People, Places, and Perceptions: Effects of Location Check-in Awareness on Impressions of Strangers

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ABSTRACT
Social media platforms and mobile applications increasingly include geographic features and services. While previous research has looked into how people perceive, interpret, and act on information available about a person, the *spatial self*, an individual's display of mobility through space for identity performance, is underexplored, especially in encounters with strangers. Strangers themselves offer a unique potential for exploring relational contexts and how those may relate to interpreting and reacting to the spatial self. We ran a 3 (*map*: personal, social, and task) × 3 (*relationship*: date, friend, coworker) × 2 (*gender of participant*: female, male) laboratory experiment with a mixed model design to see if and how the spatial self affects interest in future interaction. We find that maps, relationship, and gender all affect the ways in which people interpret and act on expressing interest in an individual. We discuss theoretical and design implications of how spatial selves affect this process.

Author Keywords
Spatial self; relationships; impression formation; experiment; location; check-ins; logistic regression

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): miscellaneous

INTRODUCTION
As GPS technology has become ubiquitous over the past 10 years, so too have social platforms that make use of location. Beginning with standalone services such as Dodgeball [32] and Foursquare [39], these features are also now common elements of social media platforms, such as Facebook [30], Twitter [49] [37] and Instagram [34]. Within these contexts, users voluntarily generate ever-increasing amounts of geographic information about themselves [22].

One open question in this area, particularly as location-aware social applications (e.g., Tinder, Grindr, etc.) have become more common in allowing people to connect with nearby strangers, is how location information can affect impression formation. Previous research shows that through profiles photos [16,56], text and other content [51,55], and information disclosure [54], audiences form impressions of an individual through the content s/he generates and aligns with. Spatial data is increasingly coupled with these other forms of content (i.e. a photo with a location tag), as well as created in its own right. There is some limited evidence from previous work on the ways in which awareness of various spatial data may matter in impression formation [14,19,26], though in what ways and to what extent has yet to be empirically tested.

Schwartz and Halegoua, synthesizing prior work on mobility and social life [17,48], have put forth a concept of the spatial self that considers an individuals' mobility through space and place in their presentation of self [46]. They argue that through curation and display, records of a person's history through place can be leveraged for identity work. For example, checking in to your gym's workout of the day may in fact be identity work and a communicative action [44], but we do not know how viewers (especially strangers) of these check-ins may interpret them. Assuming that users can leverage the spatial self for identity claims, we do not know if and how others can interpret it.

We then know that people are generating this data about themselves, that it may affect the types of impressions they give off about themselves, and that they may care to shape or craft these in particular ways based on sets of circumstances. We do not know, however, if a person's spatial footprint does indeed help shape impressions and if those are different under different conditions, such as relational context. In the paper that follows, we present a controlled experimental study to explore how context, use and spatial representation influence impression formation. Gaining understanding in the ways in which awareness of location affect impressions is important for the wide range of apps that make use of and support the growth of spatial data and connecting its users.

BACKGROUND
Broadly speaking, this project is about how strangers perceive others and make decisions about whether or not to connect with them. We are interested in exploring how lo-

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cation may affect this decision making process, as well as how potential relationship type and gender play a role.

The foundation of this work builds on the idea that people use what's available to them in order to make sense of the world. In terms of interpersonal impression formation or perception, studies have previously looked at how types of associated cues serve to affect perception and impressions (e.g. [50,51,55]). While there is a separate line of parallel research around the impressions people want to "give off" through types of identity performance [21], we are chiefly interested in the if and how locations may be "read" as cues and interpreted by individuals.

Brunswik's lens model, and its later extension, is a useful framework for thinking about and working through this notion of how people form impressions and make decisions about other people. The lens model argues that an individual may form impressions of a stranger through "lenses" formed of cues, observable elements in the environment, that are linked to him/her [12]. Gosling et al. extend this theory by articulating two distinct types of cues: identity claims, or symbolic statements made about the stranger and residue, or physical traces of the stranger within space [23]. The lens model has been used to study both impressions of others through physical spaces [23] as well as how online spaces such as social media profiles contain claims and residue that may affect impressions [56]. For our purposes, we are interested in how the spatial self, itself a residue-turned-claim, may be perceived as a type of identity claim that shapes impression.

