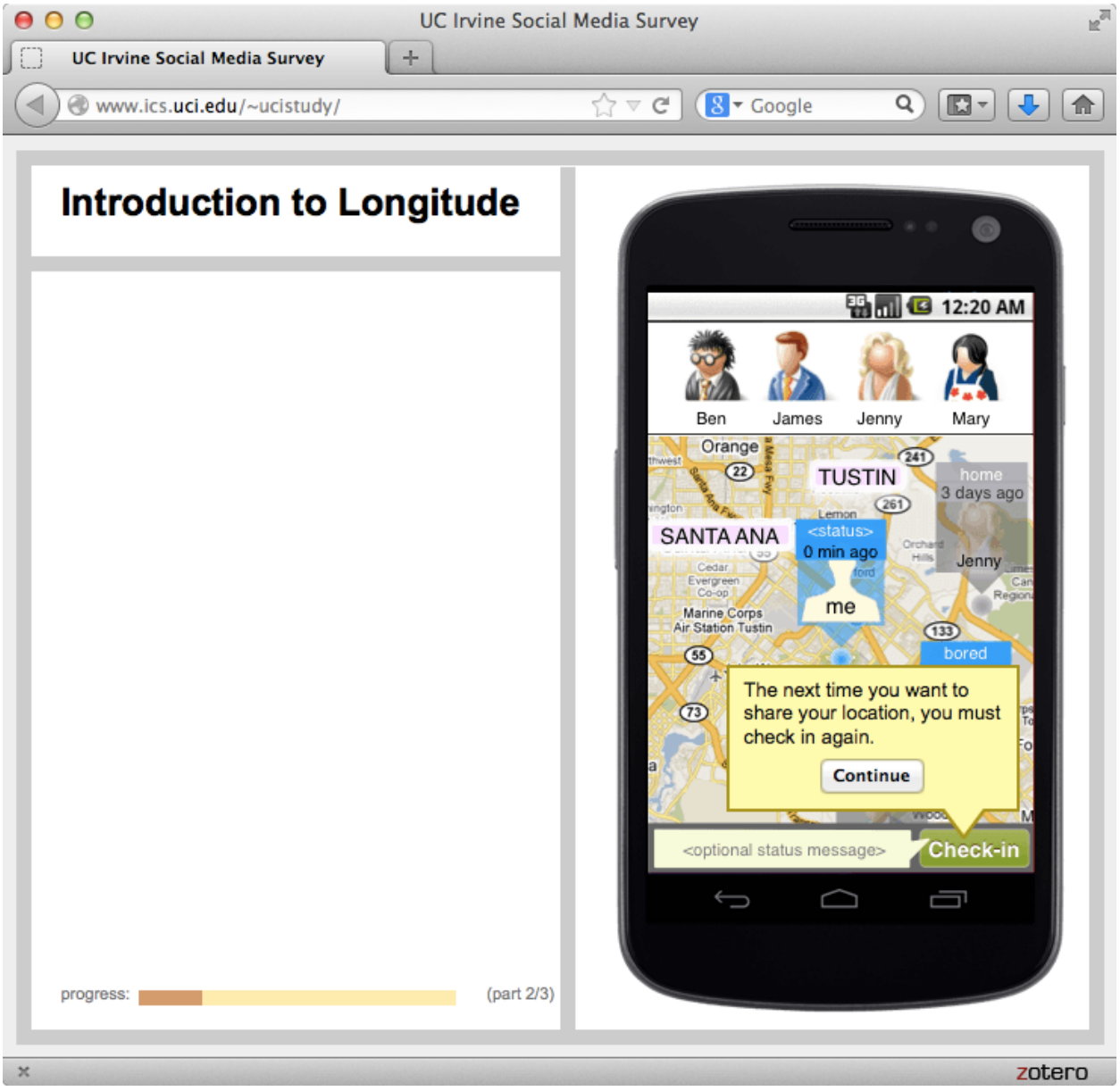
TUSTIN
SANTA ANA
Lemon Heights
Myford
Cedar Evergreen Co-op
Marine Corps Air Station Tustin
home
3 days ago
Jenny
bored
Once you type a message, you can click here to share your check-in.
Continue
Meet up?
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
Jenny
Your text would appear here, where it says <status> (in the test, please evaluate Longitude as if your text appears there).
Continue
1 day ago
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Now your Longitude friends can see that you have been here. This location is a snapshot - it does not update.
Continue
Mary
home
days ago
SANTA ANA
<status>
0 min ago
me
Jenny
Marine Corps Air Station Tustin
55
133
John Wayne Airport
Me
bored
1 hr ago
IRVINE
73
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
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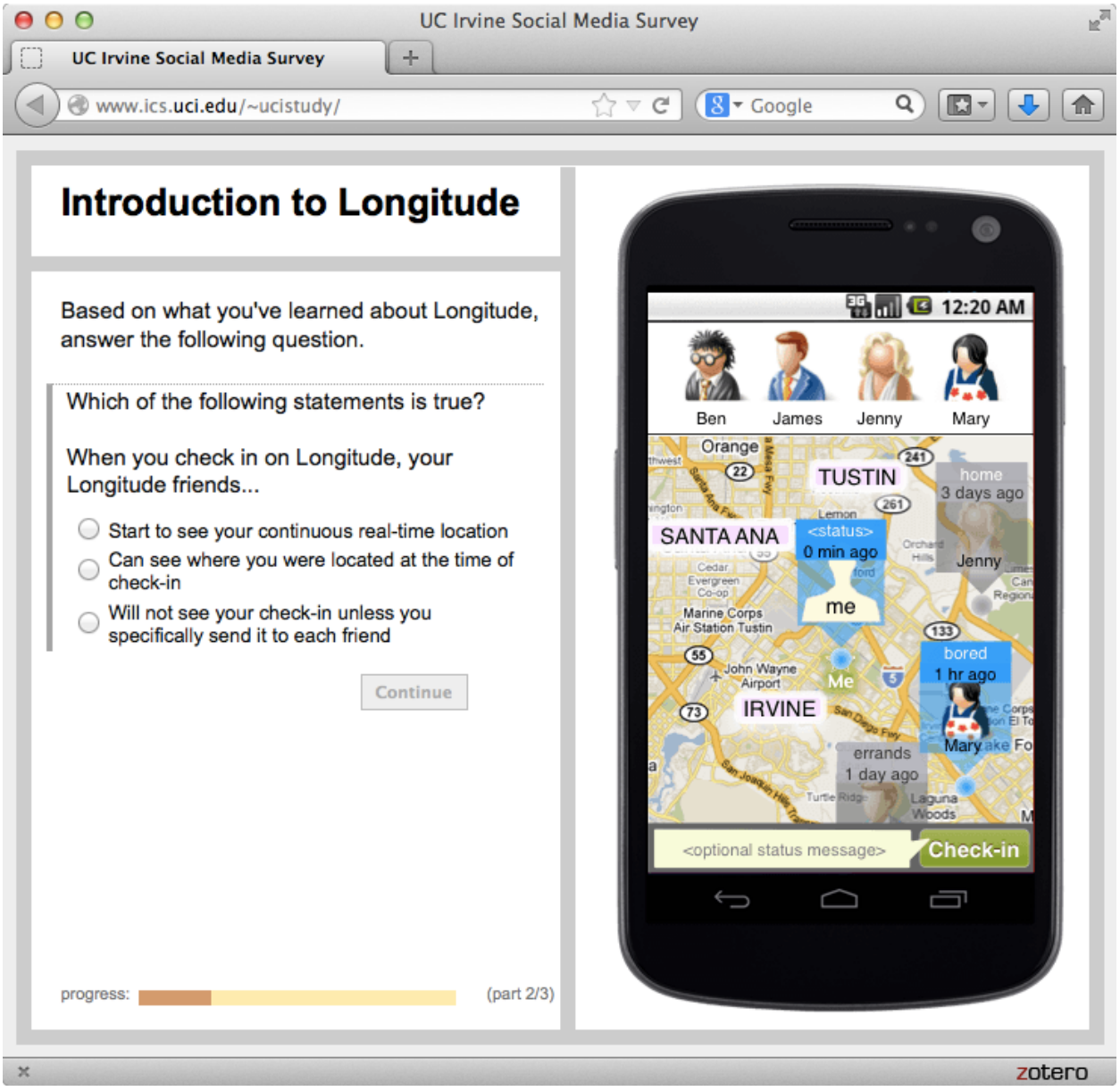
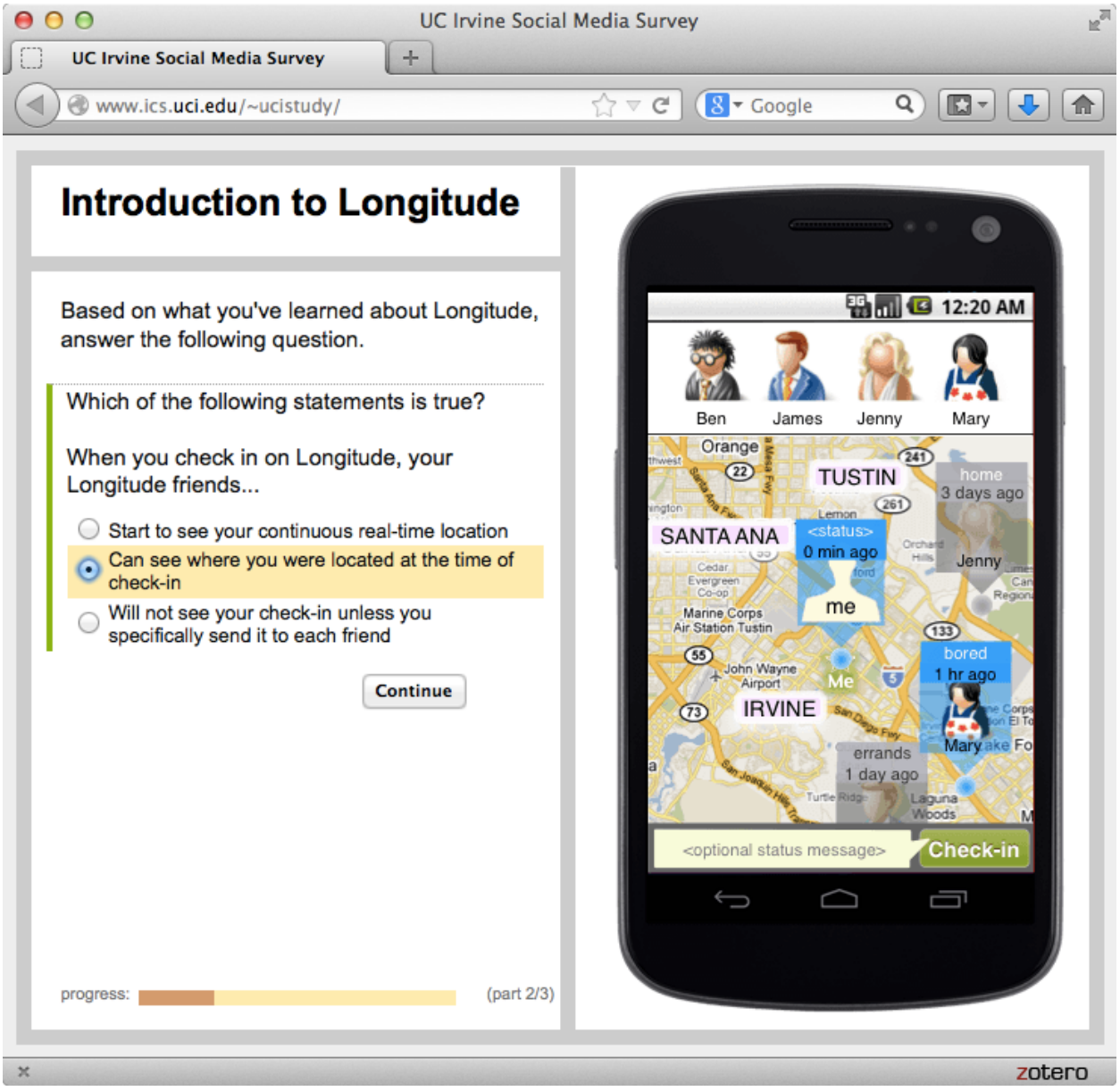
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
home
3 days ago
<status>
0 min ago
Jenny
me
Marine Corps
Air Station Tustin
bored
The next time you want to share your location, you must check in again.
Continue
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following statements is true?
When you check in on Longitude, your Longitude friends...
Start to see your continuous real-time location
Can see where you were located at the time of check-in
Will not see your check-in unless you specifically send it to each friend
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
<status>
0 min ago
me
home
3 days ago
Jenny
Marine Corps Air Station Tustin
John Wayne Airport
Me
IRVINE
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
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Google
Introduction to Longitude
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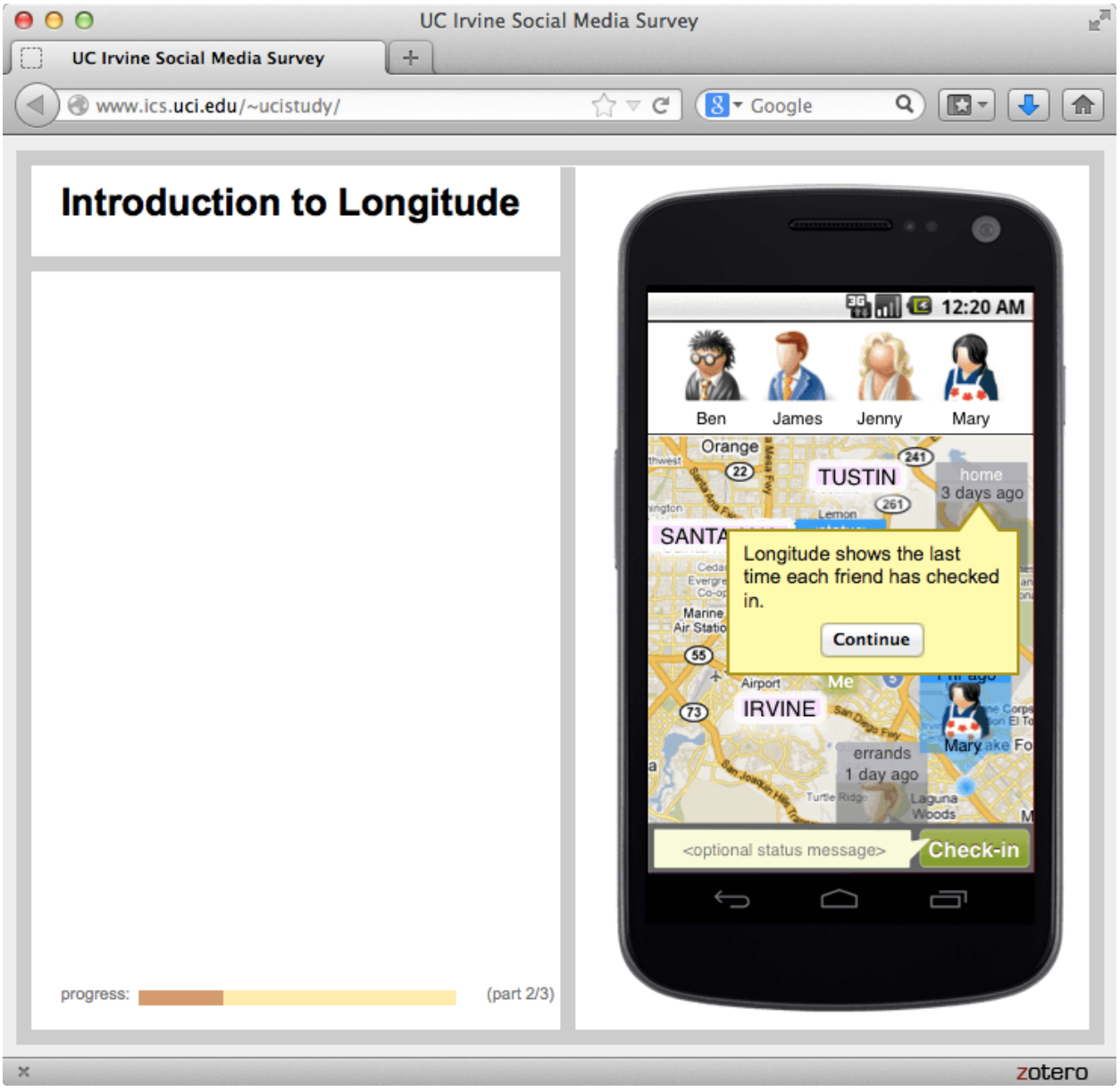
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
0 min ago
me
Jenny
Marine Corps Air Station Tustin
bored
1 hr ago
John Wayne Airport
Me
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
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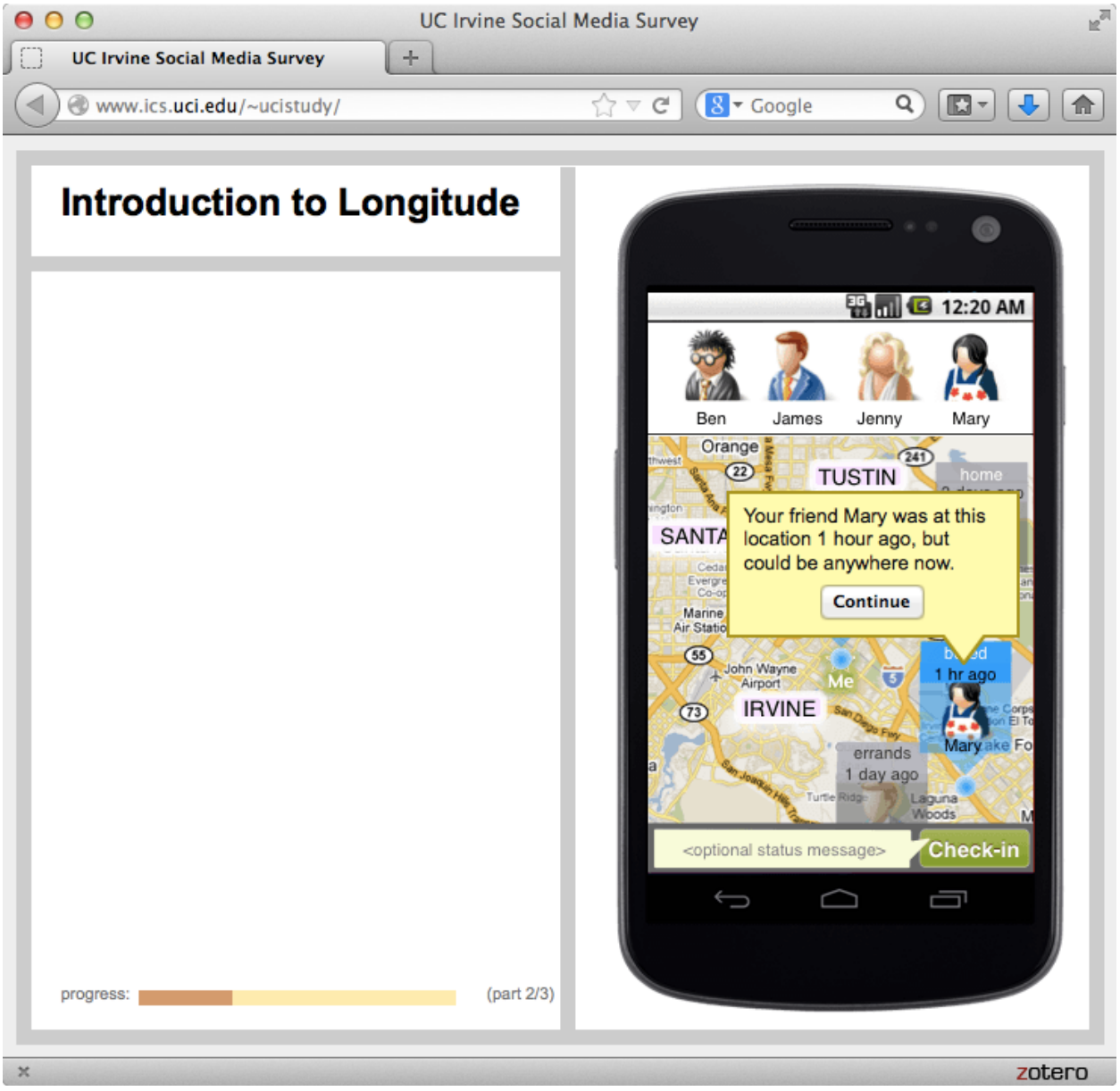
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA
Longitude shows the last time each friend has checked in.
Continue
IRVINE
Airport
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
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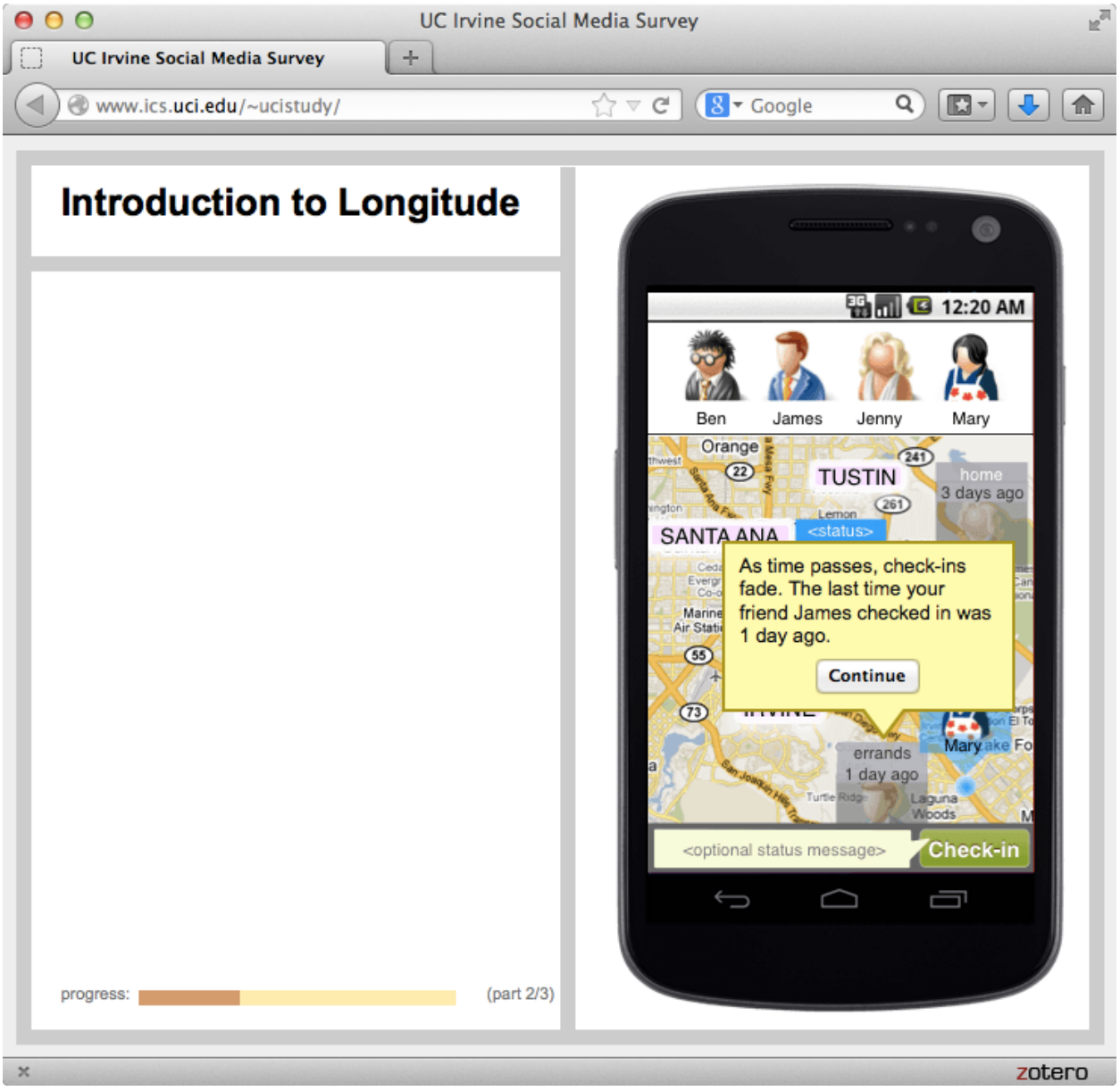
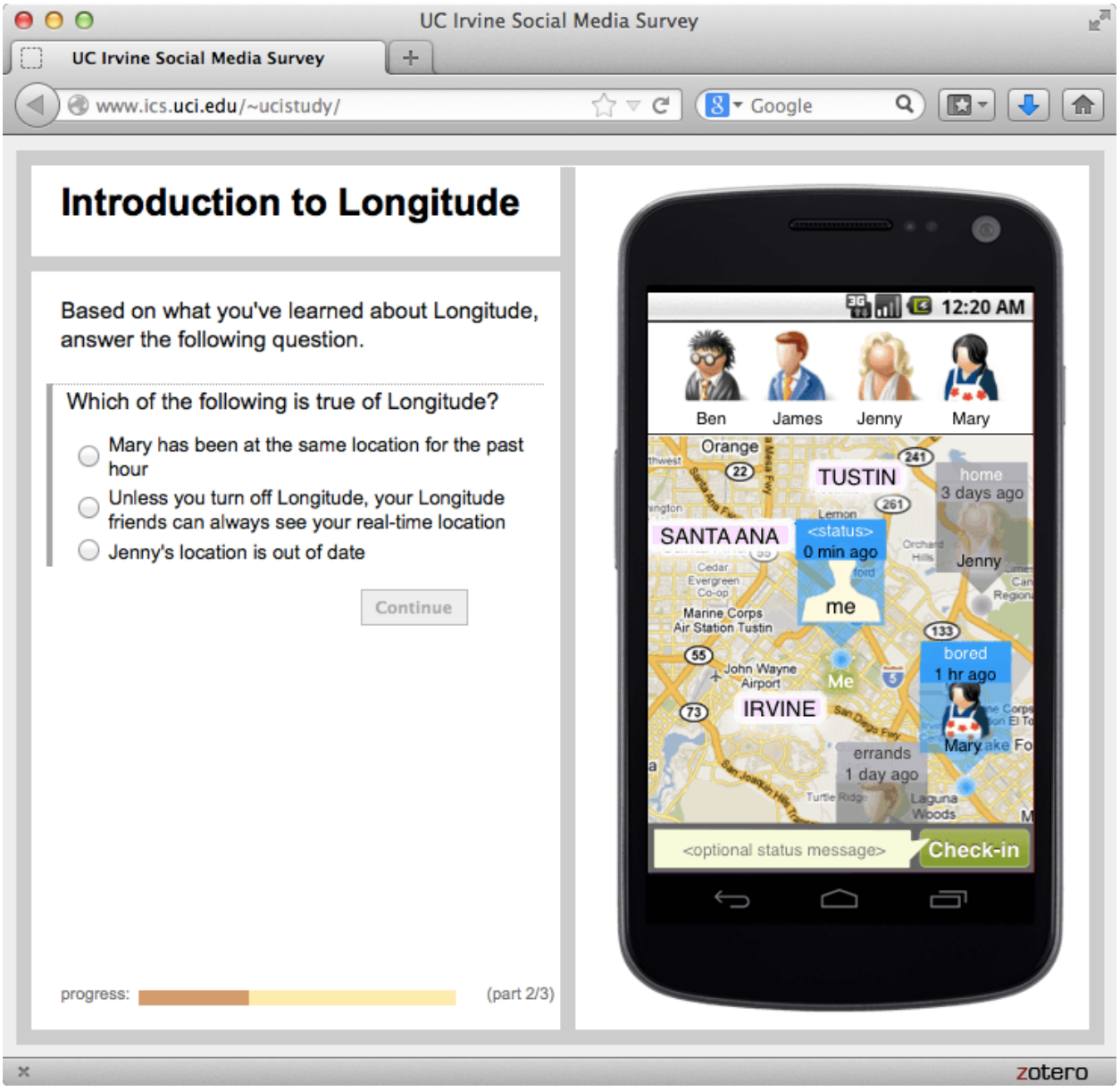
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
SANTA
Your friend Mary was at this location 1 hour ago, but could be anywhere now.
Continue
Marine Air Statio
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
As time passes, check-ins fade. The last time your friend James checked in was 1 day ago.
Continue
errands
1 day ago
Mary
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
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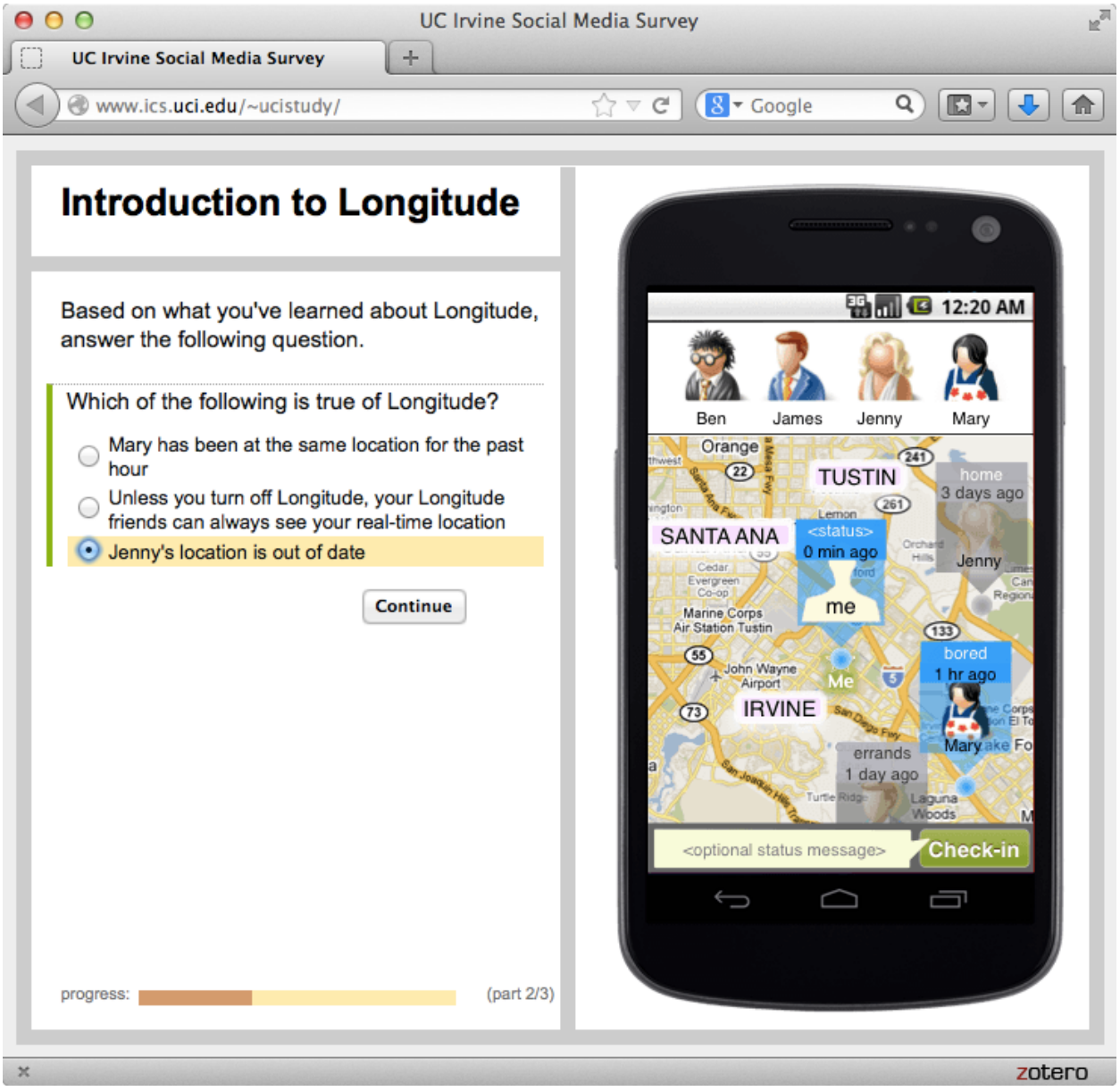
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
0 min ago
Jenny
me
Marine Corps Air Station Tustin
bored
1 hr ago
John Wayne Airport
Me
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
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Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
0 min ago
Jenny
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Marine Corps Air Station Tustin
bored
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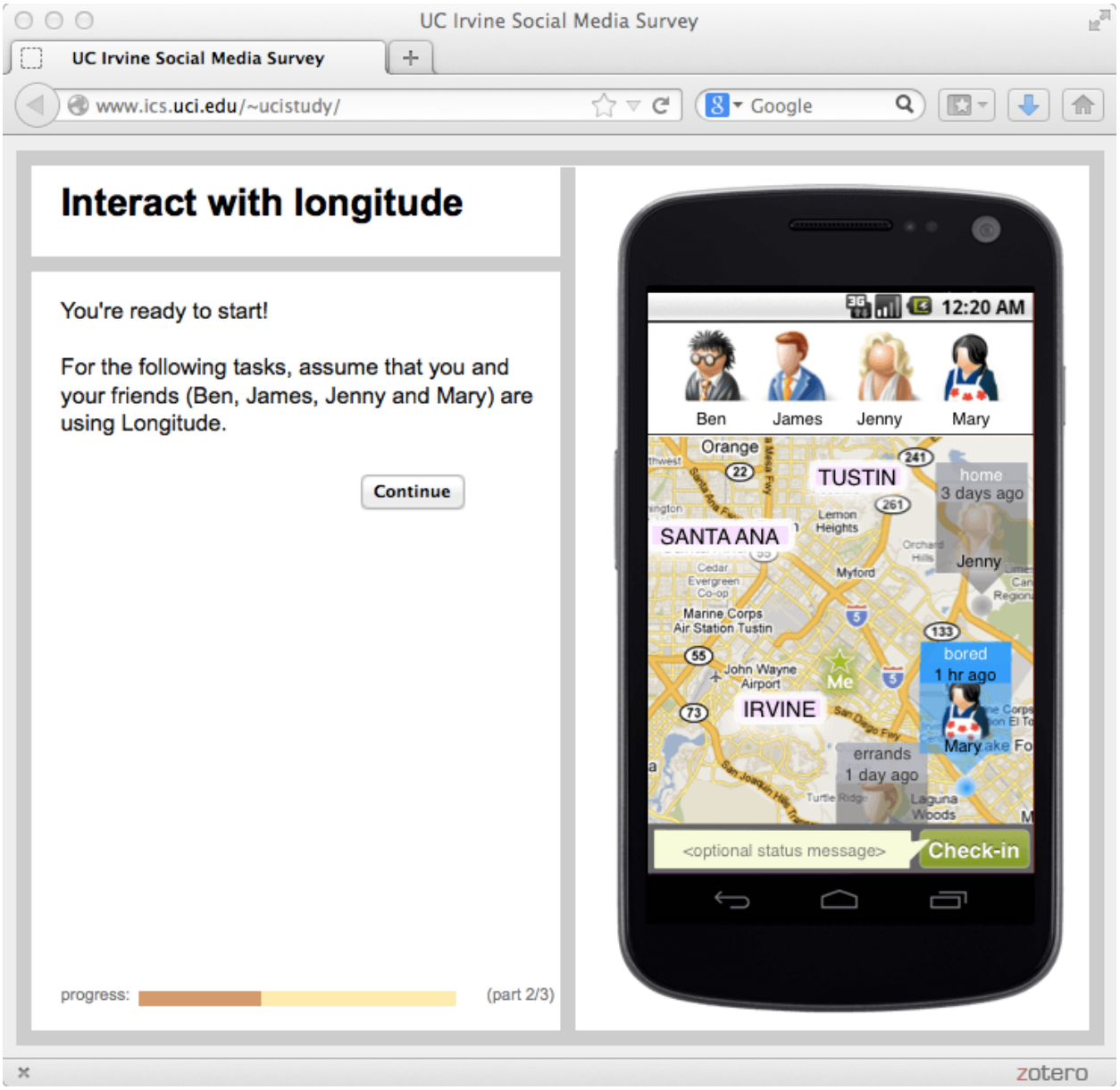
John Wayne Airport
Me
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
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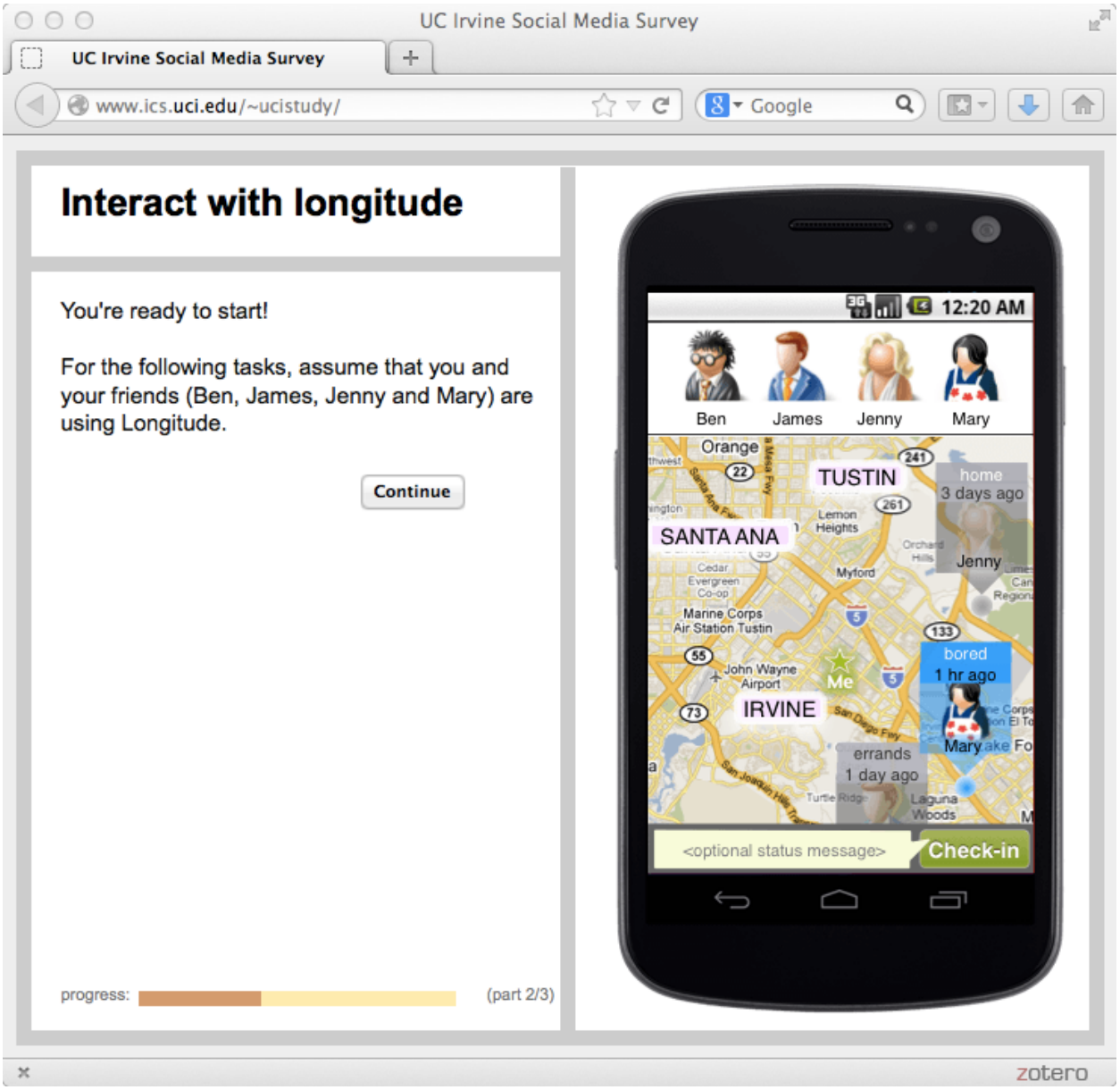
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
You're ready to start!
For the following tasks, assume that you and your friends (Ben, James, Jenny and Mary) are using Longitude.
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Lemon Heights
Myford
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero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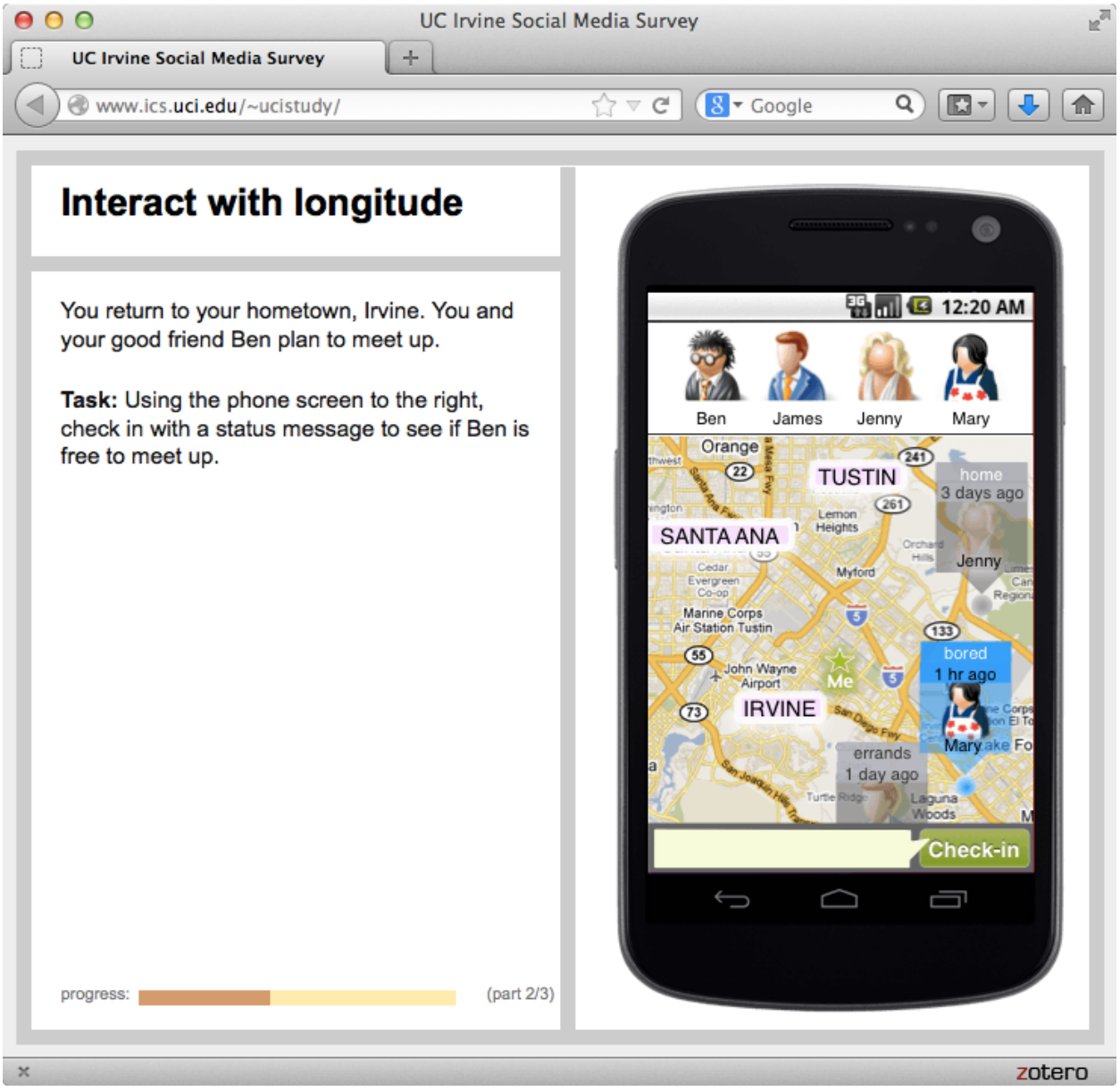
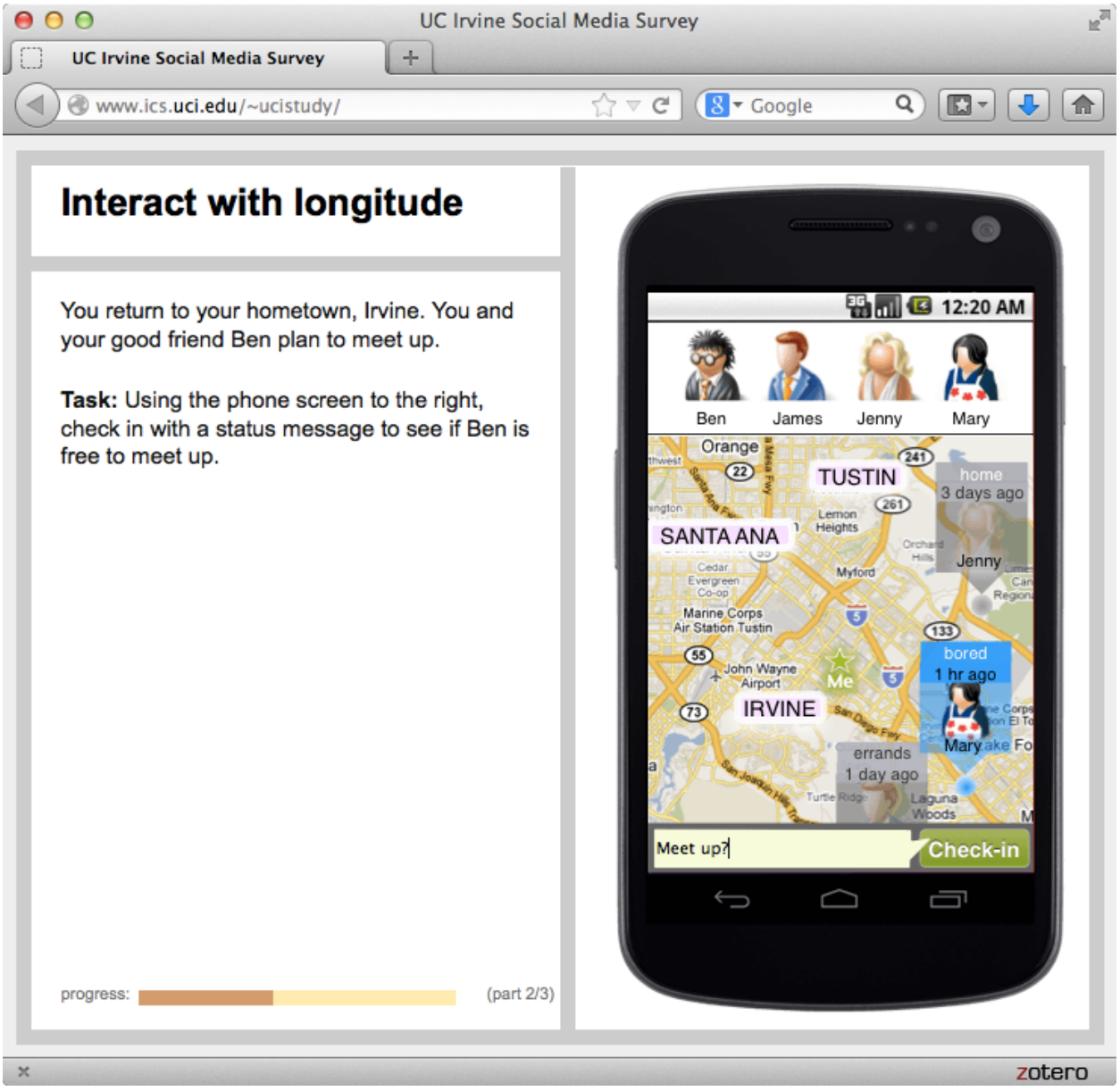
Lemon Heights
Myford
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
You return to your hometown, Irvine. You and your good friend Ben plan to meet up.
Task: Using the phone screen to the right, check in with a status message to see if Ben is free to meet up.
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Lemon Heights
Myford
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
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(part 2/3)
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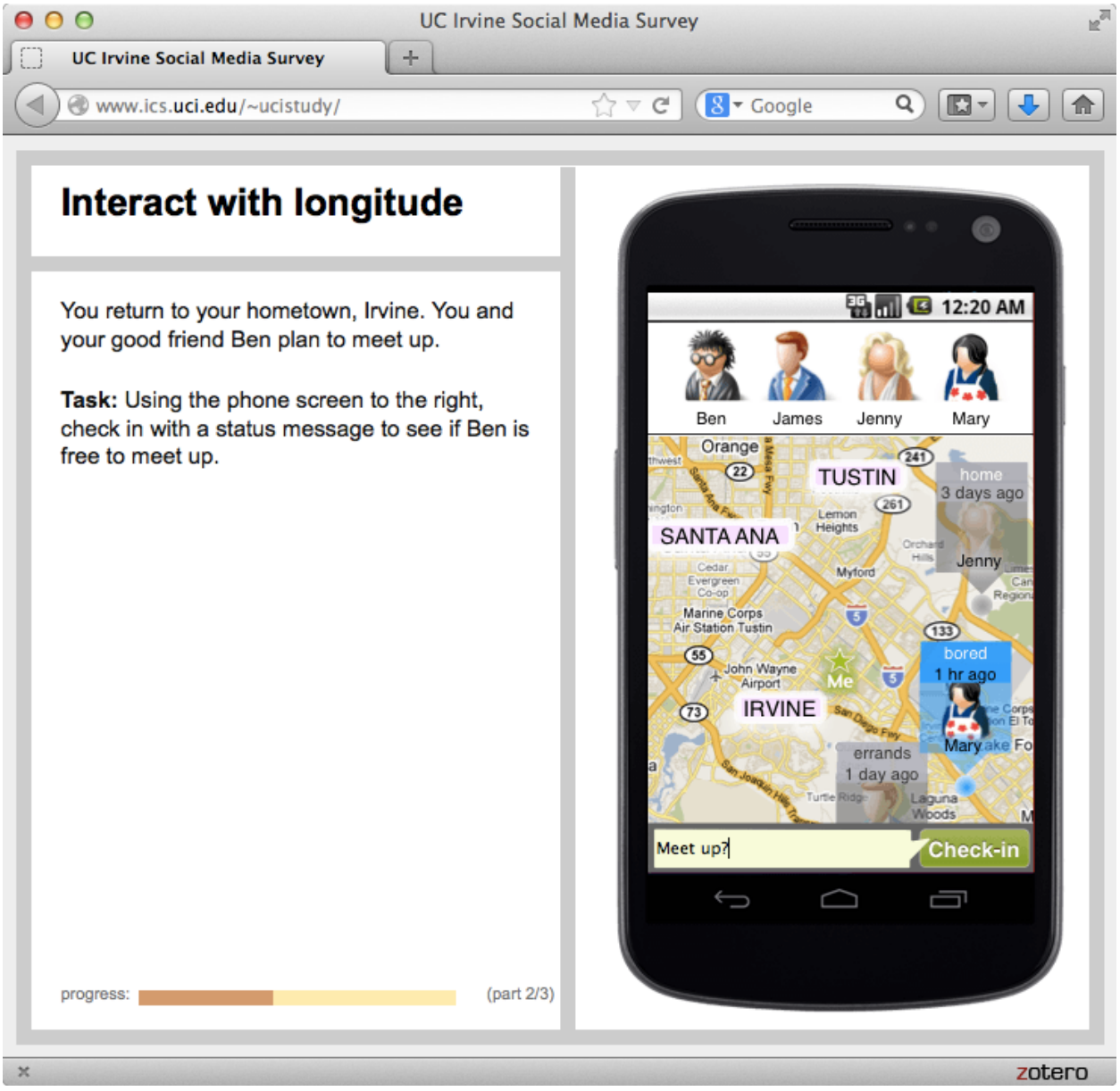
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Lemon Heights
Myford
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
Meet up?
Check-in
zotero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(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Lemon Heights
Myford
Marine Corps Air Station Tustin
John Wayne Airport
Me
home
3 days ago
Jenny
bored
1 hr ago
Mary
errands
1 day ago
Laguna Woods
Meet up?
Check-in
zotero


