User Motivations to Participate in Crowdsourcing and Contribute User-generated Content on Location-based Media: A Literature Review

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Abstract

Location-based media applications such as Google Maps, Strava and Pokémon GO together have more than a billion monthly active users, and popular social media such as Snapchat and Instagram now also feature map-based content. All these media products rely on user-generated content as a core element of their service, but there is a lack of synthesis on the users' motivations to contribute this data to the platform providers. In this study, we performed a literature review to uncover users' motivations to participate in location-based crowdsourcing and contribute shared content on these platforms. Among our findings, we show that spatial and temporal aspects, social effects, technical elements, motivational mechanisms, practical value offered to the contributors and individual differences need to be considered in motivating users to contribute shared content. We present recommendations for designers, suggest which terminology to use around this topic and propose an agenda for future research.

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CCS Concepts

• **Information systems** → *Mobile information processing systems*; *Multimedia information systems*; **Collaborative and social computing systems and tools**; • **Human-centered computing** → **Ubiquitous and mobile devices**.

Keywords

Location-based media, locative media, geographical information systems, crowdsourcing, user-generated content, motivation

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1 Introduction

Location-based media (also discussed as locative media) is understood as *"media of communication that are functionally bound to a location"* [91]. It is an umbrella term that covers navigation services with additional spatial information such as Google Maps [53], location-based games such as Pokémon GO or Ingress Prime [17, 39, 44] and other hybrid-reality systems that augment representations

of the physical world with digital content [6, 15]. Location-based media have surged in popularity over recent years due to the proliferation of related infrastructure (smartphones, cloud computing, mobile data connection, satellite navigation) and innovations within the design space [6]. The most popular locative services such as Google Maps reportedly have more than a billion monthly active users [22]. Today, location-based media are used for both recreational purposes (e.g., supporting jogging, cycling and running [86, 94]) and functional purposes (e.g., navigating to places or searching for highly rated nearby restaurants [47, 65]). Compared to digital and social media, location-based media interact directly with physical spaces and places, influencing where and how people move, how people perceive the physical world around them and can encourage or deter from certain behaviors (e.g. impact where people eat or which museum they visit [42, 65]).

Almost without exception, all popular contemporary location-based media rely on user-generated content (UGC). While products such as Google Maps also harness satellite, unmanned aerial vehicle (UAV) and street view car captured imagery [36], they gather reviews and mobility pattern data from their users to improve the service they provide [53]. Some systems such as Yelp may also offer monetary compensation to certain user groups for their contributions [67]. In addition to the term UGC, scholars discuss the collection of data from average users as crowdsourcing [55, 67]. Examples of crowdsourcing include data that users willingly and knowingly contribute, such as crowdsourced spatial data including information and pictures of relevant points of interest [6, 45], user reviews of e.g., museums and restaurants [2], dynamic data such as changes in scenery [61] or available parking spots [56], and playable quests or tasks such as hidden caches in geocaching [62] among others. An important distinction in this context, is between shared vs closed information. Shared information is made publicly available and includes data such as restaurant reviews and venue opening hours, while closed information refers to undisclosed data such as monthly active users or individual navigation behaviors. In this paper, we focus on shared content. Another distinction is between active contributions where users are engaged in contributing, and passive contributions where the data is obtained automatically from the user via sensors. In this paper, we focus on active contributions, which we discuss more in Section 2.1.

To date, there have been multiple peer-reviewed studies on UGC and crowdsourcing in general (e.g., [13, 60, 81]) but so far less work has been done in the context of location-based media. In comparison to the broader research field of UGC where much of the crowdsourced content relates to text, links, images and videos [60], in location-based media the contributions are quite different, since they contain the element of the geographical location as well as potentially other information tied to the physical reality [6]. Within this field of study, there are multiple individual papers (e.g., [8, 45, 56, 77]) focusing on specific companies and products. However, there is a lack of an academic synthesis on the users' motivations to contribute shared content. Questions remain concerning the best practices to motivate users to contribute data, and how to ensure and verify the correctness and accuracy of the contributions. Related to this research gap, Bubalo et al. [10] reviewed research on crowdsourcing geo-information, and discovered six motivational strategies that have been used in existing products: (1) citizen science; (2) strengthening attitudes towards the environment; (3) personalized feedback of the contributions; (4) ability to compare their contributions with others; (5) fun/gamification; and (6) monetary compensation [10]. However, they omit the UGC aspect (i.e., the study does not include user-generated reviews or the creation of playable content), the literature search is not systematic and the motivational dimensions appear general rather than specific and the list of motivations does not appear to be exhaustive. Thus, while location-based crowdsourcing is an important element across various products and services, there is a lack of an academic synthesis on what motivates people to contribute to these platforms and services. To address this research gap, we investigate the research field of what motivates people to contribute shared information on locative media, and to guide this research we formulate the following two research questions (RQ):

RQ1: *What theoretical frameworks have been used to explain and design motivational approaches for crowdsourcing in location-based media?*

RQ2: *What kinds of UGC and crowdsourcing processes in location-based media motivate people to contribute?*

To address these RQs, we conducted a scoping review as follows. First, we conducted a bibliometric analysis to better understand the research field and identify relevant keywords. Second, we performed a precise search in the Scopus research database to identify potentially relevant records, and applied specific inclusion and exclusion criteria to filter out unrelated research. Third, we conducted backward citation chaining and additional searches with specific product names to add further academic studies into our review. Fourth, we conducted searches with specific product names to further increase the scope of our search. Fifth, we extracted data from the final set of studies relevant to answering our two RQs and interpretively analyzed the data. With this approach we offer a synthesis of the research field as a whole, summarize important contributions to research and practice and provide avenues for future research.

2 Background

2.1 Crowdsourcing and user-generated content in location-based media

The past three decades have seen a paradigm shift from more top-down expert-based data generation to including a diverse group of participants through bottom-up approaches [55]. Some of the earlier success cases include open source development communities such as GNU and linux [14, 82, 95] and later Wikipedia [5, 41, 96, 98]. Such approaches have recently been particularly successful in the realm of locative media and spatial datasets such as landscape perception research [10], urban planning [49], navigation [20, 89] and points of interest (POIs) discovery and documentation [6, 43].

The term UGC concerns published and accessible content that shows *"a degree of personal contribution"* [60], whereas crowdsourcing is defined as an online activity in which *"a group of individuals of varying knowledge, heterogeneity, and number"* [19] voluntarily partake in a task. On one hand crowdsourcing can be regarded as a participatory *approach* to generating data, and UGC can be regarded as the *resulting* data [24], but on the other hand, UGC can also refer to the process in certain situations and it also carries the flavor of a more personal contribution [60]. Within the

UGC and crowdsourcing literature, "crowdsourced content" [26] is commonly used synonymously to UGC. To ensure consistent terminology within this work, we primarily stick to these terms for clarity.

Observing the concepts of UGC and crowdsourcing in a spatial context reveals that particularly in geographic information systems (GIS) research, scholars have come up with their own, sometimes more specific terms and concepts. Perhaps the most popular of these concepts is volunteered geographic information (VGI) which is defined as an activity where *"members of the general public create and contribute georeferenced facts about the Earth's surface and near-surface"* [29]. Thus, essentially it refers to crowdsourced geographic information that is voluntarily contributed by the public. Another similar stream of research concerns public participation geographic information systems (PPGIS) [68]. The term PPGIS was coined in 1996 to describe the involvement of laypeople in contributing to then existing academic GIS practices [9]. Other similar terms include participatory sensing, mobile crowd sensing [31], close-range sensing [61] and neogeography [93] (for an extensive list refer to [76]). These terms and concepts often show considerable overlap. For example, Guo et al. [31] define mobile crowd sensing as *"a new sensing paradigm that empowers ordinary citizens to contribute data sensed or generated from their mobile devices, aggregates and fuses the data in the cloud for crowd intelligence extraction and people-centric service delivery"* which is essentially congruent to contemporary PPGIS products and map-focused UGC-based services.

Crowdsourcing can be split into active and passive crowdsourcing [59]. Active crowdsourcing refers to tasks where contributing users actively contribute information towards a specific question or topic of interest [76] such as a restaurant review on Google Maps or a POI submission in a location-based game [43]. Examples of successful active crowdsourcing solutions include the popular citizen science platform Zooniverse which has harnessed over 2 million participants to generate over 800 million contributions over a wide range of projects [79, 100], Ingress Prime's POI submission system that resulted in the creation of a geographical database that served as a backbone for the popular Pokémon GO [43] and Amazon's Mechanical Turk, which offers a diverse global network of participants for many crowdsourcing projects and is often used in academic research to source survey participants (see e.g. [37, 40]). In contrast to active crowdsourcing systems where users actively and willingly aid in contributing to a specific research endeavor, passive crowdsourcing pertains to often sensor-based contributions that users automatically provide as they go about with their lives [76]. Passive crowdsourcing contributions may include global positioning data on the users' movement while using Google Maps as well as geotagged photos and social media posts and sensor-data obtained while playing AR games in the wild [61]. Passive crowdsourcing thus shares similarities to e.g., the processes for obtaining telemetry data. In both cases the provided data is a byproduct of the users' activities rather than the main focus of their actions. Due to passive crowdsourcing data often being heterogeneous and unstructured data, it typically requires intensive processing, refinement and analysis before becoming a reliable source of information [99].

Compared to social media that operate completely online in the digital realm, locative media are tied to the physical world. Hence, the UGC and crowdsourcing practices on locative media often rely on a combination of active and passive crowdsourcing in the sense that users may actively contribute information which is then supported by a range of passively obtained sensor data [6]. For example, in the Niantic Wayfarer system where users submit POIs for Niantic's geographically distributed Wayfarer system, the submissions include POI names, photos and location as active components but also include passively sourced metadata such as when the pictures were taken, where, on what devices and so forth [45]. There are also some data that may be obtained either via active or passive crowdsourcing. For example, the location of speed cameras, the intensity of traffic, and reporting of accidents might be obtained automatically via passive crowdsourcing as is done in Google Maps, or actively through volunteered user contributions as is demonstrated i.e., in the work of Morschheuser et al. [56].

2.2 Motivations to participate in crowdsourcing

A key factor influencing the success of crowdsourcing efforts, or participatory data collection approaches in general, is the motivation and retention of participants [21]. However, motivation and participant engagement is a complex topic that is linked to multiple theoretical approaches. Commonly, motivational incentives are categories into two overarching dimensions: *extrinsic motivation* which is broadly defined as "doing something because it leads to a separable outcome" and *intrinsic motivation* which refers to "doing something because it is inherently interesting or enjoyable" [72].

To increase participation in crowdsourcing projects, many efforts capitalize on extrinsic motivators including offering co-authorship in resulting publications for citizen science projects [76] and offering monetary or otherwise economically interesting incentives such as vouchers or the chance to win a larger prize [4]. Many gamification approaches also leverage extrinsic motivation by providing virtual rewards for participation [44]. Well known examples of crowdsourcing platforms offering extrinsic incentives include *Amazon's MTurk* platform and *Prolific Academic*, both of which rely on monetary rewards for contributions [4]. However, offering monetary rewards to increase and retain participants can become a financial burden for a given crowdsourcing project and can be a barrier for efforts with large contribution needs. Furthermore, extrinsic motivation alone may not drive long-term commitment and participation [72]. As such, tapping into the intrinsic motivation of participants becomes especially interesting.

Intrinsic motivation is most commonly divided into three categories (according to self-determination theory (SDT)): autonomy, competence and relatedness [72]. However, other research also discusses underlying motivators including curiosity, learning, social bonding, self-presentation, sense of accomplishment, and playfulness as intrinsic motivators [21, 56, 69]. Generally speaking, crowdsourcing approaches capitalizing on the participants' intrinsic motivation have been found to engage and retain participants more than extrinsic approaches [46]. Further, deliberate refraining from including extrinsic motivators has been found to improve overall quality of contributions, as only genuinely interested participants are motivated to participate in a crowdsourcing initiative [5]. However, the results remain somewhat inconclusive: while altruism and sense of community belonging have been identified in some studies to lead to more contributions (e.g., [41]), other research has not

found these dimensions to be significant predictors of crowdsourcing contributions [96]. Popular examples of platforms harnessing contributors' intrinsic motivators include OpenStreetMaps (OSM), Wikipedia and Waze [1, 35, 41]. Nevertheless, fostering intrinsic motivation remains challenging, especially when targeting a heterogeneous crowd [43].

