The Sharing Economy in Computing: A Systematic Literature Review

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The sharing economy has quickly become a very prominent subject of research in the broader computing literature and the in human–computer interaction (HCI) literature more specifically. When other computing research areas have experienced similarly rapid growth (e.g., human computation, eco-feedback technology), early stage literature reviews have proved useful and influential by identifying trends and gaps in the literature of interest and by providing key directions for short- and long-term future work. In this paper, we seek to provide the same benefits with respect to computing research on the sharing economy. Specifically, following the suggested approach of prior computing literature reviews, we conducted a systematic review of sharing economy articles published in the Association for Computing Machinery Digital Library to investigate the state of sharing economy research in computing. We performed this review with two simultaneous foci: a broad focus toward the computing literature more generally and a narrow focus specifically on HCI literature. We collected a total of 112 sharing economy articles published between 2008 and 2017 and through our analysis of these papers, we make two core contributions: (1) an understanding of the computing community's contributions to our knowledge about the sharing economy, and specifically the role of the HCI community in these contributions (i.e., *what has been done*) and (2) a discussion of under-explored and unexplored aspects of the sharing economy that can serve as a partial research agenda moving forward (i.e. *what is next to do*). [1]

CCS Concepts: • **Human-centered computing → Human-computer interaction (HCI)**; **Collaborative and social computing**;

Additional Key Words and Phrases: Sharing Economy; Literature Review; Collaborative Economy; Collaborative Consumption; Physical Crowdsourcing; Gig Economy; Taxonomy.

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1 INTRODUCTION

Information and communication technologies (ICTs) have enabled individuals to share many new aspects of their lives, ranging from their cars (e.g., Lyft and UberX) to their households (e.g., Airbnb). These sharing practices have been described as the "sharing economy." Although there is no widely adopted formal definition of the sharing economy, the term is often used to broadly refer to exchange of un(der)used assets or services between peers or between businesses and consumers, either free or for a fee [11]. According to a 2016 report from the U.S. Department of Commerce, at least 17 sharing economy firms are each worth more than $1 billion, with Uber leading the pack at a $62.5 billion market value [93] (for comparison, Ford Motor Company's market value is about $45 billion). Alongside this trend, the sharing economy has quickly become one of the most prominent subjects in the computing research community, especially in human-computer interaction (HCI) [58].

In the past, when other computing research areas have experienced similarly rapid growth, early stage literature reviews (e.g., [26, 38, 81, 103]) have helped to identify trends and gaps in the literature and have provided key directions for short- and long-term future work. The goal of this paper is to do the same for the computing community's research on the sharing economy. While a more general literature review of the sharing economy exists [20], this review did not consider the computing community's contributions to the literature. In this paper, we seek to address this gap.

More specifically, following the approach of prior reviews in computing, we conducted a systematic literature review (SLR) of sharing economy papers (112 total) in the Association of Computing Machinery (ACM)'s Digital Library (DL)—the most comprehensive repository of computing literature [3] —published between January 2008 and June 2017. In keeping with the standard approach to SLRs [53], we started by framing our two key research questions:

- What is the state of sharing economy research in computing and in HCI particularly? In other words, *what has been done*?
- What research areas have been unexplored and underexplored? In other words, *what should we do next?*

In addressing our questions above, we examined our results with both a general computing lens and a narrower lens focused on the subset of the computing literature that comes from the HCI community. Our inclusion of HCI as a secondary facet of analysis was not only driven by the home discipline of this submission: rather, we hypothesized that (1) HCI would provide the most numerous contributions to the computing literature and thus would demand further inquiry and that (2) HCI's contributions would be relatively distinct compared to those of the rest of the computing literature, possibly providing important insight for future research directions. As we discuss in the next sections, our findings supported both of these hypotheses.

More generally, our results (1) reveal important trends in current computing and HCI research on the sharing economy and (2) point to a partial agenda for future sharing economy research. With respect to the former, we found that the most common themes in computing research on the sharing economy include optimization, socio-technical design, geography, and social relationships, and we provide summaries of the research in each of these high-interest areas. We also found that half of the sharing economy literature in the ACM DL comes from HCI and is overwhelmingly qualitative (as opposed to the non-HCI research), among other results. With respect to a research agenda, our results highlight immediate opportunities for future sharing economy work that focuses on diverse geographies, marrying HCI perspectives with non-HCI approaches, prioritizing implications for policy, incorporating knowledge from pre-sharing economy analogous contexts, and others.

Next, we highlight exemplative work that informed the design of our literature review. We then discuss our methods, and this is followed by an elaboration of the findings as they relate to each of our research questions.

2 RELATED WORK

Because this paper is a literature review, the bulk of our consideration of related work comes in the form of the data we analyze, the results that emerge from our analyses, and the implications we drew from these results. However, prior to beginning our discussion of methods, results, and implications, we want to highlight two areas of prior work that can provide useful context for our research: (1) the approaches taken in previous literature reviews in computing and HCI (and how we followed standard approaches here as well), and (2) existing summative work on the sharing economy (and how our research complements this work).

2.1 Literature Reviews in Computing and HCI

Conducting literature reviews is a relatively common practice in computing [26, 38, 65, 81, 85, 103]. Indeed, as noted, early-stage reviews have identified trends and gaps in the literature and provided insights for future research that have proven to have substantial impact (e.g., [38, 81]). In this paper, we seek to provide the same benefits for computing research on the sharing economy.

Many of the aforementioned literature reviews make specific contributions to a sub-field of computing, such as HCI, ICTD, or CSCW. While these researchers used the ACM Digital Library as a primary database, most searched specifically for sub-fields (e.g., [38]). Following the approach of these prior literature reviews, we turned to the ACM Digital Library (ACM DL); however, we searched the full database and all of its venues. According to the ACM[2], the ACM DL is the most comprehensive set of bibliographic records and full-text articles in computing and information technology. Following Pittaway [79], we took a systematic approach to our literature review. We also considered López's general call for more SLRs in HCI, CSCW, and Ubicomp [65]. This approach helped us to identify existing gaps in the research field and to make suggestions for addressing them.

2.2 Reviews of the Sharing Economy

We only identified two literature reviews of the sharing economy: (1) a short review of how the sharing economy has been defined from Oh and Moon [74] in the ACM, and (2) a holistic and broad review of the sharing economy outside of the ACM [20]. Oh and Moon's short paper was a literature review of definitions of the sharing economy from 172 academic journals, magazines, and dissertations from 2008 to 2015. The authors excluded online publications and did not specify a review of conference papers. The authors conducted their search in the LexisNexis database, which describes itself as a "provider of legal, government, business and high-tech information sources" [63].

Cheng's article is a systematic and holistic review of 66 journal articles about the sharing economy from 2008 to 2015. The search for this article [20] was done from three of the largest online search engines and online databases, Science Direct, Google Scholar and EBSCOHost [16]; however, the researcher focused his discussion of implications on those for the tourism research (the home discipline of the publishing journal). Additionally and critically, deeming industry reports and conference papers—the primary publication outlets for computing—as "grey" literature, this review excluded most of computing's contributions to the sharing economy literature. Our review is intended to address this important gap in our summative knowledge about the sharing economy.

[2]http://www.acm.org/publications/about-publications

3 METHOD

To address our two research questions, we conducted a systematic literature review (SLR) of sharing economy research in the ACM Digital Library (DL). As discussed above, we selected the ACM as our corpus because it has been used in past work as the corpus for similar literature reviews in other domains (e.g., [26, 38, 65, 81, 85, 103]).