UC Irvine Social Media Survey
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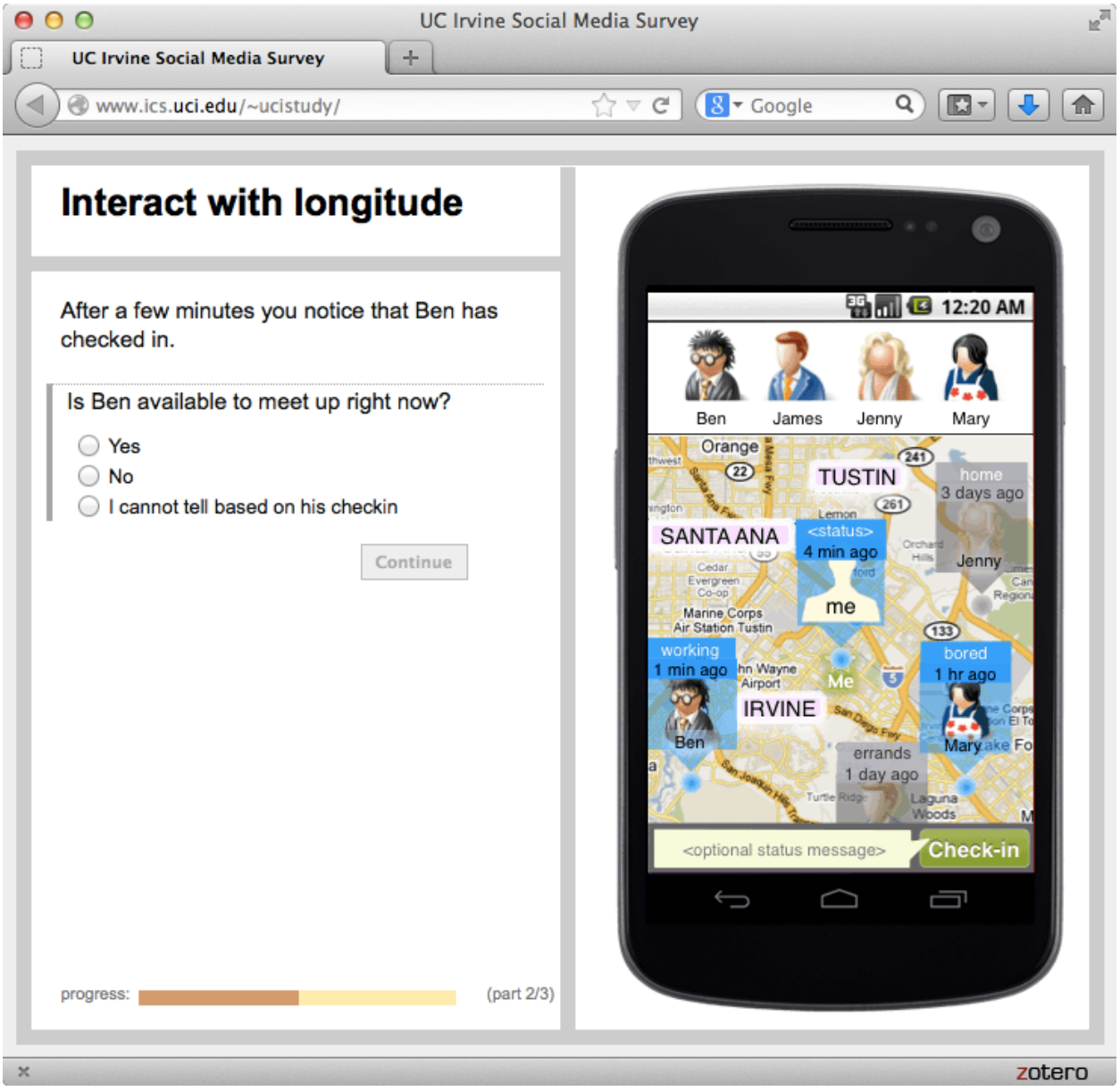
Google
Interact with longitude
You have checked in.
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
home
3 days ago
<status>
0 min ago
me
Jenny
Marine Corps
Air Station Tustin
John Wayne
Airport
Me
bored
1 hr ago
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero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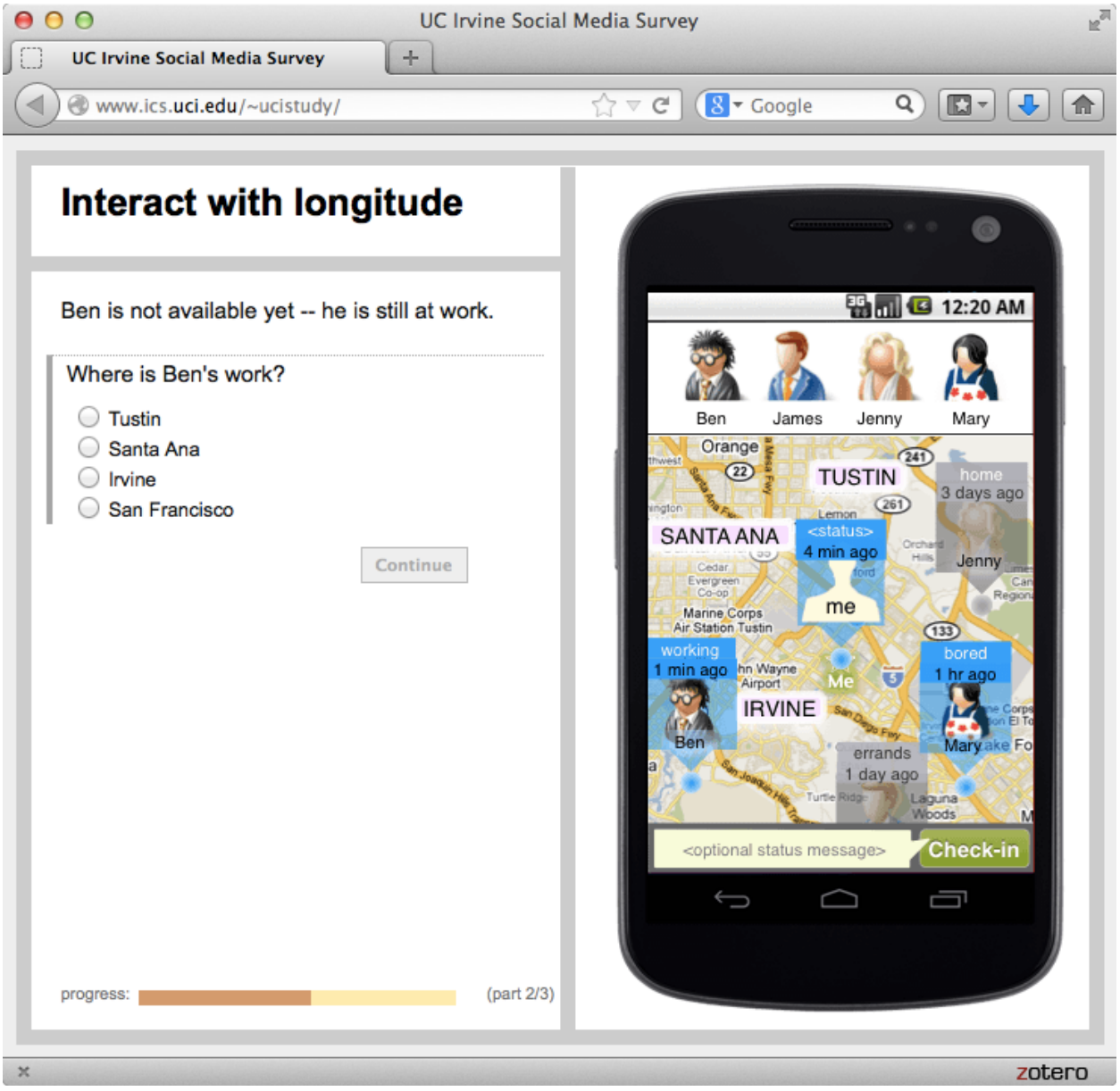
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
After a few minutes you notice that Ben has checked in.
Is Ben available to meet up right now?
Yes
No
I cannot tell based on his checkin
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
home
3 days ago
SANTA ANA
<status>
4 min ago
Jenny
me
Marine Corps
Air Station Tustin
working
1 min ago
Me
bored
1 hr ago
IRVINE
Ben
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Ben is not available yet -- he is still at work.
Where is Ben's work?
Tustin
Santa Ana
Irvine
San Francisco
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
<status>
4 min ago
me
home
3 days ago
Jenny
Marine Corps
Air Station Tustin
working
1 min ago
Me
IRVINE
Ben
bored
1 hr ago
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero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UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
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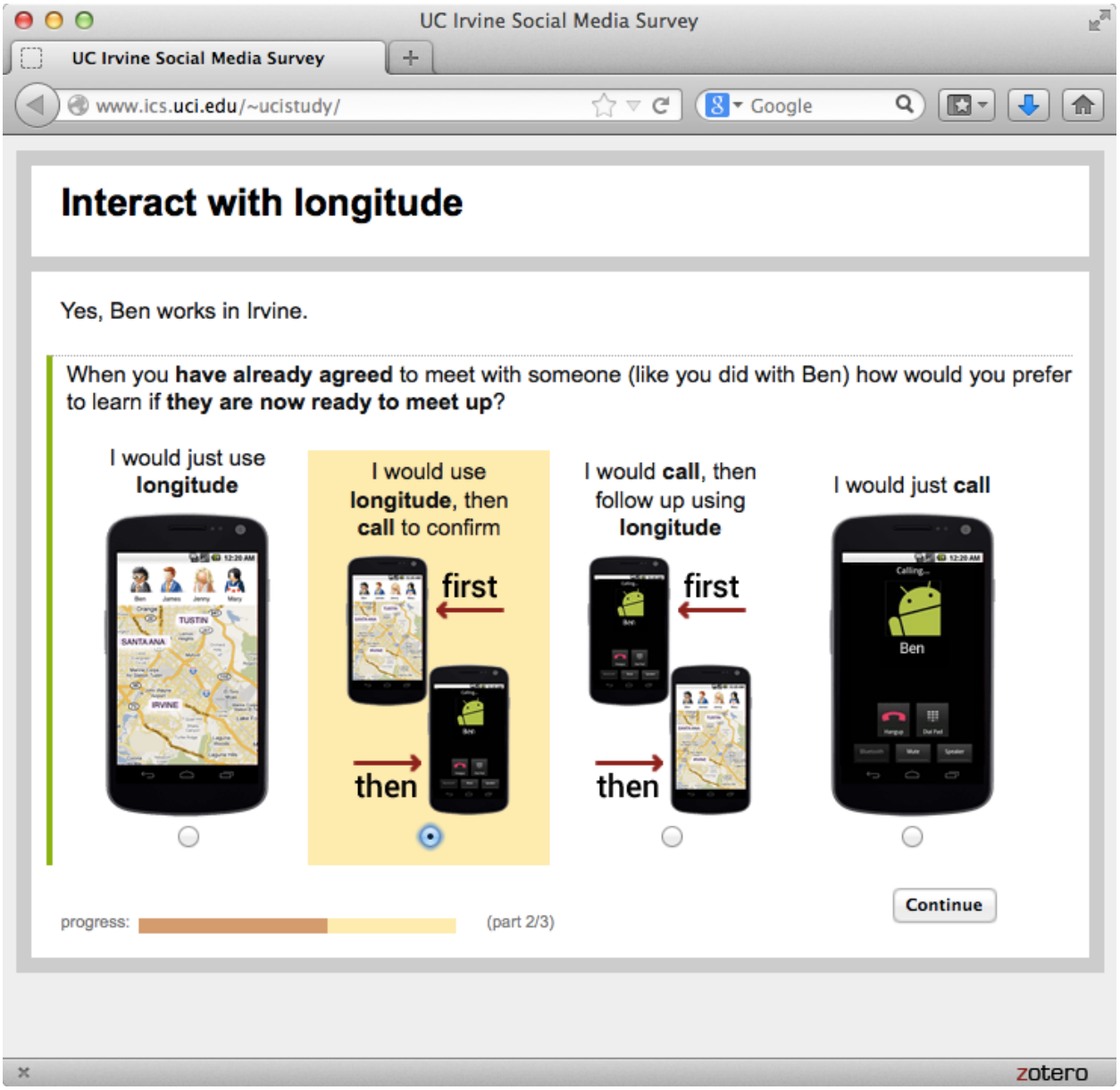
Where is Ben's work?
Tustin
Santa Ana
Irvine
San Francisco
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
<status>
4 min ago
me
home
3 days ago
Jenny
Marine Corps
Air Station Tustin
working
1 min ago
Me
IRVINE
Ben
bored
1 hr ago
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Yes, Ben works in Irvine.
When you have already agreed to meet with someone (like you did with Ben) how would you prefer to learn if they are now ready to meet up?
I would just use longitude
I would use longitude, then call to confirm
first
then
I would call, then follow up using longitude
first
then
I would just call
Ben
progress:
(part 2/3)
Continue
zotero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Google
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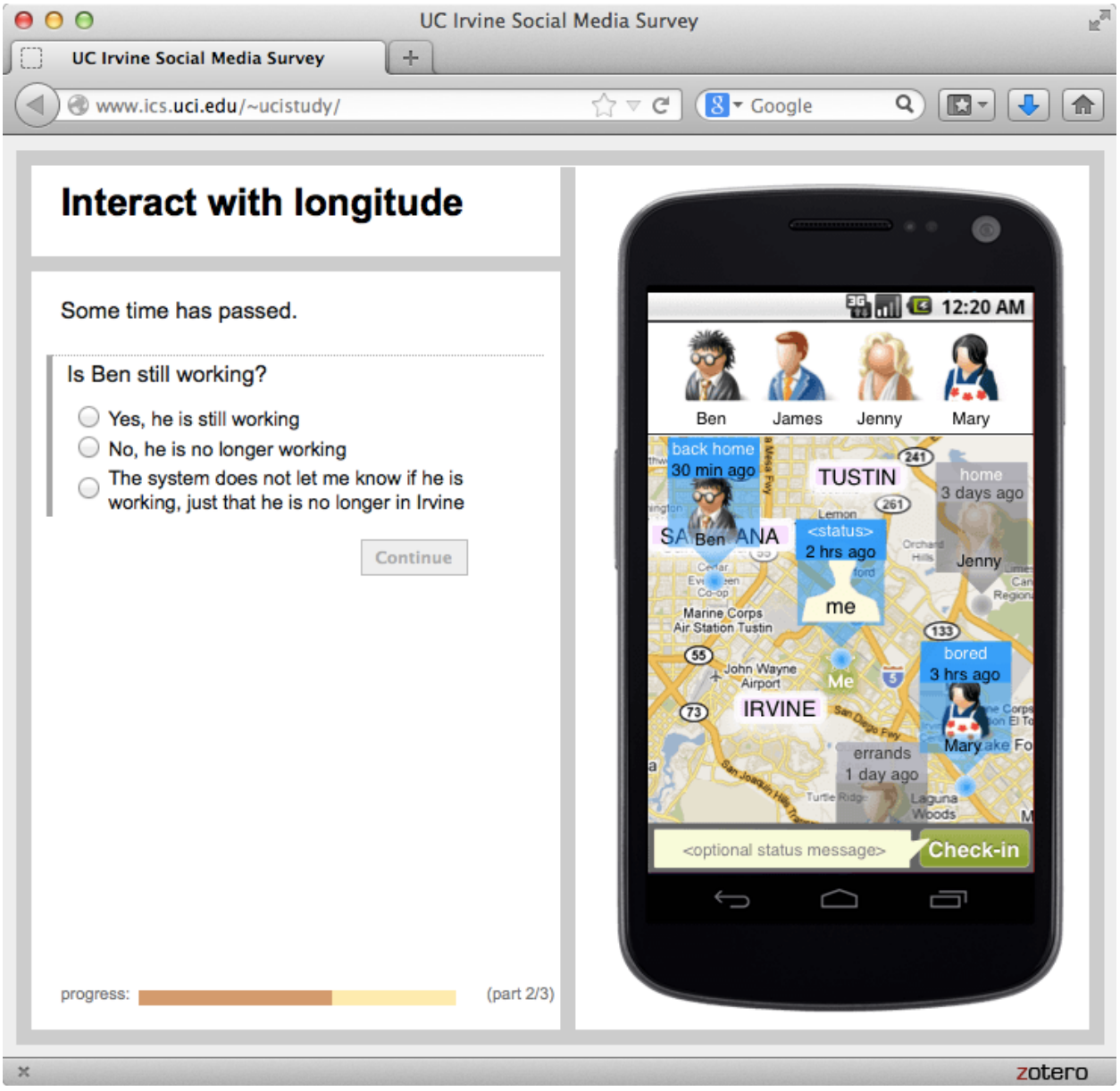
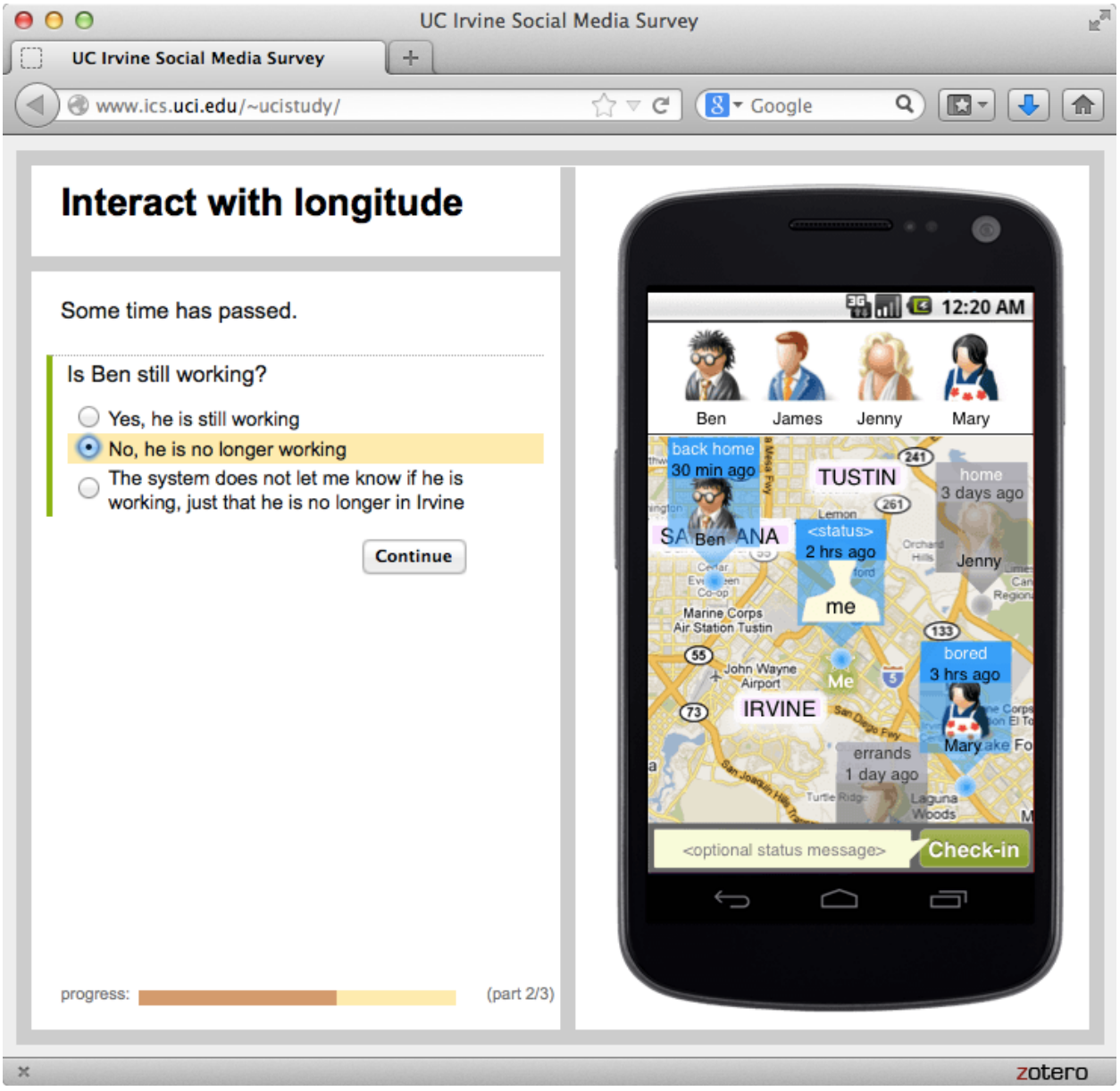
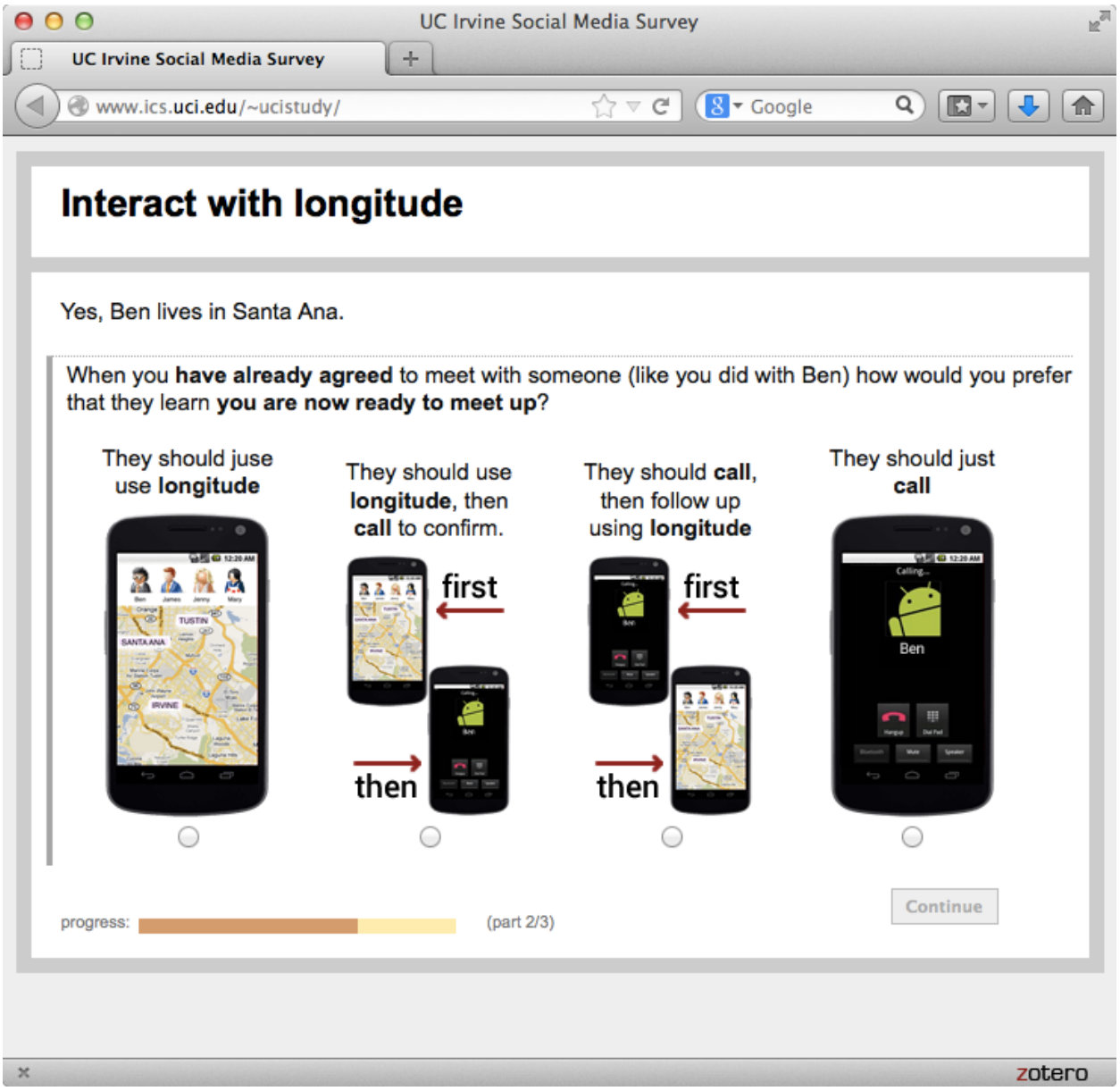
first
then
I would call, then follow up using longitude
first
then
I would just call
Ben
progress:
(part 2/3)
Continue
zotero