To address the challenge of increasing intrinsic motivation in crowdsourcing, games and gamification have been harnessed successfully in both academic [18] and real-world contexts [43, 56]. Gamification is defined as "hedonic or entertainment-oriented technologies being re-appropriated for productive use" [38] or in other words: incorporating game elements into non-game processes. Gamifying crowdsourcing approaches can increase the playfulness and resulting enjoyment of a crowdsourcing initiative as well as foster social bonds, increase relatedness with a community of peers and induce a feeling of altruism [56, 71]. As such, gamification has been identified as a useful motivational approach to increasing overall user engagement in crowdsourcing endeavors and has successfully been implemented in a number of projects ranging from detecting free parking spots [56] to gathering point cloud scans from nature [61].

Even though the literature boasts a wide array of studies revolving around user motivation in crowdsourcing efforts in general [5, 18, 41, 55, 96, 98], there is a limited number of studies focusing on motivation in spatial crowdsourcing or locative media generation [27]. In addition, the contemporary literature on participation motivation in spatial crowdsourcing seems to be dispersed over multiple academic disciplines including HCI, geographical information systems and others, and collating the findings in an up-to-date review is necessary. A few relevant literature reviews include that of Bubalo et al. [10], who offer a review of existing applications designed for crowdsourcing map and geo information. However, they do not focus on location-based media per say, and omit e.g., the perspectives of location-based games and media products featuring maps and geotagged posts and images. As such, within this paper, we set out to identify key motivators for participating in spatial crowdsourcing initiatives and locative media generation by finding and synthesizing contemporary literature.

3 Materials and methods

3.1 Literature search

We began iteratively searching for literature in this domain based on our initial expertise and knowledge in the field. As we familiarized ourselves with the research field we added more relevant search terms as we discovered them. We display the relevant terms in Table 1. We included altogether four categories of search terms: (1) map-related keywords; (2) UGC-related keywords; (3) "geography and UGC combined" -keywords; and (4) the word motivation. We conducted multiple searches (title+abstract+keywords) with various combinations of these terms in Elsevier's Scopus meta database to refine the search and minimize false positives. We chose to use Scopus since it indexes meta data from various prominent research databases such as ACM, IEEE and Taylor and Francis [55] and our university provided us full access to the tool. During this process excluded acronyms (VGI, PPGIS) due to them leading to false positives in the field of chemistry and biology where especially the VGI acronym appeared prominent. We also added terms such as "geotag" which links a geographical location to an object via sensor data. During this process we realized that the research field we were searching was huge and convoluted, and that motivations were rarely studied. As an example, a search with the map and UGC keywords (See Table 1) resulted in 2576 peer-reviewed studies published in conferences and journals whereas adding the term "motivation" reduced the number of papers to a mere 92 studies.

Keyword area/domain	**Search terms**
Location-related keywords	locative media, location-based, map-based, geo*, pervasive tech*, location-aware*
UGC-related keywords	crowdsourcing, user-generated content, citizen science
Motivation-related keywords	motivat*, incentive mechanism, incentives
Location and UGC keywords:	neogeography, volunteered geopgrahic information (VGI), public participation geographic information system (PPGIS), spatial crowdsourcing, mobile crowd sensing, participatory sensing, location-based crowdsourcing, geotag

Table 1: List of keywords relevant for this study.

To better understand the research field and assist in the discovery of further potentially relevant search terms, we harnessed a tool called VOSViewer [85] to visualize the research field. VOSViwewer is a tool often used in bibliometric reviews (see e.g., [33]) and it enables researchers to see (1) which keywords occur together; (2) which keywords are most prominent; and (3) which keywords are more recent and which ones are older [85]. In Figure 1 we display the research field based off 2576 studies. The screenshot is taken directly from the VOSViewer tool by the authors. The larger the ball, the more often the keyword appeared in the data. A line is drawn between two keywords if they appeared in a study together, and the more often the two keywords co-occurred, the stronger the line. Through this analysis we could identify that there is significant overlap between the key terms used in the field, with the most prominent terms being "participatory sensing", "mobile crowd sensing" and "spatial crowdsourcing". The field relates to issues such as data and data privacy, methods for analyzing the data, methods for obtaining the data and so on. Much of the research appears to have been conducted in professional contexts (see e.g., [10, 76]) and notably location-based media as a term is absent, while social media appears as a smaller yet connected research focus on the yellow area of the Figure on the left. We see many of the GIS-specific terms that we already identified in the background section (see Table 1) appear in the top right corner (green area) including PPGIS, VGI and neogeography. Much of the research in the red, blue and purple areas (left-hand side of the Figure) are technical in nature and keywords relating to the human aspect of HCI are not in the focus. We noticed that the literature field as a whole is rather new, which

aligns with the development of the technological infrastructure (proliferation of mobile phones, mobile data connection and satellite navigation) that enables crowdsourcing of spatial data. Finally, we see that much of the broader research field is not relevant to our case, but deals with various other important and connected research problems instead. This means that searching the entire field would yield a great number of false positives, which calls for a more precise search.

In order to make sense of this convoluted field, and to focus primarily on the users' motivations to contribute to the location-based systems, we opted for a scoping review strategy [58]. According to Munn et al. [58] a scoping review is *"useful for examining emerging evidence when it is still unclear what other, more specific questions can be posed and valuably addressed by a more precise systematic review"*. As the name implies, it is good for determining the scope of the available literature, and scoping reviews are particularly suitable approach for convoluted fields [58]. Since in our case we were dealing with a phenomenon that sits at the intersection of (1) maps; (2) UGC; and (3) motivation; each three with multiple terms, and the topic being studied in multiple academic fields, we estimated that a scoping review approach would be the most suitable research approach [58].

Following the scoping review approach, we set the goal of discovering a representative snapshot of the extant literature [80] and to understand the scope of the field. With these goals in mind, we took the relevant keywords in the three domains (1) maps; (2) UGC; and (3) motivation; which we list in Table 1 and performed a search. We ended up omitting some of the search terms that yielded excessive numbers of false positives, including "remote sensing" and "participatory sensing", which instead of location-based media, were terms unique to GIS. Since our focus was on *location-based media* specifically, we were not interested in systems intended purely for professional and geographical use. These included e.g., studies that dealt with motivations to partake in mapping specifically as opposed to UGC [23, 88] as well as studies focusing on review evaluations. For review studies in the context of GIS, see [10, 76]. As we were dealing with participant motivation, the studies were naturally limited towards activities where the participant actively share information. To compensate for the lack of a holistic initial search, we afterwards performed citation chaining and additional searches with specific product names to discover further studies. Thus, in July 2024 we conducted the final search with the following search string on Elsevier's Scopus:

```
TITLE-ABS-KEY
( ("locative media" OR "location-based" OR "map-based"
OR "geo*" OR "pervasive tech*" OR "location-aware*")
AND ("crowdsourcing" OR "UGC" OR "user-generated content"
OR "volunteered geograph*" OR "geotag") AND ("motiv*")
) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE,
"cp")) AND (LIMIT-TO (LANGUAGE, "English")) => Result
count: 186
```

3.2 Literature processing

We downloaded the metadata of all the studies in a tabular format (.csv) and proceeded with the following steps related to literature processing which we borrowed from the popular literature review guidelines PRISMA [64]. First, we defined inclusion and exclusion criteria for the data processing which we provide in Table 2. Second, we cleaned the data from empty submissions, articles not available in English and those published as editorials or other non-peer-reviewed formats. This left us with 150 studies. Third, two researchers independently went through the metadata (title+abstract+keywords) of the first 40 papers. We compared the inclusion and exclusion decisions of the two researchers together and noticed that one of the researchers was a bit more conservative, letting through 3 studies that the other did not. We agreed to continue with the conservative approach in the initial step and proceeded to go through the remainder of the papers with only one of the researchers making the inclusion/exclusion decisions.

#	Inclusion criteria
1	The study has to be in English.
2	The study has to be peer-reviewed.
3	The study has to relate to participant motivations to contribute content on location-based media. In other words, if the study concerned contributing to a location-based product with no social media element, or if it concerned a social media product without a map-based element, it was not included in the synthesis.
4	The study should focus on active voluntary participation.
5	The study can be empirical or theoretical/conceptual.
6	If the study is empirical, the discussion on motivations can be the focus of the empirical work, or it can be more implicit in the background or discussion surrounding the study.
7	If the study is a literature review on the same topic, it is included as a key reference, but not included in the synthesis of the primary studies.

Table 2: The inclusion criteria that we followed in this study. Studies not matching these criteria were excluded

The selection based on title + abstract + keywords left us with 22 studies. The researchers used the following means of obtaining the full texts of these studies: (1) open access; (2) institutional access (our combined universities had full access to all major publishers; and (3) public research repositories such as ResearchGate. We then read the full texts of these studies and again assessed their eligibility based on the inclusion and exclusion criteria (see Table 2). We set aside literature reviews that we discovered (e.g., [10, 76]), but included theoretical syntheses of the literature (e.g., [27]). After this step, only eight studies remained. We excluded, for example, the work of Dossin et al. [16] which while initially appeared to also investigate user motivations to contribute to location-based media, only discussed motivation at the level of design requirements for

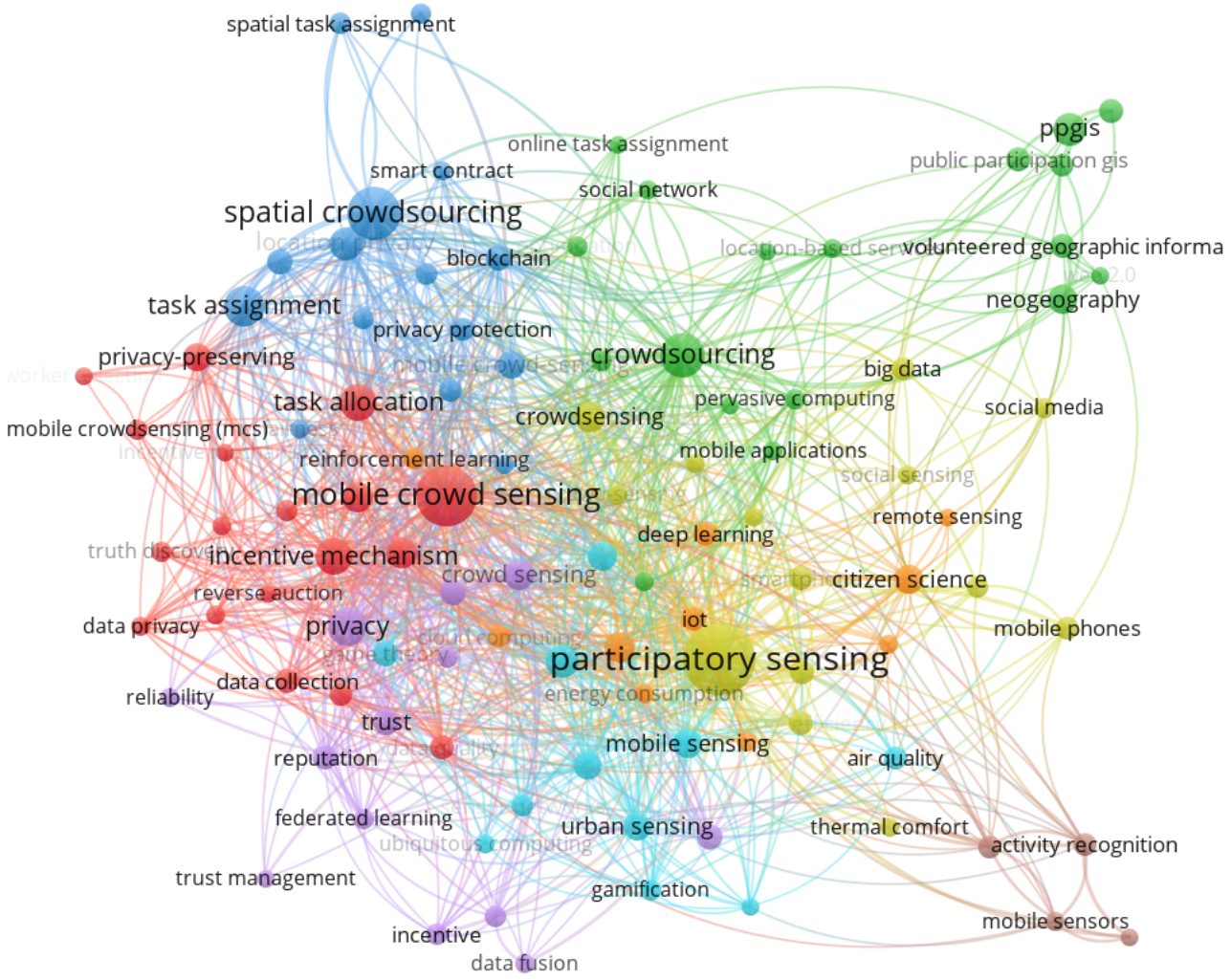

Figure 1: An overview of the research field on locative crowdsourcing based on 2576 studied discovered on Scopus.

their system "Artl@s". Another example of a study excluded at this stage was that of Guler et al. [30] that focused on a bicycle sharing system. This study, while focusing on an innovative location-based media approach, also lacked content related to the users' motivation to participate, or contribute to, such a system.