SLRs are designed to identify existing gaps in a research field and to make suggestions for addressing these gaps. Our methods were informed by Pittaway's guide to conduct an SLR [79]. Because the conception of applications as part of a larger sharing economy has only arisen since 2008 [62], our search included literature from January 2008 to July 2017. Next, we provide a summary of our steps.[3]

3.1 Identifying Search Terms / Corpus Collection

The first step of any SLR is to identify relevant work [53, 79] and to achieve this, we identified our search terms. The sharing economy has been referred to by many terms. We sought to build a comprehensive set of keywords to include terms for the sharing economy that may have been used in older literature. To accomplish this, we conducted an iterative search of repeated, relevant keywords in our corpus. First, we identified search terms based on common terms that have been used in HCI and in well-known and cited monographs of the sharing economy literature [14, 90]. The initial search terms were: "sharing economy," "collaborative consumption," "peer-to-peer exchange," "physical crowdsourcing," and "gig economy."

Next, we extracted the author-defined keywords from the corpus resulting from our first search of the digital ACM library. We compiled a list of all keywords that appeared in two or more papers, and then filtered those keywords that were overly vague (e.g., multi-agent systems, transportation) or conceptually unrelated to the sharing economy (e.g., dynamic pricing, experimentation). We considered the remaining repeated keywords to be synonymous or closely related to the sharing economy, and performed a search with that list. We performed this process three times, until the search yielded no new papers, for a total of four searches. Ultimately, we identified the following 21 keywords, which served as seeds for our final ACM search: "sharing economy," "collaborative consumption," "peer-to-peer exchange," "physical crowdsourcing," "gig economy," "algorithmic management," "collaborative economy," "local online exchange," "mobile crowdsourcing," "network hospitality," "on-the-go crowdsourcing," "platform economy," "ridesharing," "social exchange," "surge pricing," "timebanking," "micro tasking," "microtasking," "situated crowdsourcing," "workplace studies," and "spatial crowdsourcing."

This search procedure yielded 354 papers. Next, we filtered articles using specific selection criteria to assure their appropriateness, or fit to the SLR, as described in the next section.

3.2 Selection Criteria

Our first selection criterion was that articles had to be written in English owing to the constraints of the research team and the general tendency for high-quality research in computing to be published in English (for better or worse). Second, we filtered articles to exclude research that was not substantively connected to the sharing economy (despite its use of one of the keywords) or research that fell below a quality threshold. To implement this second stage, we utilized a version of the approach by Busalim and Che Hussin [17]. Specifically, researchers read each paper and ranked each article as high, medium or low on the following four criteria: (1) the paper's topic was related to the sharing economy, (2) the paper had a clear research methodology, (3) the paper described the data collection process, and (4) the paper had key findings that aligned with the posed research

[3] Details of the SLR process are available in Appendix A.

questions. Those criteria that ranked as high received a score (loading factor) of 2, medium 1, and low 0 [73]. Research papers that received a 0 for the first criterion (papers unrelated to the sharing economy) were immediately excluded. Any paper that received a 1 or a 2 on the first criterion and had a total score of 5 passed through the filter; if the total score was 4 or below, the paper was excluded. It is important to point that out we did not exclude short papers, extended workshop papers, panels, or alt.chi paper purely due to their format; they were processed like full papers.

After the second stage of filtering, we were left with 119 sharing economy articles. Of these 119 articles, we further excluded seven that we considered to be irrelevant to the sharing economy or to be think pieces (see Appendix A.2.2 Selection Criteria for details). This left us with a final corpus of 112 papers. [4].

3.3 Data Extraction

Per [24, p.36], we extracted excerpts from each work to provide: (1) *the stated or implied problem or research question that was being addressed,* (2) *the central purpose or focus of the study*, (3) *a brief statement about the sample population or subjects,* and (4) *key results that related to the proposed study.* In addition, we extracted the list of authors, publication year, title, publication venue, geographic region, the research questions, and how each paper defined the sharing economy. We also extracted keywords and coded the methodology employed as quantitative, qualitative, mixed methods, design[5], math modeling[6], or literature review. In some cases, two methodology codes were applied. For example, a paper that presented the design and field deployment of a new sharing economy application, and reported results from a qualitative user study, it would be coded as both "design" and "qualitative."

3.4 Data Analysis

To identify topical themes in the literature, three members of our research team coded each paper in the final corpus. This was beneficial for addressing both research questions. We used the selection criteria to extract and summarize article contents as attribute codes [75, 84] into a shared spreadsheet. This allowed us to develop a synopsis for each work and to sort the literature according to publication year, methodology used, populations sampled, instances or applications of the sharing economy studied (e.g., Airbnb, Lyft), and by publication venue.

More specifically, we used hybrid coding to assign topical codes to each paper [98]. We leveraged existing frameworks [76] to create a priori codes. We also coded openly in our initial coding phase and followed this with focused coding.[7] Focused coding allowed us to categorize significant or frequent codes that emerged from our data [84].

4 RESULTS

In this section, we discuss the state of the sharing economy in computing and in HCI specifically. In other words, we address our first research question, i.e. *What has been done?* This section introduces our results with respect to our first question in three sections. In the first two sections—one dedicated to the broader computing literature and the other dedicated to HCI—we present high-level descriptive statistics on the publication rate, geographic focus, research questions and methodologies employed. The third section contains an in-depth discussion of some of the major

[4] A list of these papers can be found at the following URL: http://tinyurl.com/yd6u39vj
[5] A paper was coded as "design" when its central objective was the design or implementation of a prototype application or system.
[6] A paper was coded as "math modeling" when it used a simulation or modeling to test the research objective.
[7] A summary of the codes is included in Appendix B.

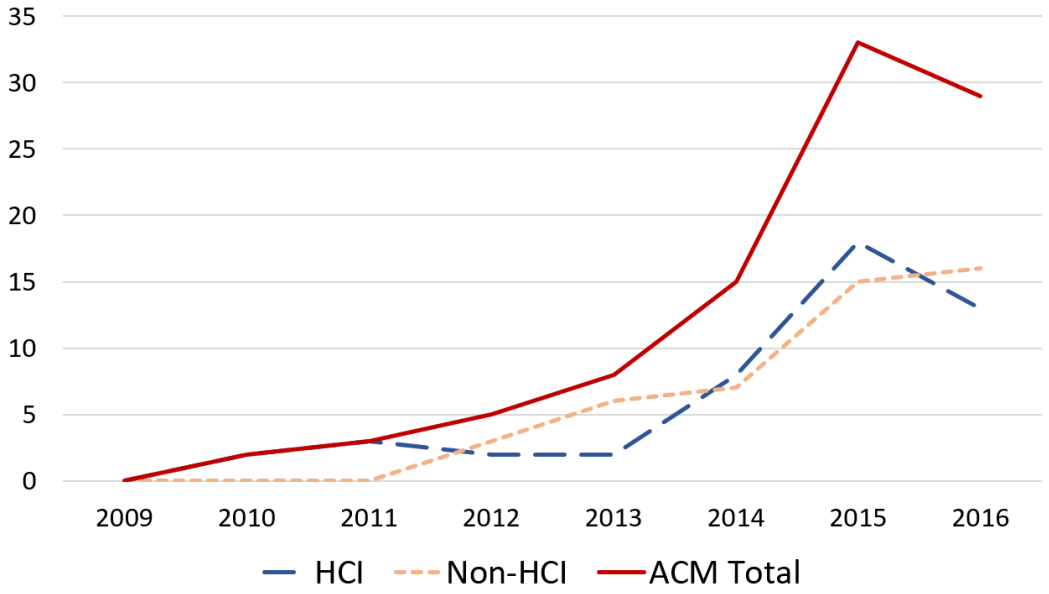

Fig. 1. Publication counts in ACM DL as HCI and Non-HCI, and all venues from 2010 to 2016. Our corpora encapsulates all papers up to July 2017, but 2017 is not shown here because a full year of publication results was not available.

trends identified in both the broader computing literature and in HCI. The final section provides a summary of themes that were under-explored.

