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BallotShare: Exploring the Design Space of Digital Voting in a Workplace Environment

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Bibliographical details

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About the authors

Vasilis Vlachokyriakos is a PhD candidate based in the Digital Interaction group at Newcastle University. His PhD is an experiment into participatory methods in voting systems. Its goal is to explore how electronic voting and electronic democracy applications can support different types of participation (e.g. direct push-button democracy, deliberation etc.). To extract the design requirements of technology for democracy, he develops exploratory prototypes that serve as technology probes to explore constructs that drive participation.

Paul Dunphy is a research associate in the School of Computing Science at Newcastle University. His research interests centre around usable privacy and security mechanisms with particular focus on security, usability, deployability and user experience.

Nick Taylor is a lecturer at University of Dundee. His research has focused on the study of technologies situated in public spaces, particularly when utilised to support communities and empower citizens.

Rob Comber is a senior research associate in Culture Lab at Newcastle University. His research currently focuses on everyday practices of community, social communication, participation and social media.

Patrick Olivier is based in Culture Lab and leads the Cultural Technologies theme in which computer scientists and electronic engineers are engaging with researchers in the arts and humanities both in the development of new technology and research methods. He is also a member of the Informatics Research Institute and the Institute of Ageing and Health. His research interests spans aspects of human computer interaction (especially for pervasive computing and computing of older people and the cognitively impaired), computer graphics, and artificial intelligence. Patrick has an undergraduate degree in Physics (Natural Sciences, Cantab, 1989) and a PhD is in computational linguistics (UMIST, 1998). Prior to coming to Newcastle (2004), he was a lecturer at the University of Wales, Aberystywth and the University of York. In York he founded Lexicle Limited where he led the development of the world's first commercial 3D embodied conversational agent.

Suggested keywords

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BallotShare: Exploring the design space of digital voting in a workplace environment

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Abstract. Digital voting is used in a variety of contexts from politics to mundane everyday decisions. One of the motivations underlying many group decision-making systems is the promotion of participation, yet there is little research that explores how features of digital voting systems can be designed to facilitate this, other than providing multiple voting channels. In this paper we propose a framework that explores the design space of digital voting from the perspective of participation. We ground our discussion in the design of Ballot-Share, a first configuration of our proposed framework, designed to enable the study of group decision-making practices deployed in a workplace setting. Across five weeks, participants created and took part in non-standard polls relating to events and other spontaneous group decisions. Following interviews with participants we identify significant drivers and limitations of individual and collective participation in the voting process: social visibility, social inclusion, commitment and delegation, accountability, influence and privacy.

Keywords: Decision making, e-voting, e-participation; HCI.

1   Introduction

Throughout the many years of voting evolution, different voting configurations have been proposed, adopted and discarded due to contextual considerations that reflect the needs of stakeholders. Lately, the application of digital technologies to voting was suggested primarily to bring convenience and efficiency benefits. Whether technology has the capacity to facilitate voting practices is still a matter of debate, with political theorists arguing that dropping the barriers to participation will not necessarily increase the quality of the participation that results [26]. This suggests that the complexity of encouraging participation in voting situations cannot be addressed simply through provision of convenient access to a digital voting interface.

The configuration of any poll reflects the values and problems specific to that group. The needs of organizers are made visible through trade-offs in the design of

the process, whereas the needs of the voters are made visible through the way they chose to express themselves through the features of the system. The decisions about whom to involve in the decision making process and how they should be involved, can provoke different types of participation, from direct collection of opinions to a deeper discussion about the issues at stake. In everyday life it is common that groups need to reach some form of consensus. Technology has facilitated voting in scenarios ranging from political debate, television talent shows, and meeting times between collaborators. In such cases, digital technologies tend simply increase the reach of a conventional poll to distributed individuals. However, methods of digital voting provide the potential to re-envision voting as a social tool that better serves democracy by exploiting the context-specific stimuli of participation. Despite the diversity of how different communities reach consensus, and the untapped potential of technology in this domain, there is currently little research into how design of digital polls can impact the overall experience of voting, and influence participation.

