

# A Review of Research on Participation in Democratic Decision-Making Presented at SIGCHI Conferences

Toward an Improved Trading Zone Between Political Science and HCI

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We present a review of 80 papers representing efforts to support participation in democratic decision-making mostly related to local or national governments. The papers were published in leading human-computer interaction (SIGCHI conferences) venues. Most of this literature represents attempts to support assembly-oriented participation, wherein decisions are made through discussion, although referendum-type participation, involving decision-making based on voting, has gained attention too. Primarily, those papers addressing agenda-setting have examined organization-led forms, in which the agenda is controlled by those issuing the call for participation. Accordingly, the authors call for more research into support for representative models and participant-driven agenda-setting. Furthermore, the literature review pinpoints areas wherein further interdisciplinary engagement may be expected to improve research quality: in political science, HCI-informed methods and new ways of using physical input in participation merit more research, while, from the HCI side, cultivating closer relationships with political science concepts such as democratic innovations and calculus of voting could encourage reconsideration of the research foci. These observations speak to the benefits of a new research agenda for human-computer interaction research, involving different forms of participation, most importantly to address lack of engagement under the representative model of participation. Furthermore, in light of these findings, the paper discusses what type of interdisciplinary research is viable in the HCI field today and how political science and HCI scholars could usefully collaborate.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing theory, concepts and paradigms**; • **Social and professional topics**; • **Applied computing** → *Law, social and behavioural sciences*;

Additional Key Words and Phrases: politics; citizen participation; civic engagement; democratic participation; political science; representative democracy; assembly democracy; trading zones; interdisciplinarity

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## 1 INTRODUCTION

From the late 20th through the early 21st century, there have been steady and mounting concerns about a *crisis of democracy*. Scholars have observed a decline in party membership, voting activity, and political interest, alongside a general decrease in both interest in and activity in participating in political and civic processes [e.g., 25, 83]. In response to these developments, social scientists have

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examined *democratic innovations*, novel institutional arrangements that support stakeholders' participation in politics [40, 94]. One example is participatory budgeting, wherein the people themselves are involved in directing how their tax money is spent [93]. Other democratic innovations are various forms of "electronic democracy," which employ information and communication technologies to support this type of civic participation [a few examples stand out: 23, 56, 68].

Digital tools that support popular participation have been addressed extensively in leading venues for the human-computer interaction research field – i.e., at SIGCHI-sponsored conferences. We carried out a literature review examining 80 papers [112–191] in an attempt to advance scholarly efforts to address how technologies mesh with strivings to support democratic participation. The set of papers found in a search for various democracy- and politics-related terms was filtered for those focusing on support for participation in democratic decision-making (the starting set was identified in work-in-progress [78]). These papers focus mostly on what (many) political scientists would call politics with capital P.<sup>1</sup> That means that most of papers focus on issues where public institutions or the government is involved, such as city planning, allocation of public resources or development of new legislation. The aim of the review was synthesis and identification of areas for future research. Literature reviews of this nature are vital, and their popularity has been growing, recently in the human-computer interaction domain specifically [12, 46, 82, 105].

While addressing political participation, we consider a broader perspective also, from which studies of political participation help shed light on the multidisciplinary of human-computer interaction work in general. Leading venues, such as CHI, often highlight the interdisciplinary nature of human-computer interaction, and Shneiderman [91] has recently sought to characterize the attempts by scholars in this field to establish interdisciplinarity. Some have adopted a more critical tone when examining this collaboration [71, 72]. To inform this discussion well, we explored how political science and human-computer interaction research could benefit each other through closer alignment in how the two address questions about digital democratic participation. Our starting point came from applying a political science perspective to human-computer interaction research into support for people's participation in democratic decision mostly related to Politics: city and community planning, elections, e-petitions, or debating and discussing such issues. Therefore, we (mostly) explore how technology is used in society-wide decision-making processes, involving elections and e-petitions. This vantage point was chosen because questions of civic participation and democratic decision-making are at the core of the latter discipline. We proceeded to examine how the papers reviewed have depicted the forms of and agency in democratic participation, also paying attention to what types of research problems have been investigated. In this paper, we take findings from the literature review as a jumping-off point for asking how the interdisciplinarity could be improved. We explore potential conceptual and methodological *trading zones* [20, 41], which deepen interdisciplinarity. Through this analysis, we identify opportunities for political scientists to benefit from human-computer interaction research and ways in which human-computer interaction researchers might further integrate political science knowledge into their work, cultivating mutual support.

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<sup>1</sup> We acknowledged that there are several different ideas of what is politics and political—in political science, human-computer interaction and social computing scholarships (for political science accounts, see for example [14, 17, 75, 90, 92] and for human-computer interaction accounts, see for example [4, 5, 58, 78]). In political science, public society-level elements such as exercising power in society or making collective decisions as a society (the politics of institutions and society) is often referred to as "politics with a capital 'P'", while issues which are personal, private or social in their scope are termed politics with a small "p" [e.g., 14]. We have discussed the definitions in a more extensive review, identifying different ways human-computer interaction researchers have worked on the topic [see the work-in-progress 78]. This said, we highlight that both this work and the work-in-progress [78] focus on a limited subset of all things political corresponding to mainstream political science understanding of these terms. Many other valuable accounts exist in political science, human-computer interaction and social computing research which are not accounted in this work.

Before embarking on the literature review, we briefly provide necessary background on how (democratic) participation has been addressed in human–computer interaction, social computing, new media, and political science writings. We then describe how the literature was selected for the analysis and elaborate on how we carried out our systematic review. After this, we discuss the findings that emerged from the literature review. In the course of this discussion, we will elaborate on the areas in which more research is called for through identifying research proposals. Furthermore, we will discuss what type of interdisciplinary research we hope to see blossom with regard to human–computer interaction research and democratic participation. On the basis of what our review has revealed, we argue that scholars have created opportunities to develop a different form of interdisciplinary research, with implications for human–computer interaction and political science research alike.

## 2 TECHNOLOGY AND PARTICIPATION

From their inception, various interactive technologies have been applied for supporting participation. Jenkins et al. [55] and Fischer [34] highlight that we now live in *cultures of participation*, enabled by technologies supporting mass participation. Today’s setting of cultures of participation can be defined as an era wherein “all people are provided with the means to participate and to contribute actively to [solving a] personally meaningful problem,” in contrast against an earlier culture of consumption and characterized as allowing users to shift from the role of consumer to that of prosumer [55].

A key challenge in examining “participation” is found in its numerous meanings. At leading human–computer interaction conferences, the word may refer to taking part in peer production [22], being part of technology-mediated collaboration for (either small or large) audiences [50, 52], being involved in event discussions via social media [60], and participating in policy-making [1, 59, 64]. The list extends much further, to numerous other themes, even when the scope is not widened beyond SIGCHI conferences to publication venues of closely related fields. To address this problem, Kelty et al. [57] have identified seven distinct dimensions to technology-enabled participation. Suggesting that particular information technology systems provide or afford particular forms of participation, they suggest that participation can be understood by asking whether a given system yields a “high” or a “low” profile for these key questions: i) do participants learn something during participation, ii) do they set the goal, iii) do they control resources rather than merely produce them, iv) can participants leave without penalty, v) can they give feedback to influence outcomes, vi) is there a clear connection between participation and outcomes, and vii) is there a sense of collective audience and sociability? Through this framework, the participation can be characterized as differing between, for example, Wikipedia (high for feedback) and OkCupid (low on that dimension). Given such a multidimensional construct, we must clarify the sense in which we refer to participation in the discussion that follows.