4.1 Descriptive Statistics: Computing Literature

The papers in our corpus represent 47 distinct publication venues, including full conference proceedings, conference companion proceedings, and some refereed journals. The most common venues are CHI (N=14), CSCW (N=13), CHI Extended Abstracts (N=10) and SIGSPATIAL (N=7). An additional 28 venues appear only once such as ACM GROUP, TOCHI, and WWW. Though IEEE publications are not ACM venues, one IEEE paper ([78]) was included in our final corpus because it was published in IEEE and Automated Software Engineering, a joint ACM venue.

As shown by Figure 1, research in computing as it relates to the sharing economy grew rapidly from 2011 to 2015. This resonates with our understanding of the birth of the concept of a sharing economy, marked by Botsman and Rogers' early work [14]. However, the publication count declined from 2015 to 2016.

Seventy-six articles specified a country in which the study was conducted and/or from which data were drawn. Out of the 76 articles, the United States was the most common study site (N=32). China (N=8) and Finland (N=7) were the next two most frequent countries where studies took place.

4.1.1 Research Methodologies and Questions. Per Figure 2, in the ACM DL, most published studies used either quantitative (N=44) or qualitative (N=43) methods. Math modeling (N=25), design (N=25), and mixed methods (N=14) are also commonly used. One literature review (N=1) also appeared and this was a short paper by Oh and Moon [74] calling for a shared definition of the

sharing economy. Figure 3 shows that a large majority of the ACM computing studies addressed descriptive research questions (N=73). Very few studies were causal (N=8) or predictive (N=9) in nature.

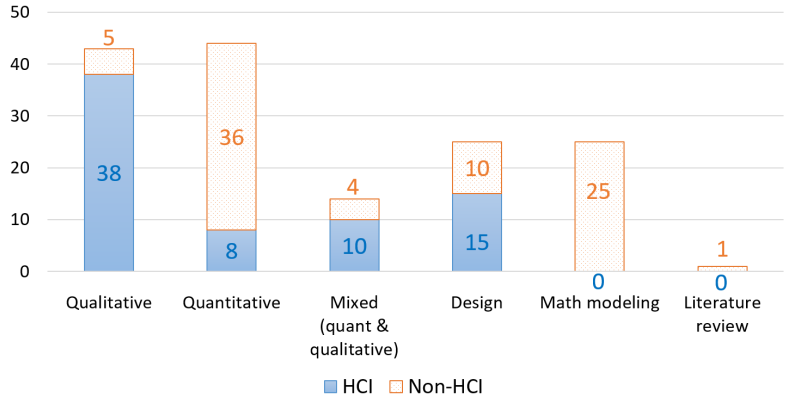

Fig. 2. Research methods distribution in ACM (separated into HCI and Non-HCI Computing)

4.2 Descriptive Statistics: HCI Literature

To understand the HCI contributions to the sharing economy in the computing community, we coded the publication venues into HCI Computing (N=56, 50%) and Non-HCI Computing (N=56, 50%). In the next section, we discuss general HCI trends within the broader context of the ACM.

As shown in Figure 1, HCI research as it relates to the sharing economy started in 2011 and began growing rapidly starting in 2013. However, publication count declined from 2015 to 2016. Non-HCI computing research has seen a steady increase since 2011.

In terms of geography, 46 study sites were specified within the HCI papers. Of the 46 sites, the most common country was the United States (N=20). The remaining 26 sites were in Finland (N=5), Germany (N=4), Australia and India (each N=3), the UK and Singapore (each N=2), and Austria, Indonesia, Italy, Kenya, Namibia, South Korea, and Taiwan (each N=1). China did not appear in the list of study sites considered in the HCI sharing economy literature.

4.2.1 Research Methodologies and Questions. Per Figure 2, in HCI studies, most published studies used qualitative (N=38) methods. Eight (N=8) used quantitative methods and ten (N=10) used mixed methods to address their research questions. Fifteen (N=15) papers employed design, deploying a prototype system that was generally paired with a user study.

The vast majority of HCI computing studies addressed descriptive research questions (N=54), with only two addressing other types of questions (Figure 3).

4.3 Major Topical Themes in Computing and HCI

Table 1 summarizes the results of our hybrid coding for themes in the sharing economy literature and Appendix B contains a complete listing of these results. In the overall literature, the most prominent themes in the literature are: (1) *optimization* (which is a theme almost exclusively in non-HCI articles) (2) *socio-technical design* of these platforms such as platform governance, entry barriers, and how specific features are used; and (3) understanding why individuals have been *motivated* to participate. Within the HCI literature specifically, the top three themes are: (1) *socio-technical*

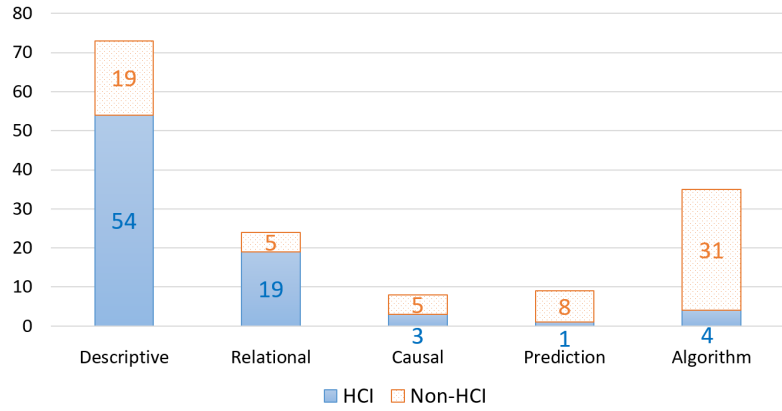

Fig. 3. Research questions distribution

Venue	Theme	Count	Salient Examples
HCI (N=56)	Socio-technical design	34	Lampinen, 2014 [57]
	Motivation	26	Bellotti et al., 2015 [8]
	Social relationship/sense of community	25	Ganglbauer et al., 2014 [39]
	Working conditions	15	Ahmed et al., 2016 [4]
	Special populations	13	Dillahunt & Malone, 2015 [30]
	User experience	12	Raval & Dourish, 2016 [83]
	Cost & benefit to society	10	Lee et al., 2015 [61]
	Trust	10	McLachlan et al., 2016 [69]
	Business/economic/pricing model	9	Ikkala & Lampinen, 2015 [49]
Non-HCI (N=56)	Optimization	38	Etienne and Latifa, 2014 [34]
	Geography	25	Dwarakanath et al., 2016 [33]
	Business/economic/pricing model	19	Bistaffa et al., 2015 [10]
	Motivation	8	Kooti et al., 2017 [56]
	Privacy	7	Xu et al., 2017 [101]
	Cost & benefit to society	6	Quattrone et al., 2016 [80]

Table 1. HCI and non-HCI venues focus on a different set of themes. Please see Appendix B for the full set of themes and their descriptions.

design of these platforms; (2) *motivation*; and (3) *social relationships between platform participants and sense of community*. In addition to optimization, the other two key non-HCI contributions include *geography*, which occurs at the same frequency as social relationships/sense of community, and *business/economic/pricing models* (see Appendix B for a complete listing of our final codes).