In this paper, after exploring instantiations of voting systems in a wide spectrum of decision making contexts – from political to less formal (e.g. social media polls, idea management systems etc.) – we propose a framework that captures the design space of voting from the perspective of designing for participation. We then introduce *BallotShare*, a first configuration of the proposed design framework that serves as a technology probe [14] to explore decision making practices in a workplace environment and the impact of the system's features on participation. We report on the deployment of BallotShare across five weeks during which we collected 578 user interactions on polls ranging from social activities to other spontaneous decisions that were required. Interviews were conducted to explore voting behaviors and drivers of participation. The preliminary findings highlight the importance of individual and collective efficacy in voting. We identify significant drivers and limitations of individual and collective participation in the voting process: social visibility, social inclusion, commitment and delegation, accountability, influence and privacy.

2   Related Work

The technological mediation of voting as a process of group decision making has received considerable attention from psychology (for review see [16]) and HCI in the domains of computer supported cooperative work and computer mediated communication (CMC). Over the last twenty years, the advances in computing and communication technologies have revolutionized group meeting and the decision making process [3]. Questions continue to be explored as to how CMC affects group decisions, interaction between group members and group performance. Some studies suggest that CMC systems could theoretically yield superior results to face-to-face communication even though some exceptions exist (e.g. anonymity of members) [3]. More recent studies have explored these elements of performance by using real world data sets from collaboration systems such as Wikipedia [6,18,27]. These studies explore how users of open source projects reach a consensus and how different variables such as group size, group formulation, and experience can lead to better decisions. The

main findings suggest that larger groups, more diverse contributions, and more experienced members generally give rise to better decisions.

An incorporation of voting into discussion forums is used widely, from online support websites to idea management. In [2] the authors explore the value of such idea management systems within a large organization and give concrete recommendations on the design decisions to be made when building a system to support grassroots innovation. In terms of the design of voting systems a lot of work has been done in comparing various systems currently used in political votes (such as paper ballots, punch cards, lever machines etc.) [7,12] with regard to their usability, accessibility and voter satisfaction.

The impact of efficacy on participation in decision-making is an area of research widely explored in the fields of HCI and psychology. Efficacy is the belief that voters will effect a change through their actions [8] and without efficacy voting is perceived as redundant. Thus ways of affecting efficacy must be considered during the design of decision making and voting systems. In [24], Taylor et al. demonstrate how simple voting interfaces can encourage participation in communities. In addition, key design factors of voting technologies have been identified including efficacy, credibility and other practical issues related to the design, and physical location of voting technologies. In [22] the authors use collaborative design and "design of politics" [11] to explore how the design of an interactive system could reflect on citizen participation in urban planning. The authors suggest that it is possible to affect citizen participation by developing flexible systems and by applying technological participatory design that allow adaptation of the system by its users.

3. Design Framework

Digital voting is widely used today in contexts such as social media polls, online scheduling solutions (e.g. doodle polls), idea management systems etc. These voting instantiations are not only designed to support different contexts but also different types of participation. For example social media polls, 'liking' stories online and online petitioning provide a form of direct collection of opinions whereas forums for policy making or consultation try to mediate a more deliberative form of participation.