In this literature review, we focus on *democratic participation in decision-making processes*. However, terms such as “political” and “democratic” are equally problematic [e.g., 14, 17, 75, 78, 90]. Where this paper refers to democratic participation in political realms, the context is formal decision-making processes that follow democratic ideals. The processes in question might be connected with national or local decision-making processes (such as parliamentary elections or policy-drafting) while also involving elements at smaller scale, such as small-group decisions. We examine participation that allows those influenced by the decision-making’s outcomes to take part in the process of making the decision. This delineation of scope with regard to democratic participation finds support also in mainstream political science. [e.g., 75, 90].<sup>2</sup> Human–computer interaction researchers and technology

<sup>2</sup> We acknowledge that scholars of critical theory such as feminist political thought have sought to expand the scoping of politics beyond the realms of classical politics [e.g., 14]. In the field of human–computer interaction, critical scholarship has recently given impetus to work such as research into anarchist, feminist, and postcolonialist HCI [4, 5, 58], but, to keep the scope of our review manageable, we do not address participation as understood in these areas of inquiry. Instead, we call for future research with such extended scope.

researchers often examine participation in decision-making in various other contexts [57]. For example, those working with decision-making support systems often seek to support participation (as reviews of these efforts attest [27, 35]). Similarly, the participatory design movement has sought to integrate users into the development of novel systems [8, 77, and many others]. Obviously, there are overlaps between these endeavors and the political realm, seen in such areas as application of participatory design approaches in city planning [e.g., 8]; however, the focus for our paper is restricted to participation-related work that makes explicit reference to politics, democracy, or civic engagement, for a narrow enough scope that points in the direction of the political sciences [e.g., 14, 17, 75, 78, 90]. This decision should address the problematic boundaries of what can be denoted as participation [57], by guiding our imposition of structure on the review in terms of particular theoretical lenses.

## 2.1 Democracy as a model of participation

“Democracy” has several meanings, ranging from models of governance focused on description of the society to detailed diagrams of the decision-making process [6, 24, 39, 51, 88, 99]. In keeping with the elaboration above, we use the term to refer to people’s ability to participate in the decision-making process. Political scientists do not hold up any single model as the “correct,” ideal one for people’s participation in decision-making processes. Rather, there exist several models of democracy, each with its own historical and normative background [51, 88]. Held [51] looks to Athens for the earliest model of democracy (he calls this the classic model of democracy), and his work identifies more than a dozen distinct models. Focusing only on modern times, Strömbäck [99] identifies fewer models of democracy. Their work highlight models such as deliberative democracy, focusing on discussion and argumentation before decision-making or exercise of global democracy; a Marxist model, wherein decision-making on policy is seen as inseparable from the economic system; and cosmopolitan democracy, wherein the impacts of globalization for democracies are highlighted. Therefore, in both sorts of taxonomy, democracy is considered not only in connection with decision-making systems but in broader societal settings too. Highly aware of the importance of context, scholars of political science do not assign any single clear meaning to “democracy.” For this review however, we seek to provide a framework to help us reflect how the papers approach the question of democracy.

Scholars have long pondered how democratic systems, however conceptualized, are implemented through technology. For example, Dahlberg [24] proposes that there are four distinct positions of democracy in online spaces: liberal-individualist, deliberative, counter-public, and autonomist Marxist. In his classification, a liberal-individualist approach highlights the role of voting in democratic decision-making while a deliberative one focuses on the discussion. His description of the counter-public and autonomist Marxist approaches discusses how the venue for public information-sharing is created and maintained; in the former, the Web has a prominent role in maintaining non-mainstream publication venues, while the autonomist Marxist approach is centered on the ownership of the venues for public decision-making. Although the two can be distinguished from each other in, the intent is not actually to place great focus on procedural aspects. For example, Teli et al. [101] have applied Dahlberg’s approach to help designers to discuss implications to democracy. Accordingly, it may be more useful to address decision-making angle through other lenses.

In a similar vein, political scientists have explored novel technology-enhanced institutional arrangements that democratically support participation, or technology-based democratic innovations [94]. Existing conceptual evaluation frameworks offer tools to explore these innovations [94]. While those frameworks can be adjusted to suit various forms of civic participation [108], applying them always entails expansive and multidimensional empirical evaluation of entire systems. For this reason, the full evaluation framework often is not considered explicitly, even in full-blown political science discussion. Extensive empirical evaluation of this nature is not always required in work on human–computer interaction, however. Gaver and Höök [42] state explicitly that, although design

contributions demand a critical evaluation, the assessment need not comprise of an empirical evaluation. Such a framework is not suitable as an overarching one for the human-computer interaction discipline, in which diverse forms of contributions must be acknowledged and appreciated.

In his discussion of the role of technology, Becker [6] proposes that it can be used either to support representative participation or to create a participatory government. In terms of participatory government, he does not further address the procedural elements: he does not expand on the various possibilities citizens would have to participate. The “laddered model of participation,” presented by Arnstein [3], has had a profound influence on thinking about technology-enhanced participation [e.g., 16] through its conceptualization of the level of people’s involvement on a continuum from non-participation to low levels of participation (consultative participation) and ultimately greater engagement (full participation). Expanding on these ideas, Fung [39] offered the “democracy cube,” wherein the dimension of the extent of power is accompanied by those of participant selection and intensity of communication in the depiction of people’s participation. Hence, ideas about technology’s role vary in this regard too. Just as there is no ideal form of participation, shapes for thinking about it range from ladders to cubes.

All of these definitions create a challenge for us in that they are not restricted to people’s role in decision-making functions. Since we are concerned with the latter for purposes of this work, we define democratic participation in a manner that leaves aside discussion of the commercialization of spaces [24] or of normative ideas of groups’ relationships in society [51]. Arnstein [3] and Fung [39] do highlight people’s role but not the procedural manner in which a decision is made. Closer to our focus is the dimension of communication intensity, with its elements of decision-making and its separation between deliberative and aggregation strategies [39]. To focus on the various mechanisms of decision-making, we are guided by Saward [88]. According to him, there are three forms of democratic decision-making:

**Representative democracy** is a model focused on delegation of the decision-making power to a group of individuals selected by the people.

**Referendum democracy** encapsulates the notion that, rather than delegate the decision-making, participants take a direct role in it. This is done through voting, wherein each participant is given an opportunity to vote on the matter at hand.

**Assembly democracy** too involves direct democracy, but the decision-making in this model takes place not via voting but through a meeting where participants discuss and engage with the topic, making the final decision on the basis of the discussion.