The next subsections provide a brief summary of the research in these six themes—the most prominent themes in the HCI and non-HCI literatures—and a description of some salient papers contributing to these themes.

4.3.1 Optimization. While almost non-existent in HCI (N=2), sharing economy *optimization* work is quite common in non-HCI computing venues (N=38). Research related to *optimization* investigated ways to maximize the utility and efficiency of the various systems and platforms used in the sharing economy ecosystem. The majority of *optimization* papers proposed and evaluated algorithms to improve the matching or task assignment in the context of ridesharing (N=17) or spatial/mobile crowdsourcing systems (N=14). In papers concerned with ridesharing, researchers proposed new approaches to improve upon the current matching and path planning algorithms (e.g., [21, 41, 47, 66]). Many of the papers on mobile or situated crowdsourcing defined new utility models for task assignment, and proposed various algorithms to best solve those problems, evaluating their designs on synthetic data and public datasets from major metropolitan areas such as New York [22], Los Angeles [27], Tokyo [54], and Shanghai [97]. There is also research that uses past data to provide optimized ridesharing recommendations for users [45] and suggests ways to optimize ridesharing payments to increase fairness among riders [10].

4.3.2 Socio-Technical Design. Papers that are related to the *socio-technical design* of sharing economy platforms predominantly appear in HCI venues (N=34). These researchers studied and evaluated how specific features/designs are used, or suggested features/design to better enhance user motivation, reduce entry barriers, and regulate user behavior in sharing economy services.

For example, Gheitasy et al. evaluated features on Etsy and identified a socio-technical gap (which is defined as the divide between what must be supported socially and what can be supported technically) in features such as customers' reviews, rating systems and social presence tools [40]. Dillahunt and Malone described design solutions for some of the trust and safety issues among people in disadvantaged communities, including the importance of meeting in safe spaces, two-way background checks, the need for understanding neighborhood makeup and cohesiveness, and the value of referrals [30]. Many researchers investigated the challenges of onboarding users or sustaining users, often through exploratory studies employing qualitative methodologies. A common assertion among these studies was that for a platform to be sustainable it first needs to attract a critical mass of users (the standard "cold start problem" in social computing) [29, 42, 88, 89].

In one group of studies the researchers investigated ways users adapted platform features to meet their own needs. For example, Lampinen [57] examined account sharing in the context of Couchsurfing. Her results revealed challenges for multi-person households that engage in account sharing, such as presenting multiple people in one profile and coordinating negotiations over access to shared space. The work called for system designers to monitor the obscure and non-popular use cases in their platforms.

Note that the papers coded for *socio-technical design* often overlapped with the papers coded for *motivation* or for *social relationships*, demonstrating the close connection between understanding users and design implications in the HCI literature.

4.3.3 Motivation. One central question researchers have attempted to answer is *why* people participate in the sharing economy. For example, through interviewing both users and providers of 46 different sharing economy systems, Bellotti et al. identified eight distinct motivations for the use of sharing economy services—value/morality, social influence, status/power, empathy/altruism, social connection, intrinsic/autotelic reasons, safety, and instrumental motivations [8]. Liao et al. proposed the Theory of Planned Behavior as a model for studying user behavior in the sharing

economy [64]; this theory frames decisions as influenced by a user's attitude toward the behavior, perceived social norms related to the behavior, and perceived behavioral control [5].

Researchers have identified a tension between instrumental motivations versus idealistic/altruistic motivations [8, 86]. For example, Shih et al. found that highly active timebank users were more idealistic and participated because they believed in "equal time, equal value," whereas less active timebank users, who were mostly regular members, more frequently utilized timebank service exchanges in order to fulfill instrumental needs [86]. The same tension sometimes exists between system providers and users: providers tend to place great emphasis on idealistic motivations; users, on the other hand are often looking for services that provide what they need [8].

In addition to examining what motivates people to participate in the sharing economy, some researchers investigated what *demotivates* people. For example, Meurer et al. found that *independence* and *decisional autonomy* are viewed as constraints for older adults to utilize ridesharing services [71]. Dillahunt and Malone showed that distrust and safety concerns are obstacles to adopting sharing economy among disadvantaged communities [30]. Similarly, in studying P2P exchange systems, Sun et al. found that trust concerns about sharing objects and the potential risks of entrusting a possession to someone else have hindered the adoption of these systems [89].

4.3.4 Social Relationships & Sense of Community. As noted in the *motivation* section, social connections play an important role in motivating people to participate in the sharing economy. However, *social relationship and sense of community* is distinct from *motivation* because it considers aspects of interaction that extend beyond a single user. The papers about *social relationships and community* examine how pairs, groups, or communities interact with sharing economy platforms.

For example, Ganglbauer et al. studied a food-sharing Facebook group to understand online social media's role in the emergence and sustainability of such a community [39]. In doing so, Ganglbauer et al. analyzed the interactions between community members and found pro-active appeals and critical awareness of community members. Mirisaee et al. studied the "social fabric" of ridersharing, which they defined as "[the] composite of both the physical and virtual sharing infrastructures (social networking groups, community email lists, sports clubs, local school events etc.) and the networks of relations formed within and between them" [72, p.451]. Works by Lampinen et. al [59] and Suhonen et. al [88] on Kassi, a local online gift exchange system, showed that the use of stable online identities in a geographically local context helped build a sense of community and trust that was hard to achieve in large-scale anonymous social exchange systems.

4.3.5 Geography. Geography was a very common theme in papers focusing on physical or mobile crowdsourcing, and overlapped heavily with the theme of *optimization*. Non-HCI papers with the *geography* code (N=25) were largely focused on spatial variables in ridesharing and crowdsourcing systems. Many papers described spatial or mobile crowdsourcing as an "emerging technology" and were devoted to problems within the domain of task assignment or user matching, contributing algorithmic approaches that outperformed existing solutions on various synthetic and real datasets. These papers introduced previously ignored variables to maximize the number of successful assignments, reduce the number of workers needed, or improve performance in circumstances of high uncertainty or limited workers.

The majority of the *geography* papers in HCI venues (N=9), however, involved field deployments of mobile crowdsourcing applications and employed user studies to evaluate the system and extract design implications. These deployments were local, frequently within a single community, and consistently found that the sense of community and relationship between users was essential to the platform's success. These findings align with those of another study, which investigated perceptions of a hypothetical local favor-exchange platform in a small town in Italy, in which the most salient finding was "the importance of the relationship between participants" [50]. The

remaining HCI papers investigated the impact of geographic factors in mainstream platforms and found that socioeconomic differences across neighborhoods and regions were strongly connected to differences in participation and success [95, 96].

4.3.6 Business, Economic, and Pricing Models. The "business/economic/pricing model" theme was present in papers from both non-HCI (N=19) and HCI (N=9) venues. In non-HCI computing venues, researchers directly studied the existing sharing economy platforms and the models these platforms incorporated. For example, researchers used large-scale data to analyze Uber's pricing and matching models [56]. Researchers also suggested alternative pricing schemes for sharing economy platforms, such as dynamic pricing models based on real-time supply and demand [7] or bidding-based models that reallocate some pricing control to the consumer [21]. Papers about business models discussed the viability of specific products for the sharing economy [19] or investigated how business models may influence the priorities or the governance of the platforms [9]. This theme also overlapped significantly with the *optimization* theme (N=12). Many of the papers introduced different pricing models that maximized the revenue, social welfare, and quality of work of sharing platforms [35, 102].