Because the number of articles discovered at this stage was small and we had streamlined the search process in favor of avoiding excessive numbers of false positives, we decided to perform citation chaining on the articles to discover any potential sources we had missed. One of the authors read all the studies mentioned in the background and discussion sections of the primary works to discover any potentially relevant papers we might have missed. This led to the discovery of one more paper. While there were multiple potentially relevant references, most of these covered crowdsourcing in general (not in the location-based media context) and others did not concern motives and incentives to contribute. In addition, we performed targeted searches on Google Scholar with specific product names (i.e. "motivations to contribute to Pokémon GO", and "motivations to contribute to OpenStreetMaps") which led to the discover of 6 additional articles, and Scopus coupling popular locative media products (Google Maps, Waze, FourSquare, TripAdvisor, Apple Maps, Pokémon GO, Ingress) and the keywords *"motivat* OR incentiv*"* which resulted in 4 additional articles on top of that. These searches were carried out by the first author, but all authors participated in sense-making around the data. The search process ultimately led us to include 19 studies in the final synthesis. The entire literature search and screening process is summarized in Fig. 2.

3.3 Data extraction and analysis

We first extracted descriptive information from the papers. This included the publication years, outlets, which location-based media products the study concerned, information about the research setting, sample, where the data was collected (in case the study was empirical) and a summary of the key findings. This was done to obtain an overview of the research field and to understand if there

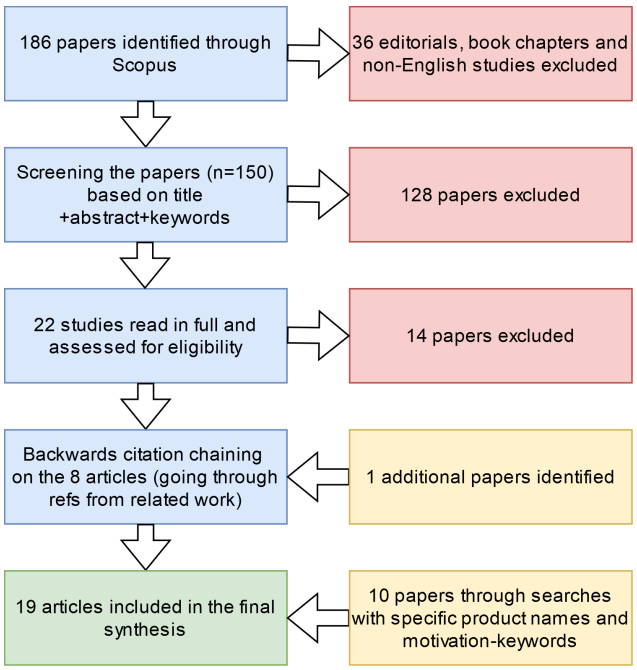

Figure 2: The literature search process summarized with a PRISMA flowchart

were any limitations, skewing, or biases in the overall research field. This also enabled us to better familiarize ourselves with the types of studies and impacted our decision to do a qualitative synthesis of the literature as opposed to a quantitative meta-analysis. Second, to answer the two RQs, we extracted from the empirical studies all factors that were reported to lead to increased number of contributions or improve the quality of the contributions (RQ2). We also qualitatively summarized evidence from theoretical studies in our sample to support empirical evidence (RQ1).

To analyze the data, we grouped the discovered motivators, combining similar motivations together, into categories. We refined the categories multiple times, and kept track of which studies supported the discovered categories and how. We sought to connect the motivations and incentive mechanisms to concrete dynamics and implementations. For example, if gamification was mentioned as a motivator, we read the study in full to understand how exactly was the gamification implemented and studied in that case. This enabled us to form a more precise understanding of the research. Regarding the motivational theories we discovered, we investigated how they are operationalized in the studies. For example, if the researchers said they drew from the points, badges and leaderboards approach for gamification [38] we then again observed their study context, and analyzed how the points, badges and leaderboards appeared in the location-based media in question.

4 Findings

4.1 Description of the research field

In the end, we included 19 studies in the literature synthesis. The descriptive data of the studies is given in Table 3. Altogether there were five theoretical/conceptual studies [7, 27, 28, 43, 50] and the remaining 14 were empirical papers. The empirical studies were conducted with a wide variety of location-based applications and in multiple different countries. There were studies on off-the-shelf applications such as Pokémon GO [77], Ingress [43, 70], Foursquare [83] Instagram [54] and OSM [11, 28] as well as various ad hoc applications created particularly for research purposes or in connection with academic research [3, 7, 52, 56, 84]. The most popular country where empirical data was collected for the studies was Germany with three studies [3, 52, 56] and then Fiji [77], Laos [75], USA [78], Finland [84] and China [97] were all present in one study each. The earliest work in the sample was a paper from Goodchild, which appeared in 2007 [28] with the latest publications we discovered appearing in 2024 [7, 84]. Altogether the research field was quite heterogeneous and balanced, with various methods, theoretical approaches and research settings being used to probe the topic of contributing shared data to locative media.

Most of the empirical research in the sample of studies (N=19) were survey-based [11, 70, 77, 83], case studies [52, 78, 97] or based on field-experiments [3, 56, 75, 84]. The outlier was McCosker et al. [54] who analyzed a large dataset (36,252) of computationally obtained geotagged Instagram posts. Among the theoretical papers two dealt with analyzing the phenomenon of location-based crowdsourcing by drawing from the example of popular products such as Wikimapia, OSM, Google Earth and Ingress [28, 43] and two from ad hoc applications [7, 50]. The remaining one created a framework based on a review of previous literature [27]. We provide an overview of these studies and their findings in the Table 7 and Table 8 in the Appendix. Taken together, the research methods applied in this field do not showcase any significant biases or skewing towards any specific direction. This can be considered a strength, since having studies observing the same phenomena from a wide range of perspectives increases the robustness of the outcomes that we can derive from the field as a whole.

4.2 Theories and mechanisms in motivating participation in location-based crowdsourcing

In this subsection we provide findings related to RQ1 regarding the used theoretical approaches for understanding crowdsourcing motivations in location-based media. The most popularly appearing theoretical frame in our sample was self-determination theory [72] and the distinction between intrinsic and extrinsic motivation. This approach was used quite loosely, for example, to classify and make sense of the motivational dynamics when applying gamification approaches [7, 43, 52, 56, 90]. There were studies harnessing gamification design frameworks [7, 56] as well as complete game features [43, 77] to explain users' motivations, but these studies did not engage in detail with the motivation building trajectories of these features. Examples of game mechanics that were implemented or identified in the studied crowdsourcing applications included points

Study	Approach	Context applications	Sample	Country
[3]	Empirical (two field studies)	Ad hoc tasks for users to complete outside	9 participants in two field studies	Germany
[11]	A literature review-based survey	OpenStreetMap	444 OSM contributors	Global
[28]	Theoretical	Wikimapia, OSM and Google Earth among others	Theoretical research / review of the phenomenon	N/A
[56]	Empirical (field experiment)	Ad hoc parking spot application	170 users	Germany
[77]	Empirical (survey)	Pokémon GO	371 Pokémon GO players	Fiji
[75]	Empirical (field experiments)	What-You-See-Is-What-You-Map	27 participants (Study 1) and 12 male farmers from rural Laos (Study 2)	Laos
[83]	Empirical (three surveys)	Foursquare	300 Foursquare users, 214 Mturkers (survey 1) and 411 + 512 MTurkers (survey 2)	Global (Amazon MTurk)
[52]	Empirical (case study)	CampusMapper + analysis of features in other apps	20 participants in Study 1, 28 participants in Study 2	Germany
[27]	Theoretical	Develops a general framework	N/A	N/A
[43]	Theoretical / case study	Ingress (Prime)	N/A	N/A
[54]	Empirical (big data analysis)	Instagram	36,252 Instagram posts	Global
[7]	Theoretical (design)	Arcane Shift (ad hoc)	N/A	N/A
[50]	Theoretical	"Big Game Huntr"	N/A	N/A
[97]	Empirical (case study)	EDIRS	not disclosed	China
[78]	Empirical (case study)	Historypin	A 45-day case study including 7 interviews	USA
[1]	Empircal (interviews)	Waze	20 Waze users	Not disclosed
[84]	Empirical (playtest)	NaturaTrack	8 playtesters	Finland
[70]	Empirical (survey)	Geocaching, Munzee and Ingress	337 participants	Global
[90]	(Empircal (survey)		Hypothetical platform 404 participants (in the main study)	Global (MTurk sample)

Table 3: Summary of Studies. The country tab denotes the country in which the empirical study was conducted and/or where the sample is from.

and badges [7, 77] (which according to SDT can be seen as an extrinsic motivator), having the crowdsourcing contributions become a part of the game [43, 77] (which typically leverages more intrinsic motivation) and social recognition in the form of displaying the crowdsourcing contributor's name inside the game as the creator of the specific contribution [43, 77] (which can be linked directly to the "relatedness" dimension of SDT. Despite the loose engagement with SDT, it was only explicitly mentioned in a few studies [27, 77]. The rest appeared to discuss concepts within the theory (such as intrinsic vs extrinsic motivation), but with a focus on the empirical work as opposed to building a theoretical understanding.

Many studies approached motivation more strongly from a "human needs" perspective [52] with Maslow's hierarchy of needs being mentioned a couple of times [27, 97]. For example, Martella et al. [52] link a set of human needs to gamification approaches for satisfying the corresponding needs, and further to player types. This approach is then developed into a framework for designing a motivating crowdsourcing approach. The work of Gomez-Barron et al. [27] cited another paper in our sample, Xu and Nyerges [97] explicitly, and built on top of their work, expanding their proposed needs-based framework. Similarly to the research on intrinsic motivation and gamification, the needs-based view on user motivation is able to take high level theoretical concepts and map them onto specific motivational crowdsourcing features [27, 52, 97]. Taken together, SDT and the human needs perspective form the backbone of the theoretical approach used in the extant scholarship (N=19). That being said, neither approach was strongly present as a whole, and a more theory-driven research may be needed to build a holistic understanding.

In the sample of studies there were also some theoretical approaches that were mentioned only in individual papers. These included, first, the DeLone and McLean models [77], which conceptualize system use as a result of organizational impact, individual impact, user satisfaction, information system, system quality, service quality and willingness to use. In this study, the DeLone and McLean dimensions were mapped into specific aspects of the location-based game Pokémon GO to understand why users participate in crowdsourcing within the game [77]. This approach enabled the authors to derive hypotheses which they then tested quantitatively. The findings showed information quality, system

quality, intrinsic and extrinsic motivation all to play a part in motivating user engagement, highlighting the multi-faceted nature of motivational dynamics in location-based apps, also discussed e.g., in the following [43]. Second, the "Mechanics Dynamics, Aesthetics" and "Gamification for Volunteered Geographic Information" frameworks were present only in the work of Baer [7]. Both these frameworks were based on operationalizations of existing motivational theories for the context of location-based systems. Third, Silva et al. [78] built on the diffusion of innovations theory, particularly the aspect of risk management when adopting new behaviors. This theoretical view enabled the study of location-based apps and contribution adoption in a marginalized community [78]. Fourth, Wang et al. [90] applied the lens of social cognition theory to understand how gamification elements motivate and guide crowdsourcing review processes. In this study social cognition theory provided a rather unique look into the mental processes of contributors and their relations to the social dynamics at play, highlighting the importance of adopting multiple theoretical viewpoints for understanding the complex phenomena at hand.

As discussed already in connection to SDT and needs-based theoretical views on motivation, a number of studies in our sample did not explicitly build upon any theoretical framework of motivation. These included more design-oriented studies [3, 50, 75, 83, 84] as well as exploratory studies [54, 70]. The work of Goodchild provides a comprehensive overview of the phenomenon of location-based crowdsourcing and discusses related terms, concepts and motivations to participate, but does not refer to any explicit motivational theory [28]. The work of Budhathoki and Haythornthwaite was based on studying a set of motivations identified in previous research, but they did not explicitly reference any theoretical approach for understanding motivation [11]. The studies lacking explicit theoretical lenses were therefore heavily empirically-oriented, and were focused on providing empirical evidence rather than building a theoretical understanding. The value of these types of studies is that they appear more explorative in nature and open new avenues as opposed to reducing the complexity of the crowdsourcing participation into the confounds of a specific theory.