Its variety notwithstanding, the work presented above illustrates that researchers’ focus is not only on the mechanism but also on the agenda-control aspects of the research [3, 19, 39, 103]. This is the core question: how do the members of the community decide which decisions to consider? The motivation for such interest in this type of analysis may be that technologies are often perceived as allowing participants to evade gatekeepers and to drive their own agenda accordingly [e.g., 18]. We find that the writings fall into two groups, by the position adopted on agenda control:

**Participant-driven** , in which model the individual participants can take part in creation of the agenda – the participants articulate the themes to be covered in the participation stage.

**Organization-led** , with a model in which the agenda is set in a top-down manner. Here, the organizers direct the participation to those themes they wish to be addressed.

We are keenly aware that such a brief review cannot do justice to the wider discussion of this topic in the social sciences. Rather, the intent is to show that there are several models of democracy, characterize them in summary, and emphasize that choosing any particular model of democracy is a normative matter. We concluded that choosing representative, referendum, and assembly democracy

and participant-driven and organization-led agenda ownership for further examination is justified by the body of literature presented above and represents it well.

### 3 SELECTION AND ANALYSIS OF LITERATURE

#### 3.1 Selection of the literature

Using a set of 17 search terms related to democratic or political participation (civic, democracy, democratic, politic, political, politics, citizen engagement, digital government, e-democracy, edemocracy, e-government, egovernment, electronic democracy, public engagement, policy, m-participation, and u-democracy), we searched ACM Digital Library material with SIGCHI sponsorship. While these keywords may represent a simplification of politics, democracy, and political participation, their selection guaranteed that the material chosen for analysis makes explicit reference to the concepts in question. We limited our analysis only to papers published before 2018. A total of 585 papers matching to the keywords and selection criteria. Using qualitative and computational tools, these papers were classified to 14 different thematic areas, such as “political communication” and “public service delivery” [see work-in-progress 78, for details on keyword selection, inclusion and exclusion criteria and classification].

In this work, we focus only on an 80-paper subset, the “supporting participation” category<sup>3</sup> [references 112–191]. Because we read full papers, rather than only titles and abstracts [cf. 78], some papers were excluded at this stage: a full reading revealed that they belonged to other categories instead.

According to Nelimarkka [78], these papers “examine the potential of information and communication technology to support participation in decision-making. The focus of [participation] activity is on participation at local level; non-political participation (such as participation at schools); and online tools for participation on a large scale, such as e-petition sites or news-commenting systems.” Among the common ideas in keywords from this literature are civic engagement, deliberation, participatory design, design, and voting. Both these keywords and the description suggest that this set of articles is well suited to examination of democratic participation.

#### 3.2 The analysis approach

All articles were read in full, they were systematically classified, and observations were recorded. In the systematic classification stage, we coded for the *participation and decision-making* and *agenda-control* approach in each work (see Subsection 2.1) We also identified the *primary research problem* motivating the work (this is elaborated upon below). The free-form observations were noted to assist with deeper investigation dealing with the topics addressed in the papers. For example, observations were made as to research context, methods, and key works cited. All coding was conducted by a single classifier, because knowledge of both political science and human–computer interaction was required.<sup>4</sup> To make sure that our classification work was of high quality, analysis was conducted twice, with recoding of the articles and checking of consistency. In addition, several experts in political

<sup>3</sup> Earlier analysis of abstracts and titles [78] found 90 papers in this category; however, our close reading identified 10 of them as not fitting this category.

<sup>4</sup> Analysis of intercoder reliability is typically expected in work of this nature; however, it is not common practice for literature reviews published in SIGCHI fora. This serves to illustrate the community’s interdisciplinary nature and the challenges that hence can arise in relation to such analysis. Where the systematic reviews address the topic at all [e.g., 29], the scope remains quite limited. For example, on their use of two classifiers, Wallace et al. [105] stated that “[w]hen agreement could not be reached, [more senior] Rater 2’s classifications were reported.” Thus, even with two raters, a *de facto* single-classifier approach was employed, with in-depth understanding of the domain being accorded priority. While Frich et al. [36] did calculate the intercoder reliability, they claimed that “ability to replicate each single categorization based on the final table is deemed reassuring” even though they achieved only moderate  $\kappa$  values. This suggests that even they did not find intercoder reliability analysis critical.

science and in human–computer interaction have reviewed the manuscript to guarantee cogent argumentation that follows from the evidence presented (see the acknowledgments).

### 3.3 The type of research problem involved

Analyzing the models of democracy helped to reveal what the papers did not cover, and we sought to identify possible gaps in the literature. Tackling this question requires an understanding of how researchers have approached their chosen model of democracy. Again, many styles of classification may be used – by method (qualitative, quantitative, or mixed), research type (bibliographic, non-empirical, explanatory, descriptive, design, or evolution), etc. Indeed, these forms of classification have been used at SIGCHI conferences for describing the research conducted [105].

However, such approaches are more suitable for reflecting on the aims for the work than on the kind of *research problem* the scholars attempt to address. Answering the latter sort of question may be more illuminating with regard to our objectives. Oulasvirta and Hornbæk [80] analyzed research problems in human–computer interaction work. They identified three individual types of problem. While two of the categories build on work by Laudan [63], referring to empirical and conceptual problems, the authors’ third category, the constructive, was proposed to accommodate the remaining human–computer interaction scholarship. Their three non-mutually-exclusive categories are these:

**Empirical** research focuses on describing a real-world phenomenon in which humans use computing. When describing this class of work, Oulasvirta and Hornbæk [80] cited examples of ethnography and usability-evaluation studies.

**Conceptual** research is a response to difficulties in explaining observed phenomena at empirical level, addressing issues such as inconsistencies between empirical models. It tackles second-order problems and is centered on organizing literature and knowledge stemming from science (inquiry into empirical problems). Oulasvirta and Hornbæk [80] highlighted examples wherein the key contribution consists of introducing concepts that reduce implausibility, inconsistency, or research results’ incompatibility.

**Constructive** work is focused on honing understanding of interactive systems by further developing those systems. Potential areas for constructive work are found where there is no known solution for a problem or the existing solutions are inefficient or incomplete. This work emphasizes the engineering and design aspects of human–computer interaction.

### 3.4 Characterization

Table 1a shows that there has been a dramatic increase in publication volume since the days of earlier papers, those from 2000–2004. This is visible both in the total number of papers (raw count) and in the percentage of publications at SIGCHI-sponsored conferences (note that the relative figures are in promilles of the literature). When only the years of greatest activity (2000–2017) are considered, Fisher’s exact test reveals no differences from the class of all politics- and democracy-related publications [78],  $p = 0.96$ . Therefore, we can state that the proliferation of scholarly work on democratic participation has been in line with the overall tendency toward more material on politics and democracy at SIGCHI-sponsored conferences. Most of the papers have appeared in the highest-quality venues, such as CHI and CSCW (see Table 1b).

## 4 FINDINGS

The literature extends across a broad spectrum of participation contexts. These include city and community planning [125, 155], elections [167, 190], e-petitions [139, 180], and commenting on online sites (e.g., news sites) [118, 142]. The literature has also examined participation in decision-making in contexts that are not traditionally considered political, such as meetings and audience

Years	Count	% of SIGCHI total	Prev. total [78]
1980 ... 1999	0	0	28
2000–2004	2	0.5	23
2005–2009	11	1.4	76
2010–2014	32	1.7	222
2015–2017	35	2.7	236

(a) The breakdown of the selected literature by five-year span.