Configuring the Poll

There appears to be a rich yet largely underexplored design space to enable poll organizers to configure and affect participation according to the needs of a particular context. Figure 1 illustrates our proposed framework to capture the design space of digital voting. This framework is tractable which makes it easily extensible by other researchers. Each one of the design categories in the framework consists of attributes of digital voting systems that can be found today across a broad spectrum of decision making contexts, from political to less formal polls (e.g. social media, scheduling polls, collective decision making, idea management systems). We consider the important decisions to be made in the configuration of any poll to be based upon the

design categories of *eligibility*, *fairness*, *secrecy* and the method of *expression* given to voters.
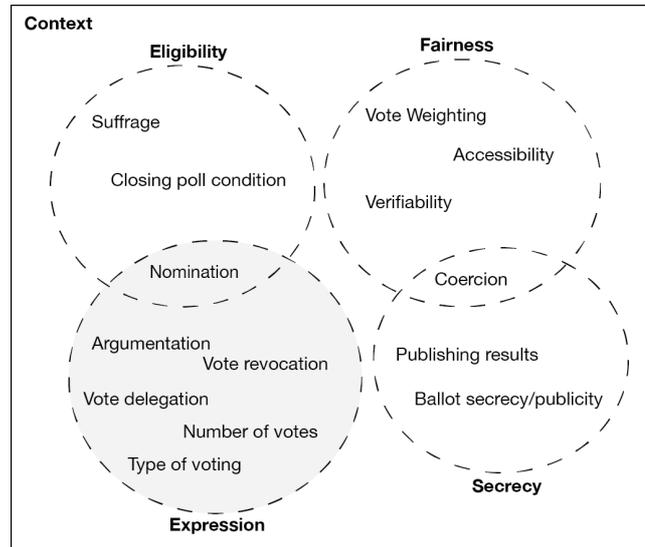
Figure 1. The design space of voting.

Eligibility

The criteria by which someone is judged eligible to participate in a poll is clearly one of the more significant determinants of the credibility of a result. In political votes the principle of universal *suffrage* is commonly applied, which allows all adult citizens to vote. The choice of who is eligible to vote can significantly impact on participation where there is a concern that the result will not reflect the views of those upon whom the result would have the most impact. Participation can also vary according to context and hierarchy. For example in a workplace setting where only shareholders have a say on significant decisions. Digital voting systems can be designed to either facilitate this hierarchy or question it.

A typical *closing poll condition* is time-based and is normally fixed. Remote voting such as voting by mail or in some cases Internet voting has been introduced partially for "extending" this polling duration. In a different voting context an event such as reaching a set number of votes could be used as the termination condition instead. In general, the question of which termination conditions are necessary to have a desired impact upon participation is context-specific.

4

Fairness

Considerations of fairness are based upon the perception that those eligible to vote have a proportional impact upon the result. If a voter does not feel their vote is having this impact the imperative to participate will be reduced. The one-person one-vote principle is generally a characteristic of political votes in western societies, yet there are many occasions where it might be unfair to assign votes equal weight. The use of *weighted votes* is common where there exists a hierarchy of stakeholders with different levels of investment in a decision. For instance, voting within the council of the European Union is weighted so that the votes of countries with larger populations are "worth" more than votes from the smaller countries.

Accessibility seeks to ensure that eligible voters are able to cast a vote. Methods to maximize this are related to proxy voting (where a delegated person can vote on the behalf of another person under extenuating circumstances) and remote voting (voting can take place away from a central voting location). Attacks on accessibility, such as voter suppression, attempt to influence a poll result by lowering participation. Such approaches include making it difficult to vote for voters deemed "undesirable" e.g. by introducing specific barriers to registration for voters from certain socio-economic groups [5]. There is an assumption that the use of technology should primarily serve to afford high accessibility to the voting material, although this may have the effect of disenfranchising digitally excluded communities. Remote voting and more specifically Internet voting is a very topical issue as it can theoretically drop participation costs and increase the reach of the voting process (for a review of remote e-voting see [17]). Whether this is positive for participation is debatable, with some studies indicating an opposite effect due to the loss of ritual, locality, voting only for self-interest etc. [20].

Recent interest in e-voting has led security researchers to explore mechanisms to electronically verify the integrity of polls and allow voters to check that their vote was indeed counted - *verifiability* (see [15] for security requirements of e-voting systems). In most cases these verification techniques involve using mathematically strong proofs to verify the vote outcome. In conventional voting systems (i.e. paper ballots) and in everyday decision-making, no such mechanism is in place mainly because the difficulty of performing a wholesale attack. However, conventional voting systems use other socially acceptable mechanisms to verify the correctness of the outcome (e.g. random citizens participating in counting votes).