The Spatial Self, Locations, and Impression Formation

With GPS technology and social media on mobile smart phones, people can interact with the space around them in ways they could not before, from creating detailed logs about where they have been to engaging in urban play that bridges the tangible and technological world [32]. Entire platforms such as Foursquare (now Swarm) have emerged as social networks based on location, with users checking-in to certain locations throughout their day and earning "mayorships" of those locations through a gamified system. This not only increases general awareness of others through articulated friendships within the platform [26], but it can also create a general sense of ambiance of places [24]. Places can be understood then as spaces in which social activities happen [28] and also have their own particular social meanings as settings for these activities [21].

Schwartz and Halegoua recently brought together several disciplines' work on location, information technology, and identity to develop a concept they label the *spatial self* [46]. Built on top of, and complementary to, the identity performance of impression management developed by Goffman, the spatial self refers to instances online and off where "individuals document, archive and display their experience and/or mobility within space and place in order to represent or perform aspects of their identity to others."

As users across platforms generate various spatial footprints, it becomes an open question as to how these footprints are understood, and how they may affect people's, especially strangers, impressions of those who created them. The spatial self is a useful concept as it emphasizes both the ways in which individuals use places within identity claims [23] and suggest that these claims may be interpreted. Given the polysemy of places [46], how this interpretation unfolds is unknown. It may be the case that certain kinds of places lend themselves to particular types of impressions, such as a gym giving the impression of being physically active and fit.

Previous work has looked at how known relationships (i.e., not strangers) are affected through this notion of the spatial self. Encountering a known individual's spatial self can signal things such as mood (e.g. frustrated, happy) or events (e.g. at a party) as places can be parsed in particular ways within a relationship [8], but also can lead to surprise or development of new parts of a relationship [26]. In Cramer et al.'s work on the performativity of the check-in, they found users check in to signal not only location but also their current activity and availability, while maintaining awareness of potential over-sharing to their audiences [14]. Previous work has also examined inhabited spaces (the office and the home) as sources for identity [23], but the breadth of places used in the spatial self quickly expands beyond the office and the home, as it includes things such as digital check-ins to places.

We believe that the *spatial self*, itself a residue of mobility through space, may be leveraged by an individual for identity claims that a stranger may utilize as a cue. Given previous work on both location check-in awareness and known relationships, we ask:

RQ1. Does the spatial self impact impression formation of strangers?

Relationship types

When meeting someone new, one's emergent relationship with them has a range of possible outcomes, from a one-time encounter to future long-term romantic partner and all sorts of relationships in between. Studies of interpersonal interaction, including communication and attraction, often examine differences across relationship types (e.g., family, friends, strangers, acquaintances, etc.) [36]. In an overview of research on interpersonal attraction and relationships, Huston and Levinger detail findings of research within psychology on different influencing factors in impression formation, including gender, physical appearance, and potential relationship type, and how this impression informs decisions about how to proceed in the interaction [33].

During impression formation, people make assessments of the individual. McCroskey and colleagues [40] have operationalized attraction on three dimensions, personal, social, and task, which can be aligned towards impressions of a romantic relationship, friendship, and working relationship

respectively. Given that relationships can be teased out into meaningful categories, we ask:

RQ2a. Does a proposed relationship type impact impressions?

It may be the case that the spatial self and relationship type affect impressions in particular ways, but the two could also interact. Information integration theory [5] and passive information seeking online [43] both suggest that cues can be interpreted and augment impressions in particular directions. It is possible, then, that if the spatial self can be used as a cue, it could have differential effects within relationship types depending on the types of places involved. When the types of places align with proposed relationships being evaluated, it stands to reason by an additive explanation [5] that the impression of the target would be more positive than if s/he displayed places of a different type. This is to say, if someone checks in to work places such as the library, s/he may give off a more positive impression as a potential co-worker than if s/he had checked in to a bar or a movie theater.

There is another layer of social norms around display of the spatial self that may disrupt potential interaction [14]. An additive explanation may not work if the locations violate social norms for the impression. For example, while someone who is well-groomed and physically fit might give a positive impression as a potential date in person, if that person is known to check-in to the gym or the barbershop/hair salon that positive impression may be lost as s/he may be seen as self-involved. Given these possibilities, we ask:

RQ2b. Do relationship type and the spatial self interact in significant ways for impression?