Name	Count
CHI	16
CSCW	12
CHI EA	10
DIS	9
UbiComp	5

(b) The top five publication venues for the selected literature.

Table 1. Descriptive statistics for the literature.

	Participant-driven	Organization-led	Total	Examples
Representative	2	7	9	Kinnaird et al. [144], Zeni [190]
Referendum	8	29	37	Claes et al. [125], Johnson et al. [141]
Assembly	28	26	54	Kriplean et al. [151], Schroeter [170]
Total	38	62	100	
Examples	[170]	[125]		

A given paper may be classified as addressing more than one type of democracy or as supporting both citizen-driven and organization-led activities; i.e., these classes are not mutually exclusive. Furthermore, some papers do not make explicit reference to the particular form of democracy (representative, referendum, or assembly) supported. The examples were chosen to present a few prominent cases.

Table 2. Approaches to democracy in the literature examined (%).

participation in events [174] or even choosing what music to play in a party through a “democratic jukebox” [174]. This shows that the politics of participation are viewed in diverse ways: the spectrum extends from small groups making decisions to society-wide decision-making that involves elections and e-petitions. Below, we will elaborate on the findings and refer to a few examples from the corpus to illustrate the analysis. The cases described are not the only ones justifying the conclusions; they are representative examples.

#### 4.1 Models of democracy: Decision-making and agenda control

As Table 2 shows, most papers have focused on the assembly-based form of democracy, with a somewhat lower percentage having examined referendum systems. Surprisingly few works have addressed representative democracy. Given the critical role of the latter in today’s decision-making processes, the impact of the corpus identified may be relatively small.

To provide insight into what is occurring in these systems, we briefly review and provide selected examples from the literature. Papers focused on the assembly form typically examine use of geolocation as a resource in city planning [130, 155, 188] or interfaces for political discussion in online environments [150, 152]. Papers considering referendum-based systems center on novel voting interfaces that incorporate pervasive buttons [125, 179], physical devices [165], public displays [184], and digital systems with input through physical actions such as raising a hand [183, 187]. Finally, those examining representative-form systems have looked mainly at how information can be shared about the citizens’ representatives [143, 144].



	Representative			Total	Citizen-driven		Total	Example
	Referendum	Assembly			Organization-led			
Constructive	3	17	24	44	14	28	42	Yu and Cai [188]
Empirical	6	19	30	55	25	32	57	TeBlunthuis et al. [180]
Conceptual	0	1	0	1	0	1	1	Foth et al. [131]
<b>Total</b>	<b>9</b>	<b>37</b>	<b>54</b>	<b>100</b>	<b>39</b>	<b>61</b>	<b>100</b>	

See Table 2 for notes.

Table 3. Characterization of the research problems addressed by the papers (%).

In terms of agenda control as well (Table 2), the focus has been predominantly on approaches that, while applying organization-led development of participation – in referendum systems in which the options to be voted upon are not selected by prospective voters, or in assembly systems for which the overall topic is chosen by the organization – allow the participants to dictate the perspective from which to address the topic, though not the voting. For example, Kriplean et al. [151] studies a case where the organization limited the topic to the pros and cons of a particular proposal to be voted on; participants were invited to investigate matters and then articulate their perspective by submitting pros and cons. While they were not able to direct the discussion to another topic, they could convey their perspectives on account of the open-ended nature of the system.

#### 4.2 Research problems

As Table 3 shows, most of the papers addressed an empirically oriented research question, and under half tackled a constructively oriented one. Note that our classification assigned constructively oriented papers reporting on a specific empirical study to both categories; this overlap may explain the higher number of empirical papers, as design papers often include an empirical contribution as well. We found very little conceptual work in the publication corpus, and Oulasvirta and Hornbæk [80]’s research examining a larger body of human–computer interaction literature is consistent with this finding. While our analysis revealed a paucity of conceptual research, it is important to remember that papers falling into other categories may offer good conceptual analysis of democracy. Finally, Table 3 suggests that there are no great variations of frequency with regard to the model of democracy or to ownership of the agenda; therefore, we discuss these together below.

The empirical papers exhibit several distinct ways of approaching the phenomena. Some focus on classical aspects of human–computer interaction, such as time spent with the system [191], as a reflection of what is taking place. Others focus on the content produced and on its analysis through the lens of grounded theory [170]; on adaptations of frameworks from fields other than political science [143, 186]; or on frameworks familiar to those employed by the political science community [112], such as the discourse quality index [97]. In many cases, researchers interviewed users to elucidate their experiences with the systems [127, 129, 175], or surveys were used in pursuit of similar goals [127]. On rare occasions, the empirical research question could be traced back to political science. For example, Kriplean et al. [150] studied how participants’ opinions changed as they engaged more

with the system. This work was motivated by political science literature suggesting that opinion change is critical for measuring the success of deliberation.

The constructive research has been focused mostly on presenting novel interfaces and systems, whether individual-level [165] or group interfaces [121], interfaces used via a public screen [121, 151] or physical devices [122, 125]. Non-digital approaches too have been proposed, such as performances [168]. Beyond systems, researchers have focused on designing the participatory processes and applying human–computer interaction principles such as user-centric design in them [136, 158].

Research opportunity 1, political science: **Develop approaches and tools that enable political scientists to utilize prototypes and design with digital materialities**

While human–computer interaction research and other work in computer science employs constructive research to explore potential futures [e.g., 84, 87] and also to communicate the research ideas more explicitly [e.g., 53, 67], these creative or novel approaches to design and development of interfaces are relatively rare in political science (and the social sciences in general), though examples do exist [e.g., 100]. At the same time, there is growing interest in social research examining materiality of digital services [30]. Various techniques from design research [e.g., 32], research-through-design approaches [e.g., 98, 111], technology probes, and speculative and critical design traditions [e.g., 10] can assist in exploring that materiality. Furthermore, methods such as utilizing in-the-wild settings [13, 76] can offer guidance in how constructive research can be studied in social settings.

We invite political scientists to take advantage of the extensive body of literature provided by human–computer interaction research in this regard. We call on them to advance their research into digital tools by applying constructive approaches accordingly. Developing novel institutional settings for enhanced civic participation [94] already demonstrates constructive aims in its own right; however, design research methods such as speculation or critical design can be used for unflinching examination of the current state of affairs without extensive system-building efforts being required. Similarly, approaches developed in human–computer interaction scholarship for rigor in testing of in-the-wild technologies can help to improve pilot studies of digital technologies.

### 4.3 An interdisciplinary field?

Above, we have shown how interdisciplinary a field supporting democratic participation through technologies is. The works reviewed evidence this clearly: they demonstrate diverse approaches to supporting participation, not only in the context and participation type supported but also in terms of the technical means for reaching this goal.

Regrettably, beyond motivations and provision of context, many of these publications do not seem to reflect an interdisciplinary investigation. Quite a few emphasize factors traditionally measured in the human–computer interaction field, such as time spent with the system [191] or the amount of content produced and number of users reached [142, 170, 184]. While such measurements are of clear value for those developing technical systems, the relevance with regard to democracy or civic participation is given considerably less attention in the papers.