Secrecy

Secret ballots are widely used to alleviate social effects (such as peer pressure) and avoid repercussions that may later face voters who have voted in a manner that is unfavorable to some institution, group or individual. In political votes, secret ballots also have implications for *coercion* resistance; when voters sell their votes, no documents are provided to verify that the vote has been cast a certain way. In other contexts being able to prove that a vote had been cast a certain way may be beneficial to gain support for future polls, or to show interest in a particular topic. Indeed, social

media polls publicly show participants to increase social pressure for participation. In some cases it might be important to know that particular individuals have voted to give the results credibility. For example in small decision making panels, the casting of votes by experts about an issue in their field, even without having higher numerical value, gives the result additional reliability.

Another aspect of secrecy involves rules relating to the *publication of interim results* prior to the end of a poll. Sociological studies have indicated that such social stimuli can positively affect the quality of decisions made [25]. A recent study found that banner messages on a social network site about friends who had voted in government elections drove more than 280,000 more people to vote [5]. Moreover, by allowing participants to review the results before they vote we can increase their perceived self-efficacy and ultimately reflect on voters' participation [1,8]. Yet studies have demonstrated [23] that by publishing articles about the strength of leading contenders or opinion polls, a bandwagon effect [19] can be stimulated that leads voters to choose one of the 'apparent' winners.

Expression

Expression refers to the way the voter is permitted to express their preference. Even though this is the main point at which the user interacts with the voting system and is an important driver of perceptions of efficacy, only limited studies have explored how to maximize participation by unpicking the various expression methods.

Nomination refers to the way participants nominate options in a poll. In most Western democracies, voters have no mechanism of adding and managing spontaneous options to the ballot slip, although they may choose to spoil the ballot paper to register a protest or may be permitted to vote in favor of reopening nominations. On the other hand, candidate nomination in less significant polling contexts is much more dynamic as candidate options can be added almost anytime (e.g. social media polls, doodle etc.).

Vote delegation (or vote transferring) is another possible method of expression. In elections, votes cannot be transferred without extenuating circumstances. In the last few years however, initiatives such as LiquidFeedback [9] used by the Pirate party in Germany and lately in Italy by the Five Star Movement show the potential of vote delegation as an alternative or complement of representative democracy.

In most cases votes cast are non-*revocable* – a voter cannot change his mind after a vote is cast. Revocable votes have lately been proposed to cope with some of the security concerns (voting under the threat of an interested party) of remote Internet voting. As vote revocability allows voters to revisit their choices before the closing of the poll, voting can be perceived as a process instead of as a single action. This can motivate effective discussion and argumentation between participants during the polling period as they explore further arguments to support their vote.

The *type of voting* is also an important decision that is often overlooked. Most of the voting systems today are approval-voting systems (the participants vote for a candidate instead of against one) that may lead to a plurality win or a proportional representation. An alternative is disapproval voting. Indeed, in ancient Greece one of the

first forms of voting was disapproval voting - once a year citizens voted to decide who would be exiled for ten years. For technology mediated decision making systems negative voting could increase perceived self-efficacy by allowing individuals to demonstrate their objection to, or disagreement with, an item. Actions such as spoiling votes emerge due to the need for voters to express themselves in a manner the voting system does not allow. In addition to adding alternative options dynamically, negative voting could open a dialogue of possible alternatives that could lead to a new nomination phase. Finally, an under-explored area of research is the way in which items can be chosen by the voter e.g. whether voters can rank candidates or select one or more. Also the way that results are interpreted (proportional or single winner) likely affects participation and voting patterns.