Gender and impressions

In addition to relationship type, dyadic relationships can be mapped to particular gender combinations (broadly speaking, male-male, male-female, female-male, female-female). These four can then be consolidated into same-sex (male-male, female-female) and cross-sex (male-female, female-male) interaction. Of these two, studies tend to take up either one or the other for examination and combine them with a particular type of relationship (i.e. same-sex friendships, cross-sex romantic relationships). We focus this work on three different relationship types of cross-sex dyads.

Previous research shows gender difference in cross-sex impressions and interactions. For example, in a romantic context, after a five minute encounter, Henningsen and colleagues show that men and women differ in their perceptions of sexual interest and sexually motivated behaviors [29]; similarly, Berry and Miller found gender difference in perception of personality and quality of interaction after cross-sex dyads met and talked for six minutes [9].

It is not uncommon for studies to pick one gender of participant and/or one gender of target (e.g. [33,38,52]), making balanced studies of cross-sex dyads less common Given the unexplored relationship around cue utilization in cross-sex pairings (male-female and female-male), we ask:

RQ3. In cross-sex pairings, does gender of participant make a difference in impression formation?

THE CURRENT STUDY

We built a custom iPad app, using the Ionic Framework [15] and Leaflet [1], to examine if and how awareness of location check-in affects expression of interest within different proposed relationships. The participants were asked to evaluate others' profiles and indicate whether or not they would be interested in a relationship of a particular type with the person displayed. This interest was operationalized as a binary variable in that participants could respond "yes" or "no" in each assessment.

We made this decision, in part, to improve the ecological validity of the experiment. Many types of responses or interactions through social media between strangers are initiated through binary responses: do you accept this friend request? do you want to connect with this professional? do you want to send a message for a potential date? Our actual implementation draws on the interaction design used on Tinder, a popular location based social application. A person sees a digital "card" of another user and then either swipes the card right, indicating interest in interacting more with that user, or swipes the card left, indicating no interest, after which a new card with a different user is loaded (see Figure 1). This decision to use a binary, single-item response based on the type of data we are trying to collect and the context it is experienced in the real world is supported by research comparing single-item and multiple-item responses [20,57].

Moreover, there is evidence that these kinds of quick judgments can be used to effectively capture accurate impressions and judgments. Research on "thin slice" judgments shows that impressions can be formed extremely quickly and from limited information, and that these impressions

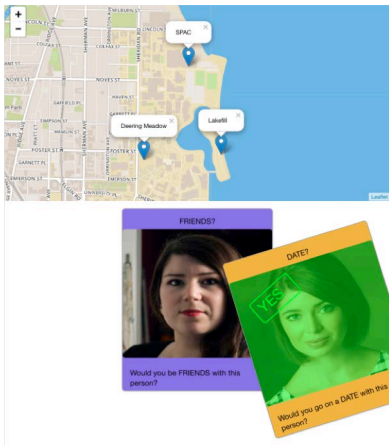

Figure 1. An example of an assessment in the experiment's app, including a photo, relationship condition (date), and three location markers on a map above [42,45]**.**

are persistent and consistent through prolonged interaction [2–4]. For our app, we supplement each target image with maps of recent check-ins of the person and a proposed relationship types. This smooth, simple design, with limited information, allows for rapid completion of each assessment.

METHOD

In order to investigate the relationship between places and expressed interest in future interaction, we ran a 3 (*map*: personal, social, and task) × 3 (*relationship*: date, friend, coworker) × 2 (*gender of participant*: female, male) laboratory experiment with a mixed model design. Types of relationship and types of map are within subject factors, gender of participant is between subjects, and as we use multiple assessments of targets, we include the participant as a random effect.

The primary outcome measure was expressed interest in further interaction and the participants assessed this across numerous images of people. The set of image stimuli were selected from publicly available images of individuals online. Images were selected so that all targets in the images were of a similar age (and near in age to the participants) and level of physical attractiveness. The images were cropped so that each target was shown in portrait. Because we did not use a set of photos that were already normalized for level of attractiveness, we ran a post-hoc stimuli check on the images to verify consistent levels of physical attractiveness. Each image was complemented by a map type manipulation and a relationship type manipulation.

Map type was operationalized by visualizing the check-in history shown in the profiles being assessed. We made a map for each target that showed three location markers (see example at the top of Figure 1). Using three markers gets at the spatial self notion of display and also offers more potential cues for the participant.