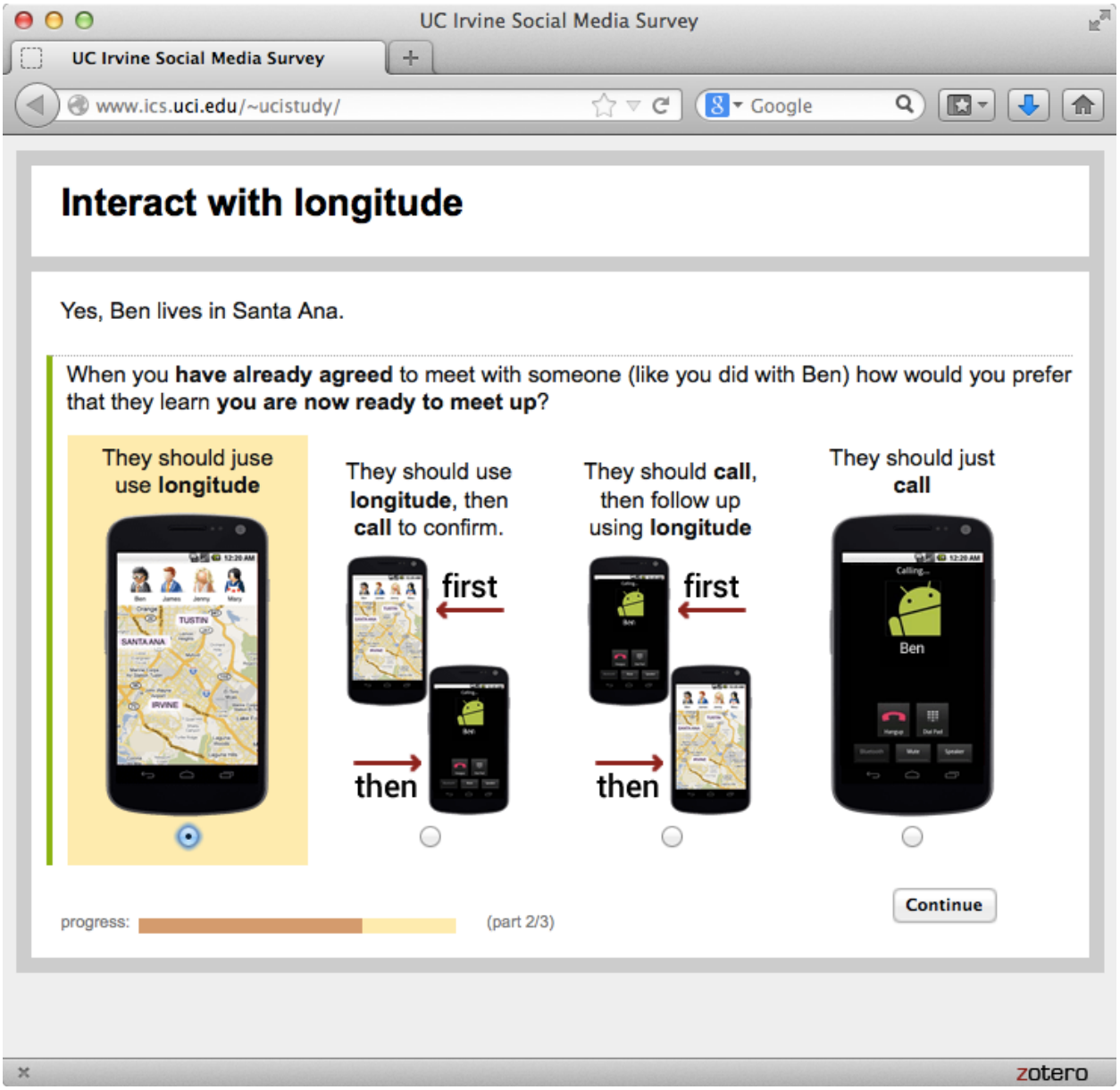

UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Some time has passed.
Is Ben still working?
Yes, he is still working
No, he is no longer working
The system does not let me know if he is working, just that he is no longer in Irvine
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
30 min ago
TUSTIN
home
3 days ago
<status>
2 hrs ago
Jenny
me
Marine Corps
Air Station Tustin
John Wayne
Airport
Me
bored
3 hrs ago
IRVINE
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Some time has passed.
Is Ben still working?
Yes, he is still working
No, he is no longer working
The system does not let me know if he is working, just that he is no longer in Irvine
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
30 min ago
TUSTIN
home
3 days ago
<status>
2 hrs ago
Jenny
me
Marine Corps
Air Station Tustin
bored
3 hrs ago
John Wayne
Airport
Me
IRVINE
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Ben's status indicates that he is no longer at work and is at home now. Ben saw you on Longitude and is expecting you.
Where is Ben's home?
Tustin
Santa Ana
Irvine
San Francisco
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
30 min ago
TUSTIN
home
3 days ago
<status>
2 hrs ago
Ben
Jenny
me
Marine Corps
Air Station Tustin
John Wayne
Airport
Me
bored
3 hrs ago
IRVINE
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Ben's status indicates that he is no longer at work and is at home now. Ben saw you on Longitude and is expecting you.
Where is Ben's home?
Tustin
Santa Ana
Irvine
San Francisco
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
30 min ago
TUSTIN
home
3 days ago
<status>
2 hrs ago
Jenny
me
Marine Corps
Air Station Tustin
John Wayne
Airport
Me
bored
3 hrs ago
IRVINE
Mary
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Yes, Ben lives in Santa Ana.
When you have already agreed to meet with someone (like you did with Ben) how would you prefer that they learn you are now ready to meet up?
They should juse use longitude
They should use longitude, then call to confirm.
first
then
They should call, then follow up using longitude
first
then
They should just call
Ben
progress:
(part 2/3)
Continue
zotero