In many cases each of the participants has the same *number of votes* to use (in most cases one vote per eligible voter). Depending on context, a more flexible system could lead to a result that better reflects the engagement of the participants who voted. For example, users of Viewpoint [10] suggested that allowing multiple votes per person was an effective way of capturing how strongly individuals felt about a community related issue. There is also an assumption that votes cannot be transferred to other polls. If this were allowed, the act of voting might become more challenging, as voters would need to consider strategies across a number of decisions rather than engaging in single-topic democracy.

Finally, whether a poll is designed to allow *argumentation* around the issues on debate and how this argumentation is presented is pivotal to the type of participation that the system motivates. By requiring a certain level of discussion before voting additional barriers of participation are added. Yet participation should be more effective as the decision is more carefully considered and the participants will be informed by the debate. In other cases it might be sufficient only to register participants' opinions through the vote.

Ballotshare

BallotShare is a voting tool that allows a group of people to arrive at decisions. As a first exploration of the proposed design framework - with a particular focus on the design category of expression - we designed BallotShare to reflect the qualities of a workplace environment. Wide research has been conducted on the effect of the workplace environment on democratic beliefs and practices [21], with findings suggesting that workplaces are pivotal environments for educating citizens in participation. BallotShare was configured according to the dynamics of an open workplace environment. Generally, in a workplace setting the group members are familiar with each other and situated in the same space for at least a few hours a day. These two characteristics make workplaces particularly social and inviting to discussion and collaboration.

A number of BallotShare's features are implemented in acknowledgement of these qualities (see Table 1 for implemented voting features and their reflection on the proposed framework.). More specifically, by showing publicly the actions of the users

(commenting, voting, revoking votes etc.) we intend to provoke social pressure for participation and discussion. Even though the votes cast are private (the system doesn't link one's name with a vote cast), whether and when a participant voted for a poll, are public to the group. In addition, multiple voting and vote delegation can increase the collective efficacy of the group or a subgroup of participants with a shared goal. We expect the familiarity of group members to facilitate the creation of tactics between the participants by delegating votes to each other, voting multiple times for options etc. Multiple voting in combination with other implemented features such as vote revocation and vote delegation can open up new spaces of engagement in the workplace. Other implemented features such as dynamically adding candidates and negative voting were implemented in anticipation of increasing self-efficacy.

Table 1. BallotShare's features and reflection on the proposed design framework

	Eligibility	Fairness	Secrecy	Expression
Revocable votes				✓
Negative voting				✓
Open nomination	✓			✓
Public actions			✓	
Intermediate results			✓	
Vote delegation				✓
Multiple voting		✓		✓

Rather than single votes, users were provided with a number of tokens that could be used for voting in different polls, where a vote is assigned a particular cost. These tokens could either be distributed evenly or unevenly as desired to reflect the level of authority and influence that can be found in different decision making contexts. Users were also able to send tokens to other participants, potentially opening a new space for engagement. Finally, snippets of participants' actions - such as voting, commenting, revoking - are displayed publicly in a list of recent activity to provide social pressure for participation.

The significance of the polling occasion and governance over the voting system can be additional determinants of participation. Defining which decisions are significant is problematic as it is widely subjective – for example even though political elections are assumed to be of increased importance, the majority of the electorate are unlikely to be more interested about national politics than for everyday decisions [21]. This applies for the workplace environment as well, as one decision may have more affect on an individual than the group, and others may affect the group as a whole. Thus we perceive the content of a poll (i.e. what is being questioned) as an aspect of the poll that is not open to direct configuration.

User Study

BallotShare was deployed amongst staff and postgraduate students in our research institute, an environment that we could observe closely in order to explore how participants interacted with the system and what social interactions the system provoked. This approach clearly has limitations, however, considering the paucity of work in this area, we wanted to gain an initial understanding of the e-voting design space and identify issues for further research.