Taken together, the theoretical basis for understanding user motivations in crowdsourcing contributions in location-based media appears to firmly stand on two foundations: (1) a divide into intrinsic and extrinsic motivation following SDT where gamification appears as the primary lens for understanding how these systems foster motivation in users [7, 43, 52, 56] and (2) a needs-based view that focuses on application design that would satisfy users' fundamental needs [27, 52, 97]. These two theoretical approaches were operationalized by connecting the theoretical motivations to concrete dynamics in the studied applications and associated crowdsourcing processes (see e.g., [7, 27]). However, it must be noted that the prevalence of these approaches in the literature does not mean alternative approaches would be less informative or effective. Indeed, there were various theories that were mentioned only once, such as the diffusion of innovations theory [78] and DeLone and McLean models [77], with no apparent reason why they lacked popularity. Furthermore, other theoretical viewpoints may also be valuable. For example, goal setting theory [51] which describes human motivation to set goals that they are able to keep might help understand why people contribute shared content in the long run. Vroom's expectancy theory [87] could be applied to, for example, understanding how users' believe that applying effort (i.e., contributing) leads to performance (i.e., contributions appearing on a locative media and become popular there) and so on. Finally, perspectives such as uses and gratifications theory [25, 32] could help quantify what are the most relevant uses and gratifications for current contributors to locative media.

4.3 How to motivate people to contribute

To answer the second RQ regarding what motivates participants to contribute, we now turn our focus to the studied concrete motivational dynamics. Within the sample of studies there were multiple mentions of specific motivators, some empirically derived and verified (e.g., [56, 77], some based on qualitative observations from the field [28, 43] and a few identified in the process of designing and implementing theory-driven application prototypes (e.g., [7]). Only one study focused on inhibitors of participation and demotivating factors [70]. Most of the literature was focused on motivational mechanisms for increasing the quantity of contributions, but a few also discussed the quality of the contributions (e.g., [56, 83, 84]). However, in many studies it was difficult to distinguish mechanisms leading to *quality* from mechanisms leading to *quantity*.

We list the key motivations to contribute that were mentioned in the studies in Table 4. One of the difficulties we faced in constructing this Table was the high level of heterogeneity in the sample, meaning that sometimes rather broad categories were used (i.e., intrinsic and extrinsic motivation [77]) and sometimes two or more studies seemed to speak essentially of the same dynamic, but with different terms. Furthermore, some of the motivations mentioned here were the result of an empirical study [56, 77], some were derived from theory-guided design science [7], some were based off a case study [43, 97] and some were mostly theoretical [28]. There was also variance in the operationalization of these dimensions. For example, in the study of Morschheuser et al. [56] participants were contributing shared information of available parking spots, helping out each other in that way, while in Laato et al. [43] and Sharma et al. [77] the participants were contributing POIs in a game-setting, effectively broadening the playing field for everyone. Furthermore, in Uhlgren et al. [84], participants were taking photographs of wildlife sightings. These cases speak of the heterogeneity of the study contexts and the difficulty of comparing findings from two studies with each other. Most studies either implicitly (e.g., [43]) or explicitly (e.g., [50]) included in their study context supporting mechanisms such as the gamification elements: points, badges and leaderboards. Perhaps unsurprisingly, there were very few highly controlled studies that would have tested the effectiveness of specific motivational interventions without major confounding factors.

The first motivational dynamic in Table 4 refers to the importance of having clear goals and feedback in the crowdsourcing system. Participants should be made aware of what is expected of them, and when they participate, they should get as immediate and as high quality feedback of their contribution as possible. The second dynamic relates to enjoyment of the activity itself. In case the crowdsourcing solution creators are able to make the very process of contributing enjoyable, participants are more likely to contribute. The third dynamic relates to the previous one, and is

#	Motivational dynamics	Explanation	Sources
1	Clear goals and feedback	Provides guidance and a sense of direction. Quantifies progress and serves as a base for adding other motivational dynamics.	[43, 52, 56, 75, 83]
2	Enjoyment of the activity itself and being stimulated while contributing	Intrinsic enjoyment of the contribution process and related actions.	[7, 11, 28, 43, 52, 77]
3	Feeling of competence, there being some level of skill associated with the contributions	People intrinsically strive for feelings of competence and mastery.	[27, 43, 52, 56, 90]
4	Recognition and reputation among the community, self-promotion	People intrinsically strive to relate with others and to advance their social position within their perceived ingroups.	[1, 7, 27, 28, 43, 52, 56]
5	Self-development, learning and gaining knowledge	People intrinsically strive for autonomy, freedom and self-improvement.	[11, 27, 28, 83]
6	Sense of ownership and commitment to the project	Taking responsibility of a task can be considered a motivational antecedent of contributing.	[11, 52, 90]
7	System and information quality and usability concerns	Quality of the system itself suggests commitment to care for contributions. Usability improves the user experience and through that, boosts motivation.	[70, 75, 77]
8	The contributor having some utility of the contribution, either personally or for their in-group	Utilitarian value, such as providing visibility for one's own restaurant on a map service, was a key driver to contribute in certain situations.	[43, 56, 77]
9	Supporting motivational mechanisms	Extrinsic rewards and supporting systems, such as points, badges and leaderboards, would in all but one study improve participants' motivation to contribute, at least if done correctly.	Almost all studies e.g. [3, 43, 50, 90]

Table 4: Implicitly and explicitly mentioned motivations to contribute shared content on location-based media in the synthesized set of peer-reviewed studies (N=19) .

about the competence dimension in SDT [27]. If participants are able to feel empowered and strong when contributing, that increases their motivation to participate. The fourth dynamic relates to social recognition, which was particularly important in social settings such as multiplayer location-based games [43, 56, 77]. Goodchild also suggests that people may be motivated by self-promotion [28] if they are able to get recognized for their contributions in light of their peers. Adornes and Muniz provide evidence of non-selfish reasons to help, such as altruism and empathy [1], highlighting that when contributing socially shared information, some of the contributions may be attributed to users' good will. The fifth dynamic relates to personal development. For example, being able to explore the world, discover new things about it and learn while contributing, are likely to boost participants' motivation.

The sixth dynamic, commitment to the project, was mentioned in a few studies [11, 52, 90]. While it remained less clear how such a commitment could be fostered in participants, it was evident that commitment to the project was an important motivational dynamic driving participation. Interestingly, the work of Wang et al. [90] suggests that gamification approaches such as badges for contributions may tap into users' desire to signal expertise and experience to each other. It could also work as a way to signal commitment and belonging in the community, linking back to the relatedness dimension of SDT. The seventh dimension was about the quality of the system and related information quality. It is perhaps unsurprising that a good user experience and high overall quality of the system boosted participants' desire to contribute in crowdsourcing tasks, since these signal to users that their contributions will be handled with care and professionally, and will be presented in a good light for other people. The eighth dimension was about the utility of the contributions i.e., instead of being only used as workforce, the participant could in some way also benefit from the contribution. Finally, perhaps the most common dimension present particularly throughout the gamification-related studies was the dimension of additional supporting tasks. While not related to the crowdsourcing activity itself, the supporting mechanisms (e.g., points, badges and leaderboards) provided an additional layer of motivation for participants. However, interestingly one study [70] reported that basic gamification features might in some cases even decrease participant motivation. This highlights the need for a more intricate and detailed design philosophy when it comes to implementing motivational dynamics in UGC contributions in locative media.

On top of the more general set of motivators displayed in Table 4 there were various predictors of crowdsourcing contributions that were not necessarily motivations the way we understand them, but more like success factors that predict participation in crowdsourcing. We list these predictors in Table 5. These included, for example, temporal and spatial consideration (i.e., when and where participants are more likely to contribute regardless of the system details) [3] and that there were individual differences between participants, meaning different user types are likely to behave and contribute differently [11, 27]. One of the more important characteristics that appeared to be missing in the literature was the distinction between crowdsourcing contribution *quality* and *quantity*. This means there weren't many studies that explicitly separated

these, but there were some dynamics that appeared to relate to only one of the two dimensions.

Consideration	Description
Spatial considerations	Participants are more likely to contribute tasks near their house or wherever they happen to move [3]. Participants care more for content that relates to where they move on a regular basis [43]
Temporal considerations	Participants contributed tasks at various hours, but the most popular time was after work [3].
Social effects	Out of three scenarios (cooperation, individual competition, team vs team competition), participants contributed the most content in the team vs team competition scenario [56]. Participants trying out ad hoc games wished for more social features, highlighting how the social dimension is strongly present in users' mind when contributing shared information [84].
Individual differences	For example, serious and casual OSM mappers had different motivations to contribute shared information [1, 11, 27]. While some users may not contribute themselves, their actions might still have an impact on the motivation of key contributors.

Table 5: Discovered additional considerations and predictors for participating in the crowdsourcing of shared information on location-based media.

In terms of quantity, we found that crowdsourcing experiences situated within a user's routine are preferable [3]. This is both spatial and temporal. Users are more likely to contribute to crowdsourcing tasks that are located near areas they are already in, such as their house or workplace. Furthermore, participants tend to make more contributions after work [3]. Additionally, the full force of the motivational mechanisms mentioned in Table 4 should be harnessed to boost participants' motivation in general to participate, leading potentially to a higher number of contributions. It is important to note that in some cases, reward systems related to the quantity of contributions can lead to lower quality contributions [83]. This brings us to discuss the quality of contributions.

In terms of quality, some good predictors appeared to be self-promotion and personal responsibility of the contributions [28]. When a participant experiences social responsibility and has their reputation on the line, they are more likely to make high quality contributions [28]. Also the motivational dynamics of having clear goals, feeling competence and self-development/learning (mentioned in Table 4) are good predictors of high quality submissions. For example in the context of a location-based game Ingress participants are given clear goals (submit POIs that have a clear criteria by taking a photo and writing a description). The system rewards players with game/gamification features, but it also draws from social recognition and utility value as players' name is displayed next to an accepted contribution (in the photo they took) and the contribution becomes a part of the game, improving the playing field for all [43]. While the dynamics related to quality appear to be rather complex and convoluted one general rule that appears throughout the studies is that intrinsic motivators seem to boost quality, while more extrinsic approaches usually lead to an increase in quantity [7]. Despite this general finding, ultimately it will depend on what kind of behavior is rewarded and supported. To summarize, if participants remain committed to the crowdsourcing cause [11, 52] and there is some reward/value attached to providing high quality contributions, they are more likely to happen.

5 Discussion

5.1 Design considerations for motivating users to contribute shared content on locative media

Based on our findings we can derive four primary themes in the emerging motivations for users to contribute to location-based media.

Theme #1. Intrinsic motivations of enjoying the activity itself is powerful for sustained and high quality contributions. We found evidence that intrinsically motivated contributors produce more and higher quality contributions over time [27, 77], and these approaches are particularly suitable for projects that require scaling up to a global user base [43]. Location-based media that requires users' contributions must tap into users' desire for enjoyment and intellectual stimulation. This in part includes offering challenges that have varying difficulty levels so that users can grow and make progress, but not get discouraged [77]. The users' creativity and self-expression can also be harnessed [84] and designers should create systems that tap into the three dimensions of intrinsic motivation in SDT: autonomy, competence, relatedness [72]. In terms of autonomy, location-based platforms should allow users sufficient flexibility to ensure their contributions align with their personal interests and values. Allowing users to exercise choice is essential for fostering intrinsic motivations to help drive meaningful engagement. In terms of competence, users should feel confident that they can gain expertise and achieve desired results. This can be facilitated through mechanisms that provide positive feedback when users contribute content, or allow users to showcase their expertise to others via e.g., contributor badges [90]. Implementing challenge at the appropriate level, so that it enables users to feel accomplished and that they are growing, but not feel discouraged, can be a difficult design tension to balance. However, when done optimally, it can further users' feeling of competence. Regarding relatedness, location-based platforms should explore strategies to inspire a sense of belonging and connection between users with shared interests [56]. This can be combined with competence-focused design elements. Positive feedback can be grounded in a user's contribution to impact the greater community. For example, feedback when another user interacts with or benefits from one's contribution can help them feel satisfaction from making socially appreciated content [1]. Another way locative media crowdsourcing design can inspire relatedness is by establishing sub-communities for users based on shared interests and

goals. Features such as customizable channels, where users can view and contribute content aligned with their specific interests, offer one way to create these communities. Based on the findings that intrinsically motivated contributors produce more and higher quality contributions [27, 77], we encourage designers to primarily identify how to draw on intrinsic motivations in their design.

Theme #2. Team-based competition harnesses the best aspects of competition and cooperation.