Research on places and social life typically take some type of categorization approach, putting places into theoretical categories [41], bootstrapping from existing technical systems' hierarchy of places [6], or categorizing based on activity and other social processes found in the place [35]. To reduce the range of possible meanings for any given place, we brainstormed a list of common places around the campus, and then bucketed the places into four groups: places for work (e.g. a library, academic buildings, study spaces on campus), places for social engagement (e.g. a movie theater, football stadium, frat quad, coffee shop), places that may make someone attractive for dates (e.g. a gym, a hair salon, a nice restaurant), and neutral places (e.g. campus green spaces, cafeterias). We then worked with three undergraduates, members of the sample population, to confirm or reject locations in the categories as well as add additional locations. After, we consolidated the lists, so as to only use locations that had unanimous agreement of its category. Each assessment map has two randomly selected markers from one of the three non-neutral categories and the third marker from the neutral category (to make the various maps appear different).

For *relationship type*, we used three categories of proposed relationships: friends, co-workers, and dates. As previous literature demonstrates, there is a range of potential relationship categories to choose from. While it is common to place strangers in a category that is separate from others, strangers have unique potential to move into a new category. Because we wanted to explore the relation of check-in awareness to proposed relationship type, we made all the targets strangers. To reinforce the manipulation changing across assessments, cards have a border with a color that matches the proposed relationship type (e.g. if a card asks about wanting to be friends with someone, the border of the card is purple).

We rotated map type and relationship type, within participant based on a Latin square, counterbalancing their order while holding the image order constant within participant gender.

Participants

Given that assessments were being made based on local landmarks, our design requires a local population. As such, participants were all undergraduates of a medium-sized university in the Midwest United States. We recruited 36 participants (18 female) via flyers, listservs, and from established subject pools of the University. Participants ranged in age from 18 to 22 years old (avg = 19.76). Relatedly, participants spent between 1.5 months to 40 months in the campus area (avg = 17.46). Participants were paid US$5 cash or research credit for their participation. Give the experiment proposed date relationships within cross-sex dyads, we only include data of self-identified heterosexual participants who were not currently in a relationship in our analyses. (Non-heterosexual participants were omitted from analyses as they may experience locations differently [13,53] and because the sample size was too small (n=4).) Participants spent an average of 5.56 seconds (SD = 1.67 seconds) per assessment and each participant completed a total of 18 assessments (9 with same-sex images, 9 with cross-sex images, with only cross-sex assessments included in the analyses). This makes for a set of 324 swipes in the analysis dataset (86 "no", 238 "yes").

Procedure

The procedure for the experiment unfolded in two parts: the task using the iPad app and a follow up survey for basic demographics and manipulation checks that was completed immediately afterwards on a desktop computer. During the experimental task, the app prompted the participants for their participant ID and gender they are most attracted to. Then, in the top half of the screen a map loaded and the bottom half a stack swipe-able "cards" loaded, one on top of another so that the participant may only interact with the top card. Participants made decisions about interest in future interaction for each assessment until they had seen all possible combinations. Immediately following, they com-

pleted the post task survey at a desktop computer that asked them basic demographic questions and questions around manipulation checks.

Stimuli and Manipulation Checks

Our first step in analysis is to check both the image stimuli and the map markers to determine whether or not any individual image or combination of two map type markers that were randomly selected had a significant effect on the response type. We found that the images can all be considered a similar level of stimuli, as no individual image was significantly predictive in a simple logistic model predicting the outcome measure. In running another logistic regression for the map markers, we found any combination of conditional map markers was comparable within its higher-level map type (i.e. for task maps, checking in to a study place and the library shows no significant difference from checking in to the library and an academic building).

In order to see if participants paid attention to the individual markers, a manipulation check was included in a post task survey. Participants were asked about whether or not they had seen a total of 28 locations, 20 they had seen and 8 that were "false" and never shown during the experimental task. Participants reported seeing over three fourths of the actual locations (mean = 15.78, SD = 3.67) and less than one false location (mean = .55, SD = .87). We consider, therefore, that the participants did pay attention to the individual map markers.

To investigate our research questions, we model the data using logistic mixed model regressions. The independent variables included were map type, relationship type, and gender of participant. The participants were modeled as random effects as each participant saw multiple assessments. We start with the most simple model and build more complex models, at each step comparing to the previous model in order to determine whether or not the addition of new parameters were significant (using likelihood ratio tests) and improved overall fit (comparing AIC/BIC) [60]. As the central concern of this paper has to do with the spatial self and impression formation, we began with our first model including only the map types.