UC Irvine Social Media Survey
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www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Yes, Ben lives in Santa Ana.
When you have already agreed to meet with someone (like you did with Ben) how would you prefer that they learn you are now ready to meet up?
They should juse use longitude
They should use longitude, then call to confirm.
first
then
They should call, then follow up using longitude
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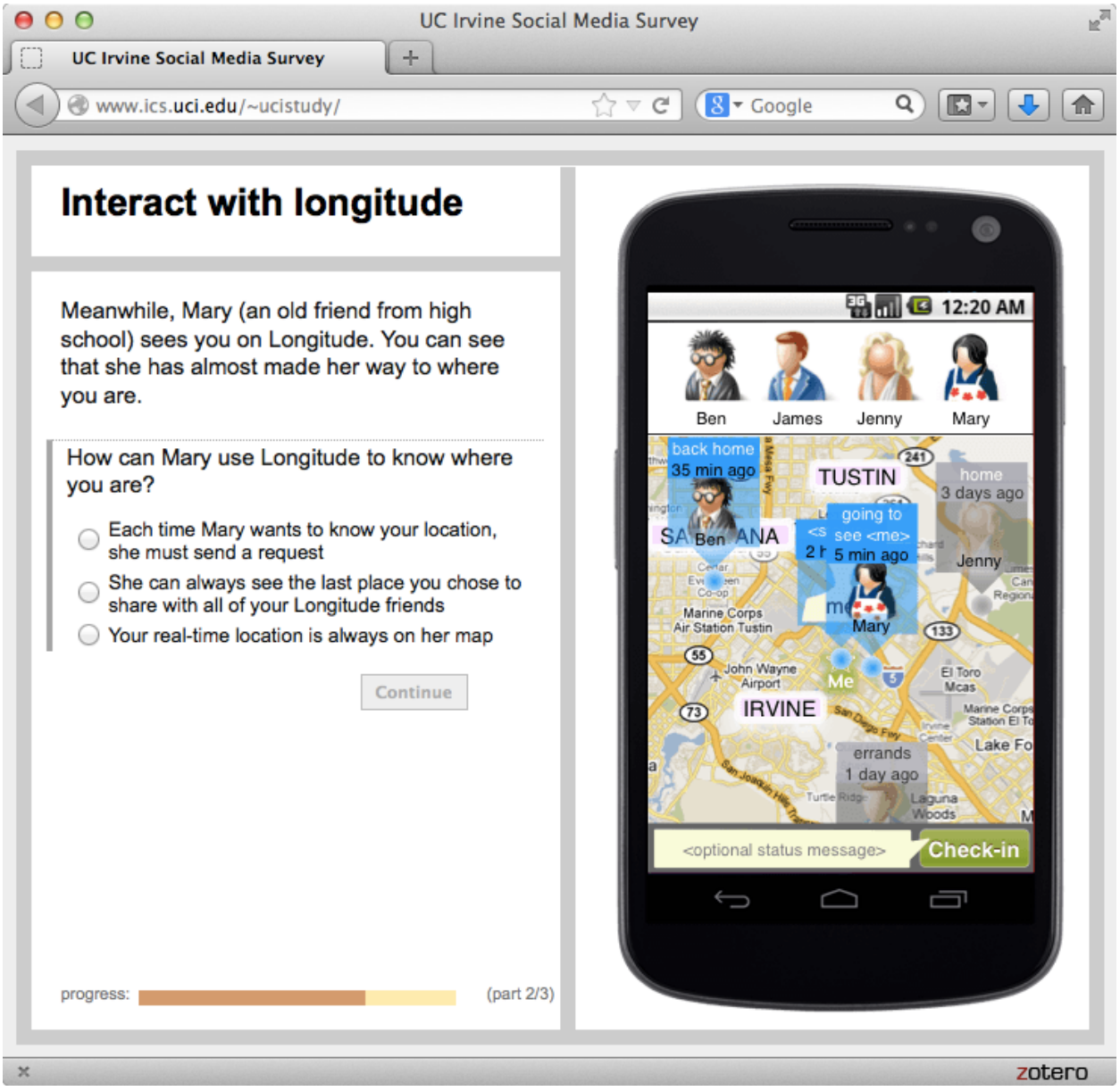
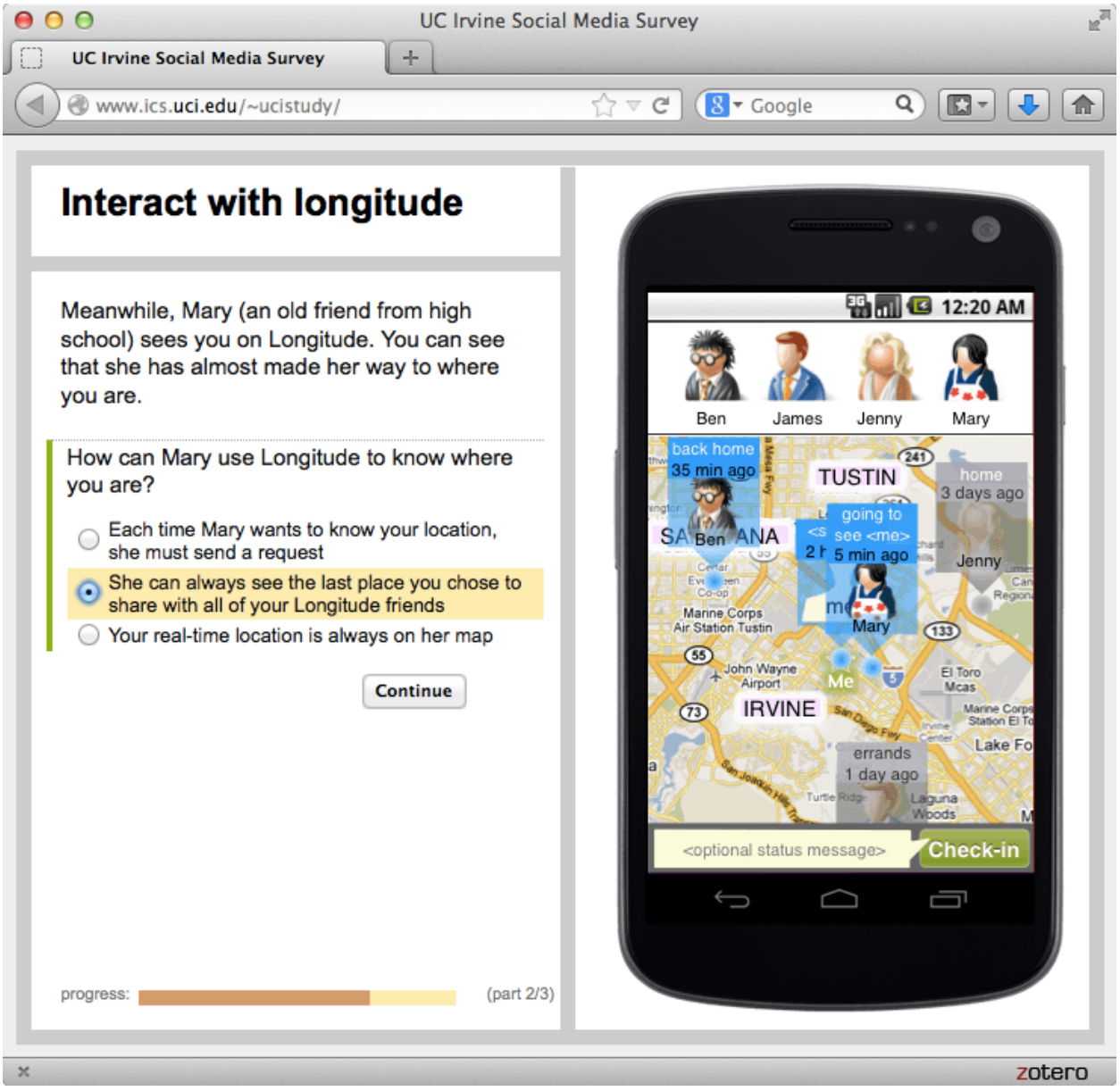
then
They should just call
Ben
Continue
progress:
(part 2/3)
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Meanwhile, Mary (an old friend from high school) sees you on Longitude. You can see that she has almost made her way to where you are.
How can Mary use Longitude to know where you are?
Each time Mary wants to know your location, she must send a request
She can always see the last place you chose to share with all of your Longitude friends
Your real-time location is always on her map
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
35 min ago
TUSTIN
home
3 days ago
going to
see <me>
5 min ago
Jenny
Marine Corps
Air Station Tustin
Mary
John Wayne
Airport
Me
El Toro
Mcas
IRVINE
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero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Each time Mary wants to know your location, she must send a request
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James
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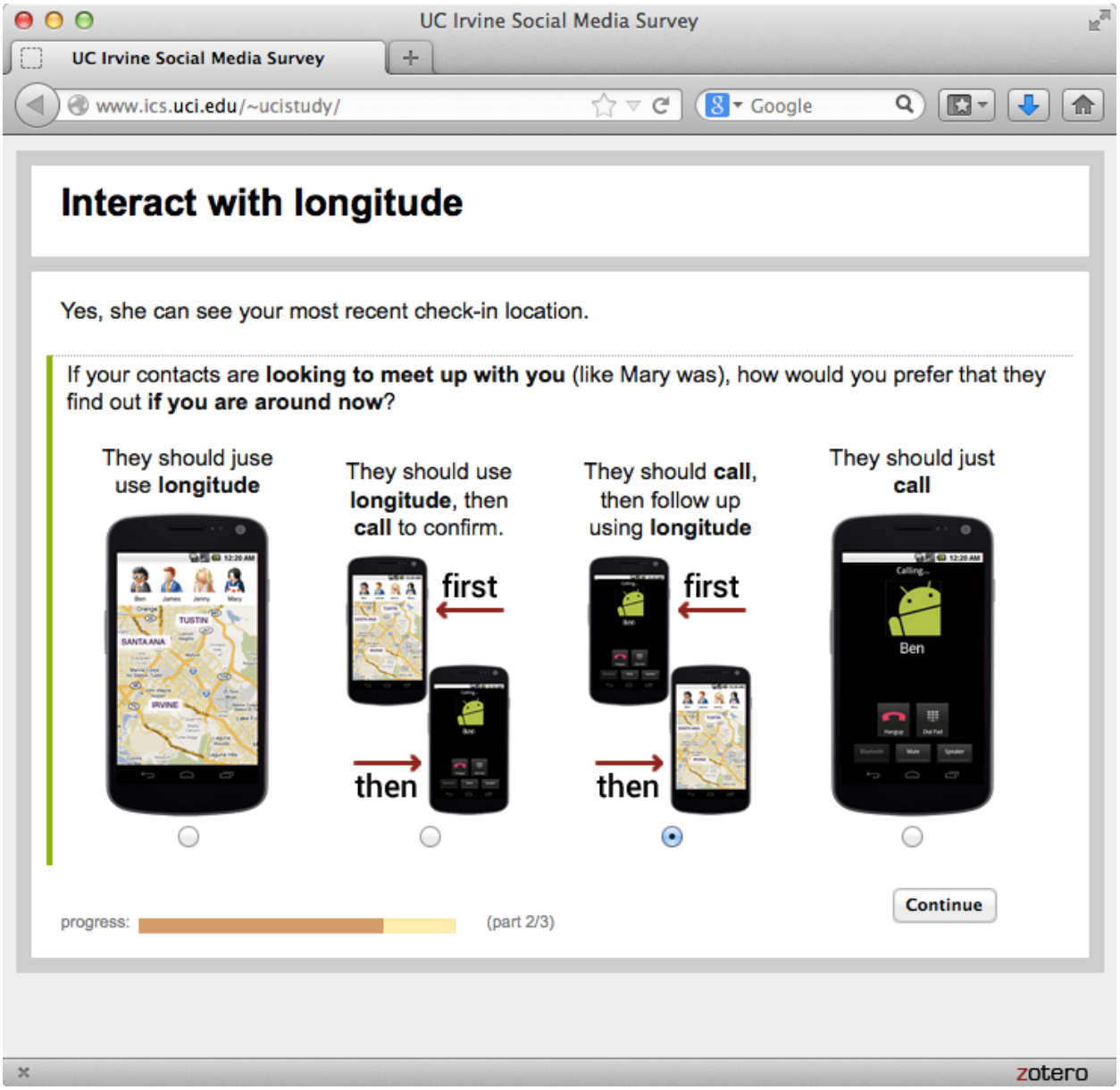
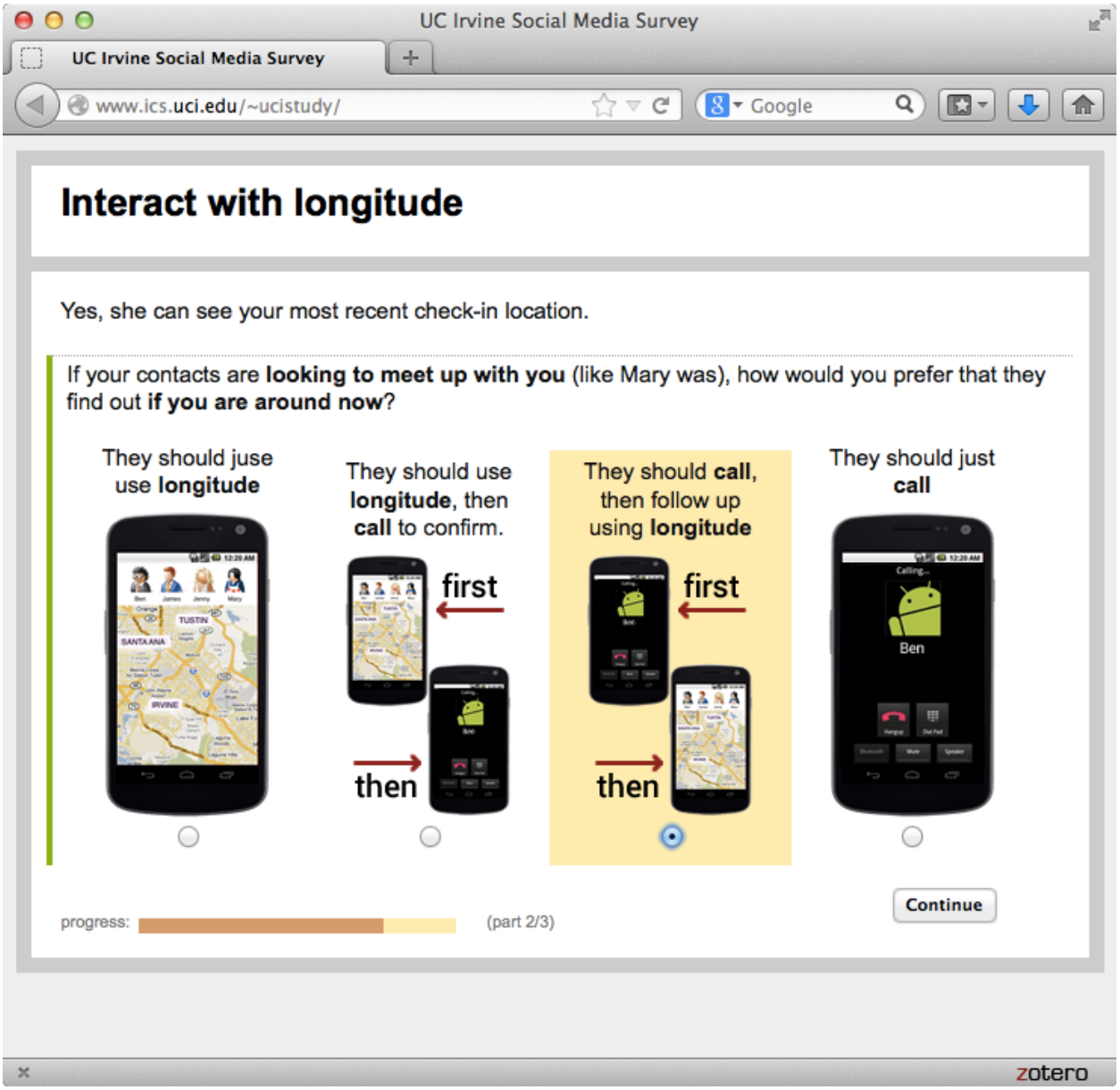
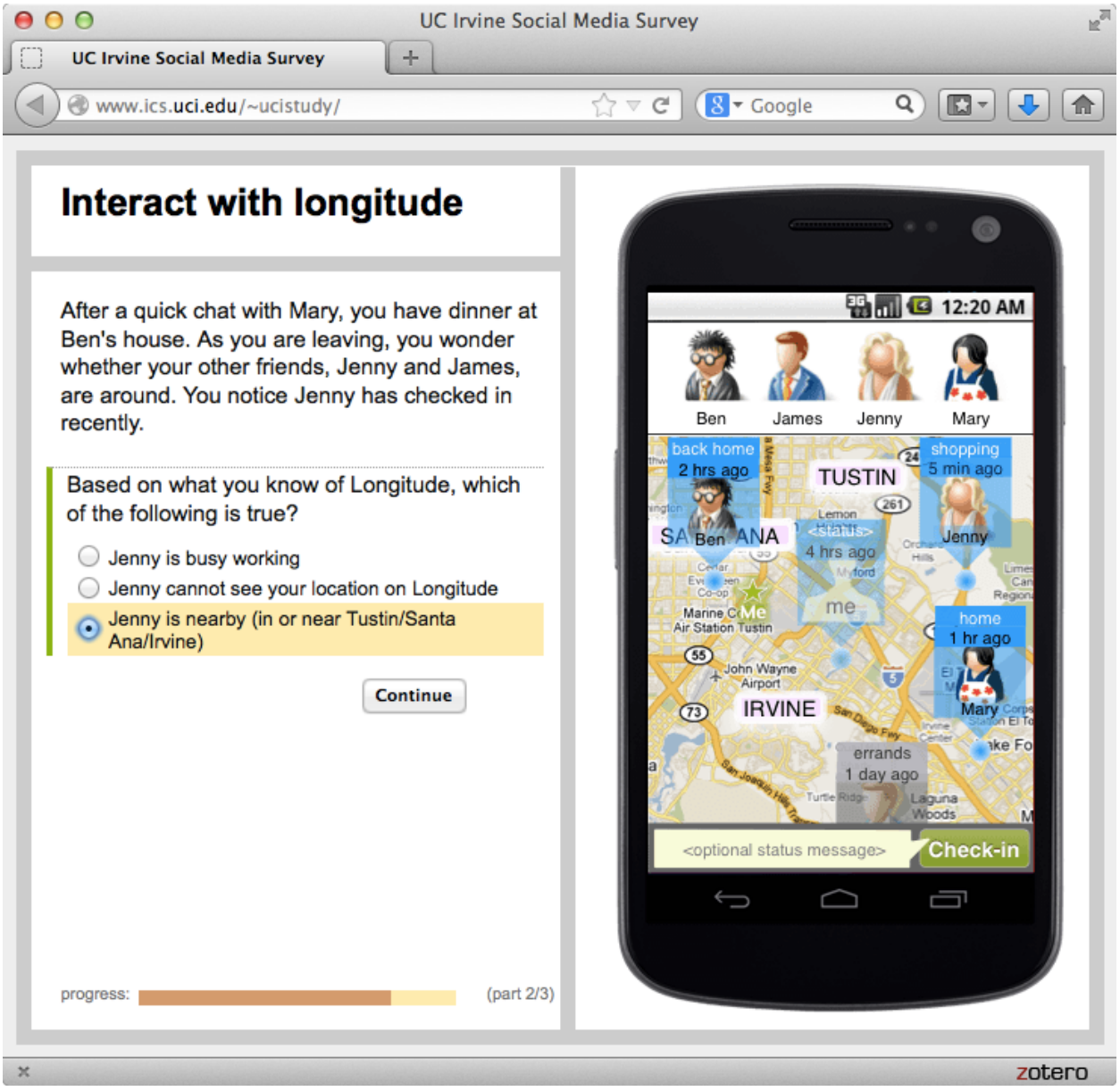
TUSTIN
home
3 days ago
going to
see <me>
5 min ago
Jenny
Marine Corps
Air Station Tustin
Mary
John Wayne
Airport
Me
El Toro
Mcas
IRVINE
errands
1 day ago
Laguna
Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Yes, she can see your most recent check-in location.
If your contacts are looking to meet up with you (like Mary was), how would you prefer that they find out if you are around now?
They should juse use longitude
They should use longitude, then call to confirm.
first
then
They should call, then follow up using longitude
first
then
They should just call
Ben
Continue
progress:
(part 2/3)
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Yes, she can see your most recent check-in location.
If your contacts are looking to meet up with you (like Mary was), how would you prefer that they find out if you are around now?
They should juse use longitude
They should use longitude, then call to confirm.
first
then
They should call, then follow up using longitude
first
then
They should just call
Ben
Continue
progress:
(part 2/3)
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
After a quick chat with Mary, you have dinner at Ben's house. As you are leaving, you wonder whether your other friends, Jenny and James, are around. You notice Jenny has checked in recently.
Based on what you know of Longitude, which of the following is true?
Jenny is busy working
Jenny cannot see your location on Longitude
Jenny is nearby (in or near Tustin/Santa Ana/Irvine)
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
2 hrs ago
TUSTIN
shopping
5 min ago
Ben
<status>
4 hrs ago
Jenny
me
Marine Corps Air Station Tustin
Me
home
1 hr ago
John Wayne Airport
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
After a quick chat with Mary, you have dinner at Ben's house. As you are leaving, you wonder whether your other friends, Jenny and James, are around. You notice Jenny has checked in recently.
Based on what you know of Longitude, which of the following is true?
Jenny is busy working
Jenny cannot see your location on Longitude
Jenny is nearby (in or near Tustin/Santa Ana/Irvine)
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
2 hrs ago
TUSTIN
shopping
5 min ago
SANTA ANA
<status>
4 hrs ago
Ben
Jenny
me
Marine Corps Air Station Tustin
Me
home
1 hr ago
John Wayne Airport
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Right, Jenny is nearby.
Task: Check-in with a message that invites Jenny and James to join you for dessert.
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
2 hrs ago
TUSTIN
shopping
5 min ago
Ben
<status>
4 hrs ago
Jenny
me
Me
home
1 hr ago
Mary
John Wayne
Airport
IRVINE
errands
1 day ago
Laguna
Woods
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
Right, Jenny is nearby.
Task: Check-in with a message that invites Jenny and James to join you for dessert.
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
2 hrs ago
TUSTIN
shopping
5 min ago
Ben
Jenny
<status>
4 hrs ago
me
Me
home
1 hr ago
Mary
John Wayne
Airport
IRVINE
errands
1 day ago
Laguna
Woods
Dessert anyone?
Check-in
zotero


UC Irvine Social Media Survey
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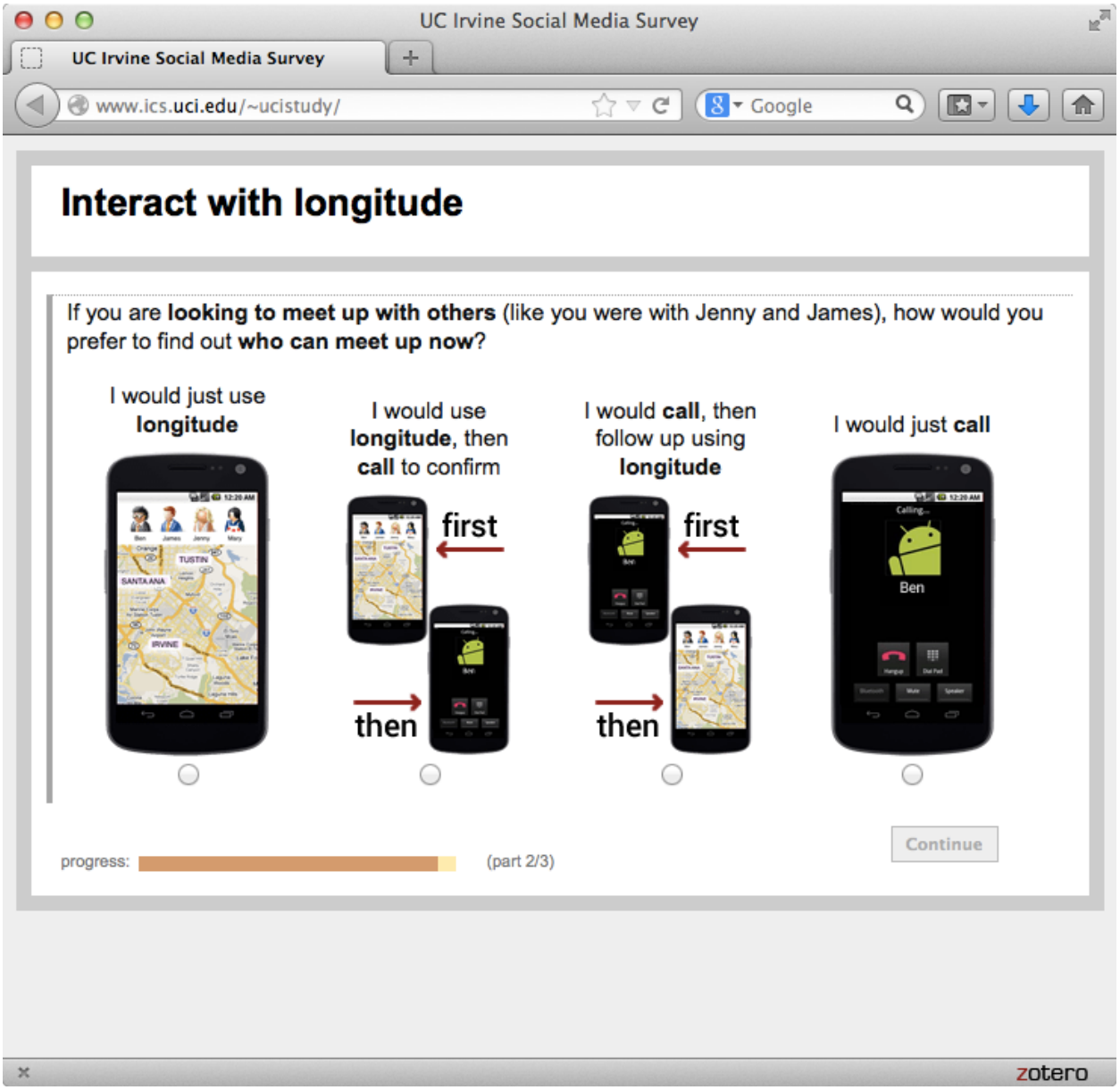
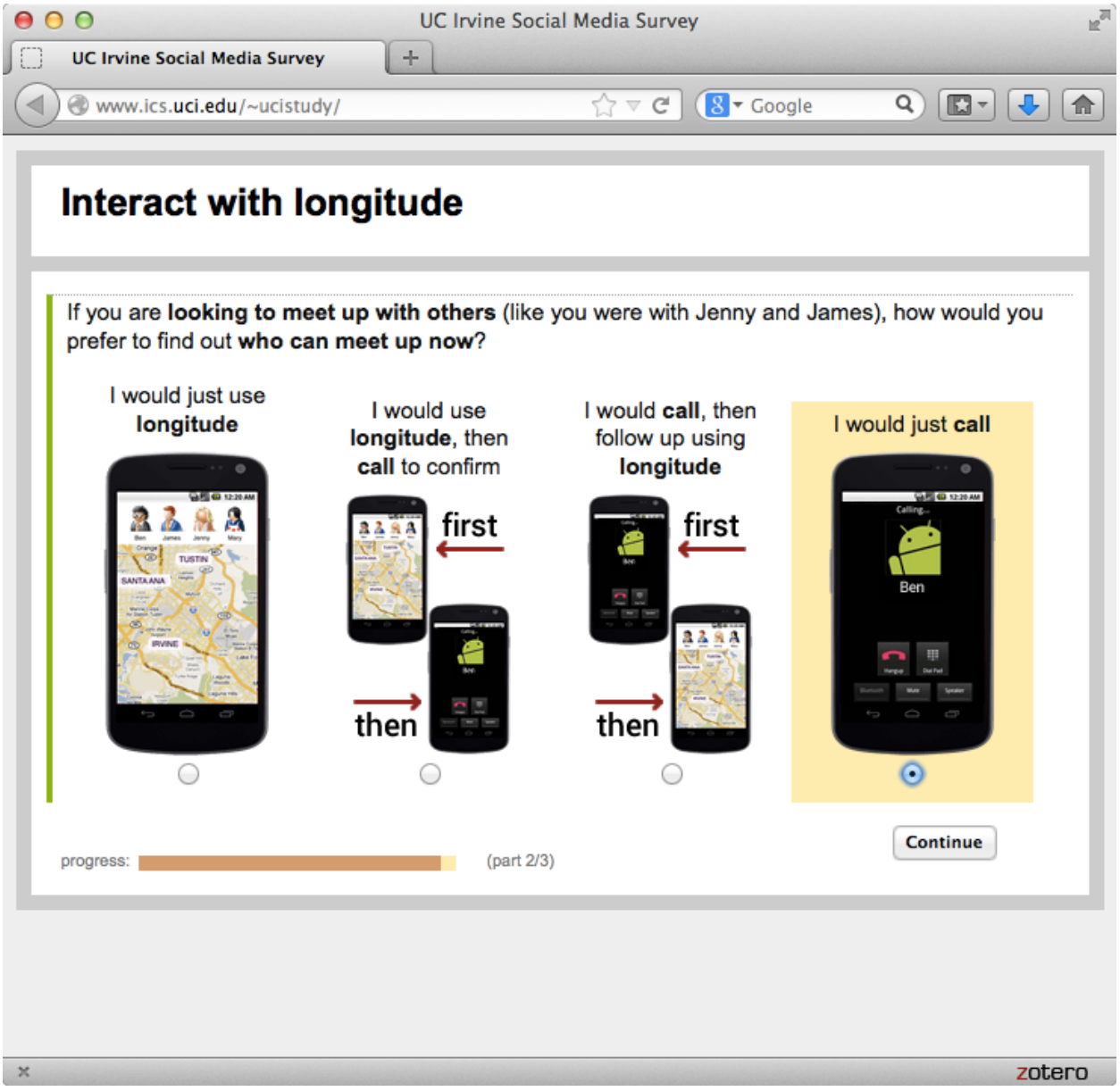
Google
Interact with longitude
You have checked in with a status message.
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
back home
2 hr
<updated>
0 min ago
TUSTIN
shopping
5 min ago
Lemon Heights
Jenny
me
Myford
Marine Corps Air Station Tustin
Me
home
1 hr ago
John Wayne Airport
IRVINE
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
You and Jenny meet up for dessert, but you wonder if James can join you. James has not checked in recently so you cannot tell.
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
<updated>
1 hr ago
with <me>
me
Jenny
Marine Corps Air Station Tustin
John Wayne Airport
IRVINE
home
2 hrs ago
Mary
errands
1 day ago
Laguna Woods
<optional status message>
Check-in
zotero

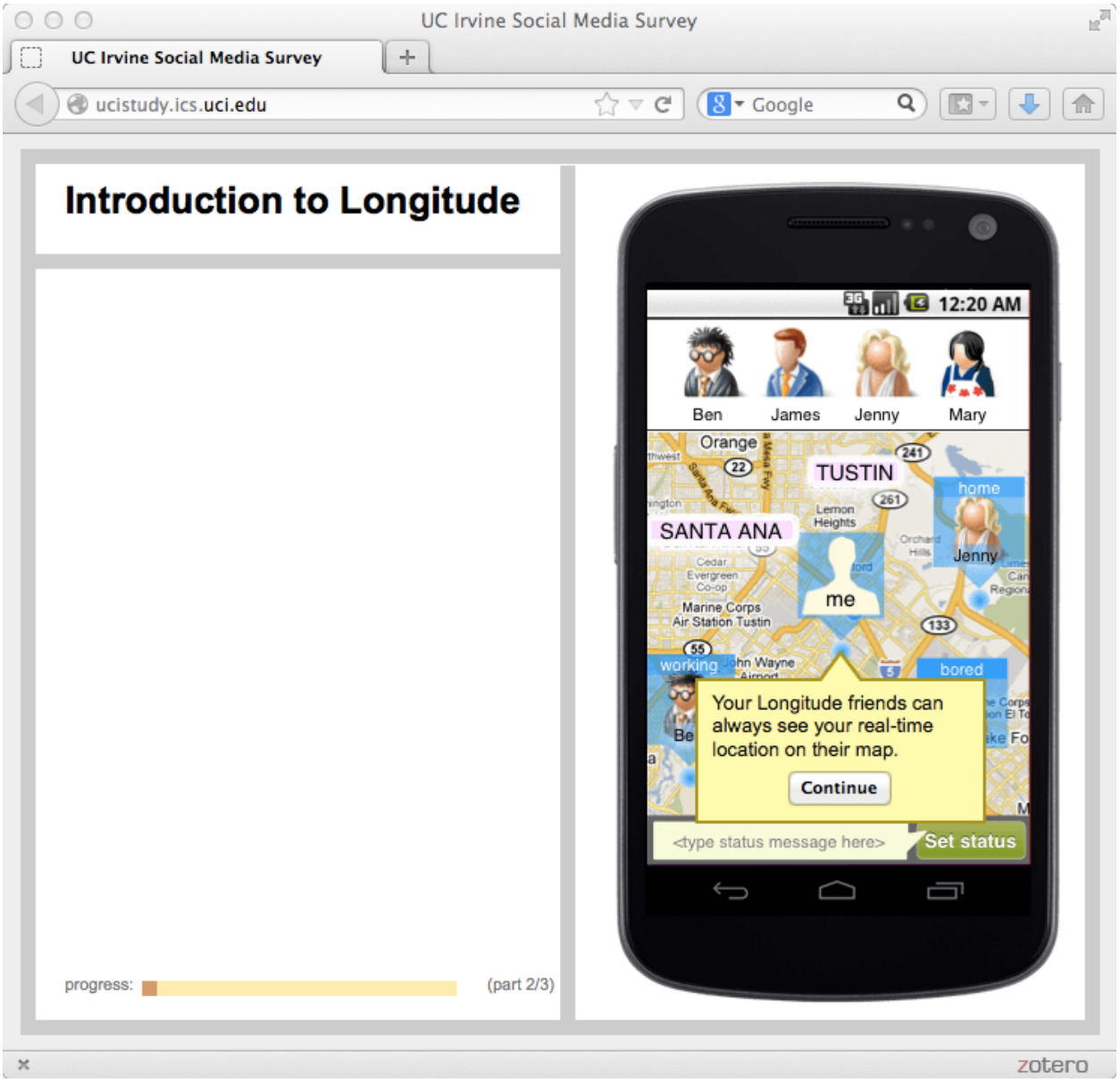

UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
If you are looking to meet up with others (like you were with Jenny and James), how would you prefer to find out who can meet up now?
I would just use longitude
I would use longitude, then call to confirm
first
then
I would call, then follow up using longitude
first
then
I would just call
Ben
progress:
(part 2/3)
Continue
zotero

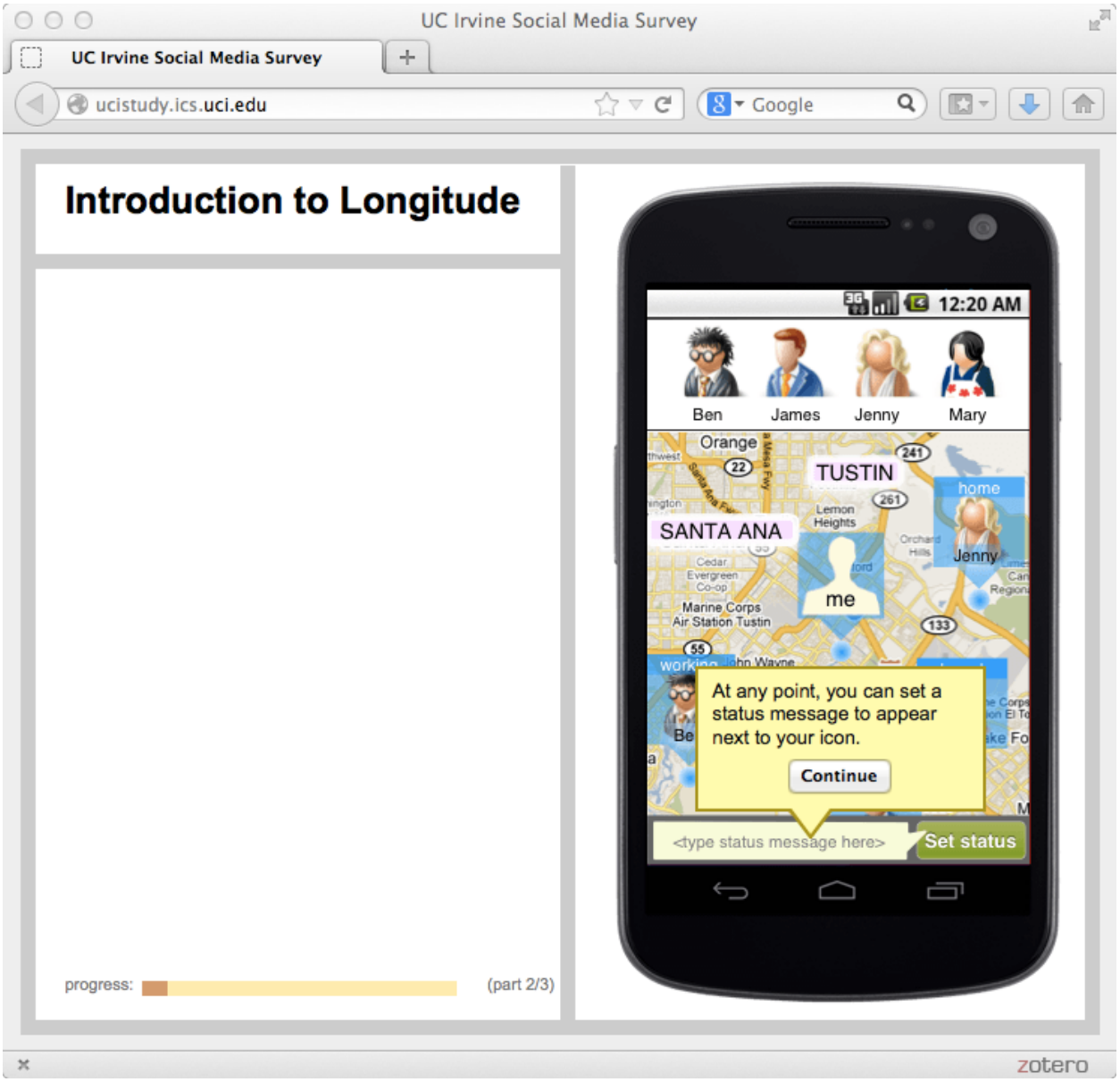

UC Irvine Social Media Survey
UC Irvine Social Media Survey
www.ics.uci.edu/~ucistudy/
Google
Interact with longitude
If you are looking to meet up with others (like you were with Jenny and James), how would you prefer to find out who can meet up now?
I would just use longitude
I would use longitude, then call to confirm
first
then
I would call, then follow up using longitude
first
then
I would just call
Ben
Continue
progress:
(part 2/3)
zotero