Engaging with a group and having a joint commitment to the mission of the location-based platform can motivate users to contribute in a way that supports this in-group [56]. However, some competition also motivates users to contribute as their desire for improved reputation or self-esteem may come into play [97]. Having a combination of cooperation with a team or sub-group that is lightly competing against another team or sub-group may result in more contributions [43]. Based on these findings, designers can implement these beneficial dynamics at least in two ways. First, systems where users select a team or affiliation and contribute to a shared cause can help them feel relatedness and identification with an ingroup. This selection can be done explicitly as in Pokémon GO or some ad hoc prototype games [43, 56, 77] or implicitly by e.g., contributing content to a specific area in Google Maps and gaining reputation and recognition in that area by the involved community. The competitive layer can then be added on top with contributors competing, for example, from the number of high quality contributions or the completeness of contributions within an area. Second, locative media can create socially shared challenges. These could include e.g., challenges for adding a certain number of restaurant reviews over time or documenting all bridges within a city. Following the findings of Morschheuser et al. [56] such challenges receive most participation when they have a cooperative social layer whereby participants are not only doing the work for their own gain, but also for a team or affiliate group. Fostering the creation of friendship between users taps into the desire to be part of a group [52] and may make users feel more socially connected to other users. This in turn drives users to contribute as they want to improve their reputation in the community [97]. While these findings seem generalizable and promising, we encourage designers to experiment and test various different ways of implementing these dynamics in their system to boost crowdsourcing participation.

Theme #3. Gamification elements can boost both the quality and quantity of contributions.

Several studies discussed how gamification elements can motivate users to contribute to location-based media, and keep them engaged [7, 43, 50, 52, 90]. Game elements that reportedly increase engagement are points, badges, bonuses, virtual goods, avatars, leaderboards, levels, friending, and votes [52], as well as more complex game-dynamics present in multiplayer location-based games [77]. These elements motivate users in different ways. For example, leaderboards tap into the desire for competition [52] and may drive users to make more contributions. Points facilitate leveling up and symbolize progress being made [52]. In addition, points can directly influence a user's status on leaderboards, enabling them to show off and drawing on competitive and achievement-based motivators [90]. Another gamification element, avatars [34], can address users' need for self-expression and may lead to more engagement, especially with customizable avatars that can foster a more significant connection between users and their avatar [52]. With more opportunities for self-expression, participants may develop a stronger intrinsic desire to work for their avatar and care for their social reputation in the virtual world. Based on these findings, designers should look into the various opportunities provided by gamification, also outside the game context. In practice this could mean implementing mechanics for robust customization of avatars, enabling a stronger sense of expression through other customization options and implementing points and badges that can be displayed and that have social value [90].

Theme #4. Elements of community and social connection create feedback loops in which users can receive recognition and create a positive reputation for themselves.

One of Maslow's social needs is self-esteem needs. This social need can motivate users to contribute in order to show their abilities or knowledge to others and receive recognition for it [27]. Being socially connected with a community and getting recognition and respect from this in-group improves a user's reputation, and increases their self-esteem [27]. This aligns with findings that two primary reasons people contribute to geographical services are for self-promotion (to leave one's mark) and providing value to an in-group [28]. Furthermore, linking likes to a user's reputation increases user engagement [77] and Themes #1-#3. Based on these findings regarding community-oriented motivations, designers should consider implementing social features such as likes and comments if they want users to feel recognized and contribute more as a result. As locative media are a hybrid experience between the physical and the digital, they are in a unique position to facilitate not only digital friendship and appreciation, but in-person interaction as well [43, 84]. A good example of this are raid events and other gatherings in Pokémon GO that bring people physically together and enable users to connect in-app user names with people's real names and faces [65]. Such dynamics can foster in users a responsibility over the shared contributions and make high quality contributions feel more meaningful as it can become more apparent that they are seen and enjoyed by others..

5.2 Disentangling key terminology for HCI

Whilst conducting this study and reviewing the literature, we encountered a wide array of terminology linked to the topic of contributing shared content on locative media. Many terms show some level of congruency in their definition, and their popularity in the academic discourse varies greatly depending on the discipline (i.e., GIS vs HCI vs information systems) and the research traditions within these disciplines. This apparent abundance of quasi-synonyms convolutes the exploration of relevant literature and can be a barrier for a shared understanding among scholars and among practitioners. In this section we map the terminology from different research fields into distinct categories based on their meaning and

give recommendations on which terms to adopt in future HCI work. We do this by sorting the key terms based on their meaning into three categories: (1) the enabling **technology** or platform, (2) the **contribution** or the process of collecting/gathering information, and (3) the **data** or content itself that is being collected/gathered.

5.2.1 Suggested terms for the technology/platform: "locative media and location-based media". At the core of the current participatory data revolution sits the enabling technology as well as its widespread adoption. These include the proliferation of internet access, ubiquitous personal computing and, in particular for spatial content creation, the global market penetration of smartphones with accurate positioning capabilities. This technological phenomenon has been summarized as the *Web 2.0* or the *participatory web* and is generally seen as the enabling technological advancement allowing for data creation by laypeople [92]. As these terms are used as umbrella terms to denote an evolving conglomerate of technological advances, we recommend refraining from including these terms in HCI studies concerning specific crowdsourcing initiatives.

Within crowdsourcing processes, we can make a distinction between the platform through which data is being collected, and the product or service in which the data is put into use [28, 43]. These are often one and the same, and in this work and context, we have used the terms locative media and location-based media. Examples of such products include Waze, Google Maps and Ingress. We recommend HCI scholars to adopt either of these terms (locative media or location-based media) since they are already widely used in HCI and beyond (e.g., [66, 83, 91]), but for more precise communication we recommend using the names of the specific products in question, such as Google Maps or Pokémon GO.

5.2.2 Suggested term to describe the contribution process: "(spatial) crowdsourcing". Within the overall research field there are some more general terms for describing the contribution process (e.g., volunteered information, UGC and crowdsourcing), but additionally various domain-specific terms originating from the research field of GIS (e.g., participatory sensing, web mapping and neogeography). Within these terms, some also overlap with the technology (such as PPGIS which describes a geographical information system where laypeople contribute) and some overlap with describing the data (such as UGC which denotes content generated by average users, but also sometimes the means of obtaining the contributions as well).

Reviewing the literature revealed that a plethora of these terms are used somewhat synonymously with *crowdsourcing* leading to confusions between studies and disciplines. These quasi-synonyms include *citizen science*, *participatory sensing*, *science 2.0* and *public participation in scientific research (PPSR)* [76]. For initiatives that involve lay-people in multiple stages of the scientific work (e.g. problem definition, data analyses and interpretation) and that are not necessarily conducted over the internet, scholars may encounter and use the terms *citizen science* or *PPSR*. Further, we came across a rather extensive number of terms used to denote participatory involvement in spatial science. This includes, but is not limited to, terms such as *PPGIS*, *web mapping*, *neogeography* and *collaborative mapping*. However, as recent studies have emphasized the importance of clearly distinguishing between these terms [48], we recommend using the term *crowdsourcing* when a participatory data generation approach is voluntary, includes diverse lay-people and uses the internet. When discussing crowdsourcing specifically in the context of locative media, we encourage the use of the term "spatial crowdsourcing" [7]. We prefer this term as it includes both passive and active contributions, whereas e.g., *PPGIS* commonly refers to active contributions to a specific question. *neogeography* and *collaborative mapping* are both rather niche terms [76] and we recommend only using these when bridging a disciplinary gap to specific established concepts.

5.2.3 Suggested term to describe the shared data: "volunteered geographic information" for spatial data and "user-generated content" for aspatial data. Finally, we need terminology to describe the content that is being generated or shared. Here scholars may use precise language to describe exactly what is being contributes (images, reviews...), but in many instances an umbrella term might be needed. Within this study we used the terms *UGC* (which also has meanings relating to the contribution process) as well as *crowdsourced content / information* somewhat interchangeably, as stated in the background section (2.1). However, the extant scholarship features even some more terms such as *social media* (that also is often used to refer to the technology/platform) and *mashups* [60, 73, 76]. These are complemented with further terms that signify a spatial component in the data such as *volunteered geographic information* and *contributed geographic information* [28, 76]. Furthermore, we found additional terms that do not imply participatory data generation, however, which were used to describe the resulting data derived from user generated content nonetheless, such as *location-based content*, *Citizen-contributed geographic information* and *ambient geographic information* [63, 76, 91]. Seeing the substantial number of terms used somewhat interchangeably, our recommendation for HCI scholars is to use the term *UGC* for aspatial content, and the term *VGI (volunteered geographic information)* when referring to crowdsourced spatial data specifically. Seeing the convoluted nature of overlapping terminologies between disciplines, we argue that using the term *VGI* enables effective and precise communication, and can help build bridges between HCI and geographic disciplines, while UGC is an established term outside location-based media, and therefore fits well to describe shared aspatial content.

5.3 Theoretical contributions

There are two neighboring disciplines that our study is closely linked to. The first comparison target are previous literature reviews relating to crowdsourcing in map-based geographical systems [10, 76]. Both these previous reviews focus on GIS rather than location-based media and only implicitly or loosely discuss motivations to contribute. In both these works there is a focus on the active vs passive crowdsourcing approaches and their differences. In our case, we were mostly focusing on active crowdsourcing and we expanded the scope towards media products such as Instagram [54] and location-based games such as Pokémon GO [77] and Ingress [43]. We contribute to the previous review studies and the research field as a whole by identifying a key set of literature (N=19) and extracting and categorizing the mentioned motivational dimensions. We also elucidate which theoretical approaches have been used in these studies to understand users' motivations to contribute shared content. This synthesis enables scholars to obtain an

overview of the research done so far and practitioners to get ideas on how they could better motivate participation in crowdsourcing and empower the creation of high quality UGC in location-based media.

Another stream of research relevant to our work is the study of motivations to contribute to crowdsourcing in general non-location-based media products such as Wikipedia, YouTube or Mario Maker [41, 55, 81, 96]. This stream of research has identified various motivators to participate in contributing UGC such as (1) enjoyment of the activity [81, 96], (2) desire to share information with others [41, 81], (3) personal documentation [81] among others such as passing time, making money, having social contact and feeling accomplished through contributions [41, 98]. Our findings align with these studies, but provide some evidence of reasons to contribute that may be unique to locative media. For example, people may be more motivated by spatial and temporal aspects [3] such as creating map-based content that has utilitarian value for themselves in their neighborhood [43] or be more driven to help because of in-person social ties in that area [56]. In other words, we did not find evidence that the literature on participation in crowdsourcing in general would not apply in locative media, but the facet of locative media integrating the physical and the digital introduces some additional motivational dynamics that are not present in non-spatial media. The main theoretical contribution of this research remains providing the synthesis and overview of the literature on motivations to contribute to crowdsourcing in location-based media. Drawing from both bibliometric [85] and scoping review [58] approaches we (1) identified key terms related to the field; (2) identified a snapshot of the literature on the topic; (3) extracted and analyzed the information to derive a list of key motivations for participants to contribute shared information on location-based media; (4) documented which theoretical approaches have been applied in the field; (5) documented the bibliometric and descriptive statistics of the field; and consequently, (6) were able to provide an overview of the field as a whole. Next, we discuss the limitations of this study and the research field we investigated as well as propose an agenda for future work.

5.4 Limitations and Future work

One of the limitations of this scoping review was that we did not obtain an exhaustive sample of all the research that has been done on this topic. While we took multiple measures to ensure that we had a broad coverage of research in HCI and neighboring disciplines, it is possible that some relevant studies were not included in the synthesis. For example, we might have missed (1) studies that were published in outlets that were not indexed in the Scopus meta-database; (2) studies that did not explicitly state they were discussing motivations to contribute even though they were; (3) studies that did not explicitly state that they were discussing crowdsourcing in a location-based media context even though they were; and so on. Some studies we intentionally left out of the scope of this study. We excluded, for example, studies relating to the motivation to play Ingress [57, 71] since while the game is also a crowdsourcing platform, participation in active crowdsourcing is not mandated in order to play Ingress. Some of the studies not included in the synthesis also related specifically to the field of GIS (e.g. [12]) reviewing content and mapping. For those interested in literature reviews on these topics, we encourage to read the work of Bubalo et al. and See et al. [10, 76].