RESULTS

The spatial self affects interest (RQ1)

Model 1 was run to determine whether the spatial self affects expressed interest of individuals (RQ1). We found that the maps did indeed affect participants' interest of others ($\chi^2(2) = 9.504$, $p < .01$). Looking closely into the different map categories, we see that, when compared to the reference category of *personal map*, there is a significant difference found in the *task map* (see Table 1). This suggests a manipulation as simple as showing three recent check-ins has significant effects on interests in individuals.

Looking at the odds ratios and predicted probabilities of the levels of the map variable can help put this finding into perspective [60]. The odds ratios of the *task map* parameter can be interpreted as the change in odds when switching the *personal map* to the *task map*: when doing so the odds of expressed interest in future interaction increases by a factor of 2.767. Put another way using predicted probabilities, the probability of expressing interest in a target with a *personal map* is .65, while a target with a *task map* is .83 (with the *social map* falling in between at .74).

Relationship type affects interest (RQ2a,b)

RQ2a asks if proposed relationship types affect expressed

	Model 1 Maps		**Model 2** Maps and Relationship		**Model 3** Maps, Relationship, and Interaction		**Model 4** Maps, Relationship, Participant Gender	
	Odds Ratio	(SE)	Odds Ratio	(SE)	Odds Ratio	(SE)	Odds Ratio	(SE)
Intercept	1.971	(0.245)**	0.757	(0.320)	0.676	(0.393)	0.486	(0.369)
Map (Personal)								
Social	1.538	(0.311)	1.633	(0.333)	2.501	(0.521)	1.634	(0.333)
Task	2.769	(0.340) **	3.164	(0.364)**	2.869	(0.525)*	3.170	(0.365)**
Relationship (Date)								
Friend			4.107	(0.346)***	5.255	(0.557)**	4.117	(0.346)***
Co-worker			5.494	(0.365)***	6.255	(0.570)**	5.509	(0.365)***
Interaction								
Social Map × Friend					0.399	(0.779)		
Task Map × Friend					1.452	(0.910)		
Social Map × Work					0.595	(0.820)		
Task Map × Work					1.219	(0.917)		
Gender (Female)								
Male							2.434	(0.387)*
Log Likelihood	-179.9		-164.9		-163.6		-162.3	
AIC	367.8		341.7		347.2		338.5	
N	324		324		324		324	

** = p < .05, ** = p < .01, *** = p < .001*

Table 1. A table of the mixed effects logistic regressions including map type, relationship type, and participant gender predicting expressed interest in future interaction.

interest. Model 2 finds that proposed relationship types indeed affect expressed interest ($\chi^2(2) = 30.04$, $p < .001$). We find that participants were significantly more likely to express interest in targets within a *friend* or *co-worker* relationship condition, as compared to the reference category *date* (as shown in Table 1); however, there was no significant difference between the friend and co-worker categories.

Model 3 explores the addition of a map × relationship interaction, to see if there is a differential affect of map types within the relationship types. We expected this may be the case given the possibility of an additive effect of certain locations on certain relationships. The model fit was not found to be a significantly better fit than Model 2 ($\chi^2(4) = 2.51$, $p = .642$), suggesting that there is little effect of the interaction (RQ2b).

Given that Model 2 is a better fit for the data, and includes more parameters, we can explore the odds ratios and predicted probabilities a bit more. For example, holding the map level constant and switching from the *date relationship* (reference category) to the *friend condition* increases the odds of expressing interest by 4.1; this shift represents a change of predicted probabilities from .43 to .74, with map held at *personal*. Taking the example from Model 1 and moving from *task map* to *social map*, while holding the relationship constant, now increases the odds of expressing interest by 3.16. We also see that as more conditions are added, the range of predicted probabilities changes dramatically, highlighting how strongly proposed relationship types affect expressing interest. The predicted probabilities for the nine possible conditions laid out in Model 2 (all permutations of the three levels of map and three levels of relationship) range from .43 (*personal* map and *date* relationship) to .92 (*task* map and *work* relationship).

Participant gender affects interest (RQ3)

Finally, we ran Model 4 to test whether there was a difference in the ways in which male and female participants complete the assessments (RQ3). We found that participant gender influenced expressing interest ($\chi^2(7) = 5.2$, $p < .05$); the odds of *male* participants expressing interest in their targets were 2.434 times higher than *female* participants expressing interest in theirs. Again, using predicted probabilities, male participants assessing a profile with a *task map* and *date relationship* had a .93 probability of swiping right, women participants assessing the same conditions, only .59. This finding is not surprising, as one could imagine that women would be more discriminating than men when making assessments about proposed relationships (especially for dates).