In contrast, HCI researchers tended to explore the social implications or social dynamics related to *business, economic or pricing models*. For example, Ikkala and Lampinen [49] found that the monetary-based model of Airbnb gives hosts more control compared to other non-monetary-based hospitality services: the hosts can select the guests consistent with their preference and have control over the volume and type of demand. In their 2014 paper, Ikkala and Lampinen studied how the social and economic factors get intertwined in this context of Airbnb and how hosts divert their accumulated reputational capital into the rental price [48].

4.4 Underexplored Themes in ACM

Our results suggest that the three least-explored sharing economy themes in the ACM research were 1) topics related to the *pre-sharing economy*, or the sharing of under-used assets before the rise of the sharing economy (e.g., carpooling, rickshaws, and timeshares); 2) *safety*; and 3) *special contexts of sharing* (e.g., shared space, couches, etc.). In the HCI research, the least-explored themes included *optimization*, *sustainability or environmental effects*, *pre-sharing economy*, and *special sharing contexts*. Outside of HCI, the least-explored topics were *special populations* (N=0) and *algorithmic auditing*, *participant diversity*, *pre-sharing economy*, *safety*, and *sustainability* (all N=2).

While this list suggests implications for future work, it is unclear why these topics were the least explored. Perhaps these topics are not as relevant to their specific sub-field. For example, *optimization* as an unexplored topic within HCI is reasonable given the number of *optimization* papers in non-HCI-related fields. It is possible that *algorithmic auditing* papers are published outside the ACM. These are all points that we revisit in the next section.

5 IMPLICATIONS FOR COMPUTING AND HCI RESEARCH

Our findings show key trends in the literature on the sharing economy in computing and HCI specifically. For example, for computing overall, we saw a steady increase in sharing-economy papers from 2009 to 2015 and a decrease from 2015 to 2016; this decrease represents a drop in HCI-related research particularly, despite a steady increase in non-HCI-related work over time. We found that overall, there were an equal number of HCI and non-HCI papers and an equal representation of qualitative and quantitative methods. Few papers used mixed-methods approaches and many of these were from HCI. There was only one literature review on this topic [74]. An overwhelming majority of research questions were descriptive in nature and were primarily from HCI; causal and

predictive research questions were few in number. Finally, our results show that 42% (N=32) of the works specifying a location (N=76), were from the United States.

In this section, we draw on these results to address our second research question, i.e., *What should we do next?* In other words, this section highlights the under-explored topic areas identified in our results to derive key directions for future sharing economy work in computing and HCI.

5.1 Environmental Sustainability and Concerns

Broadly, environmental sustainability, a well-studied topic in HCI (e.g., [32, 38]), was not well represented in our results. In general, the papers in our corpus presented a physical-crowdsourcing application to report environmental concerns such as water and air quality issues [55] and food sharing applications to reduce domestic food waste [36]. A paper from Pargman et al., identified in our review, noted that the sharing economy offers a potentially beneficial solution in a resource-scarce future [77]. Outside of computing, Cheng identified sustainability and development as one of three main focus areas across the literature in the sharing economy that receives little attention [20]. It was also noted that while environmental savings from shared mobility may exist [23], there is a dearth of studies that actually confirm that these savings exist (despite most sharing economy platforms' advertising supposed environmental benefits). More work is needed to address sustainability and the sharing economy, a point that has also been suggested by Silberman et al. in their discussion of sustainable HCI [87].

5.2 Engaging with Pre-sharing Economy Phenomena

One purpose of the sharing economy is to bridge the online and offline worlds by connecting individuals who need goods or services, to those who have access to these goods and services [11, 14] via technology. Although the sharing economy has rapidly become a prominent subject across many disciplines including computing, business, policy, and law [74], the underlying notion of sharing is not a new concept. Despite this, our results suggest that very few papers discuss sharing prior to the rise of the sharing economy. There are some exceptions: one paper from Kasera et al. [51] conducted an exploratory study of shared taxis in Namibia to understand how successful ridesharing is achieved without digital technology. Similarly, Carroll and Bellotti [18] conceptually traced the development of bartering and gift exchange by studying literature in history and anthropology. These studies benefit the field by informing the design of sharing economy applications.

The need to consider the precursors to modern sharing economy platforms is particularly important as the sharing economy enters new domains. For instance, Cheng's findings suggest an emergence in food sharing and land sharing in urban environments [20]. Land sharing and food sharing have extraordinarily long precedents in human history (e.g., [1, 2]), complete with many positive (e.g., [1]) and negative examples (e.g., [2]). An important direction for future work is examining the prior research on these historical sharing economy platforms to develop implications for the design of computer-mediated sharing tools in these domains.

5.3 More Diverse Geographic Contexts

Our results related to the geographic distribution of study sites—combined with very recent work by Thebault-Spieker et al. [96]—point to a clear and important direction for future sharing economy research. In particular, our study site results show a clear bias toward the United States in the HCI sharing economy literature. While it is not uncommon in the computing literature for there to be geographic biases in study site selection, the work of Thebault-Spieker et al. suggests that this should be a particularly serious issue for sharing economy research. More specifically, Thebault-Spieker et al. showed that local geographic factors ranging from population density patterns to urban structure

to community mental maps have major effects on many of the phenomena of interest in the sharing economy literature (e.g. user motivation, optimization of important properties; see Table 1). Because these local geographic factors vary from city to city and from country to country (e.g., Chinese urban structures are very different from those in the United States and those in sub-Saharan Africa [15], there is a strong probability that many of the findings in our paper corpus would change if studies were repeated in new geographic contexts. Exploring the nature of these changes—and better explicating the relationship between local geography and variables of interest—should be a high priority in future research.

Additionally, on a much more specific note that was also reflected in Cheng [20], our results point to the glaring need to do much more HCI sharing economy research in China: no HCI papers considered Chinese study sites, despite China having an enormous sharing economy ecosystem consisting of unique platforms that do not exist in Western countries. As such, important contributions can likely be made in the near-term by simply re-examining several influential HCI sharing economy papers in a Chinese context using Chinese platforms.

As is typical in the computing literature, more attention should also be paid to the sharing economy in developing countries. While a minority of work occurred in countries like Namibia and Kenya, the sharing economy is known to play a different role in developing countries than developed ones (e.g., [4, 43, 51]). A similar approach to what we have recommended for China could likely yield important near-term contributions.

Finally, the work of Thebault-Spieker et al. [95, 96] discussed how local geographic factors are not only critically important determinants of the performance of sharing economy platforms, but also that they can cause geographic biases that benefit certain demographics. However, as suggested by Thebault-Spieker et al., this result needs exploration in diverse geographic contexts with a wide range of demographic biases and organizations of the built environment. There are many immediate opportunities for research here, as well.

5.4 Pro-Social Objective Functions

Our results highlight a specific and important arbitrage opportunity between the more qualitative and descriptive HCI sharing economy literature and the optimization work that is predominately being done outside HCI: quantifying and optimizing sharing economy properties that are not currently the priority of the optimization literature. In other words, our results suggest an opportunity for doing human-centered optimization in the sharing economy.