Another limitation relates to the literature synthesis. Within our sample of 19 papers we had various empirical and theoretical approaches (surveys, field experiments...) operationalized in multiple ways (different measurements...) across a wide range of products (games and map-based services...) and contexts (different countries, different samples...). Due to the heterogeneity of the scholarship we were unable to perform statistical meta analyses and instead, focused on providing a general synthesis of the field. Because of this limitation, the synthesis should be understood as a general overview rather than a strict guideline for location-based crowdsourcing developers. The heterogeneity of the field can also be regarded as a weakness since there are not enough studies or similarities between studies to understand users' motivations precisely. The studies were also from different disciplines, and used different but overlapping terminology, and there seemed to be an apparent disconnect in the field where e.g., HCI scholars and GIS scholars were not always referencing the same research. Following these limitations we propose an agenda for future research. We list the key directions for future research in Table 6.

In addition to the eight future research directions in Table 6, there are various other avenues scholars could pursue, such as related aspects that impact user motivation to participate in crowdsourcing. For example, the ethics relating to the ownership of crowdsourcing contributions or privacy aspects. Elements relating to passive crowdsourcing [10, 76], such as to what degree users should be made aware of the data that their devices are providing, might impact motivation, and therefore could be valuable for this stream of research. Finally, we recommend scholars to follow the latest advancements in technology, including wearable devices, head-mounted displays and other developments that may advance, disrupt or even revolutionize location-based media applications.

6 Conclusions

The research in location-based crowdsourcing is currently scattered across disciplines (geography, HCI, information systems and so forth) and obfuscated by the existence of various overlapping yet related terms (VGI, PPGIS, neogeography, crowd sensing, close-range sensing, location-based crowdsourcing, UGC in locative media). As a fundamentally inter-disciplinary field, HCI is in a position to provide literature syntheses that may help scholars across fields to better discover and understand each other, and make use of each others' findings. In this study, we conducted a literature review on the users' motivations to contribute UGC and participate in crowdsourcing in location-based media. We synthesized the field, analyzed the theoretical frameworks used as well as compared the empirical findings, and organized the motivations into altogether 9 categories of motivational dynamics for participating in location-based crowdsourcing (Table 4). Following the literature review, we provided recommendations for designers, elaboration on which terminology scholars should adopt and avenues for future research.

#	Future direction	Description
1	Comparison between applications.	Real world contexts and applications are complex and there is a need to compare how the identified motivations to contribute function across different applications in order to derive more generalizable insights [43, 56]
2	Unification of terminology	It is not uncommon for new emerging scientific fields to develop overlapping terminology, particularly when the fields are inter-disciplinary. In this study, we provide our take on what terminology HCI researchers could adopt moving forward in Section 5.2, but we fully acknowledge that in a moving field we have to stay alert on new developments and research endeavors impacting terminology.
3	Alternative theoretical approaches	So far the research field is dominated by a few theoretical approaches: namely, intrinsic vs extrinsic motivation, gamification and theories on human needs. There are various other theoretical frames which might be relevant here ranging from goal setting theory [51] to Vroom's expectancy theory [87] and uses and gratifications theory [25, 32]. We encourage researchers to approach the topic of location-based crowdsourcing from these perspectives to add new potentially relevant knowledge.
4	Long-term engagement	Even the longitudinal studies in our sample were rather short (e.g. 45 days [78]). However, currently we have location-based crowdsourcing applications/media such as OSM, Pokémon GO and Ingress which have been in active use for multiple years [77]. Future research should look into the long-term engagement with these platforms and how engagement and the motivational dynamics evolve over time.
5	Relative strength and costs of the motivational strategies	While there was evidence of the existence of motivational dynamics that have been useful, there was not enough data in the sample to prioritize them based on effectiveness in quality or quantity of the contributions, or cost-efficiency. Future research could address this by conducting A/B tests or comparing two almost similar products together for their motivational effects.
6	What does not predict motivation to participate	The research seemed to overwhelmingly focus on identifying the positive predictors for contribution, but only a few studies provided evidence of non-predictors [77] or negative predictors. Future research could focus on understanding the elements that lead to discontinuance of crowdsourcing projects
7	Negative incentives to contribute	The literature as a whole appears over-focused on predictors of contribution (positive motivators). The exception is the work of Reinhardt and Heinig [70] who numerate a full list of reasons why people do not contribute content to locative media. We encourage scholars to further explore the inhibitors of contributions across various locative media platforms.
8	The missing perspective of the non-users	A timeless article by Satchell and Dourish reminds us of the importance of studying those who are not engaged with the system at hand, to understand their needs and motivations [74]. This perspective was missing in the studies (N=19) included in our synthesis.

Table 6: A future research agenda in the field of motivations to contribute in location-based crowdsourcing.

Our findings can be useful for both researchers and practitioners in improving the quality of crowdsourcing contributions and empowering a future of meaningful UGC in location-based media.

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References

[1] Gustavo Scheffel Adornes and Raquel Janissek Muniz. 2019. Collaborative technology and motivations: utilization, value and gamification. *Innovation & Management Review* 16, 3 (2019), 280–294. doi:10.1108/inmr-04-2019-0056

[2] Victoria D Alexander, Grant Blank, and Scott A Hale. 2018. TripAdvisor reviews of London museums: A new approach to understanding visitors. *Museum International* 70, 1-2 (2018), 154–165. doi:10.1111/muse.12200

[3] Florian Alt, Alireza Sahami Shirazi, Albrecht Schmidt, Uwe Kramer, and Zaman Nawaz. 2010. Location-based crowdsourcing: extending crowdsourcing to the real world. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*. ACM, Reykjavik, Iceland, 13–22.

[4] Amazon Mechanical Turk. 2024. Amazon Mechanical Turk. https://www.mturk.com Accessed: 2024-09-08.

[5] Judd Antin. 2011. My kind of people? Perceptions about Wikipedia contributors and their motivations. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, Vancouver, Canada, 3411–3420. doi:10.1145/1978942.1979451

[6] Manuel Baer, Thomas Tregel, Samuli Laato, and Heinrich Söbke. 2022. Virtually (re) constructed reality: the representation of physical space in commercial location-based games. In *Proceedings of the 25th International Academic Mindtrek Conference*. ACM, Tampere, Finland, 9–22. doi:10.1145/3569219.3569339

[7] Manuel F. Baer. 2024. Designing and implementing a global multilingual real-time location-based game as a novel highly gamified spatial crowdsourcing platform. In *Proceedings of the 8th International GamiFIN Conference*. CEUR workshop proceedings, Ruka, Finland.

[8] Andrea Ballatore and Stefano De Sabbata. 2020. Los Angeles as a digital place: The geographies of user-generated content. *Transactions in GIS* 24, 4 (2020), 880–902. doi:10.1111/tgis.12600

arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.1111/tgis.12600

[9] Gregory Gordon Brown and Pat Reed. 2012. Social landscape metrics: measures for understanding place values from public participation geographic information systems (PPGIS). *Landscape Research* 37, 1 (2012), 73–90. doi:10.1080/01426397.2011.591487#d1e289

[10] Mislav Bubalo, Boris T van Zanten, and Peter H Verburg. 2019. Crowdsourcing geo-information on landscape perceptions and preferences: A review. *Landscape and Urban Planning* 184 (2019), 101–111.

[11] Nama Raj Budhathoki and Caroline Haythornthwaite. 2013. Motivation for open collaboration: Crowd and community models and the case of OpenStreetMap. *American Behavioral Scientist* 57, 5 (2013), 548–575.

[12] David Coleman, Yola Georgiadou, and Jeff Labonte. 2009. Volunteered geographic information: The nature and motivation of produsers. *International journal of spatial data infrastructures research* 4, 4 (2009), 332–358.

[13] Terry Daugherty, Matthew S Eastin, and Laura Bright. 2008. Exploring consumer motivations for creating user-generated content. *Journal of interactive advertising* 8, 2 (2008), 16–25. doi:10.1080/15252019.2008.10722139

[14] Donald Davis and Iffat Jabeen. 2011. Learning in the GNU/Linux community. In *Proceedings of the 2011 conference on Information technology education*. 21–26. doi:10.1145/2047594.2047600

[15] Adriana de Souza e Silva and Daniel M. Sutko. 2008. Playing life and living play: How hybrid reality games reframe space, play, and the ordinary. *Critical Studies in Media Communication* 25, 5 (2008), 447–465. doi:10.1080/15295030802468081

[16] Catherine Dossin, Nicole Ningning Kong, and Béatrice Joyeux-Prunel. 2017. Applying VGI to collaborative research in the humanities: the case of ARTLAS. *Cartography and Geographic Information Science* 44, 6 (2017), 521–538. doi:10.1080/15230406.2016.1216804

[17] John Dunham, Konstantinos Papangelis, Nicolas LaLone, and Yihong Wang. 2024. The player traits and gratifications of casual and hardcore players in Harry Potter: Wizards Unite, Ingress, and Pokémon GO. *Behaviour & Information Technology* (2024), 1–24. doi:10.1080/0144929X.2024.2345293

[18] Carsten Eickhoff, Christopher G Harris, Arjen P de Vries, and Padmini Srinivasan. 2012. Quality through flow and immersion: gamifying crowdsourced relevance assessments. In *Proceedings of the 35th international ACM SIGIR conference on Research and development in information retrieval*. 871–880. doi:10.1145/2348283.2348400

[19] Enrique Estellés-Arolas and Fernando González-Ladrón de Guevara. 2012. Towards an integrated crowdsourcing definition. *Journal of Information Science* 38, 2 (2012), 189–200. doi:10.1177/0165551512437638

[20] Xiaoyi Fan, Jiangchuan Liu, Zhi Wang, Yong Jiang, and Xue Liu. 2017. Crowdsourced road navigation: Concept, design, and implementation. *IEEE Communications Magazine* 55, 6 (2017), 126–128. doi:10.1109/MCOM.2017.1600738

[21] Yuanyue Feng, Hua Jonathan Ye, Ying Yu, Congcong Yang, and Tingru Cui. 2018. Gamification artifacts and crowdsourcing participation: Examining the mediating role of intrinsic motivations. *Computers in Human Behavior* 81 (2018), 124–136. doi:10.1016/j.chb.2017.12.018

[22] Center for AI Innovation. 2024. Google Maps Statistics and Interesting Facts. https://center.ai/blog/google-maps-statistics-and-interesting-facts/. Accessed: 2024-12-11.

[23] Zoe Gardner, Peter Mooney, Stefano De Sabbata, and Liz Dowthwaite. 2020. Quantifying gendered participation in OpenStreetMap: Responding to theories of female (under) representation in crowdsourced mapping. *GeoJournal* 85, 6 (2020), 1603–1620. doi:10.1007/s10708-019-10035-z

[24] Nitza Geri, Ruti Gafni, and Peter Bengov. 2017. Crowdsourcing as a business model: Extrinsic motivations for knowledge sharing in user-generated content websites. *Journal of Global Operations and Strategic Sourcing* 10, 1 (2017), 90–111. doi:10.1108/JGOSS-05-2016-0018/full/html

[25] Ezlika M Ghazali, Dilip S Mutum, and Mei Yuen Woon. 2019. Multiple sequential mediation in an extended uses and gratifications model of augmented reality game Pokémon Go. *Internet Research* 29, 3 (2019), 504–528. doi:10.1108/intr-12-2017-0505

[26] Anindya Ghose, Panagiotis G Ipeirotis, and Beibei Li. 2012. Designing ranking systems for hotels on travel search engines by mining user-generated and crowdsourced content. *Marketing Science* 31, 3 (2012), 493–520. doi:10.1287/mksc.1110.0700

[27] José-Pablo Gómez-Barrón, Miguel-Ángel Manso-Callejo, and Ramón Alcarria. 2019. Needs, drivers, participants and engagement actions: A framework for motivating contributions to volunteered geographic information systems. *Journal of geographical systems* 21, 1 (2019), 5–41.

[28] Michael F Goodchild. 2007. Citizens as sensors: the world of volunteered geography. *GeoJournal* 69 (2007), 211–221.