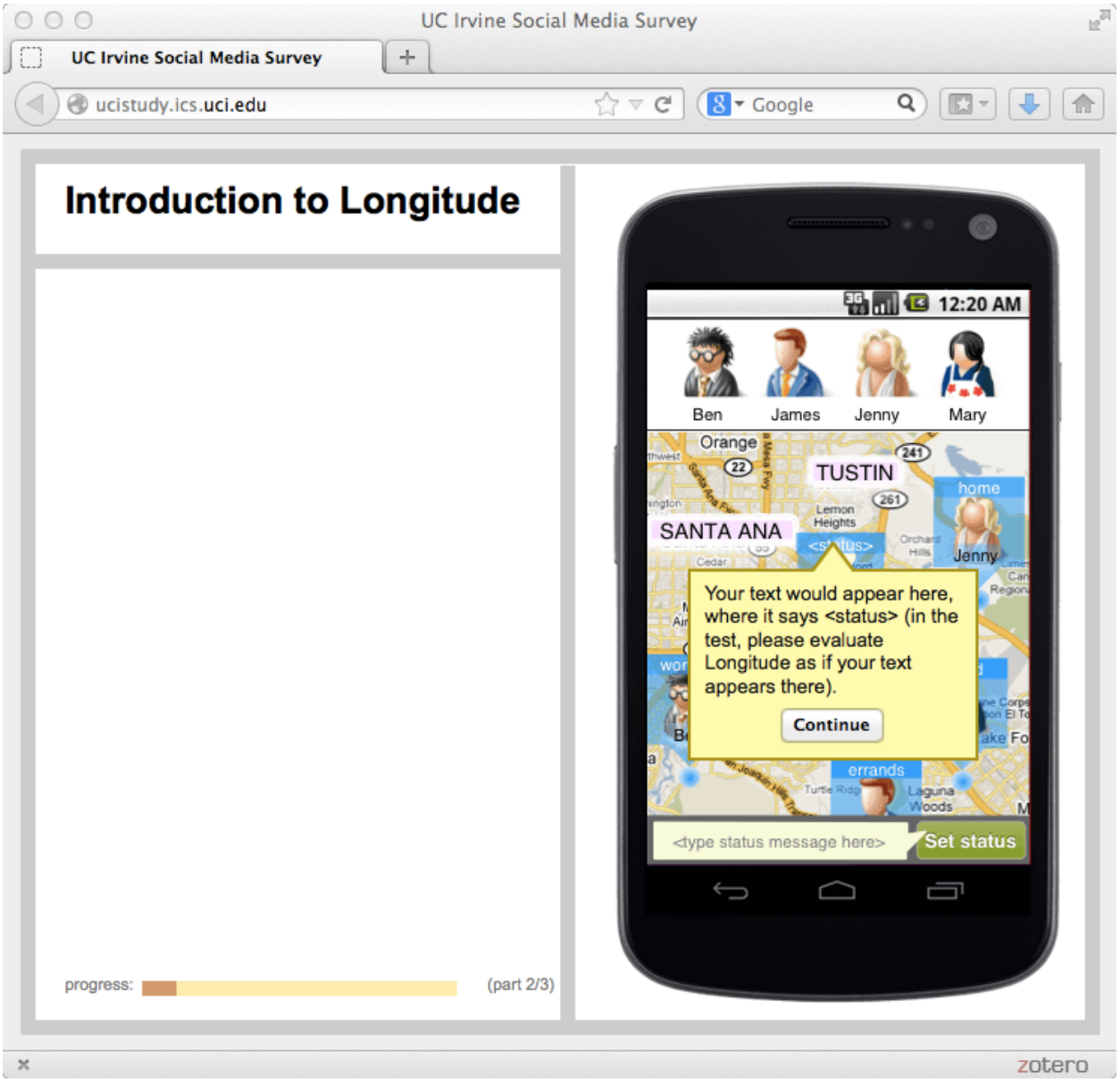
Check-in sharing without Signaling

The design is exactly the same as the Check-in sharing with Signaling except that there is no text field to include a message with the user's check-in:

Continuous sharing with Signaling


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
home
Jenny
me
working
bored
Your Longitude friends can always see your real-time location on their map.
Continue
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
Lemon Heights
home
Jenny
me
Marine Corps Air Station Tustin
At any point, you can set a status message to appear next to your icon.
Continue
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
home
Jenny
Your text would appear here, where it says <status> (in the test, please evaluate Longitude as if your text appears there).
Continue
errands
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
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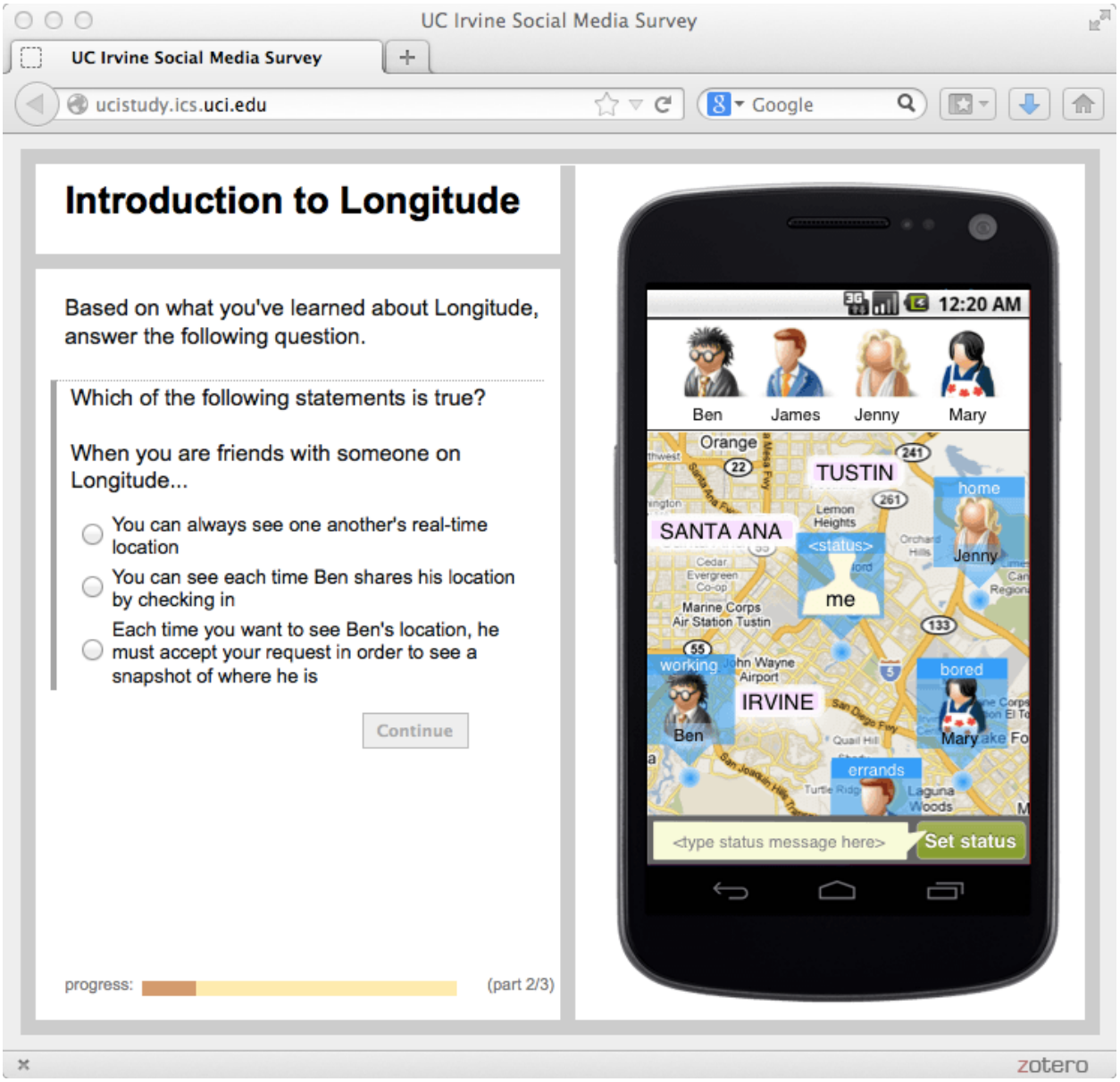
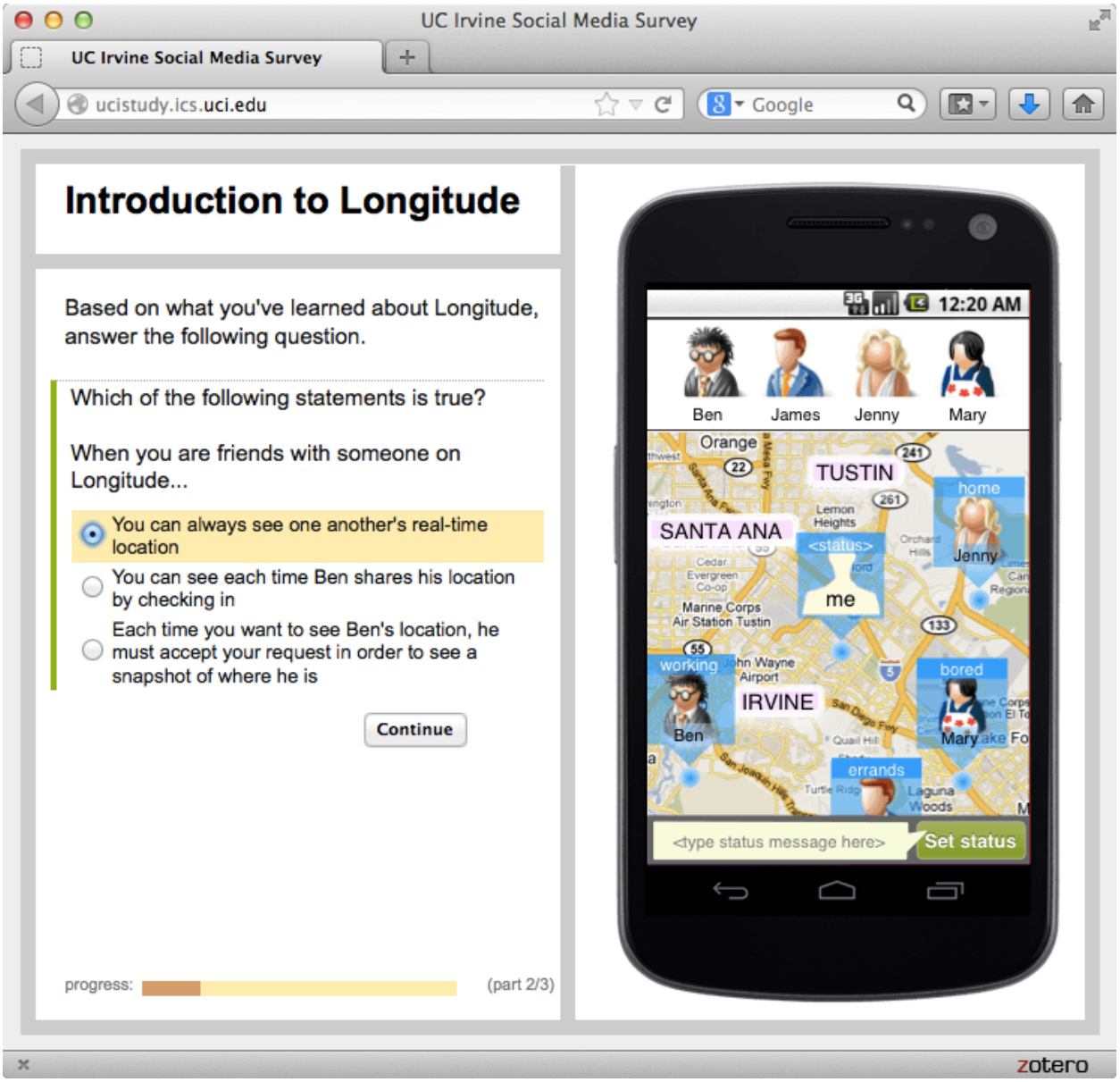
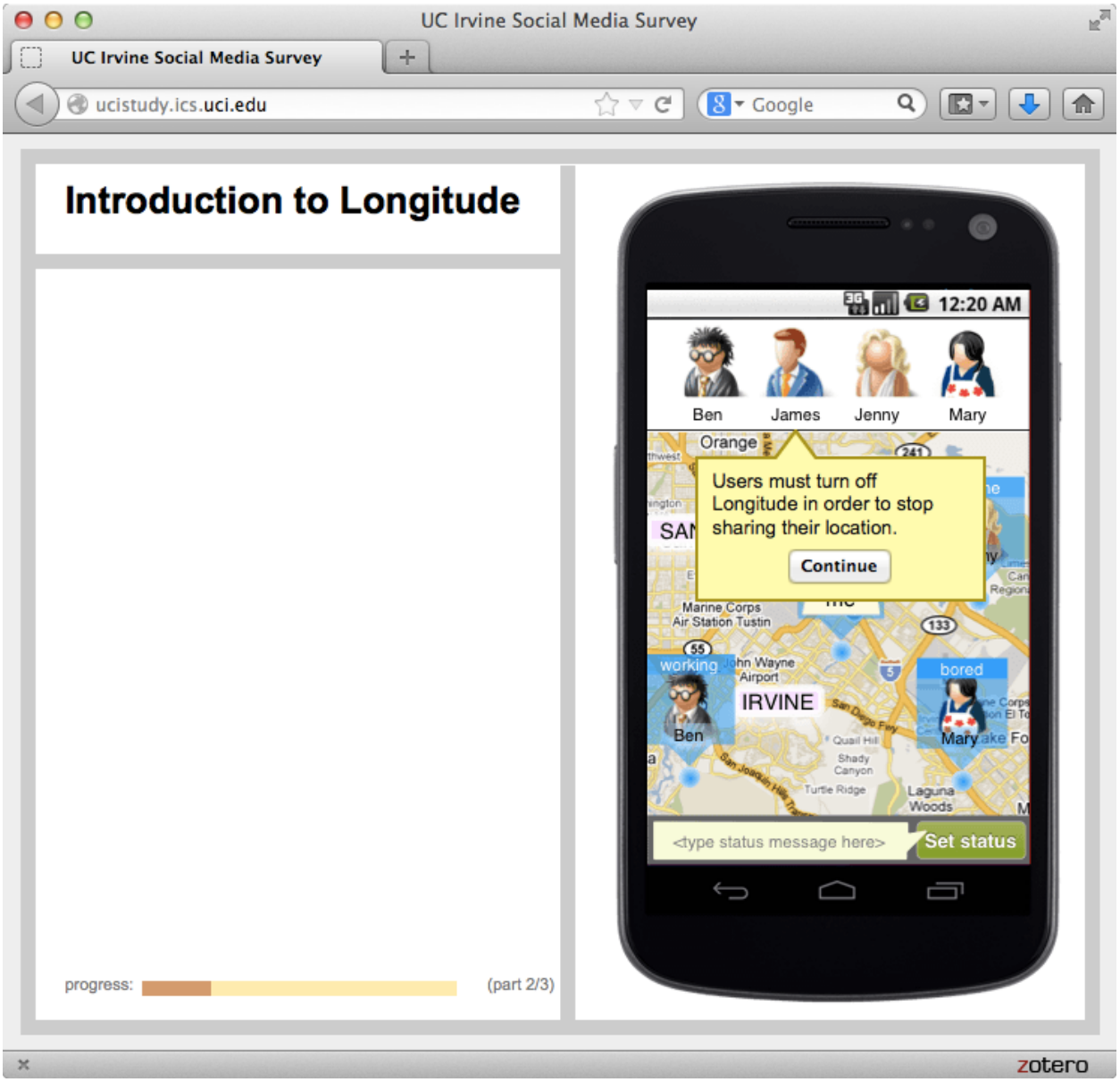
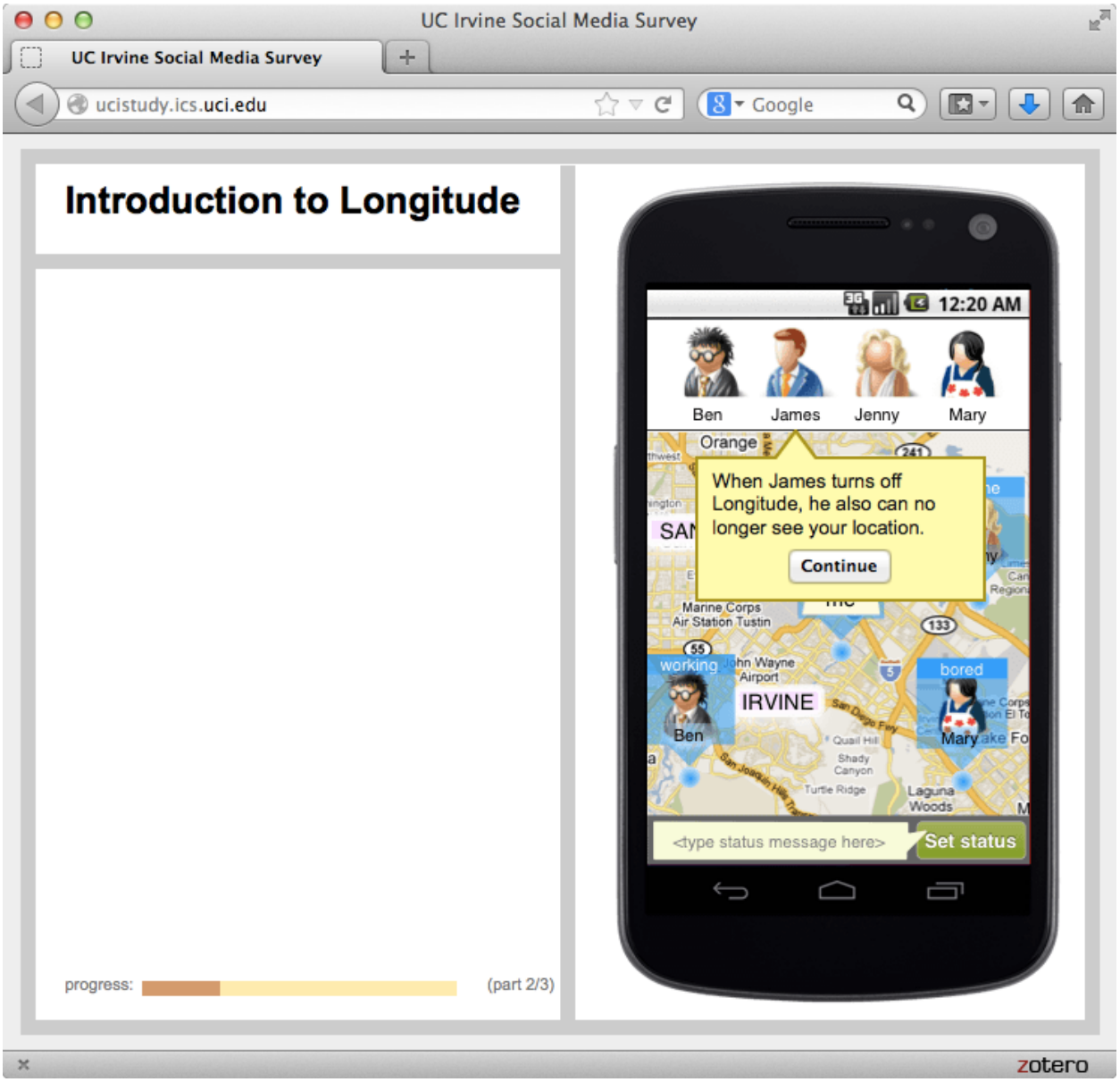
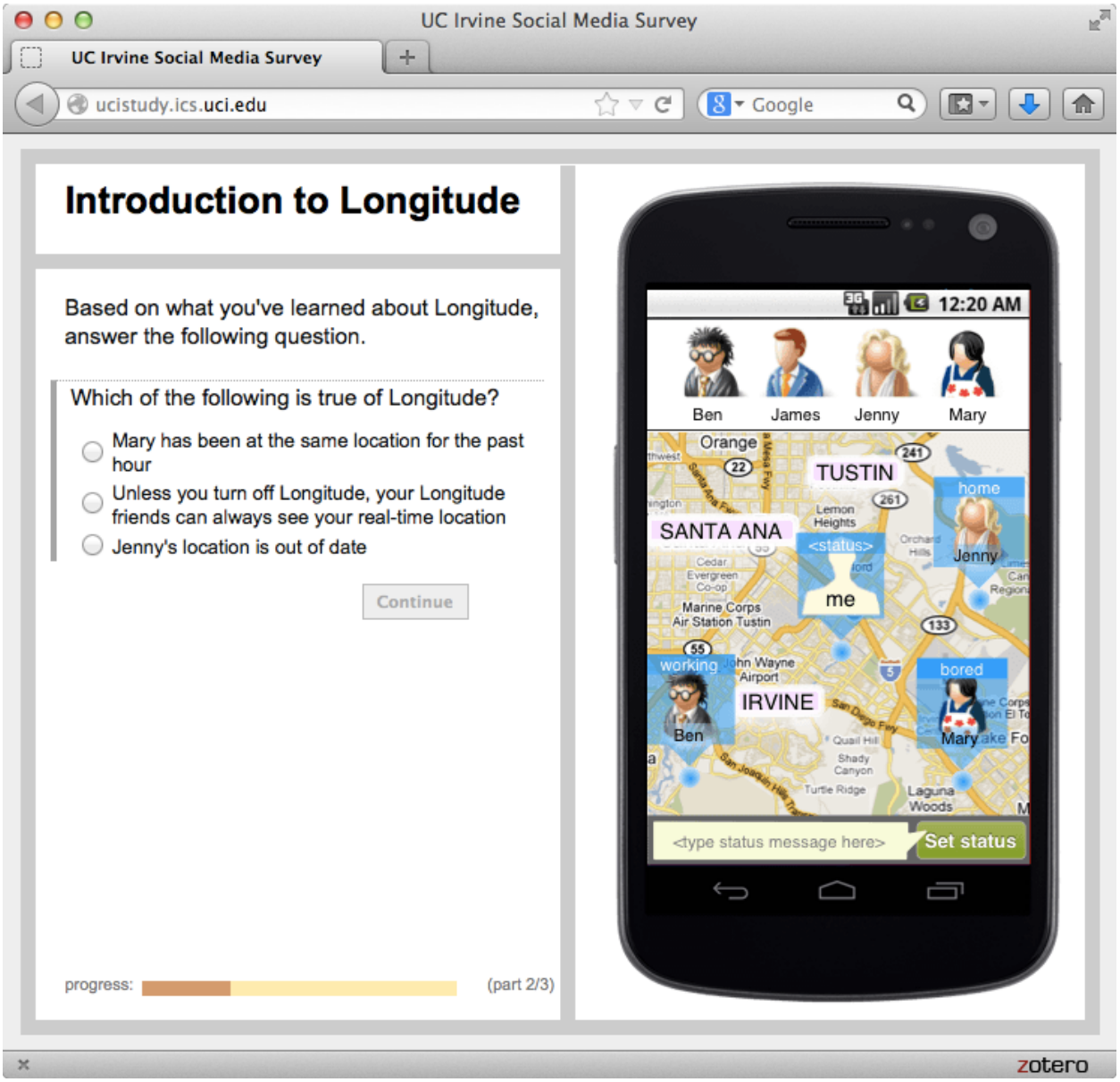
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
You can always see your Longitude friends' real-time location and status message.
Continue
home
Jenny
working
bored
IRVINE
Ben
Mary
errands
<type status message here>
Set status
zotero

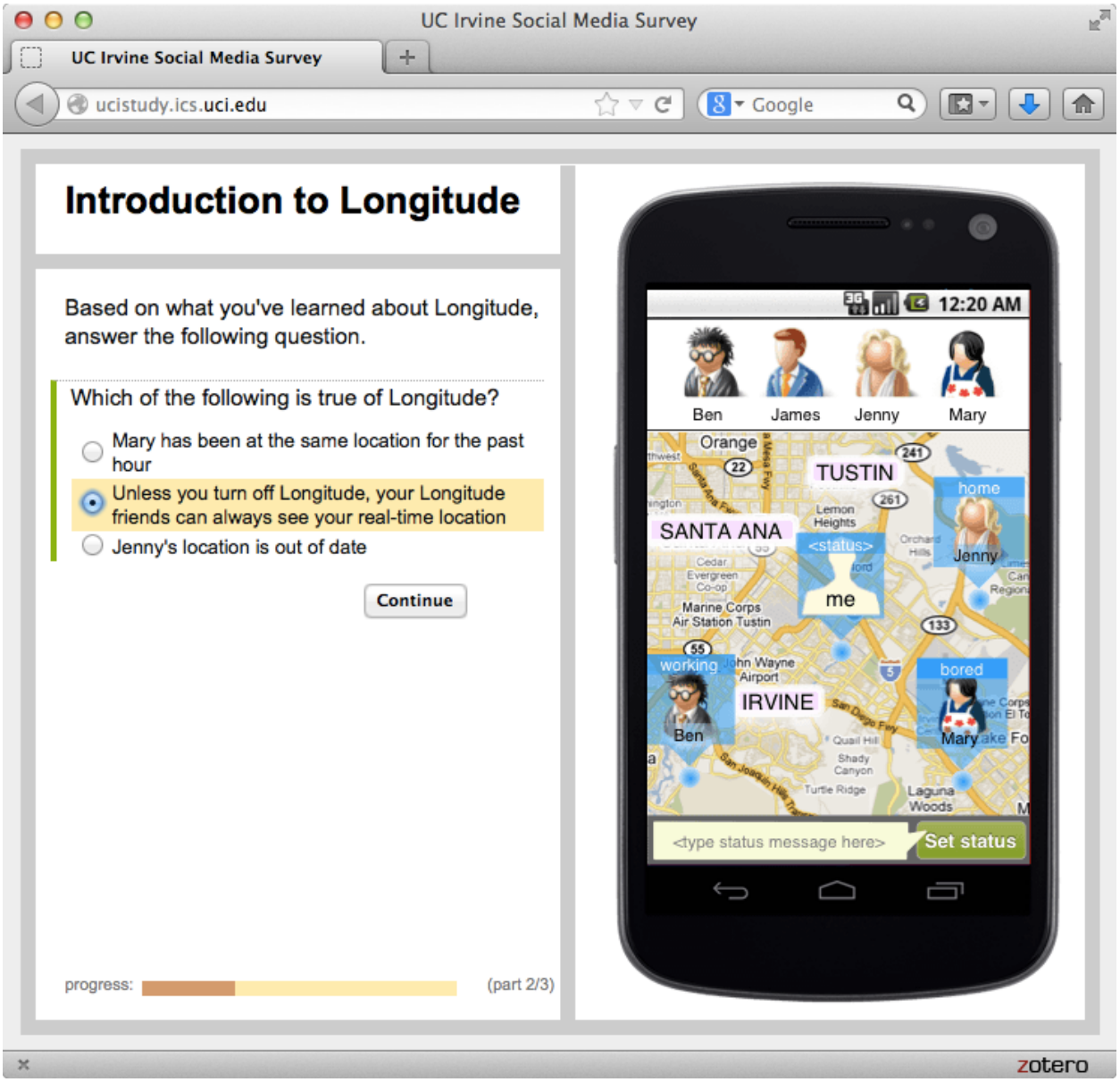

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following statements is true?
When you are friends with someone on Longitude...
You can always see one another's real-time location
You can see each time Ben shares his location by checking in
Each time you want to see Ben's location, he must accept your request in order to see a snapshot of where he is
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
home
<status>
me
Marine Corps Air Station Tustin
working
IRVINE
bored
errands
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following statements is true?
When you are friends with someone on Longitude...
You can always see one another's real-time location
You can see each time Ben shares his location by checking in
Each time you want to see Ben's location, he must accept your request in order to see a snapshot of where he is
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
home
Jenny
<status>
me
Marine Corps Air Station Tustin
working
IRVINE
bored
Ben
Mary
errands
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Users must turn off Longitude in order to stop sharing their location.
Continue
Orange
Marine Corps Air Station Tustin
John Wayne Airport
IRVINE
working
bored
Ben
Mary
Shady Canyon
Turtle Ridge
Laguna Woods
<type status message here>
Set status
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
When James turns off Longitude, he also can no longer see your location.
Continue
Orange
Marine Corps Air Station Tustin
John Wayne Airport
IRVINE
working
bored
Ben
Mary
Shady Canyon
Turtle Ridge
Laguna Woods
<type status message here>
Set status
zotero