While the addition of gender showed a significant difference, the direction, magnitude, and significance of the previous parameters remained relatively stable. Holding other variables constant and moving the relationship from *date* to *friend*, we see a similar odds change as we did in Model 2, increasing by a factor of 4.1; the same is seen when moving just the map from *personal* to *task*, with an increase of 3.17. With the highest specification, Model 4 gives us a finer range of predicated probabilities across the combinations of levels of the *map*, *relationship*, and *gender*, from .33 (*personal*, *date*, *female*) to .95 (*task*, *work*, *male*).

We further tested higher order interaction terms in later models not reported in Table 1. We explored gender interacting with the map condition and gender interacting with the proposed relationship condition, as well as three way interactions. None of these interaction parameters had significance in the models, so we stopped at Model 4.

DISCUSSION

We began this study to explore how impressions of others and interest in interacting with them is affected by visual representations of the spatial self. We had reason to believe that the spatial self would affect impressions, but did not know to what extent or in what direction. We focus here on three key implications of our work.

The robust meaning of places matters

The first implication is an urge to revisit the distinction frequently drawn between curated and composed social network site profile elements (e.g., photos, favorite music, etc. [59]) and displayed trace histories of activity (e.g., location check-ins, comments on others' posts, photo maps, etc.). In theoretical terms, this is the separation that Gosling et al. draw in their extension of the lens model between identity claims, or symbolic statements an individual makes about herself, and residue, or physical traces an individual leaves as they move through an environment [23].

This distinction matters because it affects the actual and perceived locus of control in curating the information that appears in a profile, and the elements of a profile that we as designers allow users to easily edit or manipulate. While it is often tempting to treat location histories as residue, for example, prior work by Guha and Birnholtz showed that people strategically checked in, avoided checking in or took steps to mask check-ins at certain locations because they were aware of the audience that would see those check-ins [26]. Additionally, Guha and Wicker have found social surveillance and deceptive check-in practices at play in these networks [25,27]. This suggests an awareness on the users part for crafting check-ins as strategic identity claims, in which the most visible check-ins are at desirable locations.

Our results, in showing that visual representations of the spatial self influence impression formation and interest in interaction with others, suggest that these strategies were warranted. This raises the important question of how we treat location history and other trace history data. As designers, do we display all data or allow users to edit their histories, for example, and how does this affect both the perceived credibility of the information presented and the validity of the trace history data. Allowing people to edit what information is displayed, for example, may reduce

credibility for viewers, but could also make people more likely to check in, if they know they have more control over who will see the information.

From a theoretical standpoint, this suggests that we consider the ways that information may be transformed from residue to identity claims, and how this affects the role of this information in impression formation.

Expanding the concept of the spatial self

A second implication of our results is that the concept of the spatial self should be expanded to consider interactions between strangers. Where Schwartz and Halegoua [46] largely focus on how the spatial self functions within established relationships between known individuals, such as those articulated via ties on Instagram Facebook and Foursquare/Swarm, our results show that similar phenomena are at work when strangers meet and form impressions of each other.

These initial impressions between strangers – and the role of the spatial self in impression formation – are particularly consequential in two respects. First, strangers have less information about each other and often must form impressions quickly, so any given piece of information can be more heavily weighted than it would be in an established relationship where there is a longer history of information and often more context as well [8]. Second, the increasing prevalence of social applications that connect strangers means that these phenomena are likely already at play, but we have made limited effort to understand them, though this awareness could have impact. As others have argued, social location check-in systems create an awareness of familiar strangers [47], providing a sense of commonality between people [31]; reasonably, this could increase interpersonal attraction [18].

Moreover, our work suggests that impressions based on visual representations of the spatial self can be formed quickly and based on relatively few visible locations. Given that work on thin slices suggests that these quick impressions are often stable over time [2–4], we urge researchers and designers to think carefully about the temporal dynamics of how the spatial self, impressions and relationships play out. How do people, for example, use spatial information over time to update their understandings of and impressions of one another?

From a design standpoint, this means we should also think carefully about how we display location history information that may influence impression formation quickly without a user even being aware that it is being shown or how it might have an effect.