[29] Michael F Goodchild and Linna Li. 2012. Assuring the quality of volunteered geographic information. *Spatial statistics* 1 (2012), 110–120. doi:10.1016/j.spasta.2012.03.002

[30] Dogus Guler and Tahsin Yomralioglu. 2021. Location evaluation of bicycle sharing system stations and cycling infrastructures with best worst method using GIS. *The Professional Geographer* 73, 3 (2021), 535–552. doi:10.1080/00330124.2021.1883446

[31] Bin Guo, Zhiwen Yu, Xingshe Zhou, and Daqing Zhang. 2014. From participatory sensing to mobile crowd sensing. In *2014 IEEE international conference on pervasive computing and communication workshops (PERCOM WORKSHOPS)*. IEEE, 593–598. doi:10.1109/PerComW.2014.6815273

[32] Juho Hamari, Aqdas Malik, Johannes Koski, and Aditya Johri. 2019. Uses and gratifications of pokémon go: Why do people play mobile location-based augmented reality games? *International Journal of Human–Computer Interaction* 35, 9 (2019), 804–819. doi:10.1080/10447318.2018.1497115

[33] Walayat Hussain, Honghao Gao, Rafiul Karim, and Abdulmotaleb El Saddik. 2024. Seventeen Years of the ACM Transactions on Multimedia Computing, Communications and Applications: A Bibliometric Overview. *ACM Transactions on Multimedia Computing, Communications and Applications* (2024). doi:10.1145/3660347

[34] Katharina Jahn, Bastian Kordyaka, Alla Machulska, Tanja Joan Eiler, Armin Gruenewald, Tim Klucken, Rainer Brueck, Carl Friedrich Gethmann, and Bjoern Niehaves. 2021. Individualized gamification elements: The impact of avatar and feedback design on reuse intention. *Computers in Human Behavior* 119 (2021), 106702. doi:10.1016/j.chb.2021.106702

[35] Levente Juhász, Tessio Novack, Hartwig H Hochmair, and Sen Qiao. 2020. Cartographic vandalism in the era of location-based games—The case of OpenStreetMap and Pokémon GO. *ISPRS International Journal of Geo-Information* 9, 4 (2020), 197. doi:10.3390/ijgi9040197

[36] Junghwan Kim, Dayoung Kim, and Brendan David-John. 2024. The role of privacy concerns, perceived benefits, and trust in citizens' acceptance of street-view image collection by local planning agencies. *Cities* 154 (2024), 105339. doi:10.1016/j.cities.2024.105339

[37] Aniket Kittur, Ed H Chi, and Bongwon Suh. 2008. Crowdsourcing user studies with Mechanical Turk. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, Florence, Italy, 453–456. doi:10.1145/1357054.1357127

[38] Jonna Koivisto and Juho Hamari. 2019. The rise of motivational information systems: A review of gamification research. *International journal of information management* 45 (2019), 191–210. doi:10.1016/j.ijinfomgt.2018.10.013

[39] Bastian Kordyaka, Samuli Laato, Sebastian Weber, Juho Hamari, and Bjoern Niehaves. 2024. Exploring the association between engagement with location-based game features and getting inspired about environmental issues and nature. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (Honolulu, Hawaii, USA). ACM, 1–15. doi:10.1145/3613904.3642786

[40] Bastian Kordyaka, Solip Park, Jeanine Krath, and Samuli Laato. 2023. Exploring the relationship between offline cultural environments and toxic behavior tendencies in multiplayer online games. *ACM Transactions on Social Computing* 6, 1-2 (2023), 1–20. doi:10.1145/3580346

[41] Stacey Kuznetsov. 2006. Motivations of contributors to Wikipedia. *ACM SIGCAS computers and society* 36, 2 (2006), 1–es. doi:10.1145/1215942.1215943

[42] Samuli Laato, David Fernández Galeote, Frederic Altarriba Bertran, Konstantinos Papangelis, and Juho Hamari. 2023. How Location-Based Games Incentivize Moving About: A Study in the Context of Nature-Going. *Proceedings of the ACM on Human-Computer Interaction* 7, CHI PLAY (2023), 642–664.

[43] Samuli Laato, Sami Mikael Hyrynsalmi, and Marika Paloheimo. 2019. Online multiplayer games for crowdsourcing the development of digital assets: The case of ingress. In *Software Business: 10th International Conference, ICSOB 2019, Jyväskylä, Finland, November 18–20, 2019, Proceedings 10*. Springer International Publishing, Springer, Jyvaskyla, Finland, 387–401.

[44] Samuli Laato, Sampsa Rauti, Bastian Kordyaka, Konstantinos Papangelis, Sangwon Jung, Timo Nummenmaa, and Juho Hamari. 2024. Gamification of walking in nature: A field experiment with Pokémon GO Routes. *Proceedings of the ACM on Human-Computer Interaction* 8, CHI PLAY (2024), 1–25. doi:10.1145/3677075

[45] Samuli Laato and T Tregel. 2023. Into the Unown: Improving location-based gamified crowdsourcing solutions for geo data gathering. *Entertainment Computing* 46 (2023).

[46] Cliff Lampe, Jonathan Obar, Elif Ozkaya, Paul Zube, and Alcides Velasquez. 2012. Classroom Wikipedia participation effects on future intentions to contribute. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. 403–406. doi:10.1145/2145204.2145267

[47] Tal Laor and Yair Galily. 2022. In WAZE we trust? GPS-based navigation application users' behavior and patterns of dependency. *Plos one* 17, 11 (2022), e0276449. doi:10.1371/journal.pone.0276449

[48] Regina Lenart-Gansiniec, Wojciech Czakon, Łukasz Sułkowski, and Jasna Pocek. 2023. Understanding crowdsourcing in science. *Rev. Manag. Sci.* 17, 8 (Nov. 2023), 2797–2830. doi:10.1007/s11846-022-00602-z

[49] Pinchao Liao, Yaolin Wan, Pingbo Tang, Chunlin Wu, Yumeng Hu, and Sichun Zhang. 2019. Applying crowdsourcing techniques in urban planning: A bibliometric analysis of research and practice prospects. *Cities* 94 (2019), 33–43. doi:10.1016/j.cities.2019.05.024

[50] Mark Lochrie, Kate Lund, and Paul Coulton. 2010. Community generated location based gaming. In *Proceedings of HCI 2010*. BCS Learning & Development, ScienceOpen, Dundee, UK, 1–5.

[51] Edwin A Locke and Gary P Latham. 2006. New directions in goal-setting theory. *Current directions in psychological science* 15, 5 (2006), 265–268. doi:10.1111/j.1467-8721.2006.00449.

[52] Roberta Martella, Christian Kray, and Eliseo Clementini. 2015. A gamification framework for volunteered geographic information. *AGILE 2015: Geographic Information Science as an Enabler of Smarter Cities and Communities* (2015), 73–89. doi:10.1007/978-3-319-16787-9_5

[53] Boonyanit Mathayomchan and Viriya Taecharungroj. 2020. "How was your meal?" Examining customer experience using Google maps reviews. *International Journal of Hospitality Management* 90 (2020), 102641. doi:10.1016/j.ijhm.2020.102641

[54] Anthony McCosker, Peter Kamstra, Tracy De Cotta, Jane Farmer, Frances Shaw, Zoe Teh, and Arezou Soltani Panah. 2021. Social media for social good? A thematic, spatial and visual analysis of humanitarian action on Instagram. *Information, Communication & Society* 24, 13 (2021), 1870–1890. doi:10.1080/1369118X.2020.1748089

[55] Benedikt Morschheuser, Juho Hamari, Jonna Koivisto, and Alexander Maedche. 2017. Gamified crowdsourcing: Conceptualization, literature review, and future agenda. *International Journal of Human-Computer Studies* 106 (2017), 26–43. doi:10.1016/j.ijhcs.2017.04.005

[56] Benedikt Morschheuser, Juho Hamari, and Alexander Maedche. 2019. Cooperation or competition–When do people contribute more? A field experiment on gamification of crowdsourcing. *International Journal of Human-Computer Studies* 127 (2019), 7–24. doi:10.1016/j.ijhcs.2018.10.001

[57] Benedikt Morschheuser, Mohamed Riar, Juho Hamari, and Alexander Maedche. 2017. How games induce cooperation? A study on the relationship between game features and we-intentions in an augmented reality game. *Computers in Human Behavior* 77 (2017), 169–183.

[58] Zachary Munn, Micah DJ Peters, Cindy Stern, Catalin Tufanaru, Alexa McArthur, and Edoardo Aromataris. 2018. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC medical research methodology* 18 (2018), 1–7. doi:10.1186/s12874-018-0611-x

[59] Laia Muñoz, Vera H Hausner, Carly Runge, Gregory Brown, and Renaud Daigle. 2020. Using crowdsourced spatial data from Flickr vs. PPGIS for understanding nature's contribution to people in Southern Norway. *People and Nature* 2, 2 (2020), 437–449.

[60] Teresa K Naab and Annika Sehl. 2017. Studies of user-generated content: A systematic review. *Journalism* 18, 10 (2017), 1256–1273. doi:10.1177/1464884916673557

[61] Timo Nummenmaa, Samuli Laato, Philip Chambers, Tuomas Yrttimaa, Mikko Vastaranta, Oğuz Turan Buruk, and Juho Hamari. 2024. Employing Gamified Crowdsourced Close-Range Sensing in the Pursuit of a Digital Twin of the Earth. *International Journal of Human–Computer Interaction* ahead of print (2024), 1–17. doi:10.1080/10447318.2024.2352922

[62] Kenton O'Hara. 2008. Understanding geocaching practices and motivations. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, Florence, Italy, 1177–1186. doi:10.1145/1357054.1357239

[63] Tiago H. Oliveira and Marco Painho. 2015. Using Ambient Geographic Information (AGI) in Order to Understand Emotion & Stress within Smart Cities. In *AGILE 2015: 18th AGILE International Conference on Geographic Information Science*. AGILE, Association of geographic information laboratories Europe, Lisbon, Portugal, 1.

[64] Matthew J Page, Joanne E McKenzie, Patrick M Bossuyt, Isabelle Boutron, Tammy C Hoffmann, Cynthia D Mulrow, Larissa Shamseer, Jennifer M Tetzlaff, Elie A Akl, Sue E Brennan, et al. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj* 372 (2021), 1. doi:10.1136/bmj.n71

[65] Vandith Pamuru, Warut Khern-am nuai, and Karthik Kannan. 2021. The impact of an augmented-reality game on local businesses: A study of Pokémon Go on restaurants. *Information Systems Research* 32, 3 (2021), 950–966. doi:10.1287/isre.2021.1004

[66] Konstantinos Papangelis, Michel Saker, Jin Ha Lee, and Catherine Jones. 2020. Smart cities at play: Lived experiences, emerging forms of playfulness, and problems of participation. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM, Online due to the pandemic, 1–8. doi:10.1145/3334480.3375146

[67] Will B Payne. 2021. Powering the local review engine at Yelp and Google: Intensive and extensive approaches to crowdsourcing spatial data. *Regional Studies* 55, 12 (2021), 1878–1889. doi:10.1080/00343404.2021.1910229

[68] Miisa Pietilä and Nora Fagerholm. 2019. A management perspective to using Public Participation GIS in planning for visitor use in national parks. *Journal of Environmental Planning and Management* 62, 7 (2019), 1133–1148. doi:10.1080/09640568.2018.1473757

[69] Luiz Fernando Silva Pinto and Carlos Denner dos Santos. 2018. Motivations of crowdsourcing contributors. *Innovation & Management Review* 15, 1 (2018), 58–72. doi:10.1108/INMR-02-2018-004

[70] Delphine Reinhardt and Christian Heinig. 2016. Survey-based exploration of attitudes to participatory sensing tasks in location-based gaming communities. *Pervasive and Mobile Computing* 27 (2016), 27–36. doi:10.1016/j.pmcj.2016.01.001

[71] Mohamed Riar, Benedikt Morschheuser, Ruediger Zarnekow, and Juho Hamari. 2024. Altruism or egoism–how do game features motivate cooperation? An investigation into user we-intention and I-intention. *Behaviour & Information Technology* 43 (2024), 1–25. Issue 6. doi:10.1080/0144929X.2023.2196581

[72] Richard M Ryan and Edward L Deci. 2000. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology* 25, 1 (2000), 54–67. doi:10.1006/ceps.1999.1020

[73] Marcelo Luis Santos. 2021. The "so-called" UGC: an updated definition of user-generated content in the age of social media. *Online Information Review* ahead-of-print (05 2021). doi:10.1108/OIR-06-2020-0258

[74] Christine Satchell and Paul Dourish. 2009. Beyond the user: use and non-use in HCI. In *Proceedings of the 21st annual conference of the Australian computer-human interaction special interest group: Design: Open 24/7*. 9–16. doi:10.1145/1738826.1738829

[75] Felix Schmid, Lutz Frommberger, Carl Cai, and Fabian Dylla. 2013. Lowering the barrier: How the What-You-See-Is-What-You-Map paradigm enables people to contribute volunteered geographic information. In *Proceedings of the 4th Annual Symposium on Computing for Development*. ACM, Cape Town, South Africa, 1–10.

[76] Linda See, Peter Mooney, Giles Foody, Lucy Bastin, Alexis Comber, Jacinto Estima, Steffen Fritz, Norman Kerle, Bin Jiang, Mari Laakso, et al. 2016. Crowdsourcing, citizen science or volunteered geographic information? The current state of crowdsourced geographic information. *ISPRS International Journal of Geo-Information* 5, 5 (2016), 55. doi:10.3390/ijgi5050055

[77] Shivani Sharma, Nigel Slack, Kamalika Devi, Trevor Greig, and Sera Naidu. 2021. Exploring gamers' crowdsourcing engagement in Pokémon Go communities. *The TQM Journal* ahead of print (2021), 1.