For instance, a relatively straightforward human-centered extension of the optimization literature would involve attempting to increase decisional autonomy of workers and consumers (as was found to be important by Meurer et al. [71]) while minimizing other costs (e.g., prices, reduced availability). Over the longer term, however, our results suggest that there is a large need for research that takes a much broader human-centered view of *optimization* in the sharing economy. For instance, networks and platforms could be optimized for social tie-building over time (as was studied by Mirisaee et al. [72], for accruing trust and safety in disadvantaged communities (c.f. Dillahunt and Malone [28]), or for minimizing the socio-technical gap (c.f. Gheitasy et al. [40]). Another issue worthy of study at the nexus of HCI and optimization relates to this question: "How optimized is too optimized?". There is a long history of HCI literature on the long-term costs of maximizing short-term human performance. A similar phenomenon is plausible for many sharing economy platforms. This is perhaps an especially large concern given the "emotional labor" (i.e. attending to the social and emotional needs of customers) demanded of workers in the sharing economy [83], a concern that did not arise in Cheng's study [20].

5.5 More Implications for Policy

Although several papers were included in the topic theme *government and policy* (e.g., [67, 68, 92]), only a small number of empirical studies in this group of papers provided direct implications for policy. The few studies that did so include the work of Lecuyer et al. [60], who provided a method for improving transparency and extracting detailed data that are otherwise hidden, such as a comprehensive transaction history and estimated revenue of Airbnb hosts. In this quantitative analysis, the authors concluded that advocating a policy enforcing a 90-day maximum of Airbnb rentals per year would eliminate the majority of concerns surrounding illegal hotels [60]. Similarly, in a qualitative analysis, Dillahunt et al. [29] uncovered barriers to ridesharing applications that can be used to inform policies for ridesharing subsidies for transportation-scarce individuals from low-socioeconomic areas.

Given the importance of policy in the sharing economy domain, the small number of papers focused on implications for policy in our corpus highlights the immediate need for more research in this direction. Indeed, Cheng identified a similar problem in his review of the non-computing literature [20]. More generally, our results back recent calls for more policy work in HCI more broadly (e.g., [46, 52]). One approach to addressing these calls in the sharing economy domain would be to work to implement fair wages across sharing and gig economy platforms as suggested by the contributors of Meatspace Press [70], a new project concerned with important issues of technology and society for people of diverse backgrounds.

5.6 More Diverse HCI Approaches are Needed

A key takeaway from our results is that the majority of HCI research on the sharing economy is qualitative and descriptive in nature. Given the societal import of the sharing economy, it is a credit to qualitative researchers in the HCI community that they have so quickly established major lines of research in this domain. This should clearly continue. However, our results highlight that the important perspectives provided by the quantitative and system-building traditions of HCI are incomplete in the sharing economy literature. Future sharing economy work in HCI should seek to bolster these perspectives.

5.7 Is HCI Losing Interest?

Finally, our results show a small decrease in sharing economy papers in 2016 relative to 2015, driven primarily by a decline in HCI sharing economy papers. This negative slope surprised us, and it is unclear whether it is a temporary reduction of interest or whether HCI interest in the sharing economy has peaked. Given the number of important directions for future HCI work outlined in this section— and the many others that can likely be drawn from our results—we hope that the former is the case rather than the latter. As has been highlighted by our results, the HCI community has a distinct perspective, and our belief is that this perspective should remain strong in the computing literature.

6 LIMITATIONS

Literature reviews on ACM publications around the sharing economy are subject to a number of limitations. First, the ACM Digital Library's search engine has its own set of limitations [85]. For example, the search engine at times generated inconsistent results despite researchers using the same search terms and date ranges. To minimize this limitation, several team members confirmed consistency among the final search results.

In addition, the articles in our review were limited to papers written in English, and papers published in other languages might exhibit different trends. Next, although we went further than

most computing SLRs by considering the entire ACM DL rather than just a subset and although ACM DL claims to be the most comprehensive digital library in computing, the ACM DL does not contain all possible relevant articles. Our review does not include articles from the Institute of Electrical and Electronics Engineers (IEEE) (aside from one joint ACM/IEEE venue) or the Association for the Advancement of Artificial Intelligence (AAAI), for instance. That said, the exclusive use of the ACM Digital Library is common in prior early-stage reviews (e.g., [85]). To minimize this limitation, we considered our results in the context of a separate review of 66 sharing economy journal articles by Cheng [20].

7 FUTURE WORK AND CONCLUSION

This research highlights a few opportunities for further reviews of the sharing economy literature, for instance expanding our literature review beyond ACM venues and performing co-citation analysis (c.f. Cheng [20]). Such a citation analysis would, for instance, identify which of computing's works bridge to other fields as well as identify opportunities to bridge clusters of research. Although this would be a very substantial endeavor, there is some ongoing research to make this process less intensive [99].

To conclude, we have provided the results of a systematic review of 112 sharing economy papers in the computing literature, thereby filling an important gap left by the only other major sharing economy literature review [20]. Our review reveals important trends in the computing community's sharing economy research and those of our focus sub-community, human–computer interaction. These trends include a predominance of descriptive work and a tendency for the HCI community to use qualitative rather than quantitative methods. These results inform the presentation of a number of short- and long-term opportunities for new sharing economy research directions in computing and HCI, for instance expanding the geographic range of current research, focusing on environmental effects, and combining the strengths of the HCI and non-HCI literature.

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A APPENDIX A: SYSTEMATIC LITERATURE REVIEW

We compare and contrast HCI's contributions to the broader ACM sharing economy contributions.

As the first step in the systematic literature review, we identified a set of search terms. We then collected and analyzed data derived from those terms. We describe the process in this appendix.

A.1 Identifying Search Terms

Our goal was to identify a set of search terms that had been used in HCI and in well-known and cited monographs in the sharing economy literature [14, 90]. We confirmed our decision based on Botsman's model of the collaborative economy where Collaborative Finance and Collaborative Education are not associated with sharing and peer economies [11]. Collaborative Consumption consists of the sharing economy, which consists of peer-to-peer exchanges per this model [11]. Therefore, we identified our three initial search terms (i.e., sharing economy, collaborative consumption, peer-to-peer exchange), which we define in the first subsection.

In CSCW and HCI, the sharing economy—particularly as it relates to utilizing assets and matching "needs" with "haves"—has also corresponded with the phrases "gig economy" and "physical crowdsourcing." As a result, we also included these terms in our initial search and we define them in the second subsection.

A.1.1 Sharing Economy. Historically, there has been no consensus on a definition of the sharing economy. However, Botsman and Rogers first defined the broader term collaborative consumption in the book *What's mine is yours* [14] and Botsman is one of the most frequently cited authors for the term—hence, we leverage her terminology to identify initial search terms for our literature review. She defined the sharing economy as "an economic system based on sharing underused assets or services, for free or for a fee, directly from individuals" [11]. In a RSA Replay video from 2016, "The State of the Sharing Economy," Botsman redefined the term as "an economic system that unlocks the value of underused assets through platforms that match 'needs' with 'haves' in ways that create greater efficiency and access" [13, 12:22]. In her opinion, the sharing economy is a subset of collaborative consumption and is focused on peer-to-peer exchange.

Collaborative Consumption: Collaborative consumption maximizes the use of assets through efficient models of shared access and redistribution [12]. It is considered to be the reinvention of conventional market behaviors such as sharing (Airbnb, Couchsurfing), lending (Zipcar, Chegg), renting (Getable, Liquidspace), bartering and swapping (Yerdle, TradeYa), and gifting (Skillshare), made possible at a large scale through the Internet and digital technologies [11].