On only rare occasions is a clear link presented between how the topic was studied (methods and operationalization) and grounding in political science literature. For example, Nelimarkka et al. [160] applied a rigorous approach adapted from Habermas’s work to examine the impact of their system on participation; Aitamurto and Saldívar [112] examined comments via a discourse quality

index; and Kriplean et al. [150] used concepts such as opinion change, a critical aspect of deliberative democracy, in their analysis.

Research opportunity 2, human–computer interaction: **Pursue alignment with political science, to inform scholars’ conceptualization and operationalization work**

For decades, political scientists have striven to understand how best to study democratic participation. They have developed both qualitative and quantitative methods that can serve this purpose [e.g., 9, 37, 39, 43]. Applying these methods can benefit human–computer interaction research too. Firstly, they can align the empirical work more closely with the intentions envisioned for the political participation in the case at hand, often presented in the introduction to the report or in its background section. Secondly, among these approaches are several valid and reliable instruments and concepts that can be applied to augment the classification and reflection (in qualitative work) and/or increase the measurements’ validity (in quantitative work). Applying them brings greater scientific rigor. Furthermore, these steps can increase the contribution’s impact. If human–computer interaction researchers render their output more clearly relevant to political and social researchers by speaking the same language, their work can more readily be built upon (and therefore, cited) by political and social scientists. The seeds are already there, since human–computer interaction researchers work with novel methodology or perspectives on technologies that are highly relevant for the social sciences.

At the same time, as we have noted, human–computer interaction researchers sometimes utilize measurements and concepts that have less clear connections to political science or the social sciences. However, these may still be relevant in the latter disciplines. Perhaps human–computer interaction scholars could work *alongside* domain experts to improve the alignment in terms of existing theories, methods, and operationalizations. For example, social scientists have recently shown interest in the critical walk-through method [66], which builds on the walk-through method familiar from usability studies by addressing values embedded in technologies. Such work would be highly relevant in both fields. Fundamentally, investigation of this sort is centered on finding opportunities to consider anew how political science questions are approached.

Our review indicates that, overall, studies undertaken to support democratic participation are not applying methods, concepts, and operationalizations from political science, even though such engagement could lead to many benefits (see Opportunity 2). This demonstrates how demanding interdisciplinary research can be. Contributing to the issue are several common misunderstandings that Marshall et al. [72] identified in human–computer interaction literature that builds on works from other disciplines. They suggest that the highly interdisciplinary nature of the field contributes to such misunderstandings, which both contribute to and are created by referencing works from other disciplines at surface level rather than considering the core concepts and phenomena more deeply. Our sample indeed seems to display this pattern. With the next section, we seek to pinpoint areas wherein, we believe, deeper integration with political science could guide the research to new areas and fertile ground. These illustrate the potential that can be unlocked by scholars who strive for fuller engagement with political science.

#### 4.4 Concepts and operationalization

*4.4.1 In referendum-type participation, who are the participants?* As outlined above, numerous systems have been developed to support referendum-style participation – i.e., voting. Many of the relevant papers in the constructive domain cite aims of making voting “lightweight” [179], “lower[ing] the barrier” to voting [187], and considering “cross-sectional citizens” who have limited abilities to

participate [132]. This suggests that the main reason not to vote is found in various costs (cognitive, time, etc.) related to voting activity. The papers do not go beyond these suggestions to address *who* is participating through the systems in question.

That is, while the target is to make voting easier, the papers do not examine how traditional socio-economic variables (or other background variables) influence the likelihood of voting, even though election studies have decisively established that factors such as socio-economic status [73, 95], wellbeing [74], and even distance from the polling station [7] affect the likelihood of voting. Since these are well-known influences, we found it surprising that only one piece in our sample examines the connection between personal characteristics and activity level. This was by Pierson [164], who examined personal attributes' impact on the level of participation in a context of assembly participation: she studied gender and activity in an online discussion forum.

#### Research opportunity 3, human–computer interaction: **Understand what constrains voting**

Political scientists have shown that likelihood of voting in elections is not uniform. It depends on voters' resources, such as education [95], wealth [73], health [74], and even distance from polling stations [7]. Political scientists understand this problem through the *calculus of voting*, as described by Riker and Ordeshook [85], a model suggesting that voting occurs only if the perceived benefit from it is greater than the costs related to voting. Building on this framework, we should ask what kinds of costs and benefits are linked to voting when the novel referendum systems proposed are applied. Through the aid of such analysis and better information on the socio-economic background of participants, referendum-based systems could be developed solidly from new theory-motivated ideas for participation, then tested in a rigorous manner. Most importantly, only through this type of analysis can the researchers speak to the ultimate goal behind their papers: improving democracy by making it easier to vote.

**4.4.2 How can scholars utilize existing knowledge?** Another shortcoming identified is the lack of a shared framework *across* the studies. There are obviously benefits in this – namely, not limiting the scope of contributions and openness to innovative approaches. However, a challenge emerges in lack of cumulative effect: each paper can be considered a unique case study, with its own research context, research questions, and approach to answering them. Naturally, this issue is not unique to study of democratic participation: the problem is present in many fields wherein the research is outside the bounds of controlled laboratory research design. Diamond [28] argues that these “soft sciences” are often more difficult to build than traditional “hard sciences” (such as the natural sciences and mathematics), by dint of the complexity of operationalization and of there often being an everyday sense of the concept (e.g., democracy or participation) in parallel with the academic one. Though tricky to establish, shared conceptual frameworks can greatly benefit scientific research. Accordingly, for political science, Smith [94] presents a framework to evaluate democratic innovations, which, in simple terms, are novel institutional arrangements that support civic participation. He suggests that by analyzing democratic innovations via a clear framework, researchers can ascertain what kinds of innovations are successful. Given the similarities in goals between work on democratic innovations and human–computer interaction efforts to develop (technology-enabled) tools for participation, his framework could bring commonality of evaluation to the latter field too. The framework highlights inclusiveness, popular control, considered judgment, transparency, efficiency, and transferability.

The framework suggested for evaluating democratic innovations is just one of many proposed by the political science community, and it is not without its critics. For example, it seems to be focused primarily on deliberative settings, highlighting elements such as considered judgment [108]. Nonetheless, the framework has been successfully applied to reflect on referendum-based forms of

participation [for example, online petition systems 108]. A second possible issue is that, while the framework provides concepts for use in discussing democratic innovations, it does not operationalize them in any particular manner. Therefore, those employing this framework for evaluation may find it difficult to compare settings directly. While it may be considered problematic that comparative work does not emerge directly from applying the framework, the framework's flexibility enables its broader use as a conceptual apparatus to aid in reflection on a democratic innovation's success [e.g., 94, 108]. Used thus, the framework does not dictate particular methodological decisions.

There are several ways in which human-computer interaction scholars could use the democratic innovation framework to reflect on their findings. For example, Opportunity 3, with the core argument that the literature reviewed has not addressed the representativeness of those taking part, ties in directly with the inclusiveness construct. At a rudimentary level, we have considered the dimension of popular control also, in examining whether the work was participant-driven or instead organization-led. The literature could consider this factor too much more comprehensively. As for the dimension of considered judgment, some works focus on it [most prominently, 112, 160], but the attention could be expanded. These three examples illustrate how scholars can use the framework as a "checklist" for what they ought to examine and/or discuss.