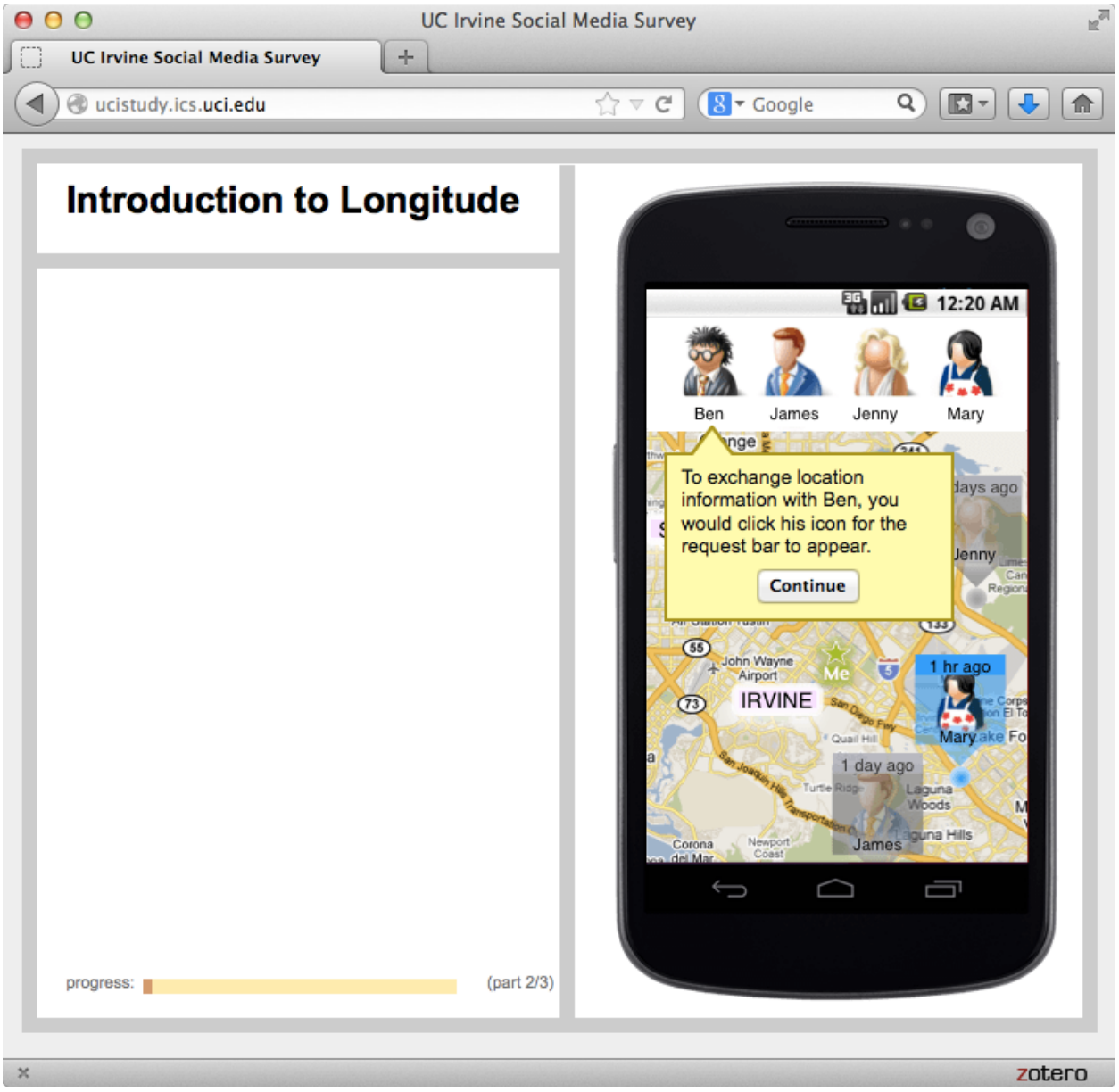

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
home
Jenny
<status>
me
working
Ben
bored
Mary
Marine Corps Air Station Tustin
John Wayne Airport
Lemon Heights
Shady Canyon
Turtle Ridge
Laguna Woods
<type status message here>
Set status
zotero

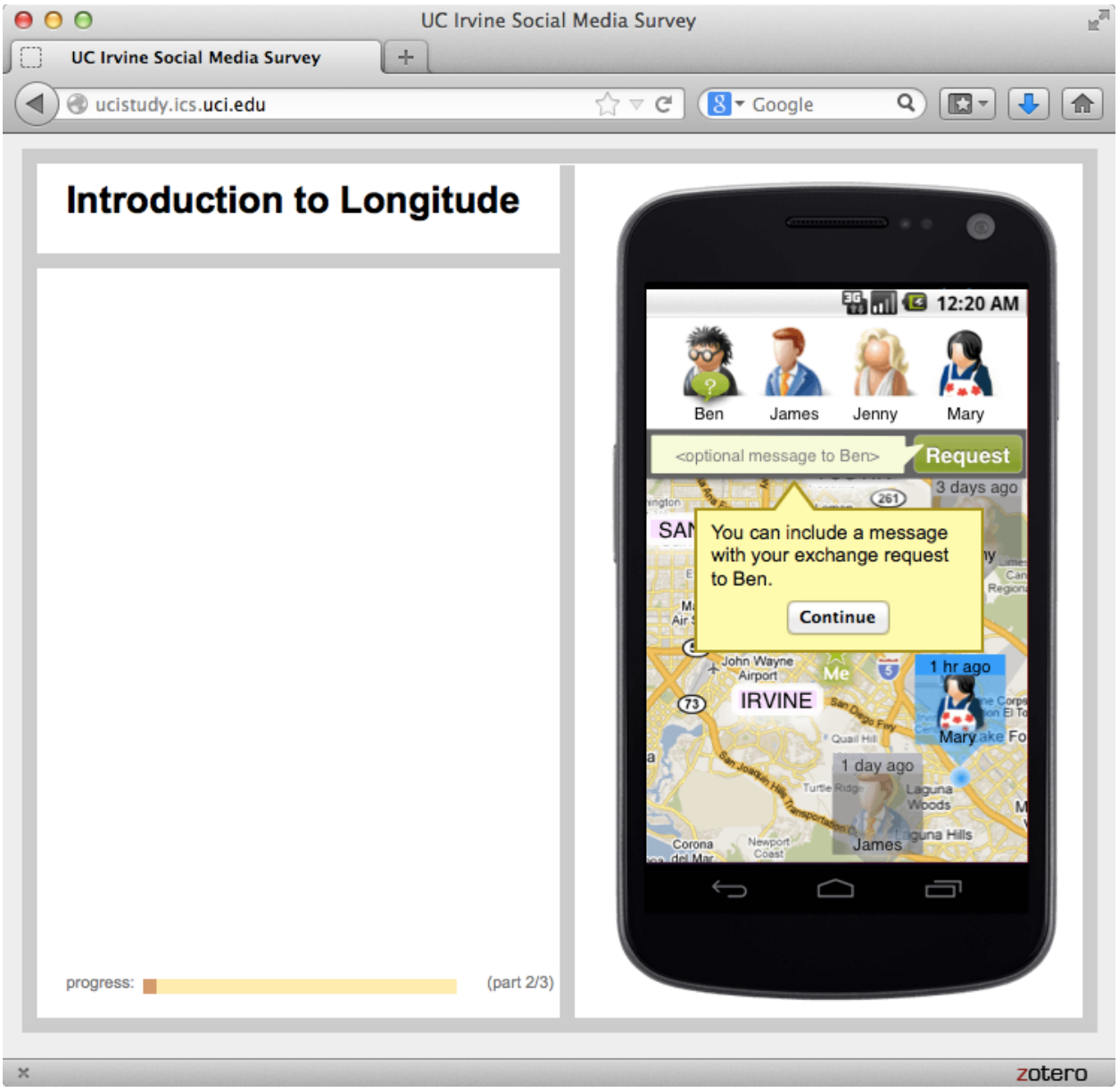

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
<status>
me
home
Jenny
working
bored
IRVINE
Ben
Mary
<type status message here>
Set status
zotero

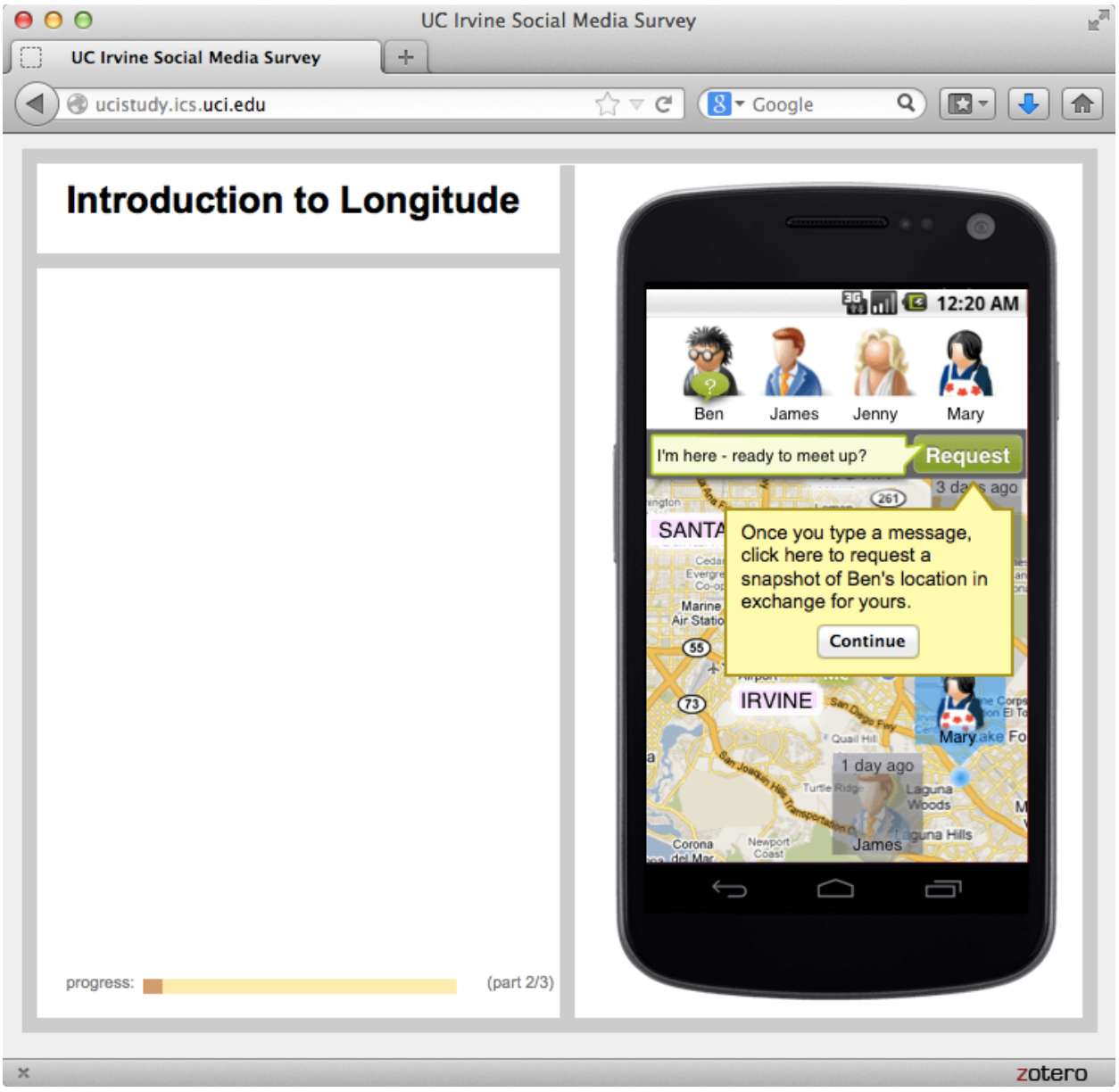
Continuous sharing without Signaling

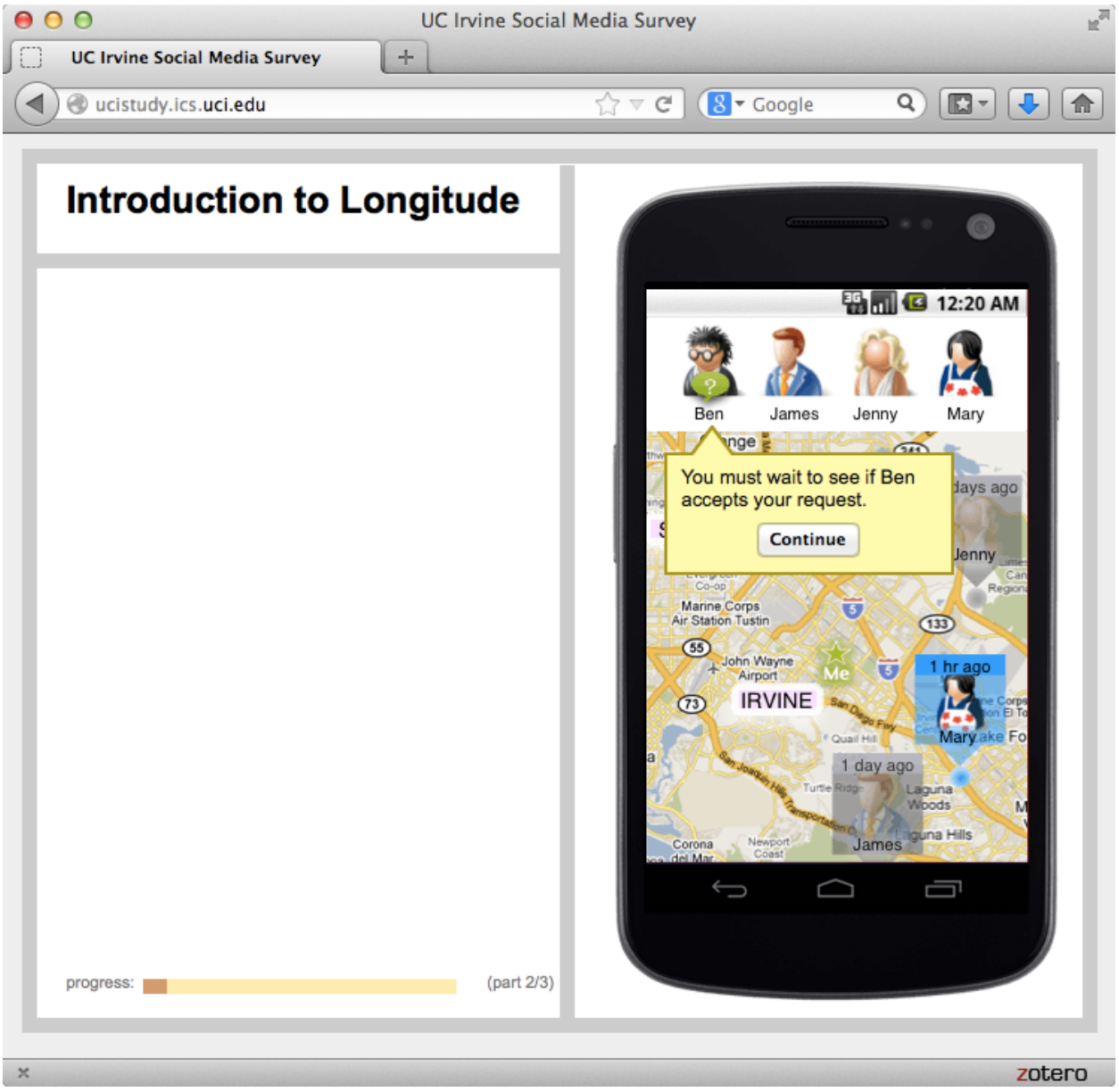
The design is exactly the same as the Continuous sharing with Signaling except that there is no text field to type or display a status:

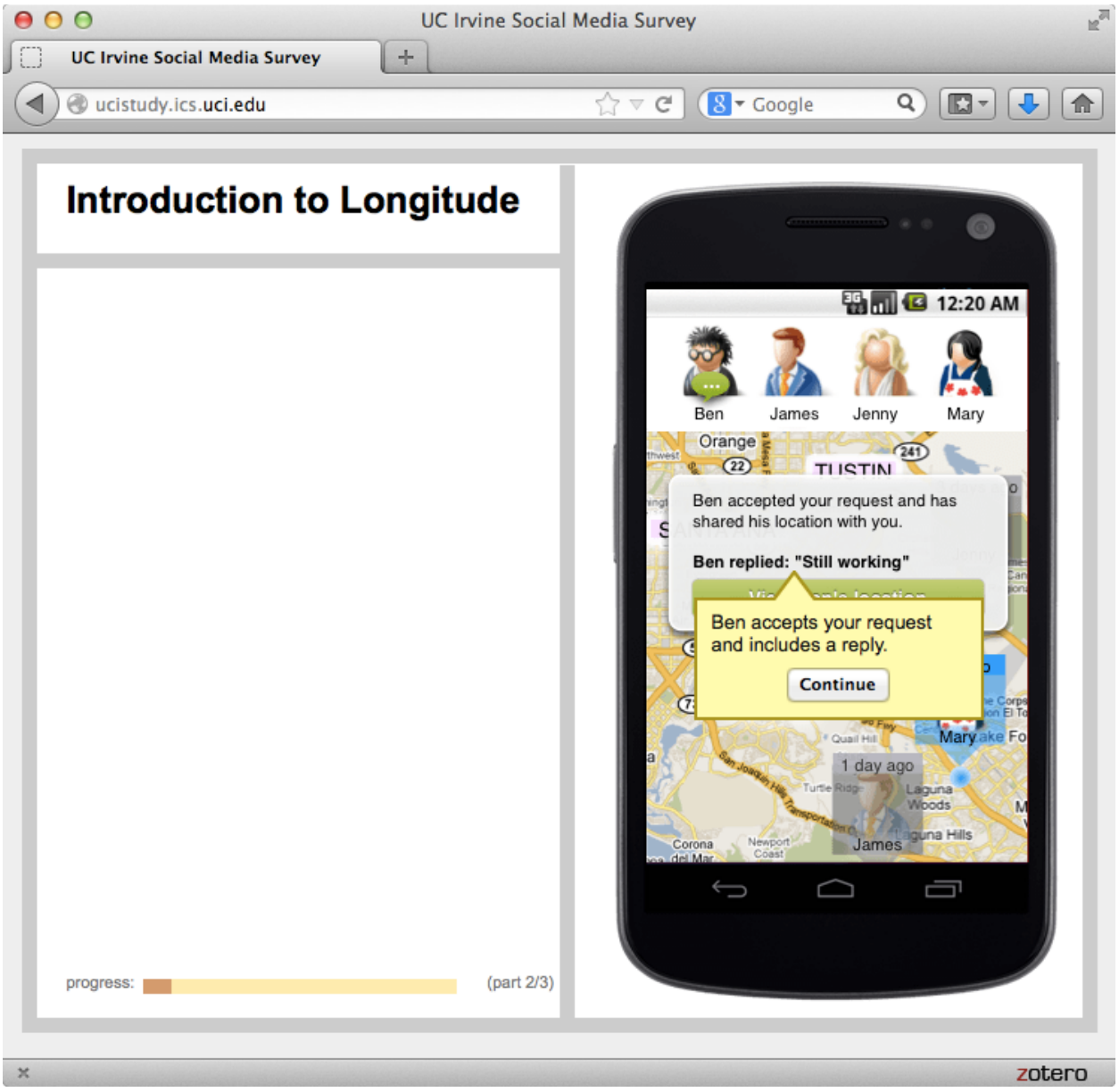
Request-based sharing with Signaling

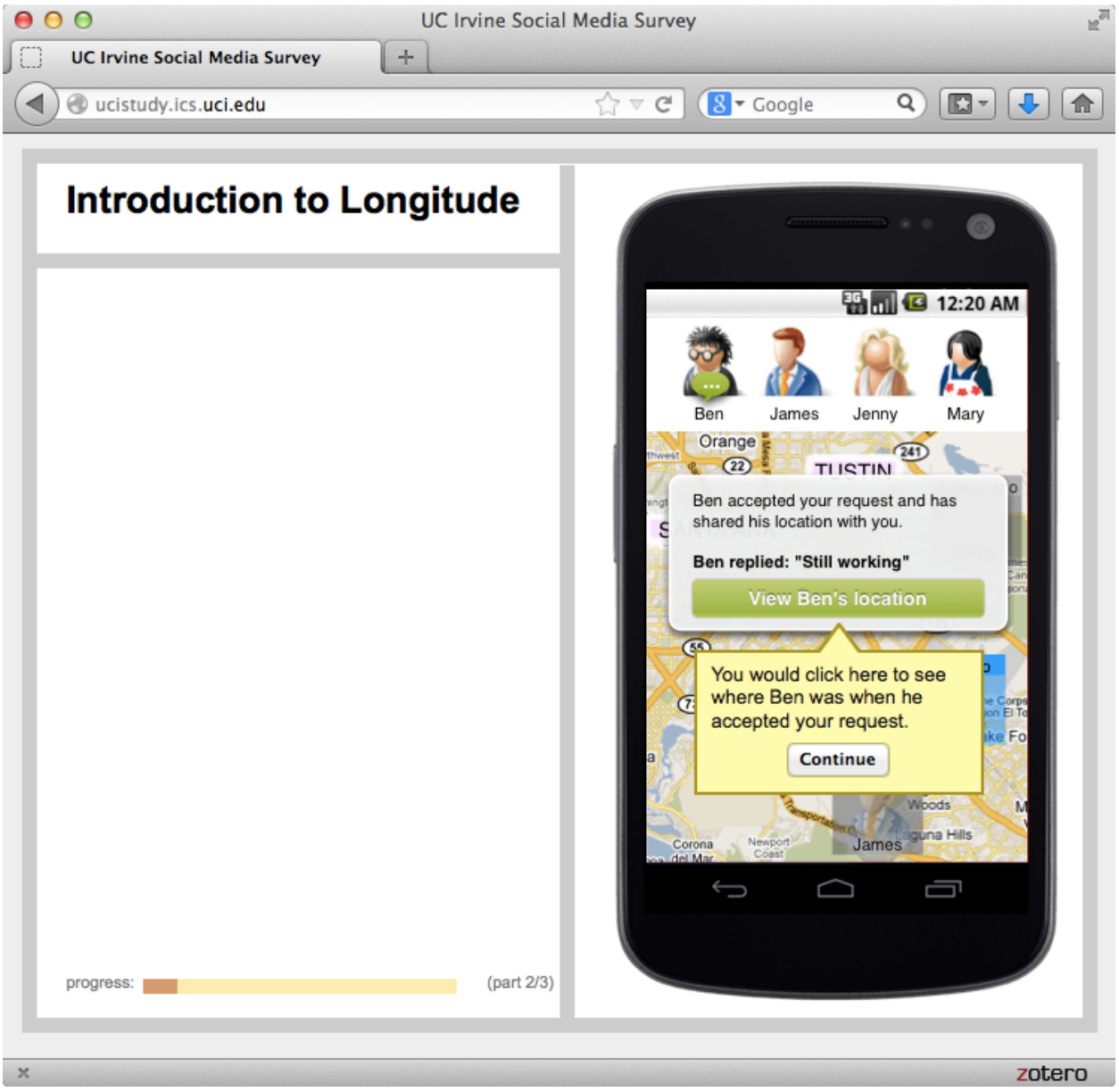

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
To exchange location information with Ben, you would click his icon for the request bar to appear.
Continue
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
1 day ago
James
Laguna Woods
Laguna Hills
Corona del Mar
Newport Coast
zotero

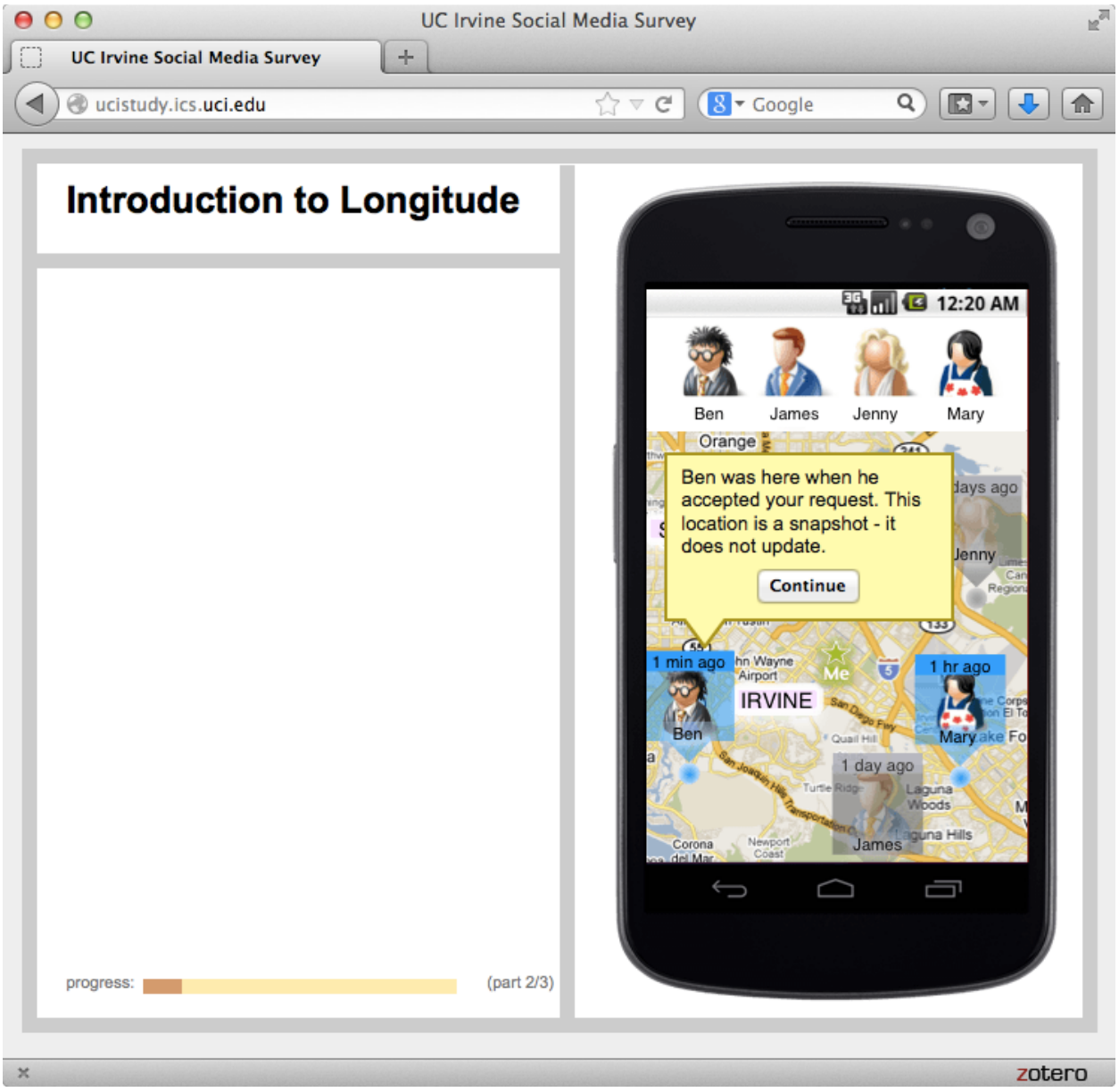

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
<optional message to Ben>
Request
3 days ago
You can include a message with your exchange request to Ben.
Continue
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
1 day ago
James
Laguna Woods
Corona del Mar
Newport Coast
zotero

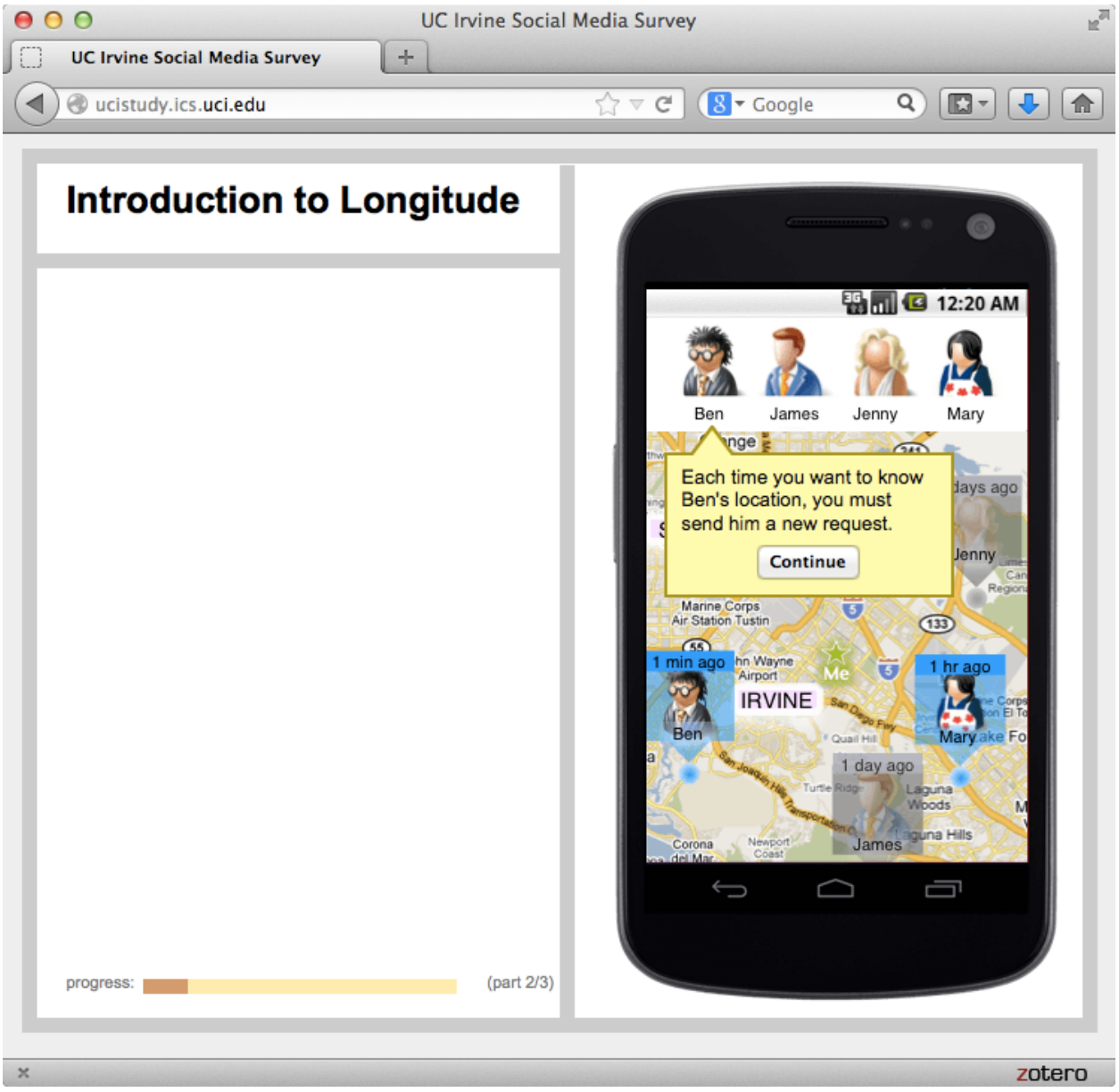

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
I'm here - ready to meet up?
Request
Once you type a message, click here to request a snapshot of Ben's location in exchange for yours.
Continue
IRVINE
1 day ago
James
zotero