Peer-to-Peer Exchange: In peer-to-peer (P2P) exchange (e.g., Lyft, Airbnb), inventory and assets are owned and exchanged directly to and from individuals. This model is also known as a decentralized model. Marketplaces that facilitate this type of sharing and exchange are known as peer economies, and these economies are built on trust between and among peers. According to Botsman, the sharing economy is primarily focused on peer-to-peer exchange; however, as discussed in this paper, this is not entirely the case.

A.1.2 Gig Economy. We refer to Sundararajan's [90] definition of the gig economy because this term is not defined in Botsman and Rogers' monograph [14]. Sundararajan provides a more capitalist perspective on the sharing economy, and he adamantly asserts the inclusion of the gig economy within its scope. Within this context, the gig economy refers to the service-related employment opportunities that include physical tasks such as cooking, driving, cleaning, and handiwork (e.g., TaskRabbit). The gig economy also refers to the service-related employment opportunities that include online tasks (e.g., Upwork). Instead of having an ongoing relationship with an employer, independent workers take on a series of temporary gigs that are mediated via an online platform [31].

A.1.3 Physical Crowdsourcing. The term physical crowdsourcing has been used to describe the engagement of crowds in taking on actions in physical spaces, beyond the structure of traditional crowdsourcing. Whereas online crowdsourcing tasks utilize the wisdom of the crowd, physical crowdsourcing utilizes the crowd's diverse skills and contexts to allocate convenient or appropriate tasks to individual members. Physical crowdsourcing may also make use of large groups of people to complete or help to complete tasks in the physical world [94], either for free or for a fee. One example of a physical crowdsourcing application is Google Waze, a system that relies on the community to provide detailed information such as police sightings and traffic jams. The community members provide this information freely, which assists others in navigating to their destination in a timely and more efficient way than using a traditional navigation system. Another example of physical crowdsourcing example is FixtheCity, an application that allows citizens to help maintain their

city by reporting problems such as potholes. Other platforms that utilize physical crowdsourcing include Gigwalk and TaskRabbit.

A.2 Data Collection

We searched the ACM Digital Library for our review. The ACM Digital Library contains the full-text collection of all ACM publications, including journals, conference proceedings, technical magazines, newsletters and books; we used this digital library to conduct our primary search.

A.2.1 Search and Search Terms. To address our first research question, we conducted two rounds of search, with our second search resulting in three additional search rounds to obtain additional keywords:

Search 1: Collecting Sharing Economy Related Literature in the ACM

First, we searched the ACM Digital Library for: *sharing economy*, *collaborative consumption*, *peer-to-peer exchange*, *physical crowdsourcing*, and the *gig economy*. We conducted an advanced search using the default settings: "Where 'any field' 'matches any' of the following words or phrases":

("sharing economy" OR "collaborative consumption" OR "peer-to-peer exchange" OR "physical crowdsourcing" OR "gig economy").

This search led to 92 papers.

Search 2: Using Common Author-defined Keywords. Next, we extracted the author generated keywords from the papers generated from Search 1 and identified any keyword that occurred twice or more. Filtering out the irrelevant keywords led to 11 new keywords, which we used as seeds for a new round of searching in ACM. We repeated this process until no new seeds arose. The second search led to 183 papers, and 5 new seeds for the next search round. The third search led to 169 papers, and 1 new seed for the next search round. The fourth and final search led to 4 papers, all of which were duplicates from the previous searches. In sum, we identified 16 new seeds from this iterative search, resulting in 262 new papers, excluding duplicates from our previous corpus. We also eliminated those search terms resulting in an overwhelming number of responses (e.g., multi-agent systems).

Combining searches 1 and 2, the 21 search terms for the final ACM search included: "sharing economy," "collaborative consumption," "peer-to-peer exchange," "physical crowdsourcing," "gig economy," "algorithmic management," "collaborative economy," "local online exchange," "mobile crowdsourcing," "network hospitality," "on-the-go crowdsourcing," "platform economy," "ridesharing," "social exchange," "surge pricing," "timebanking," "micro tasking," "microtasking," "situated crowdsourcing," "workplace studies," and "spatial crowdsourcing." Overall, these comprehensive searches led to 354 papers, which constitute our full corpus.

A.2.2 Selection criteria. Next, we used specific selection criteria to screen all articles. To be included in the review, articles had to be written in English, use the search terms in a way that matched the previously defined definitions, and include the following variables of interest per [24, p.36]: (1) *a stated or implied problem or research question that was being addressed,* (2) *the central purpose or focus of the study*, (3) *a brief statement about the sample population or subjects,* and (4) *key results that related to the proposed study*. Researchers extracted excerpts from each work that answered these questions. In addition to including the list of authors, publication year, title, the research questions, focus of the paper, sample used in research, sharing economy instances provided, and how each paper defined the sharing economy, we extracted keywords and coded the methodology employed as quantitative, qualitative or mixed methods, and coded publication venue as HCI or non-HCI. We did not exclude short papers, extended workshop papers, panels, or alt.chi. We then applied quality assessment criteria described in the next section to further filter out papers that did not fit our research objective.

A.2.3 Quality Assessment (QA). Inspired by Busalim and Che Hussin [17], we developed four simple criteria to begin identifying the appropriate fit of each study. Systematic literature reviews refer to this step as QA, though the criteria are not objective. For the purposes of this SLR, QA served as a light mechanism to double-check the final corpus.

In this stage, three researchers read each paper and ranked each paper as high, medium or low on the four criteria described below. Those criteria that ranked as high received a score, or a loading factor, of 2, medium 1, and low 0 [73].

- QA1: Is the topic addressed in the paper related to the sharing economy, or aspects of the sharing economy as outlined in the definition?
- QA2: Is the research methodology described in the paper?
- QA3: Is the data collection method described in the paper?
- QA4: Do the key findings align with the posed research questions?

We applied the four criteria to the 354 articles using the above scoring mechanism. For example, if a study met a criterion fully, it received a loading score of 2. If the study partially filled the criterion, it received a loading score of 1. Studies that did not meet the criterion received a 0 score and papers receiving a 0 score for QA1 were removed immediately. The maximum score that a study could receive was 8; we considered those studies scoring a 5 or more as high fit, 4 as medium fit, and any score below a 4 as low fit. We chose the threshold of 5 because it implies that the study either: (a) scored in all categories and scored high in at least one, or (b) scored in three categories and scored high in at least two. A score of five was also safe enough for us not to prematurely eliminate papers that may have been in question. After applying this filter, we were left with an updated corpus of 119 papers.

Eleven papers were marked by at least one coder as "Accidentally made it through filters," either due to a paper's apparent irrelevance to the sharing economy [100] or its appearance as something other than research [25]. The flagged papers were reviewed in detail by the first and last author to determine whether they should be removed from the final corpus; papers were kept in cases where the faculty authors believed the paper was sufficiently relevant to the sharing economy or sufficiently qualified as a research article. This acted as a final quality assessment (QA), eliminating articles that were not meaningfully related to the sharing economy but made it through the previous QA procedure due to high overall quality. Of the 11 identified articles, seven were removed [6, 25, 37, 44, 82, 91, 100]. This left us with a final corpus of 112 papers that we assert to be moderate to high in terms of fit to the sharing economy. These 112 papers are the subject of our quantitative results. A visual summary of the data collection process is also shown in Figure 4.

A.3 Data Analysis

A.3.1 Coding of Papers. Coding of papers was beneficial in partially addressing both of our research questions. We used the selection criteria to extract and summarize article contents as attribute codes [75, 84] into a shared spreadsheet. This allowed us to develop a synopsis for each work and to sort the literature according to publication year, publication venue, methodology used, populations sampled, and instances or applications of the sharing economy studied (e.g., Airbnb, Lyft). This specifically enabled us to address RQ1 by: showing publication rate over time [24], specifying the publication venues that had been studied the most extensively, and identifying any gaps between years in terms of the number of studies conducted.