Places, impressions and privacy

The third implication of our results is that visual representations of the spatial self can affect impression formation with limited context. Our participants were generally familiar with our university campus and the surrounding environment, but did not know specific details about why a person had been (or not been) to a particular place on the visual map. They still used this information to form impressions, however. This becomes important when we think about both the level of granularity at which applications share location information and the initial context of its display.

For the level of granularity question, most apps that facilitate interaction between strangers do not reveal granular information about location. Often they show people who are nearby, possibly including some information about exactly how far away those people are (e.g. [11]). Even this information can likely affect impressions. That is, meeting another gay man on Grindr who is nearby in a predominantly gay neighborhood is different from meeting the same man in a rural small town. Prior work supports this idea in that people often use language in their profiles to identify with specific locations such as universities and urban neighborhoods to identify with a more granular location and, presumably, affect impressions [10].

This suggests an emerging tension between privacy and impression formation. On the one hand, we know from this study that location information affects impression formation. On the other hand, we know from users' attitudes toward sharing location with strangers [7,58] and the common practice of apps like Tinder and Grindr, that it can be desirable to mask or obscure fine-grained location information. An open question here is how varying points on this continuum operate in impression formation. It could be useful, for example, to share information about others who have recently been e.g., in the same neighborhood, city or even bar/club. On the other hand, this could have significant privacy implications. More empirical work is needed to explore these issues.

For the intended sharing context of information, another important issue is how spatial information is shared within and between social applications. Tinder, for example, pulls photos, work and education details, and other key profile information from Facebook because this provides some likely warranting value. It would be possible, of course, to also include information about the spatial self and location history, but this may raise concerns about audience on the shared-to platform being different from the originating platform. The larger overarching question here is how the context of sharing affects users' feelings about sharing spatial data, and how to help them manage the tensions inherent in moving this information between contexts.

FUTURE WORK AND LIMITATIONS

As with any study, we urge interpretation of our results with caution, as there are several key limitations.

First, experimental manipulations allow significant control and internal validity at the expense of ecological validity. We manipulated maps using fictional (but plausible) data to ensure that all participants had a nearly-identical experience and reduce the influence of potentially confounding factors. We of course expect that an encounter with a user's spatial

self on an actual social media platform would include a greater number and wider range of visited locations. We argue, however, that showing evidence of an effect in this artificial setting suggests that the effects would be even more robust in a setting with higher social stakes (e.g., meeting on Tinder).

Second, experimental design requires that variables be operationalized and set to specific levels to distinguish between conditions. We acknowledge that not all relationships, places or impressions fit neatly into the categories that we have defined, but argue based on prior work above that these represent useful points of distinction for exploring this topic in a controlled manner.

Third, we acknowledge that our participants are in a particular life stage: undergraduates in college at a top-tier US university. Participants may have differed from the broader population in that they may be more career oriented (which could bias their impressions of the task-oriented maps) and also more focused on meeting new friends and contacts than older people, who may be in more established romantic relationships and friend networks. Additional research is needed with a broader population, but this does not negate our core findings that the spatial self affected impression formation at least for this population.

Finally, it should be noted that there are a number of ways to represent geographic information and the digital footprints of people. We chose markers on a map, but one could also use text-based representations (such as place name, address, coordinates). We also collapsed time by saying that the locations represented their three most recent check-ins. Adding time to the awareness of location could have more nuanced affects (as someone who goes to the library at 2pm on Thursday may be different than someone who goes at 8am on Saturday).

We hope our findings will prompt future work into exploring the ways audiences read and interpret the identity claims of the spatial self and the ways in which users create and leverage the spatial self in their identity performance.

In addition to the open questions above, we urge exploration of additional locations, relationships, and (same vs. opposite) gender dyads. We also urge exploration of these phenomena in established relationships with known individuals who likely have more contextual information and in which initial impressions of spatial self information may matter less. Finally, we urge investigation of how people generate and curate their spatial self, what they include and what they do not include, and what they are trying to communicate about themselves.

CONCLUSION

We have described the first empirical experiment around how visual representations of the spatial self affects initial impressions of and interest in interacting with local strangers. We found that, while also accounting for proposed relationship type and gender of participant, the spatial self has a significant effect on impressions. We also found that there were no differential effects of the spatial self across proposed relationship type, and that men are less discriminatory than women when using the spatial self for cues around impression.

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