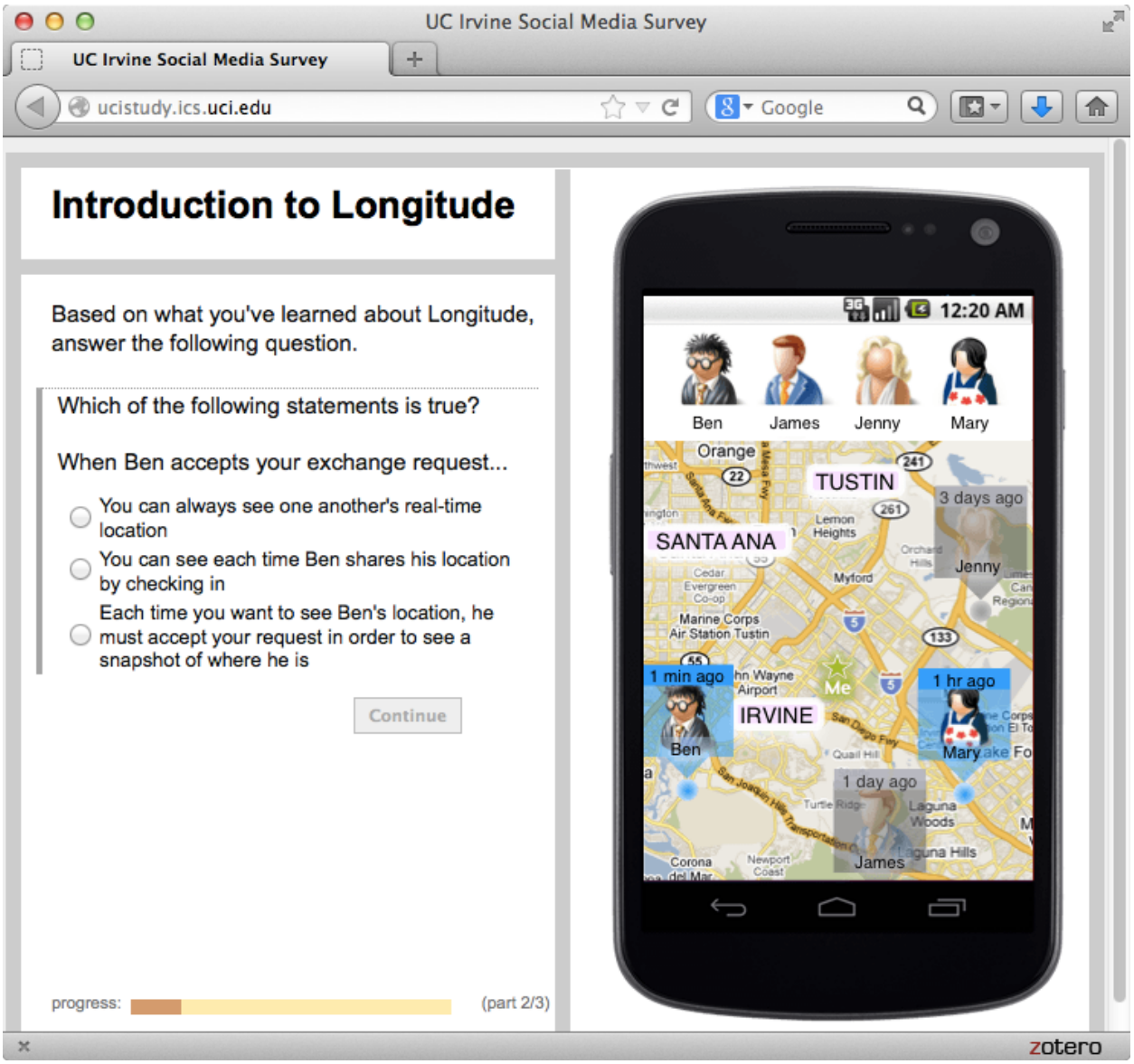

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
You must wait to see if Ben accepts your request.
Continue
Marine Corps Air Station Tustin
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
1 day ago
James
Laguna Woods
Corona del Mar
Newport Coast
zotero

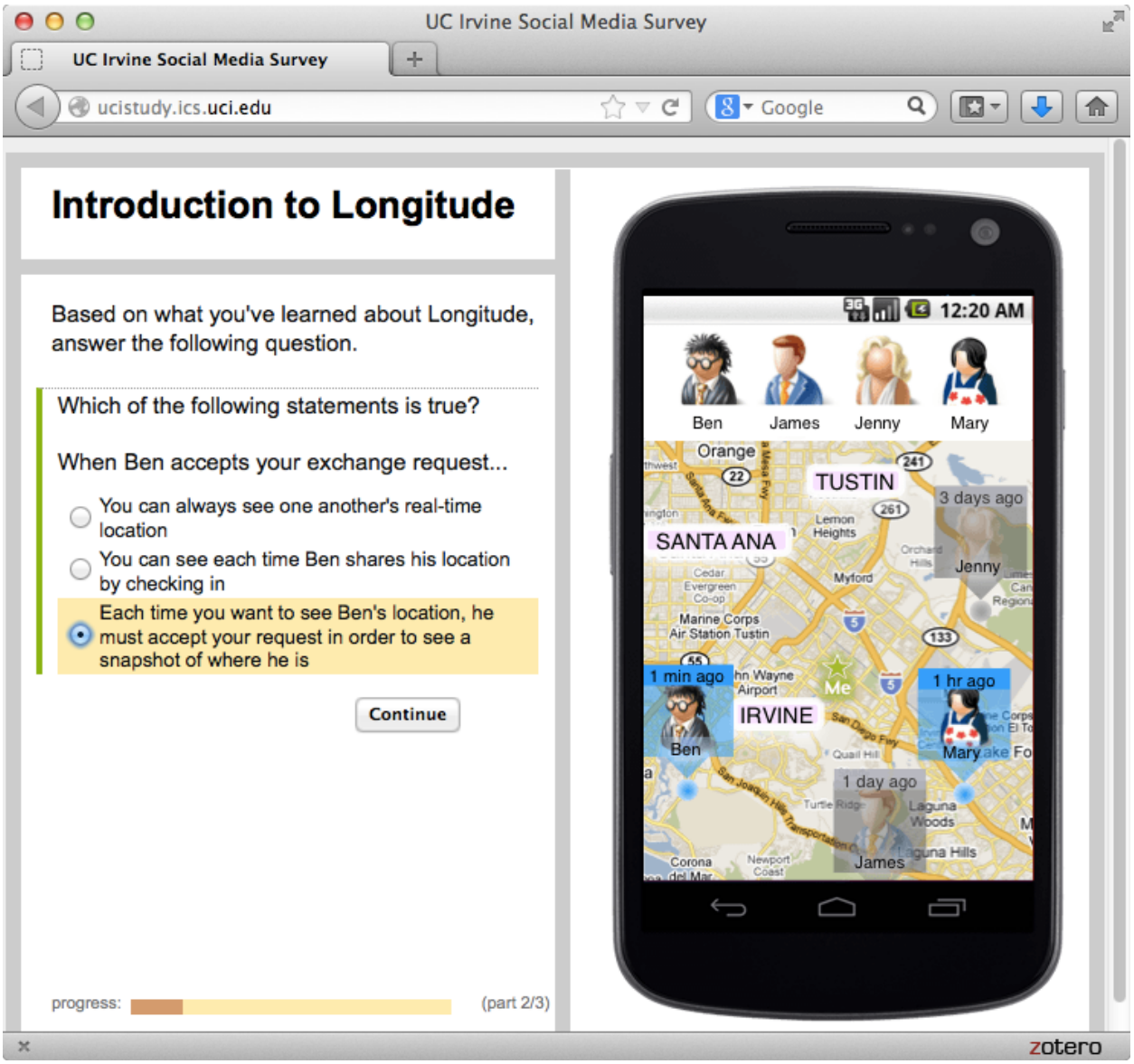

UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
Ben accepted your request and has shared his location with you.
Ben replied: "Still working"
Ben accepts your request and includes a reply.
Continue
1 day ago
Laguna Woods
Laguna Hills
Corona del Mar
Newport Coast
James
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
Ben accepted your request and has shared his location with you.
Ben replied: "Still working"
View Ben's location
You would click here to see where Ben was when he accepted your request.
Continue
Woods
Laguna Hills
James
Corona del Mar
Newport Coast
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Ben was here when he accepted your request. This location is a snapshot - it does not update.
Continue
1 min ago
1 hr ago
1 day ago
Me
IRVINE
Orange
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Each time you want to know Ben's location, you must send him a new request.
Continue
Marine Corps Air Station Tustin
1 min ago
Me
IRVINE
1 hr ago
Ben
Mary
1 day ago
James
Laguna Woods
Corona del Mar
Newport Coast
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following statements is true?
When Ben accepts your exchange request...
You can always see one another's real-time location
You can see each time Ben shares his location by checking in
Each time you want to see Ben's location, he must accept your request in order to see a snapshot of where he is
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Me
3 days ago
1 min ago
1 hr ago
1 day ago
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following statements is true?
When Ben accepts your exchange request...
You can always see one another's real-time location
You can see each time Ben shares his location by checking in
Each time you want to see Ben's location, he must accept your request in order to see a snapshot of where he is
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
Me
3 days ago
1 min ago
1 hr ago
1 day ago
zotero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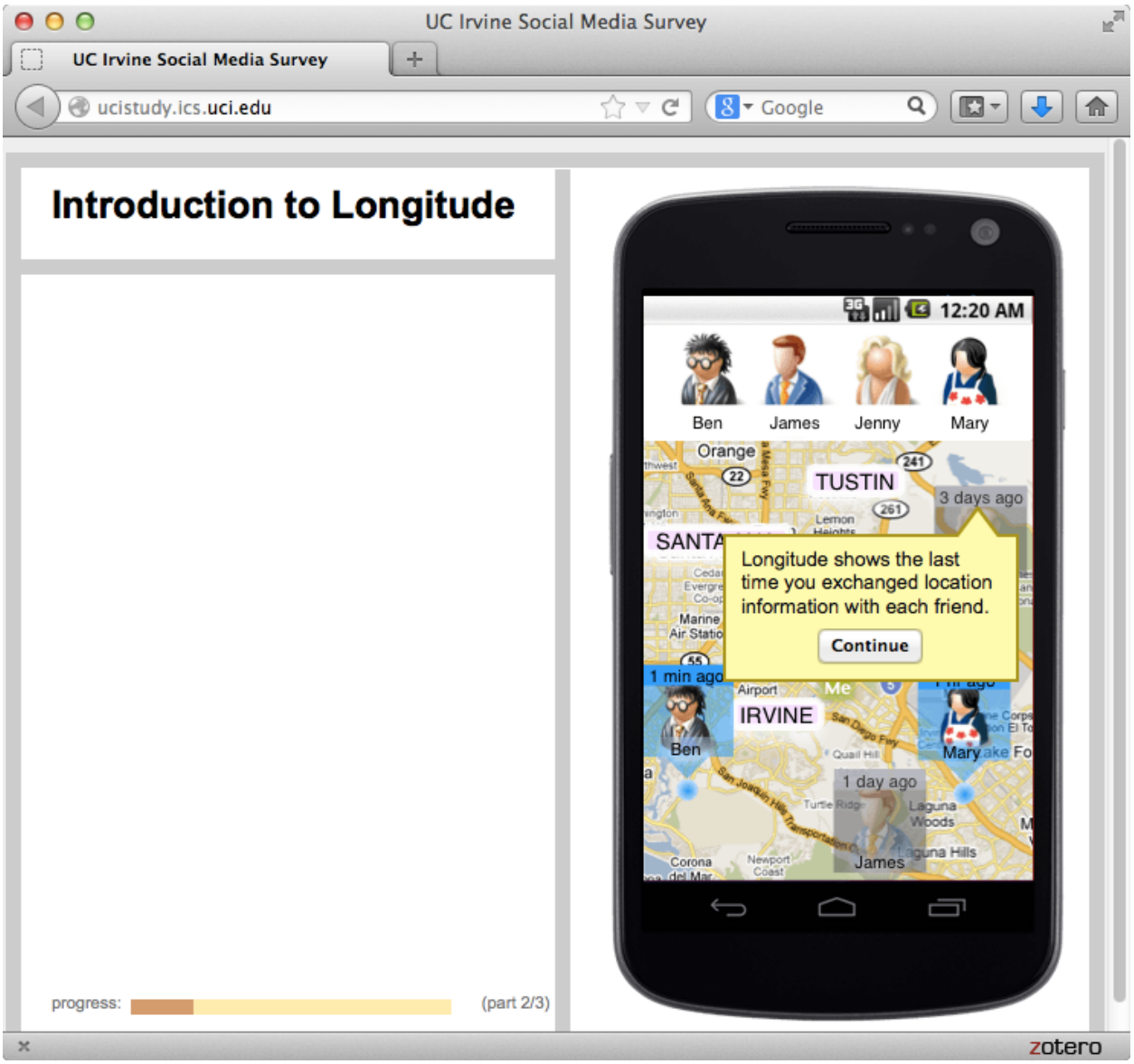
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
3 days ago
Jenny
Lemon Heights
Myford
Marine Corps Air Station Tustin
1 min ago
1 hr ago
Me
IRVINE
The star always shows your current location. Only you can see this.
Continue
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
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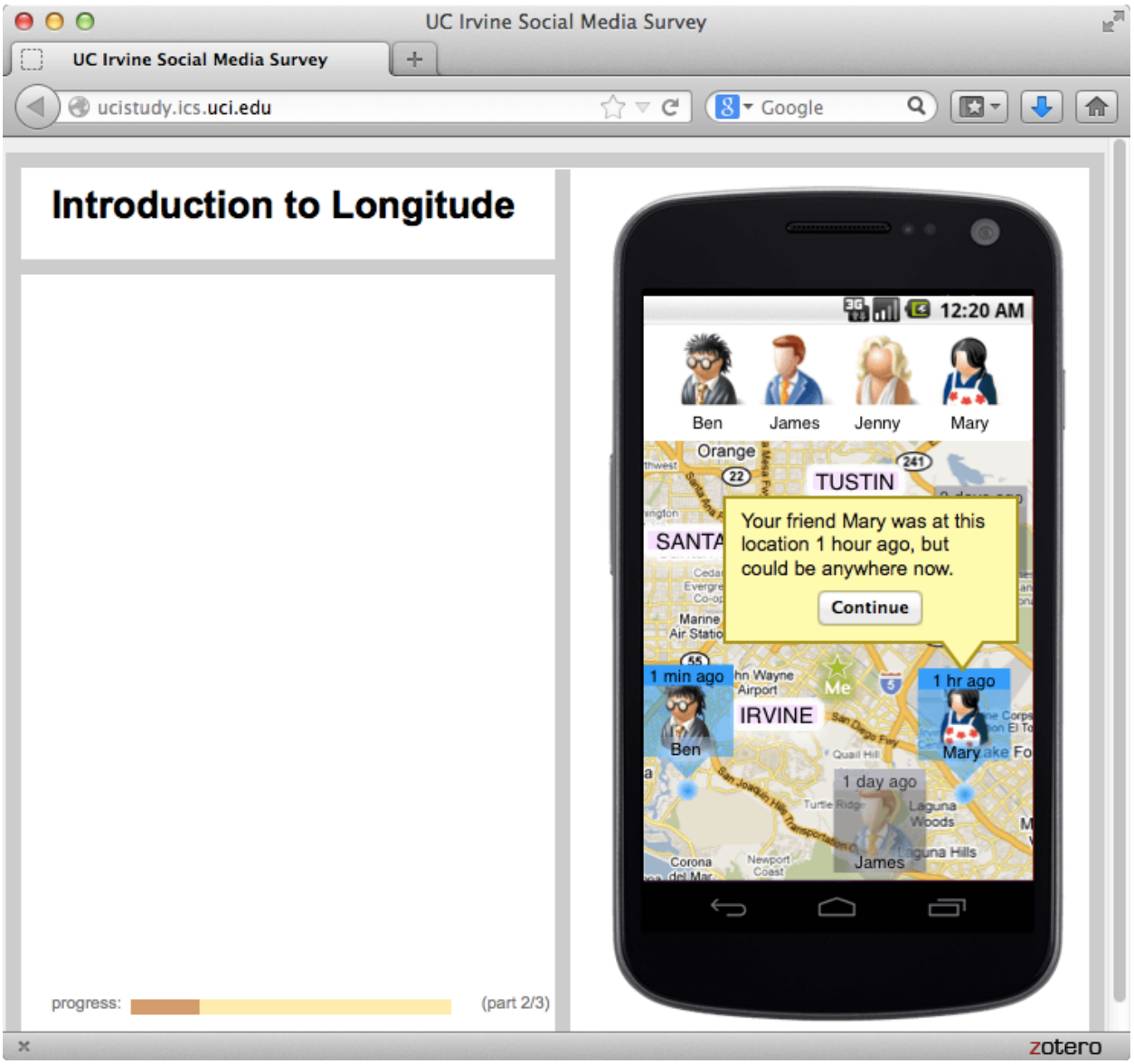
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
3 days ago
Longitude shows the last time you exchanged location information with each friend.
Continue
1 min ago
IRVINE
Me
1 day ago
Laguna Hills
zotero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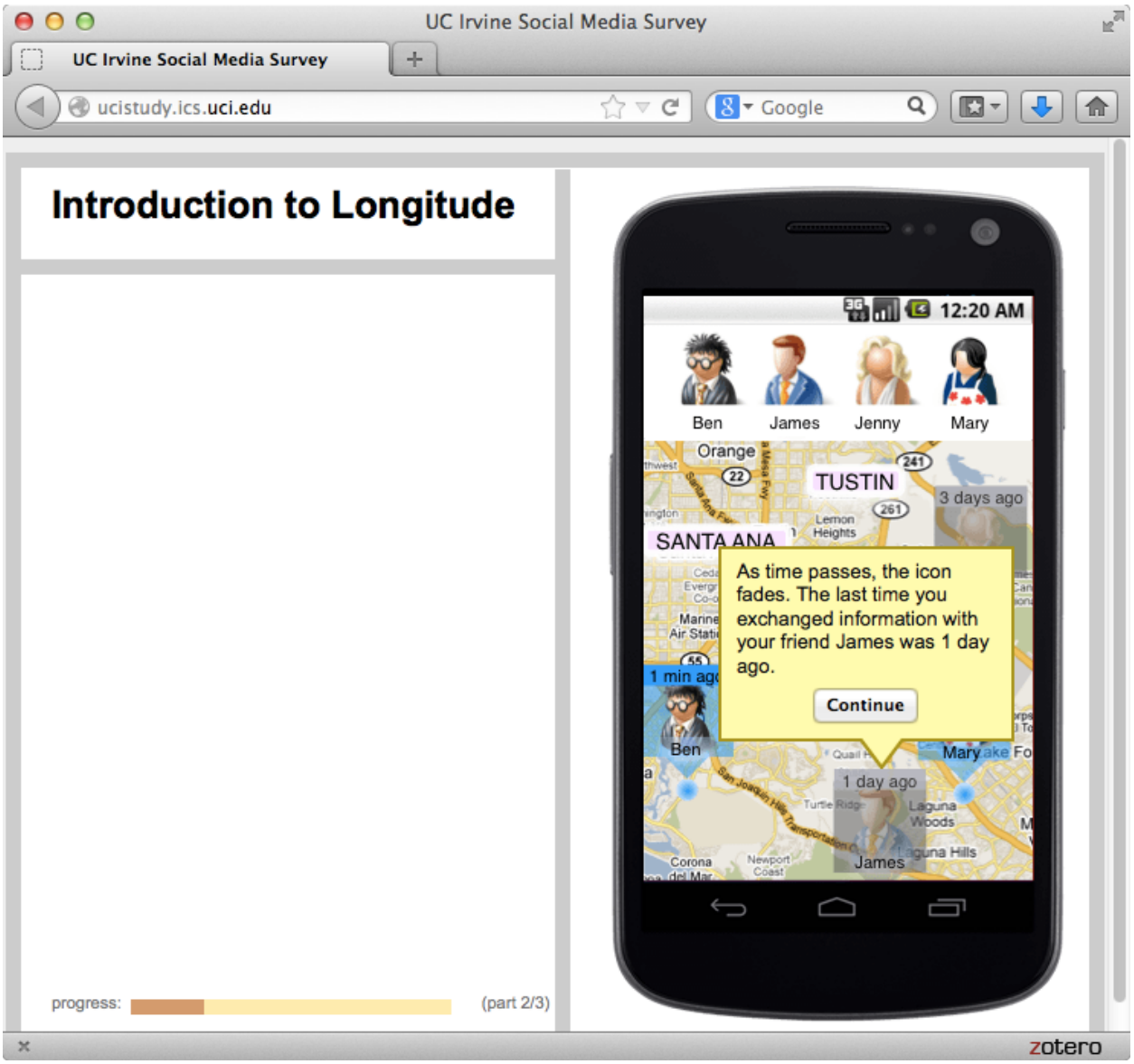
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA
Your friend Mary was at this location 1 hour ago, but could be anywhere now.
Continue
1 min ago
1 hr ago
IRVINE
Me
Ben
Mary
1 day ago
James
Laguna Woods
Laguna Hills
Corona del Mar
Newport Coast
zotero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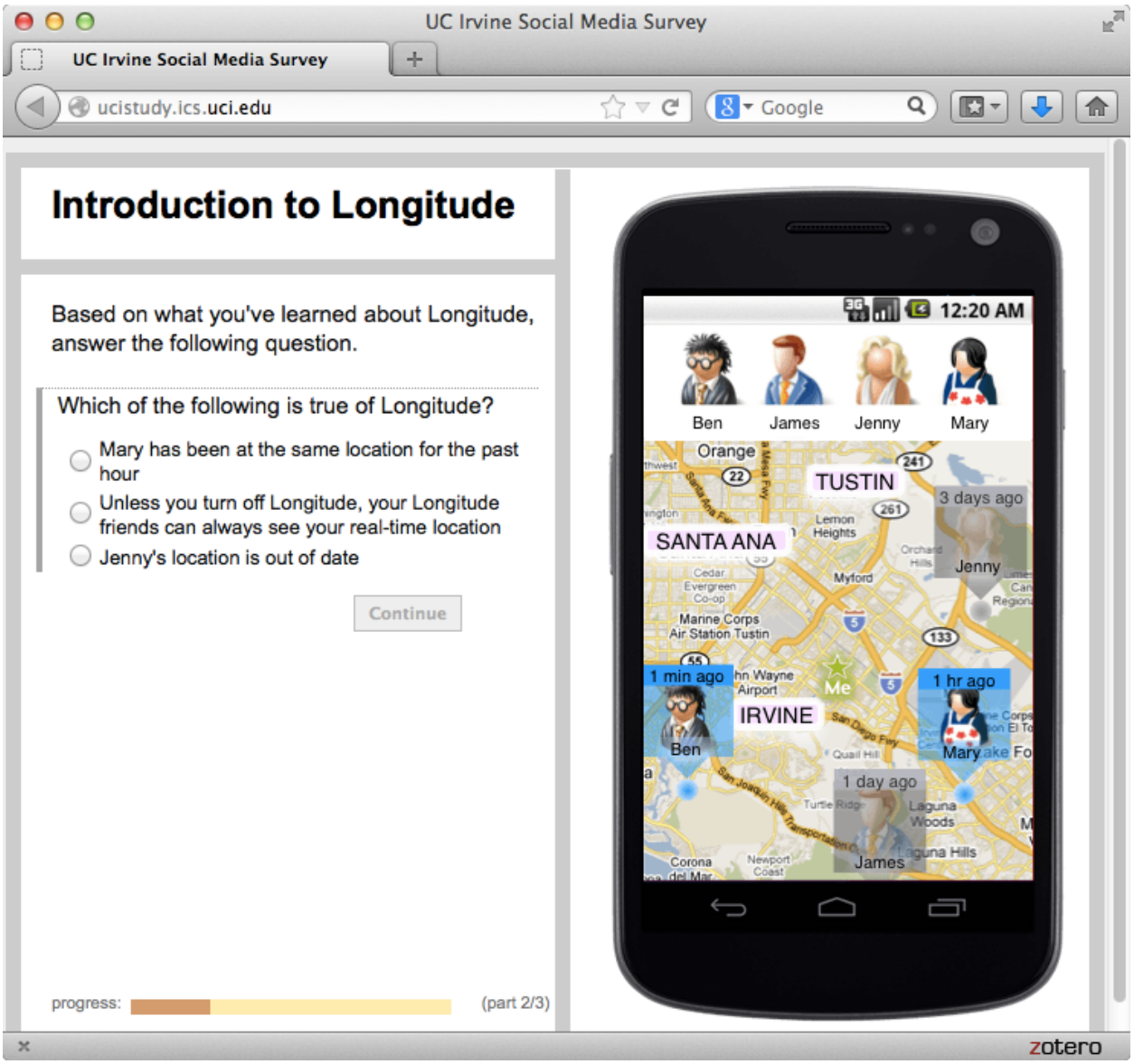
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
3 days ago
1 min ago
As time passes, the icon fades. The last time you exchanged information with your friend James was 1 day ago.
Continue
1 day ago
zotero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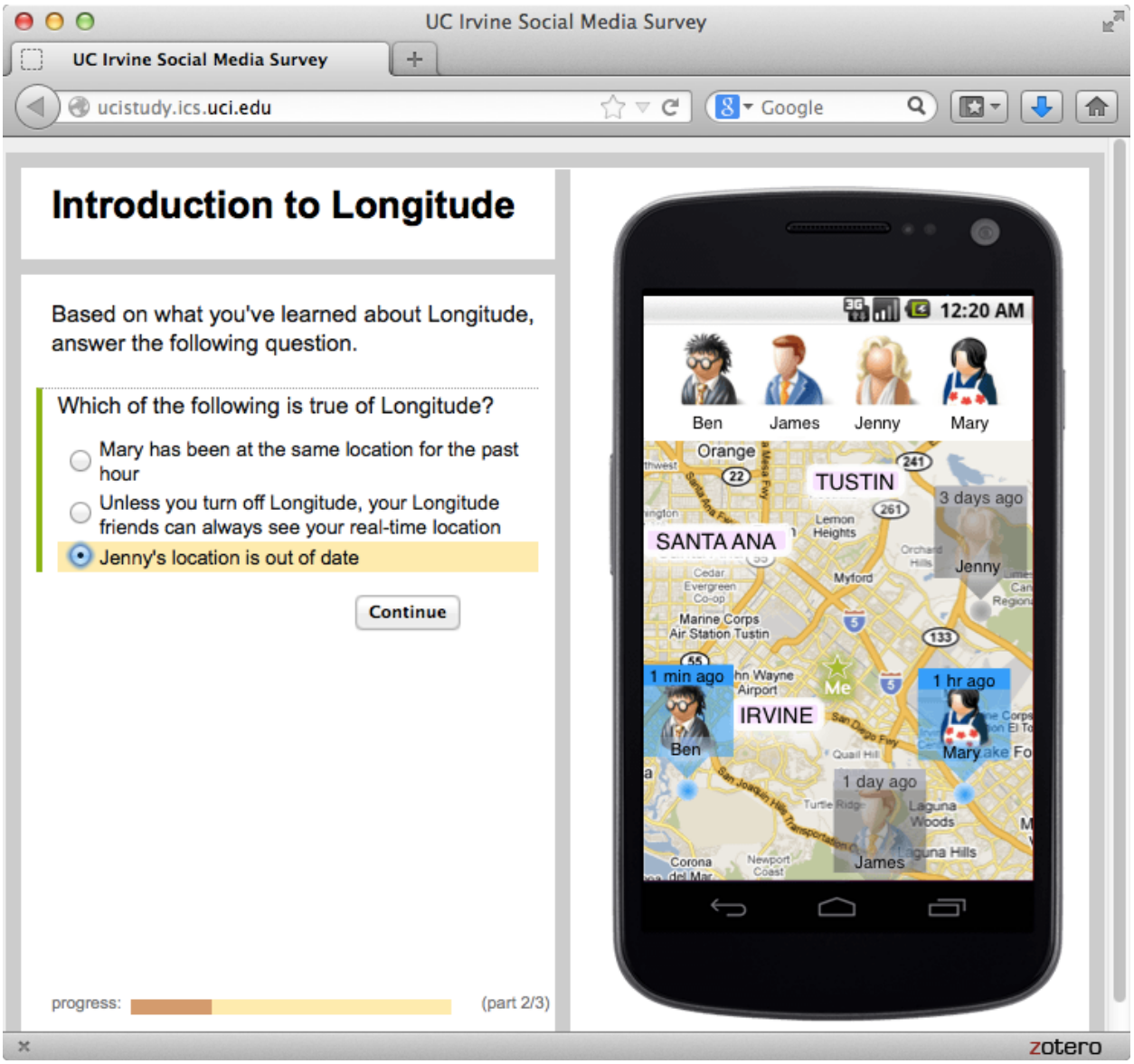
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
3 days ago
1 min ago
1 hr ago
1 day ago
Me
zotero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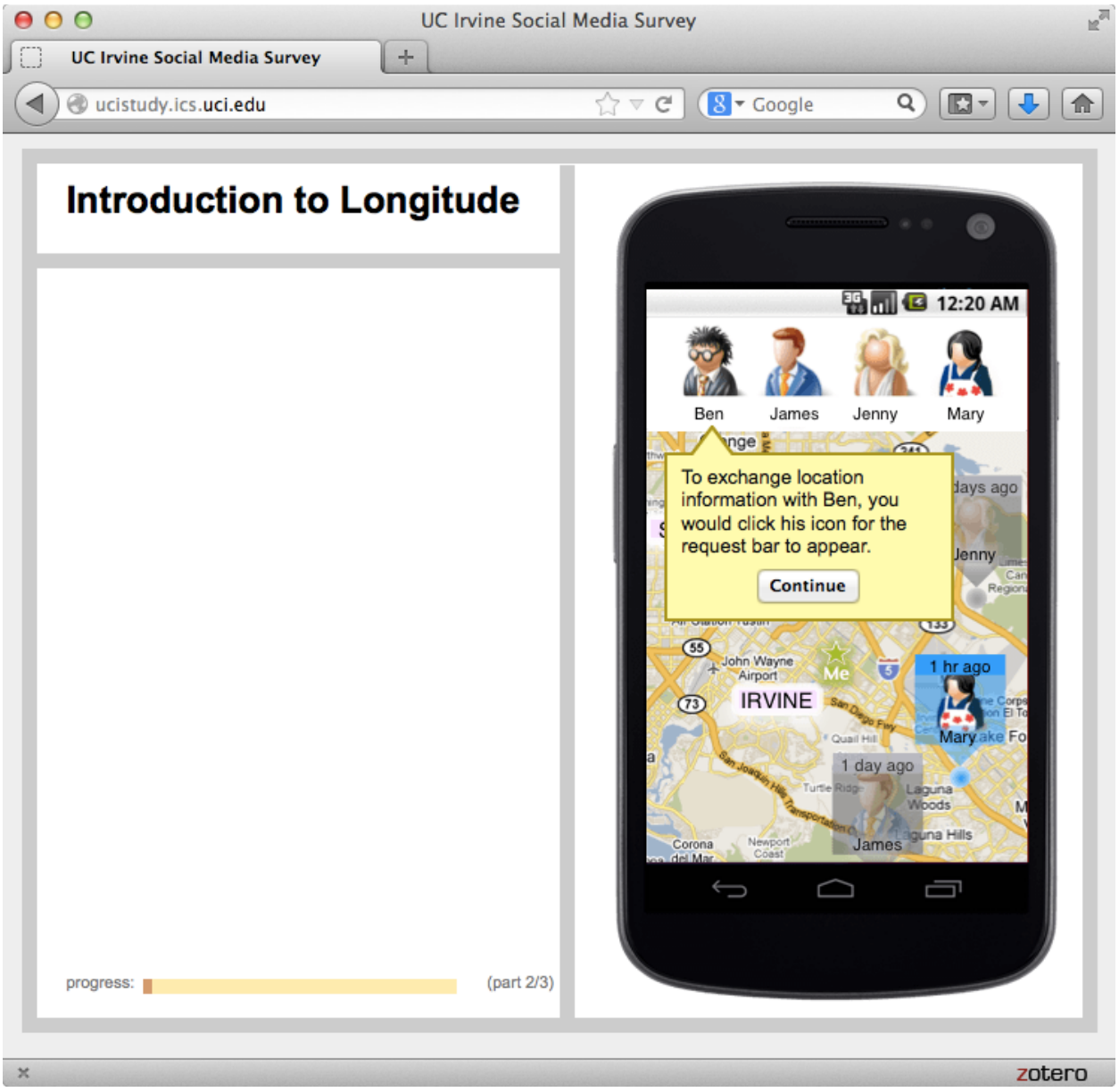
Google
Introduction to Longitude
Based on what you've learned about Longitude, answer the following question.
Which of the following is true of Longitude?
Mary has been at the same location for the past hour
Unless you turn off Longitude, your Longitude friends can always see your real-time location
Jenny's location is out of date
Continue
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
SANTA ANA
IRVINE
3 days ago
1 min ago
1 hr ago
1 day ago
Me
zotero