Research opportunity 4, human-computer interaction: **Evaluate various dimensions of democratic innovation**

Political scientists have been involved in efforts to evaluate novel institutional arrangements for civic participation. They speak of *democratic innovations*, several dimensions of which can be extracted [94]. These dimensions do not entail a normative approach to the type of democracy or dictate any single research design or set of methodological choices. We believe that the greatest benefit of such frameworks may lie in allowing reflection and serving as a "checklist" that researchers discussing technology-enabled democratic participation can apply so as not to omit critical components from their analysis. For example, one dimension discussed little in our sample is ideas' transferability to other institutional settings. Conclusions with regard to this are often implied but not explicitly highlighted or directly discussed. We believe that more explicit attention to this dimension will not only increase the depth of the work but also help practitioners – a critical audience for human-computer interaction scholarship – benefit more fully from it.

*4.4.3 How can one design for physical spaces of participation?* Thus far, we have mostly discussed what human-computer interaction research could gain from political science scholarship. However, transfer of concepts can take place in the other direction too, from human-computer interaction to political science. For example, scholars in our discipline have investigated the role of physical spaces for participation. Both Valkanova et al. [183] and Xu et al. [187] examined referendum-type participation wherein the voting act took place in public and, therefore, was visible to other people in their location. The findings showed that the public nature of the voting inspires collocated people to discuss the topic voted upon and that these discussions were fruitful: participants constructively exchanged opinions on the topic. This can be viewed as a form of in-the-wild *ad hoc* deliberation. Works such as these demonstrate how deliberative spaces can be created without major effort. There are clear connections with any work that employs *mini publics*, researcher-organized stakeholder or citizen gatherings to discuss a policy topic.

Political scientists, in contrast, have not extensively explored physical spaces and arrangements in the context of participation. Further work could explore areas familiar to human-computer interaction researchers, such as physical spaces and collaboration [49, 54] and public displays [81, 86]. For example, work by Goffman [44], particularly with regard to conceptualization of "frontstage" and

“backstage” in physical spaces (distinguishing among modes of behavior and action in interpersonal interaction), has been used extensively in human–computer interaction studies. These concepts, originally from sociology, can be usefully applied beyond human–computer interaction as well. Similarly, people’s orientation to technical artifacts has been shown to influence which forms of collaboration emerge. An illustration of this idea in a political science context can be found in the architectural style of parliament chambers, which is linked to the type of parliamentary system in use. For instance, in those following the Westminster model, two rows of bench seating are set opposite each other, reflecting and encouraging adversarial-style debate between the parties, while the Western European model meshes with a semi-circular debating chamber and a more consensus-oriented debate system. Attention could be directed to what kinds of physical arrangements for participation should be used in other venues to afford inclusive, engaging spaces for considered judgment.

Research opportunity 5, political science: **Study the importance of materialities in political participation**

We could extend the analysis of democratic participation to account also for the setup of the physical spaces and how it affords public display of acts traditionally considered private (such as voting). This is an under-investigated topic when one considers the strength of human–computer interaction scholars’ evidence of the importance of the physical configurations for collaboration and their examination of the public nature of private acts. This opening highlights emerging opportunities to support and study democratic participation, which is considered to be embedded in the space as well.

## DISCUSSIONS

To complete this work, we enter into two separate discussions, serving two distinct contributions. The first of these is centered on what our findings indicate about potential directions for human–computer interaction research into supporting democratic participation. The suggestions are rooted in observations described above, but this discussion situates the ideas more clearly in relation to human–computer interaction research. Secondly, we discuss how closer collaboration between political scientists and human–computer interaction researchers can benefit both disciplines. This exploration too follows from results presented above: where several opportunities for certain methods and key concepts were summarized in the boxes, the second discussion “opens the boxes,” as it were, by delving into whole new areas for investigation. It proceeds from our observations that highlight the disconnect between the two disciplines and the untilled fertile ground between them. At the same time, we will reflect on how digital systems’ pervasiveness is leading to an increase in research that parallels work in human–computer interaction studies.

### 5 DISCUSSION 1: A FUTURE AGENDA FOR STUDYING DEMOCRATIC PARTICIPATION

Tables 2 and 3 indicate that the literature is equally distributed between referendum and assembly models of democracy, and between empirical and constructive research problems. We will now discuss work on each of the three models of democracy, in turn, and consider how observations from our review can support further research connected with it.

#### 5.1 The effectiveness of the referendum model

Our review demonstrated well that significant effort is put into developing novel tools for voting, or referendum-based democracy. Represented particularly strongly is research into how ubiquitous

computing can be used to support voting [183, 187]. At the same time, companies such as Happy-OrNot<sup>5</sup> are adapting systems of this type to serve commercial ends. Therefore, we argue that scholars may need to think in terms not of research prototypes but of research products [79].

We believe that this transition could be aided by directing greater efforts to studying the impact of novel devices. To aid in this, we propose that we should adopt political science's rational-voter assumption and, therefore, apply a calculus-of-voting approach [85]. The first step in applying such an approach is understanding *who uses these systems*. As Proposal 3 illustrates, this area is nearly devoid of human-computer interaction research. But without understanding potential biases and non-representation, how can we hope to understand the value these novel technologies possess for participation?

The same focus can inform the design-research agenda: *how technologies can decrease the overall cost of voting*. While the general argument in favor of ubiquitous voting systems (e.g., tele-democracy and other systems that lower the barrier to voting, which are already subject to research in a non-representative context [e.g., 132, 179, 187]) is that they reduce the execution costs of voting, at least some of the benefit may be offset by the cognitive costs of making a choice (as in use of voting-advice applications, which can help one choose a candidate in multi-party and other systems [2]). In addition to the cost angle, researchers could examine how to increase the perceived benefit from voting. Finally, political scientists have suggested that, alongside benefits and costs, duty plays a part in a voting decision. Therefore, various social technologies, as with Facebook's efforts to get people to vote [11], or persuasive technologies could be used in efforts to increase the sense of a duty to vote. Given the commercial interest in the above topics, the discipline could engage in work on increasing the impact of these systems and on understanding what actually drives their use, thereby moving beyond merely showing what is technically possible.

## 5.2 A process turn for assembly-related efforts

There has been extensive research into assembly-based participation, covering geolocation-based systems [188], public displays and ubiquitous computing [130, 170], novel online fora [150, 191] to support assembly-style decision-making, and many other mechanisms geared for everything from extremely local themes to matters of national interest. However, the focus is largely limited to the technologies for participation.