We coded the remaining data from our spreadsheet, which included the research question, the focus of the study and key findings, and how the paper defined the sharing economy. This allowed us to address RQ2 by identifying the explored and under-explored areas of the sharing economy in HCI.

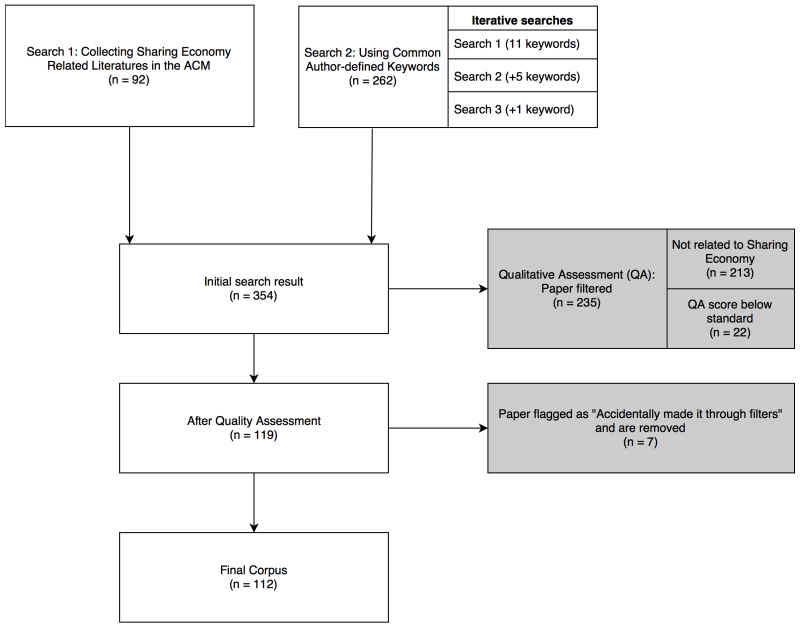

Fig. 4. Flowchart of the data collection process

Our general approach was to take a hybrid-coding approach [98]. We leveraged existing frameworks [76] to create a priori codes. We also coded openly in our initial coding phase, which was followed by focused coding. Focused coding allowed us to categorize significant or frequent codes that emerged from our data [84].

A.3.2 Categorization of Study Focus and Key Study Themes. The study focus coding included two phases: open coding and closed coding. In the first phase, authors five and six separately open-coded the 68 remaining articles in the corpus based on the title, abstract, and extracted research question, study focus, and findings. These authors then discussed the open codes together and organized them into 22 broader themes. Authors one–four discussed these themes offline and raised open questions to the larger group. In the second phase, authors three and four coded the articles based on the 22 themes. Note that the themes are not mutually exclusive; one paper could belong to multiple themes. The final results are shown in Table 1 and Appendix B.

A.3.3 Categorization of Research Questions. To categorize each article's research questions, we conducted a hybrid-coding approach where we first leveraged the three types of research questions from social research methods: descriptive, relational, and causal [98].

(1) Descriptive: A study designed primarily to describe what is going on or what exists (e.g., public opinion polls).
(2) Relational: A study designed to look at the relationships between two or more variables (e.g., a public opinion poll comparing the opinions of males to females).
(3) Causal: A study designed to determine whether one or more variables causes or affects one or more outcome variables.

We then openly coded research questions that did not easily fit into these categories and discussed these codes as a group to categorize the themes that emerged. For example, "prediction"

was a new code to emerge based on some of the mathematical modeling papers that did not fit into these three categories of research questions. Another new code to arise included algorithm/invention/optimization. This code emerged primarily from papers whose authors aimed to invent new algorithms or optimize old ones to better match resource providers with resource consumers.

A.3.4 Categorization of Publication Venue. We coded publication venues as HCI if the proceeding or journal's site stated that human interaction with computing systems was a primary interest of the venue; these were predominately CHI and CSCW. Because the source of these papers was the ACM Digital Library, we coded the remaining venues as Non-HCI Computing.

A.3.5 Other Categories. Finally, we identified other categories of information, such as the study site by country and the distinct focus platform (i.e. sharing economy instance such as Uber or Lyft).

A.3.6 Coding Agreement. Two of the authors independently coded for agreement among the research questions, research methodology, the sharing economy definition, and for the evaluation of the quality assessment scores. They each independently coded a random sample of 30% of the articles and then reviewed the coding of the other coder's articles. This resulted in an inter-rater reliability Cohen's kappa value of .57 (moderate agreement), .81 (very good agreement), 1.0 (perfect agreement), and .72 (substantial agreement) respectively.

B APPENDIX B: HYBRID CODING THEMES AND COUNTS

Topic Themes	Total	HCI	Non-HCI	Description
Adoption	14	8	6	Issues related to adoption, such as reasons for adoption decision, diffusion process of the adoption among a population, scaling up, and localization.
Algorithmic Auditing	9	7	2	Describes how algorithms can rule the sharing economy sites.
Business/economic/pricing model	28	9	19	How the platforms create and distribute economic value, whether the platform is for profit or not for profit, how to decide the price or other compensations for sharing goods/services, and issues of liability of damage or excess wear-and-tear.
Cost & benefit to society	16	10	6	Discuss the overall costs and benefits to society and groups.
Geography	34	9	25	Issues related to geography, or human activities as it is affected by the physical features of the environment.
Government & policy	11	6	5	Relationship with local government, government regulation, policy implication and societal implication.
Motivation	34	26	8	Reasons/costs/benefits to (not) participate in sharing economy systems.
Non-economic or theoretical framework	12	7	5	Provide theoretical or statistical framework to better understand sharing economy systems.
Optimization	40	2	38	How to optimize/maximize the important success metrics, such as platform performance, user activity, system equity, system inclusion, system capacity and matching efficiency.
Participant diversity	7	5	2	Issues related to participant diversity.
Pre-sharing economy	4	2	2	Collaborative consumption of time or under-used assets before the rise of the sharing economy, such as carpooling, rickshaws, and timeshares.
Privacy	12	5	7	Privacy issues in sharing economy platforms.
Relationship to traditional industry	11	7	4	How the rise of sharing economy affects traditional industry such as hotel industry or existing transportation systems.
Safety	6	4	2	Safety issues in sharing economy platforms.
Social relationship/ sense of community	28	25	3	Social relationships between participants on the platforms and sense of community.
Socio-technical design	37	34	3	Issues related to socio-technical design of sharing economy platforms, such as platform governance, entry barriers, member self-representation, co-option of features and features designed to prevent abusive use.
Special population	13	13	0	Describes how special populations, such as elderly, disadvantaged, disabled, children, or people in developing world, use sharing economy systems.
Special sharing context	6	3	3	Special sharing contexts, such as sharing shared resources (e.g., roommates co-list their home on Couchsurfing/Airbnb), tiered ownership (excess capacity, penalty for over-use; e.g. mobile broadband), and beyond job-to-job (e.g. passenger transfers).
Sustainability or environmental effects	6	4	2	Issues related to sustainability or environmental effects, including effects on ownership and sustainability-related pervasive computing.
Trust	14	10	4	How and why users trust the sharing economy platforms, particularly the role of reputation systems in the sharing economy.
User experience	15	12	3	Issues about user experience such as social comfort and quality of service.
Working conditions	18	15	3	Focus on the service providers' working conditions.

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