Request-based sharing without Signaling

The design is exactly the same as the Request-based sharing with Signaling except that there is no message field to type a message when requesting location: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Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
To exchange location information with Ben, you would click his icon for the request bar to appear.
Continue
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
1 day ago
James
Laguna Woods
Corona del Mar
Newport Coast
zotero


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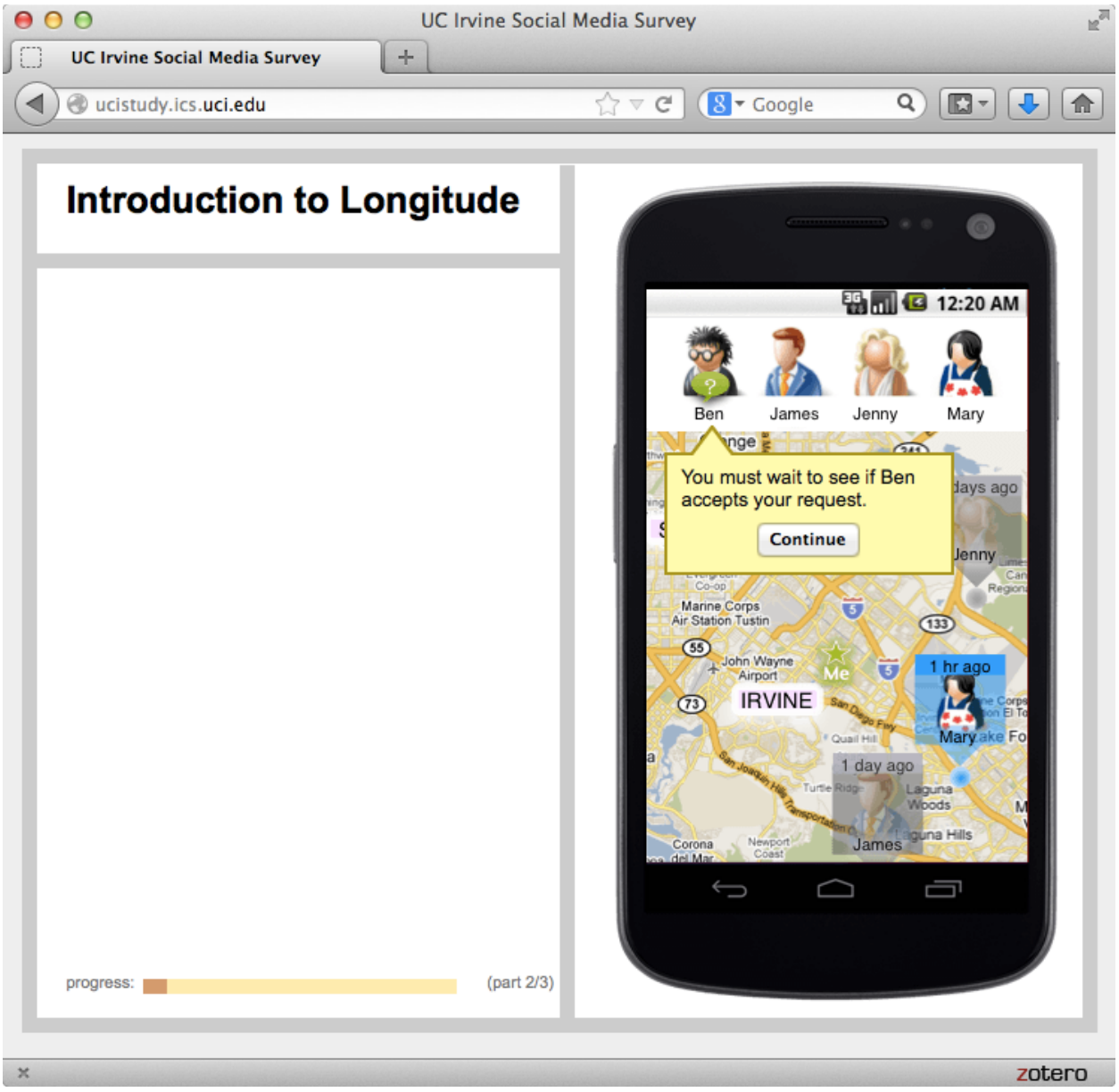
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
Orange
TUSTIN
3 days ago
Request a snapshot of Ben's location in exchange for yours?
Request
Cancel
Click to request a snapshot of Ben's location in exchange for yours.
Continue
Woods
James
Corona del Mar
Newport Coast
zotero


UC Irvine Social Media Survey
UC Irvine Social Media Survey
ucistudy.ics.uci.edu
Google
Introduction to Longitude
progress:
(part 2/3)
12:20 AM
Ben
James
Jenny
Mary
You must wait to see if Ben accepts your request.
Continue
Marine Corps Air Station Tustin
John Wayne Airport
Me
IRVINE
1 hr ago
Mary
1 day ago
James
Laguna Woods
Corona del Mar
Newport Coast
zotero

APPENDIX B: Marginal Effects Graphs

These are the marginal effects graphs for the final model in chapter 7. These can be compared with the total effects graphs for the model to see how closely the model captures the data. As discussed in Chapter 7, most of the graphs are fairly well represented by the model. The noticeable exception is the Intention graph, which has a bit more complex 3-way interaction effects in the marginal effects graph. Thus, the model produced in this research does not account for the additional 3-way interactions. This can be explored in future research.

In all graphs, the x-axis is the FYI score (in standard deviations) and the y-axis is the outcome variable (e.g., Intention to use LSSN). Thus, in the first graph, one can see that a fairly low-FYI scorer at -1 on the x-axis (representing 1 standard deviation below the mean) has much lower Intention to use LSSN scores for all 6 design conditions than for a relatively high-FYI scorer at +1 on the x-axis (representing 1 standard deviation above the mean). Refer to the legend on the right of each graph for the color- and pattern-coded design conditions.

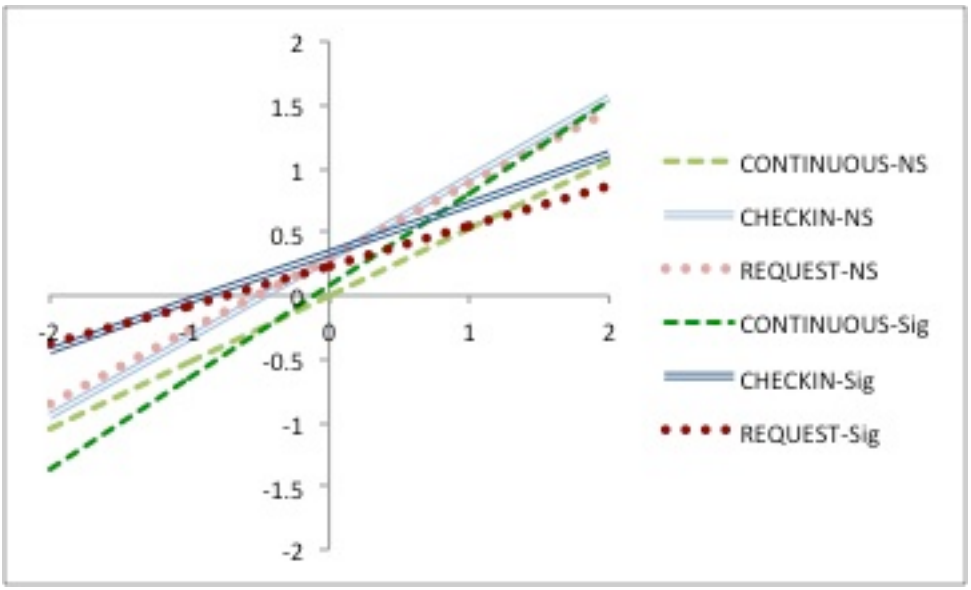


Figure B1: Marginal effects graph for Intention

Variable	Beta	S.E.	p-value
FYI style	0.525	0.091	0.000
Is Check-in Condition	0.301	0.156	0.053
Is Request Condition	0.298	0.145	0.039
Is Signal Condition	0.077	0.158	0.628
FYI X Check-in	0.104	0.159	0.511
FYI X Request	0.051	0.151	0.736
FYI X Signal	0.200	0.154	0.195
Check-in X Signal	-0.040	0.228	0.860
Request X Signal	-0.138	0.224	0.539
FYI X Check-in X Sig	-0.442	0.223	0.048
FYI X Request X Sig	-0.465	0.230	0.043

Table B1: Regression Coefficients for Marginal effects on Intention.

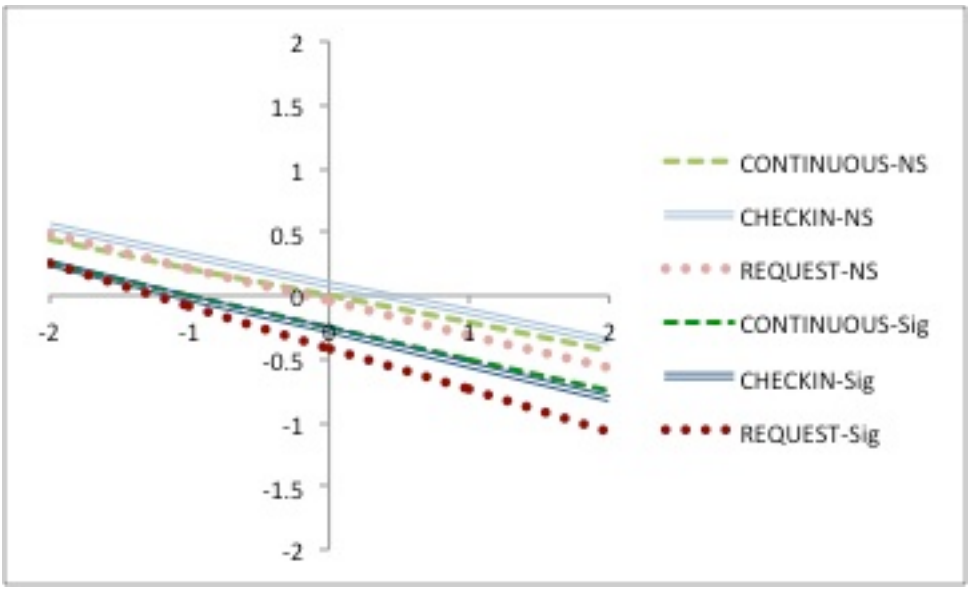


Figure B2: Marginal effects graph for Choice

Variable	Beta	S.E.	p-value
FYI style	-0.217	0.110	0.049
Is Check-in Condition	0.094	0.177	0.594
Is Request Condition	-0.049	0.169	0.771
Is Signal Condition	-0.246	0.167	0.140
FYI X Check-in	-0.011	0.180	0.950
FYI X Request	-0.046	0.165	0.779
FYI X Signal	-0.035	0.167	0.834
Check-in X Signal	-0.131	0.238	0.582
Request X Signal	-0.116	0.226	0.608
FYI X Check-in X Sig	-0.001	0.246	0.996
FYI X Request X Sig	-0.034	0.234	0.885

Table B2: Regression Coefficients for Marginal effects on Choice.

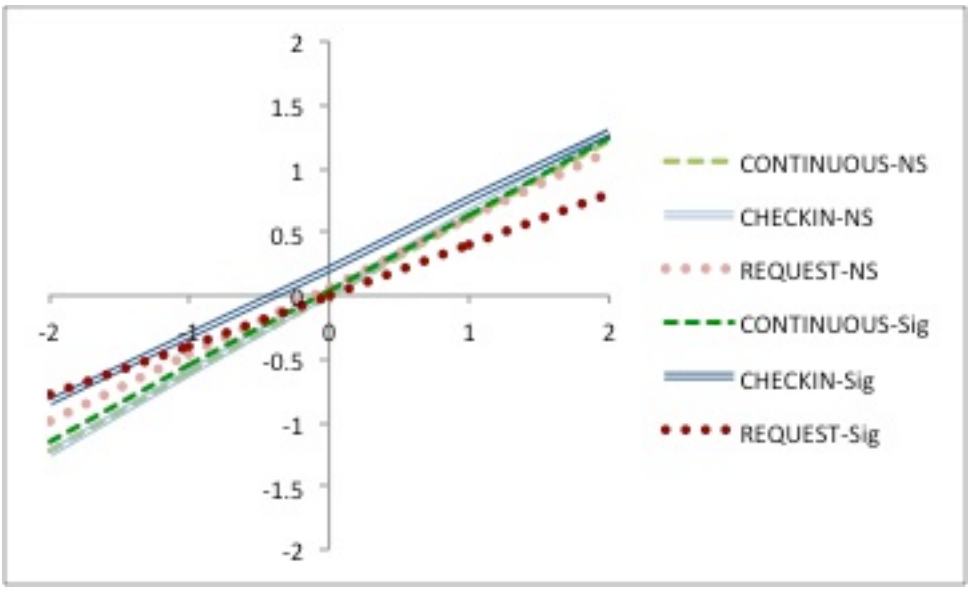


Figure B3: Marginal effects graph for Boundary Enhancement expectation

Variable	Beta	S.E.	p-value
FYI style	0.611	0.092	0.000
Is Check-in Condition	0.024	0.152	0.876
Is Request Condition	0.071	0.143	0.622
Is Signal Condition	0.041	0.153	0.789
FYI X Check-in	0.023	0.151	0.881
FYI X Request	-0.078	0.144	0.591
FYI X Signal	-0.015	0.145	0.918
Check-in X Signal	0.155	0.223	0.489
Request X Signal	-0.106	0.222	0.632
FYI X Check-in X Sig	-0.090	0.218	0.680
FYI X Request X Sig	-0.121	0.216	0.577

Table B3: Regression Coefficients for Marginal effects on Boundary Enhancement expectation.

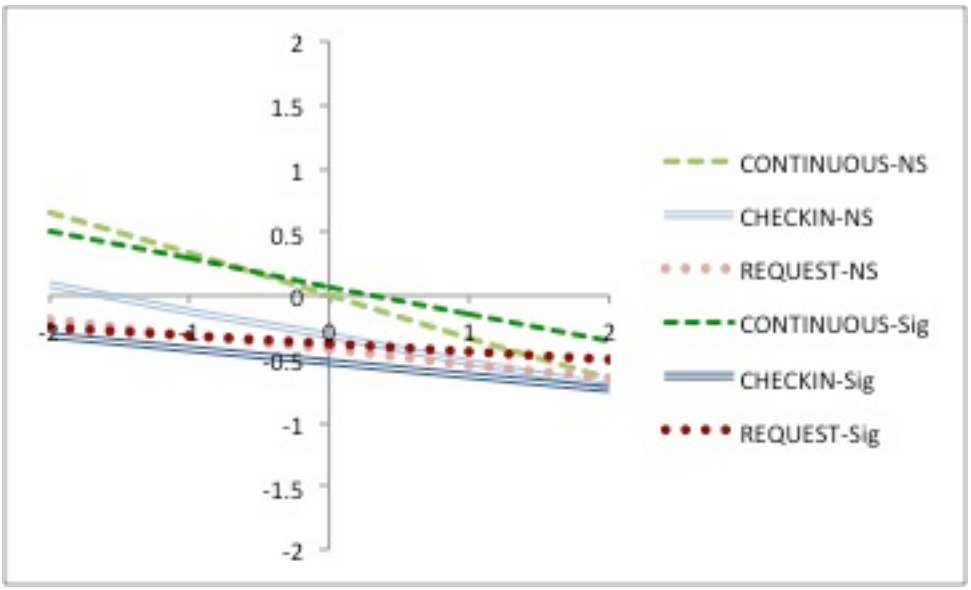


Figure B4: Marginal effects graph for Boundary Preservation Concern

Variable	Beta	S.E.	p-value
FYI style	-0.330	0.101	0.001
Is Check-in Condition	-0.324	0.159	0.041
Is Request Condition	-0.427	0.156	0.006
Is Signal Condition	0.073	0.156	0.643
FYI X Check-in	0.130	0.146	0.376
FYI X Request	0.213	0.145	0.142
FYI X Signal	0.112	0.14	0.422
Check-in X Signal	-0.277	0.22	0.209
Request X Signal	-0.027	0.224	0.905
FYI X Check-in X Sig	-0.020	0.203	0.922
FYI X Request X Sig	-0.058	0.203	0.774

Table B4: Regression Coefficients for Marginal effects on Boundary Preservation Concern.

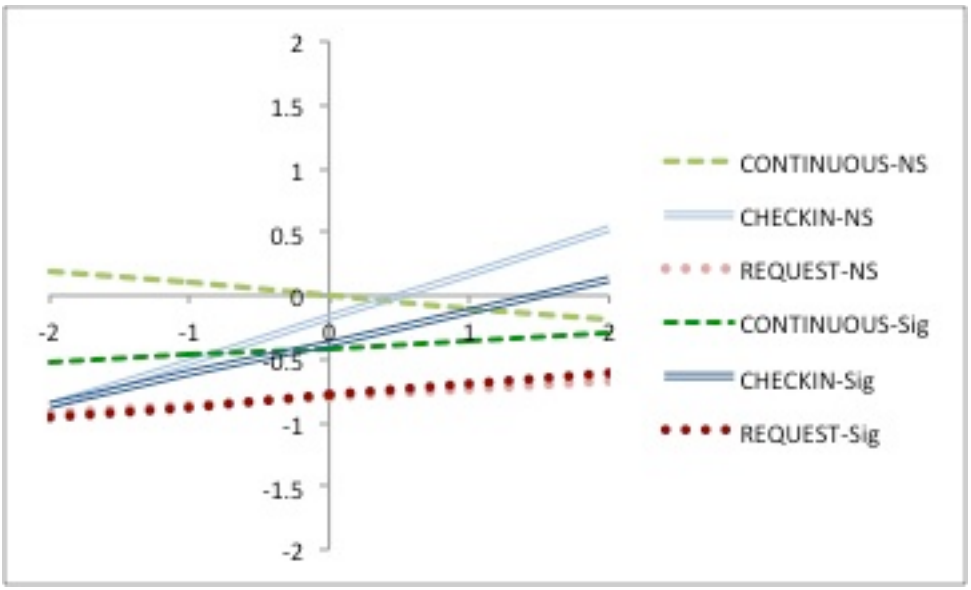


Figure B5: Marginal effects graph for Ease of Use

Variable	Beta	S.E.	p-value
FYI style	-0.098	0.084	0.242
Is Check-in Condition	-0.176	0.152	0.248
Is Request Condition	-0.796	0.148	0.000
Is Signal Condition	-0.412	0.152	0.007
FYI X Check-in	0.445	0.132	0.001
FYI X Request	0.164	0.137	0.232
FYI X Signal	0.155	0.125	0.217
Check-in X Signal	0.214	0.221	0.332
Request X Signal	0.420	0.225	0.062
FYI X Check-in X Sig	-0.255	0.198	0.199
FYI X Request X Sig	-0.135	0.201	0.503

Table B5: Regression Coefficients for Marginal effects on Ease of Use.

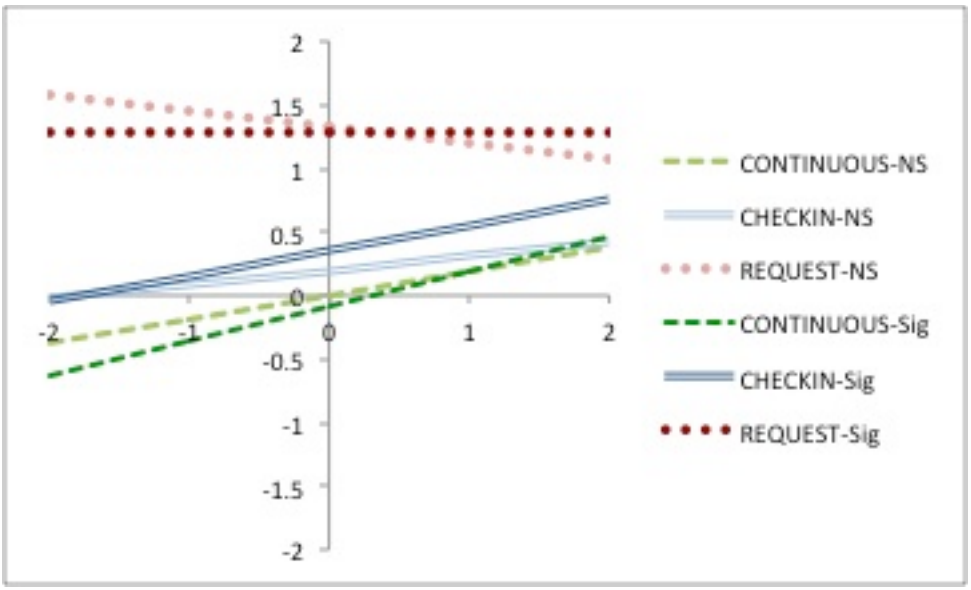


Figure B6: Marginal effects graph for ability to share with a subset of friends

Variable	Beta	S.E.	p-value
FYI style	0.186	0.067	0.006
Is Check-in Condition	0.198	0.108	0.067
Is Request Condition	1.326	0.105	0.000
Is Signal Condition	-0.087	0.105	0.406
FYI X Check-in	-0.078	0.106	0.461
FYI X Request	-0.317	0.103	0.002
FYI X Signal	0.090	0.105	0.392
Check-in X Signal	0.244	0.155	0.117
Request X Signal	0.043	0.153	0.779
FYI X Check-in X Sig	0.002	0.157	0.989
FYI X Request X Sig	0.043	0.153	0.780

Table B6: Regression Coefficients for Marginal effects on ability to share with a subset of friends.

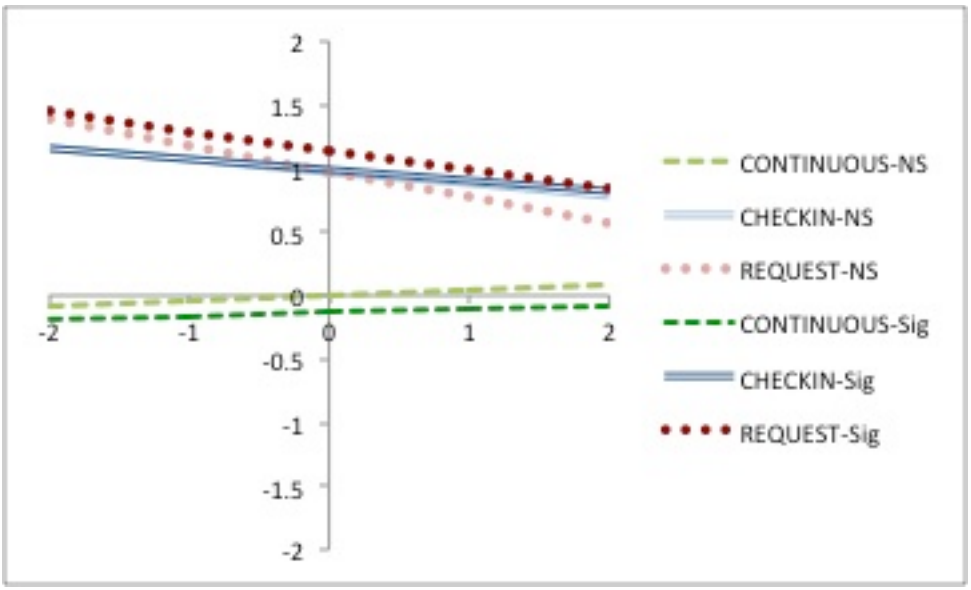


Figure B7: Marginal effects graph for ability to share location at discrete moments in time

Variable	Beta	S.E.	p-value
FYI style	0.044	0.078	0.571
Is Check-in Condition	0.974	0.125	0.000
Is Request Condition	0.974	0.121	0.000
Is Signal Condition	-0.133	0.121	0.275
FYI X Check-in	-0.140	0.123	0.253
FYI X Request	-0.249	0.120	0.037
FYI X Signal	-0.017	0.122	0.891
Check-in X Signal	0.142	0.180	0.429
Request X Signal	0.301	0.177	0.089
FYI X Check-in X Sig	0.030	0.182	0.868
FYI X Request X Sig	0.071	0.177	0.689

Table B7: Regression Coefficients for Marginal effects on ability to share location at discrete moments in time.

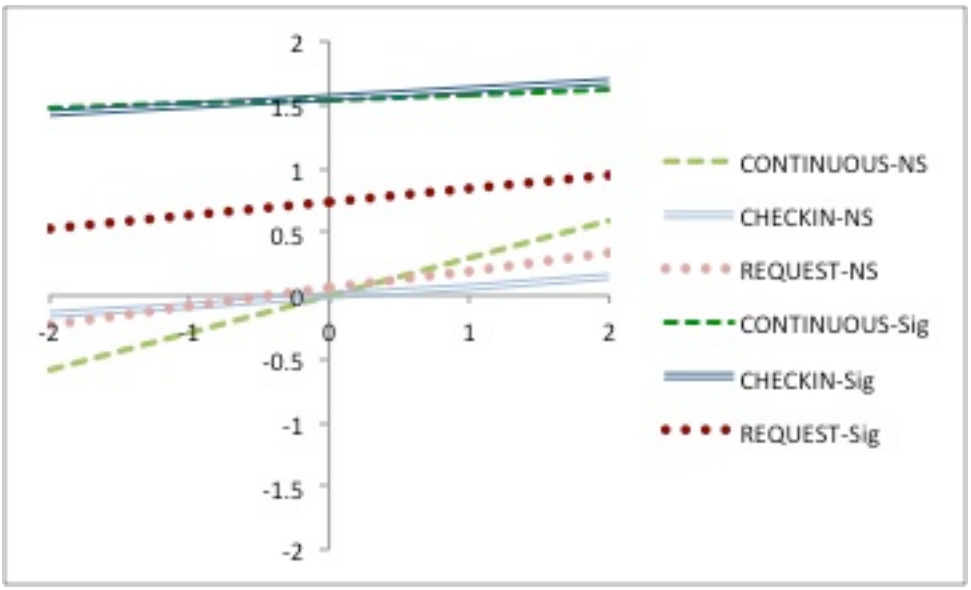


Figure B8: Marginal effects graph for ability to convey contextual cues

Variable	Beta	S.E.	p-value
FYI style	0.293	0.062	0.000
Is Check-in Condition	-0.008	0.100	0.938
Is Request Condition	0.055	0.097	0.572
Is Signal Condition	1.545	0.097	0.000
FYI X Check-in	-0.219	0.098	0.025
FYI X Request	-0.150	0.095	0.116
FYI X Signal	-0.258	0.097	0.008
Check-in X Signal	0.027	0.144	0.849
Request X Signal	-0.867	0.141	0.000
FYI X Check-in X Sig	0.248	0.145	0.087
FYI X Request X Sig	0.219	0.142	0.122

Table B8: Regression Coefficients for Marginal effects on ability to convey contextual cues.