[78] Cláudia Silva, Valentina Nisi, and Joseph D Straubhaar. 2017. Share yourself first: exploring strategies for the creation of locative content for and by low-literacy communities. In *Proceedings of the 8th International Conference on Communities and Technologies*. ACM, Troyes, France, 236–245. doi:10.1145/3083671.3083698

[79] Robert Simpson, Kevin R Page, and David De Roure. 2014. Zooniverse: observing the world's largest citizen science platform. In *Proceedings of the 23rd international conference on world wide web*. ACM, Seoul, Republic of Korea, 1049–1054. doi:10.1145/2567948.2579215

[80] Velvet Spors, Samuli Laato, Oğuz'Oz' Buruk, and Juho Hamari. 2023. Longing to be the mountain: A scoping review about nature-centric, health-minded technologies. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. ACM, Hamburg, Germany, 1–16. doi:10.1145/3544548.3581479

[81] Ralph Stoeckl, Patrick Rohrmeier, and Thomas Hess. 2007. Motivations to produce user generated content: Differences between webloggers and videobloggers. *Bled 2007 Proceedings* 30, 1 (2007), 30.

[82] Xin Tan, Minghui Zhou, and Brian Fitzgerald. 2020. Scaling open source communities: an empirical study of the Linux kernel. In *Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering*. ACM, Seoul, Republic of Korea, 1222–1234. doi:10.1145/3377811.3380920

[83] Ye Tian, Wei Wei, Qiang Li, Fan Xu, and Shurui Zhong. 2018. Mobicrowd: Mobile crowdsourcing on location-based social networks. In *IEEE INFOCOM 2018-IEEE Conference on Computer Communications*. IEEE, Honlulu, Hawaii, USA, 2726–2734.

[84] Ville-Veikko Uhlgren, Samuli Laato, Juho Hamari, and Timo Nummenmaa. 2024. Gamification to Motivate the Crowdsourcing of Dynamic Nature Data: A Field Experiment in Northern Europe. In *Proceedings of the 27th International Academic Mindtrek Conference*. ACM, Tampere, Finland, 230–234. doi:10.1145/3681716.3689440

[85] Nees Jan van Eck and Ludo Waltman. 2010. VOSviewer: A Computer Program for Bibliometric Mapping. In *Proceedings of the 12th International Conference on Scientometrics and Informetrics*. International Society for Scientometrics and Informetrics, Rio de Janeiro, Brazil, 886–897.

[86] Zander S Venter, Vegard Gundersen, Samantha L Scott, and David N Barton. 2023. Bias and precision of crowdsourced recreational activity data from Strava. *Landscape and Urban Planning* 232 (2023), 104686. doi:10.1016/j.landurbplan.2023.104686

[87] Victor H. Vroom. 1964. *Work and Motivation*. John Wiley & Sons, New York, NY, USA.

[88] Volker Walter, Michael Kölle, and David Collmar. 2022. A gamification approach for the improvement of paid crowd-based labelling of geospatial data. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 4 (2022), 113–120. doi:10.5194/isprs-annals-V-4-2022-113-2022

[89] Xiangpeng Wan, Hakim Ghazzai, and Yehia Massoud. 2019. Mobile crowdsourcing for intelligent transportation systems: Real-time navigation in urban areas. *IEEE Access* 7 (2019), 136995–137009. doi:10.1109/ACCESS.2019.2942282

[90] Lei Wang, Kunter Gunasti, Ramesh Shankar, Joseph Pancras, and Ram Gopal. 2018. Impact of gamification on perceptions of word-of-mouth contributors

and actions of word-of-mouth consumers. *Wang, L., Gunasti K., Shankar, R., Pancras, J. Gopal, R., Impact of Gamification on Perceptions of Word-of-Mouth Contributors and Actions of Word-of-Mouth Consumers, MISQ (Management information systems quarterly), Forthcoming* (2018).

[91] Rowan Wilken and Gerard Goggin. 2015. Locative Media. In *Locative Media*. Routledge, London, UK, 1–18.

[92] David Wilson, Xiaolin Lin, Phil Longstreet, and Saonee Sarker. 2011. Web 2.0: A Definition, Literature Review, and Directions for Future Research.. In *AMCIS 2011 Proceedings - All Submissions.*, Vol. 368. AIS digital library, Detroit, USA.

[93] Matthew W Wilson and Mark Graham. 2013. Situating neogeography. 3–9 pages. doi:10.1068/a44482

[94] Emma Witkowski. 2018. Running with zombies: Capturing new worlds through movement and visibility practices with zombies, run! *Games and Culture* 13, 2 (2018), 153–173. doi:10.1177/1555412015613884

[95] Haoxiang Xia. 2010. A collective-intelligence view on the linux kernel developer community. *International Journal of Knowledge and Systems Science (IJKSS)* 1, 3 (2010), 20–32.

[96] Bo Xu and Dahui Li. 2015. An empirical study of the motivations for content contribution and community participation in Wikipedia. *Information & management* 52, 3 (2015), 275–286. doi:10.1016/j.im.2014.12.003

[97] Jinghai Xu and Timothy L Nyerges. 2017. A framework for user-generated geographic content acquisition in an age of crowdsourcing. *Cartography and Geographic Information Science* 44, 2 (2017), 98–112. doi:10.1080/15230406.2016.1163644

[98] Heng-Li Yang and Cheng-Yu Lai. 2010. Motivations of Wikipedia content contributors. *Computers in human behavior* 26, 6 (2010), 1377–1383. doi:10.1016/j.chb.2010.04.011

[99] Xiang Zhang, Hans-Frederick Brown, and Anil Shankar. 2016. Data-driven personas: Constructing archetypal users with clickstreams and user telemetry. In *Proceedings of the 2016 CHI conference on human factors in computing systems*. ACM, San Jose, California, USA, 5350–5359. doi:10.1145/2858036.2858523

[100] Zooniverse. 2024. Zooniverse: People-Powered Research. https://www.zooniverse.org/. Accessed: 2024-09-01.

A Appendix: Additional tables

See tables 7 and 8 for summaries and findings from the papers included in the synthesis.

Study	Description of the study	Key findings summarized
[3]	Across two field studies 9 participants were invited to perform a set of tasks outside such as "take a photo of the closest mailbox" or "check how many laptops on sale are left at the local supermarket".	Picture tasks (take a picture of spot x) and informative tasks (count how many trees..) were equally popular, whereas users were less enthusiastic about action tasks (buy a small bottle of coke). Tasks were mainly solved around the area the users walked anyway, such as near their home or workplace. The most common time to solve tasks was after work. 77% of the tasks solved had monetary compensation and only 23% were done without any compensation.
[11]	The authors conducted a literature review based on which they sent an online survey to a global sample (N=444) of OSM contributors asking them why they contribute to OSM.	Motivators related to "personal but shared need", participation in the community were important for OSM contributors. There were significant differences between the motivations of serious vs casual mappers. For serious mappers, the community, local knowledge, learning and career motivations were important. For casual mappers, free availability of mapping data was important.
[28]	A theoretical overview of the phenomenon of volunteered geography. Provides analysis of multiple topics, including why people voluntarily contribute geographic information e.g., on OSM.	Speculates on why people participate in contributing knowledge to geographic services. Arrives at three possible explanations: (1) self-promotion and leaving a mark; (2) making knowledge available for the ingroup; and (3) satisfaction derived from seeing one's own work become a part of a system.
[56]	Tested a map-based crowdsourcing solution for discovering free parking spots across Germany. Measured multiple things with 170 participants, among one of which was crowdsourcing participation.	Among competitive, cooperative, and inter-team competitive game designs, participants engaged with the inter-team competitive setting scored the highest on intrinsic motivation, crowdsourcing participation and willingness to recommend. The cooperation (without a human opponent) scored the lowest on these dimensions.
[77]	A cross-sectional survey with 371 Pokémon GO players from Fiji. Extrinsic motivation was measured as crowdsourcing behavior. Intrinsic motivation was measured as behavior driven by intellectual satisfaction and enjoyment.	Both extrinsic (0.38^{***}) and intrinsic (0.55^{***}) motivation had statistically significant positive relationships with crowdsourcing engagement intention. Perceptions of system (0.24^{***}) and service (0.32^{***}) quality also had positive relationships with crowdsourcing engagement intention.
[75]	Provides two user studies (N=27 and N=12) in the unique context of rural Laos. Focuses on an application called What-You-See-Is-What-You-Map and another called MapIT.	Demonstrates that the easy-to-use service appears to improve data quality and remove barriers for contribution. Hence by making the crowdsourcing process fluent we can potentially improve user engagement.
[83]	Three surveys investigating participants' speed and accuracy when contributing crowdsourced information - comparison between extrinsic motivation (payment via MTurk) vs more intrinsic motivation (Foursquare). (note: also contains a follow-up study)	The Foursquare participants offered significantly more accurate information than the MTurkers, arguably due to MTurk users being incentivized to finish their tasks quickly, emphasizing speed over quality. Further suggests that for certain crowdsourcing tasks where it matters who is doing the task, there could be systems in place to ensure that the best possible candidate is assigned the task.
[84]	Reports on findings from playtesting an ad hoc locative app for collecting dynamic nature data collection with 8 participants.	Participants' feeling of contributing to citizen science or doing meaningful work boost motivation to contribute. Participants also desired more opportunities for social and cooperative play.

Table 7: Description of the studies in the sample and summary of the key findings. Set 1/2.

Study	Description of the study	Key findings summarized
[52]	Created a conceptual model for gamifying location-based applications. Then runs user studies on an app called CampusMapper.	According to the developed model, users can be motivated to contribute via various gamification elements. Crowdsourcing tasks can be framed to users as "challenges".
[27]	Reviews the literature and develops a process/framework for designing crowdsourcing in location-based media.	After onboarding users to use the location-based application, they should be engaged in a core crowdsourcing task loop that has two central components: (1) contribution motivator; and (2) behavior sustainer. Users should be guided back to this loop via retention-related dynamics.
[43]	Observes Ingress as an example of a game that was created specifically for a crowdsourcing task (discover the playable POIs within cities).	Ingress has been highly successful in achieving to motivate users to contribute high quality information, and should therefore be used as a prime example when designing location-based crowdsourcing solutions.
[54]	Collects and analyses 36,252 Instagram posts that have tags related to location-based good deeds. Focus on a subset of 680 posts geotagged in the Melbourne area.	Social media platforms, with all the motivators for using them, can be viewed as location-based platforms through geotagged posts. Being able to post online about altruistic and charity work may be an additional motivator for people to use these platforms.
[7]	Develops a game called Arcane Shift that follows best practices in the field for motivating location-based crowdsourcing contributions.	There are multiple frameworks for designing games that motivate crowdsourcing contributions. Users should have a wide variety of meaningful in-game activities and tasks to keep them engaged in the game.
[50]	Discusses the development of a community-driven location-based games called "Big game huntr".	Location-based games may be tools to empower participants for creative location-based self-expression, exploration of their environment and discovery of new places. In such a setting if participants are offered multiple means for participating in contributing, it is likely that they will do so.
[97]	Reports on a case study with a system called EDRIS that is designed for crowdsourcing information on disasters.	Building off the theoretical frame of Mazlow's hierarchy of needs, three sets of needs can be harnessed to motivate participation: (1) love and belonging needs; (2) esteem needs; and (3) self-actualization needs. The exact operationalization of these needs in the app depends on the context.
[78]	Conducted seven interviews regarding the participants' experiences of a geography-based crowdsourcing website Historypin.	Methods for motivating participants included (1) personal mentorship; and (2) providing tasks that can be completed. Emphasis should be placed on resolving usability issues.
[1]	Conducted 20 interviews with Waze users asking specifically about the motivation to share information there.	Participants are motivated by reciprocity, personal values, altruism and empathy. Different user groups may have different motivations.
[70]	Online survey (N=337) with Munzee, Ingress and Geocaching users.	Point-based reward systems may not be a positive motivator for all participants. By contrast, tasks integrated into the gameplay in the context of geocaching might boost participation.
[90]	Two studies with MTurk samples (pretest N=100, 2x2 between-subjects study N=404) on POI reviews on a hypothetical locative media platform.	Points for contributions are motivating. Badges may signal expertise to other users, and serve as an additional social motivator for contributors.

Table 8: Description of the studies in the sample and summary of the key findings. Set 2/2.