Already 25 years ago Grudin [47, 48] highlighted that research on collaborative systems must extend beyond technical aspects. Similarly, those researching online deliberation often stress a need to study outcomes, pointing to the important influence of various aspects of the system on individuals' attitudes and the overall impacts of the deliberation on decision-making quality [37]. Therefore, we recommend carrying research into assembly-style deliberation beyond its current, rather isolated context – i.e., shifting the emphasis from particular information systems to the overall process of assembly-based participation. Questions related to impacts of participation and data generated from it are not extensively discussed, though exceptions exist [141]. How does participating through these interfaces, as compared with non-assembly participation, influence the individuals involved? Secondly, where in the larger socio-political system do scholars seek to position the assembly-form participation? The latter question in particular may seem quite alien to human-computer interaction researchers, but we insist that it is highly relevant. Rather, as is acknowledged in traditional studies of computer-supported collaborative work systems, we seek to highlight that no system on its own is sufficient to lead to transformation of practices. This awareness has motivated social computing research, and our proposal is a natural extension from it.

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<sup>5</sup> See <https://www.happy-or-not.com/en/>.

### 5.3 Underrepresentation of the representative model of democracy

As is evident from tables 2 and 3, more research is needed into systems that can better support today's representative-type political systems. Naturally, research on referendum models may enrich the building of systems that help people vote in the representative model. Even research related to the assembly model can support representative decision-making: assembly participation can be taken as input to representatives' decisions [e.g., 89]. However, for these types of impact to materialize, the context needs to meet the needs of representative decision-making. This means that researchers must move further "into the wild" and address cases that are directly relevant for representative policy-making. Researchers may find this approach difficult, since there is less control of the system, with numerous potential external interests of civic organizations and policy-makers at play.

Another avenue for research, mentioned in most papers we reviewed, is interfaces that give voters information. These tools are designed for evaluation of decisions made by representative bodies, such as the budgets or local policies chosen [128, 143]. Work that supports human–data interaction in the context of representative systems may be interesting in general. One specific family of tools is voting-advice applications, which can help participants act on their preferences so as to decide who should get their vote [2]. As mentioned above, such systems may be of use in multiparty systems, where the number of alternative election options may reach the hundreds. While, again, the purpose of these systems is to inform voters, voting-advice applications demonstrate the opportunities that interactive systems offer beyond helping one choose a candidate through a questionnaire (the current main paradigm of voting-advice applications) – designers could consider applying them to other decisions under a representative model or explore novel interaction approaches. For instance, how could ubiquitous computing or "data as design material" thinking improve on the current questionnaire-driven design approach? In one concrete example, instead of people's policy preferences being reported via questionnaires in voting-advice applications, they could be deduced from individuals' behavior, collected through smart devices and Internet of things-sensors [see 65, using this data to support assembly-participation in city planning].

### 5.4 Beyond an organization-led agenda?

Finally, we focus on a finding that emerged in connection with both the referendum and the representative approach: most of the systems studied were focused on traditional organization-led agenda-setting for participation. For example, even where participants had an opportunity to provide free-form input, the overall scope or framing question seemed to stem from the organizers' needs. Since one area in which technology holds the greatest promise is in affording "bottom-up" organization and agenda-setting, more work should be done on considering how to design and deploy open-ended systems of participation. While political scientists have sought to highlight the importance of agenda ownership [e.g., 3, 39], ample room for further research remains in both disciplines. Research into human–computer interaction could address themes such as supporting participants' efforts to make sense of complex discussions and thereby develop common ground [33] and supporting collaboration by widely divergent groups [62]. Both are mature research areas, but our review highlights an additional contribution that could be made: further addressing shifting agencies and the implications thereof for information systems.

### 5.5 Future research areas for a literature review

In this work, we have applied narrow conceptualizations of key concepts, such as the democratic, participation, and even decision-making. For a further review, with broader conceptualization, one could attempt to draw together the research on participation done in the human–computer interaction domain. Such research might explore whether other areas of application or theoretical insight could



lead to a wider perspective on participation. For example, a more broad-based literature review could yield insights into how, if at all, human-computer interaction researchers have started to consider the directions for research discussed above. At the same time, an extensive review of this sort could serve the aforementioned integrative role, as a net for seeking connections across the various emergent politics-focused approaches within human-computer interaction research (including but not limited to feminist and anarchist efforts [4, 5, 58]).

Secondly, this review is limited as much by its focus on SIGCHI conferences alone as by the boundaries related to conceptual narrowness. Much relevant work appears outside the corpus considered here – for example, presented at conferences such as the European Conference on Computer-Supported Cooperative Work and in various journals. Among other things, this restriction in scope could lead to bias toward U.S. scholarship on the topic at hand [26]. This is concerning on account of the importance of workplace democracy and participation in the Nordic countries [77], for instance; therefore, further investigation is clearly warranted, with a wider range of literature. The source materials could include human-computer interaction journals in general and material presented at non-ACM-sponsored conferences.

## 6 DISCUSSION 2: TRADING ZONES AND SIGCHI

### 6.1 Collaboration across human-computer interaction and political science

Both human-computer interaction and political science are pluralistic disciplines [70, 80, 92]. That means that the work is done by multiple theoretical and epistemological schools. From this perspective, collaboration *within* the disciplines may already require developing trading zones. For example, Zimmerman et al. [111] see interaction designers' role as being to integrate knowledge from engineering, social science, and behavioral science and thereby bring research artifacts into being. In that project, the interaction designer must engage in collaboration across disciplinary boundaries – in other words, be active in trading zones. Designers' work also demonstrates the importance of the third type of scientific contribution: constructive work, which distinguishes human-computer interaction research from the social sciences [80].

Given that both disciplines themselves are diversity-rich and multifaceted, collaboration between them might be all the more problematic in some respects. For example, several types of contribution could be required for advancing in one's career, as can be seen with regard to information visualization [e.g., 104]. Design-oriented human-computer interaction researchers may need to show mastery of using novel technologies, and empirically inclined human-computer interaction researchers may need to demonstrate that their research has "implications for design." Meanwhile, intervention-oriented political scientists may have to show that the intervention in question has an effect irrespective of socio-economic status, and many political scientists may need to demonstrate how their scholarship builds on and extends from classics of the field. Beyond such career-linked practical considerations, foundational issues surrounding the nature of knowledge and aims of research may emerge. Addressing computational social science, Wallach [106] highlights that social scientists often seek to explain, while computer scientists seek to predict. According to her, achieving both goals in the same project may be difficult. Just such tendencies can be seen in relation to human-computer interaction research, on one hand, and political science, on the other. For example, Gaver and Höök [42] argue that design papers must both discuss and critically evaluate design work, although an extensive literature review and empirical evaluation may not be required in all cases. Such elements may be far less optional for political scientists.

Hence, while advocating development of trading zones and improvement of interdisciplinarity within SIGCHI, we acknowledge that such developments much occur within the lines of established academic practices. Rather than call for a new interdisciplinary field, such as the computational social

science that may be emerging [45, 106], we hold that trading zones afford improving each discipline from its own vantage point. Accordingly, we are all “safe,” and we stand to make political science stronger by introducing human–computer interaction approaches to it and, simultaneously, make the human–computer interaction discipline stronger by adopting ideas from political science. This responsible undertaking is by no means the same as academic imperialism.

## 6.2 The kind of interdisciplinarity visible in SIGCHI venues

With Opportunity 2, we issue a strong call for a deeper relationship with political science scholarship on the topic of democratic participation in the papers published at SIGCHI conferences. Further, opportunities 3 and 4 reflect some benefits that could arise from accounting for this perspective. Seizing these opportunities would contribute to work on democratic participation within SIGCHI-sponsored venues but also provide a critical perspective on the group’s ability to engage with and acknowledge interdisciplinary contributions. We are not the first to make such claims. Marshall et al. [72] have made a strong case that CHI conference publications demonstrate misunderstanding of concepts from other fields, leading to misconceptions or misunderstandings of the scholarly knowledge that follows. Furthermore, Marshall et al. [71] suggest that this is partly due to citation practices: citations are used mainly to support particular perspectives. While we extend these suggestions to new areas of human–computer interaction research, we also aim to be constructive and point to paths that may lead both human–computer interaction researchers and political scientists to solid exploration of technology (we elaborate on the political science perspective further on).

We acknowledge that interdisciplinary scholarship is difficult. Galison [41] suggests that scholarship emerges in what we refer to above as trading zones. We expand on the notion here. These are areas in which key concepts and ideas can be transposed from the original field to another scientific field in collaboration. He explains that these allow collaboration “*despite* the differences in classification, significance, and standards of demonstration” (emphasis in the original) and, hence, exchange of concepts. Trading zones differ in the level of force in the respective parties’ give and take, and in the amount of new culture developed [20]. Our observation of a tendency to refer to political science in the opening of one’s paper (that is, in the introduction and the section on related work or background) may be a consequence of working in a *fractionated trading zone*, where there is no truly shared culture between the communities [20]. It might be that, to keep their work readily accessible in the culture of human–computer interaction work, scholars present familiar research designs and methods without delving deeply into the culture of political science from which they have borrowed or with which they have exchanged ideas.<sup>6</sup> However, what long-term implications might such practices have for human–computer interaction scholarship?

We suggest that it is time for research in the area of democratic participation to move forward from the light interdisciplinary scholarship culture and cultivate a fuller trading zone via more extensive inter-language, shared culture between the disciplines [20]. As we have shown, there is already a steady stream of basic-level literature addressing various, quite different contexts. By presenting opportunities 3 and 4, we seek to extend the research agenda on democratic participation. We envision deepening the relationship with political science and, through this, bringing concepts and theories from that field into fruitful use in our own. Therefore, we call for deeper exchange to occur in the trading zone. Cooperation at a basic level has been achieved, but deeper engagement can help develop trading zones into areas where truly collaborative interaction can flourish. Similar considerations may be merited with reference to other aspects of human–computer interaction [e.g., 71, 72].

<sup>6</sup> We acknowledge that we have, in similar fashion, simplified the topic of interdisciplinary science and technology studies to citations and chosen not to engage with the topic more deeply. This is done in an attempt to render the idea accessible enough here.

### 6.3 The expansion of HCI research?

Another contribution we hope to make through this review is to highlight for political scientists working on digital democratic innovations that works published on human-computer interaction are relevant to political scientists as well. Among the recent “turns” in the social sciences are a *materiality turn* and an *algorithmic turn* [61, 102]. Scholars have argued that, to understand the current media environment, one must take into account user interfaces and design [96, 109, 110], affordances [e.g., 15, 21, 31], algorithms [61, 102], and other elements embedded in digital systems. Human-computer interaction scholars have shown awareness of the material aspects well before each turn; for example, Dourish [30] told members of the social sciences community that they need to recognize the digital as material, the latter being a traditional subject of investigation for that community. We argue, therefore, that stronger participation in the trading zone with human-computer interaction may help scholars engaged in the study of digital forms of democratic participation. In fact, social scientists are already creating or repurposing concepts and methods that bear similarities to those used by human-computer interaction scholars, such as the walk-through method [66] and affordances [e.g., 15, 21, 31]. With Opportunity 1, we suggest that there is much more that human-computer interaction scholarship can provide for those in the political science community who study novel ways of supporting democratic participation.

Opportunity 1 illustrates also that, with the transformations now occurring in social research, more scholars are conducting (in the broadest sense) human-computer interaction research. That is to say that, whether or not they employ the latter label themselves, more researchers are exploring how humans interact with technology and what its implications are for behavior. In the long term, this development may force human-computer interaction scholars to reconsider and re-articulate the identity of the discipline. For the short term, though, the trend may put human-computer interaction expertise at the fingertips of those studying various new research areas, increasing the impact of human-computer interaction research. If handled incorrectly, however, this could entail takeovers between disciplines, in appropriation of methods or theories that is known as scientific imperialism [20, 38, 69]. If we wish to avoid such coercion (whether of our field by others or *vice versa*), we must consider how to organize the institutional structures so as to nurture positive forms of collaboration.

The first step toward institutions that do this may be to develop education programs aimed at balance between human-computer interaction research and domain sciences (in our case, political science). In the United States, for example, Schools of Information demonstrate such efforts, but even they differ in emphasis with regard to scholarly background and identity [107]. Similarly, research groups and even study programs have emerged around digital civics. However, traditional mainstream computer science and social sciences departments continue to teach their respective disciplines. Should they as well too respond to this challenge and ongoing digital transformation? What types of minor-subject modules should be developed to support the development of new kinds of trading zones?

### 6.4 Future research to explore trading zones

As we discussed both in Section 2 [and at greater depth our work-in-progress 78], the greatest challenge with our analysis and reflection on trading zones lies in the restriction to SIGCHI conferences alone. A literature review examining political science studies of information technology for participation would expand our insights from the one-sided perspective yielded by this work and, thereby, further advance scholarship in general. Reviewing political science journals in line with a similar aim would inform us of how knowledge of human-computer interaction is applied in the associated work and aid in generating a more well-rounded set of proposals. The results should shed light on the nature of the interdisciplinary collaboration and on potential trading zones suitable for both disciplines.

Secondly, citation analysis could assist further with the identification of key concepts and theories used in the literature. This could inform the development of classifications that are more organic than ones driven by political science theory are. In addition, researchers can examine citation networks for identifying the literature that is most critical in the study of democratic participation in the context of SIGCHI conferences. This could further fuel conceptual analysis and help the human–computer interaction and the political science community to find common ground and new perspectives both. In addition, citation network analysis can be used for systematically seeking additional literature, works not covered by the study reported upon here. Most importantly, such analysis could assist in further examining the forms of interaction between fields and also how trading zones emerge.

## 7 CONCLUSIONS

We have explored how democratic participation – that is, participation in decision-making processes governed in a democratic manner – has been examined in material presented at SIGCHI conferences, by looking at the 80 papers found to focus on this area. We found that they address numerous contexts of participation and explore both referendum and assembly forms of participation. As for recommendations, our findings lead us to suggest that research into referendum participation ought to home in on the impacts and effectiveness of the proposed systems, and work on assembly participation should investigate how the systems are integrated into the decision-making. Finally, the clear lack of research focused on representative participation points to many areas ripe for further research, especially in relation to informing voters.

Furthermore, we observed that political scientists and human–computer interaction researchers alike still have much to learn from work in the others’ discipline. Areas for improvement were found in relation to methodology and research design but also with regard to the theoretical or conceptual approaches to the research. We will continue to reflect on our observations, since we find development of truly interdisciplinary research practices to be sorely needed, not only for those working on democratic participation but also for the larger human–computer interaction community.

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