Staff and postgraduate students in our research institute (N=18) used BallotShare to vote on polls ranging from social activities to other spontaneous decisions that were required (eight polls in total). As inventing abstract decisions would add biases, over a period of five weeks, five weekly scheduled polls about already common social activities were created (e.g. "Choose a place to go out on Friday after work"). In addition three polls were created by request (naming a robot, choosing a colleague's birthday gift, and deciding the type of cake being made by another colleague). These polls had a more personal focus, as they had impact on specific members of the research group. Notification messages were sent to participants through email and an online messaging system to notify them when they were invited to a poll and to remind them during the week, as well as shortly before the poll closed.

E-mail invitations were sent to a total of 12 people by using a group's mailing list. The system was introduced as a research prototype that will facilitate decision making in the group. A further six people asked to be included after noticing that they were not registered in the system (as their emails were not on the mailing list) leading to a total of 18 participants. From those 18 invitations, 16 of them participated at least once in a poll. The mean participation for the weekly scheduled polls was 8.6 people, with the highest participation being 16 and the lowest being one. In general participation in the weekly social activity polls decreased over time (see Figure 2). The mean participation for all polls, including polls created by participants, was 11.

As shown in Figure 2, turnout was relatively high at the beginning of the study. This could be attributed to the novelty of the system. After the first two weeks, participants seemed to disengage from the regular polls. By the third week the decision was not being followed by the participants and active participants dropped from 16 to seven. By the fourth week participation was even lower with just one active participant from the group. By comparison, participation in the spontaneous polls was quite high (14, 16 and 12 active participants), even when being run in parallel with the less popular social activities polls. According to the interviews and questionnaires, spontaneous polls were perceived to be more significant as they were affecting an individual from the group personally.
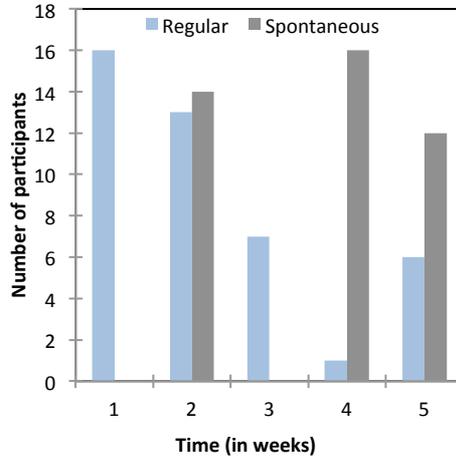
Figure 2. Active participants for regular weekly and unscheduled polls (by request).

Even though the system could be used remotely, collocation of participants in the working environment appeared to affect participation. Usage logs show that the participants used the system only during office hours and the majority of activity occurred within two hours after the invitation had been sent. The duration of the poll did not affect participation. Users tended to vote shortly after the creation of the polls and reconsider their vote shortly before voting closed. Other than voting, the most popular features of the system were vote revocation, negative voting and adding alternative options. Commenting on polls and vote delegation were less popular than expected (see Table 2).

Interview and Questionnaire Data

In order to gain a greater insight into behaviors and attitudes regarding the system, we distributed questionnaires to all users regarding usability, features of the system and engagement with the polls. We received 13 responses to this questionnaire. This was followed by 10 semi-structured interviews, each lasting for approximately 30 minutes and serving to gain a richer understanding of users experiences with the system and the group decision-making process.

To analyse the interview data we carried out a hybrid thematic analysis [13]. Hybrid thematic analysis incorporates theoretical deductive analysis with an inductive coding process to refine codes and themes. Core underlying psychological theories of decision-making (such as self-efficacy and collective efficacy) and aspects closely related to voting (such as privacy) were identified as the initial coding themes. A thematic analysis was then applied to the collected data, taking into consideration the predefined theoretical concepts.

Table 2. Usage of BallotShare's features.

Usage of features (%)	Regular	Regular	Spontaneous	Regular	Regular	Spontaneous	Regular	Spontaneous
Votes cast (negative & positive)	77 (45)	46 (74)	85 (77)	24 (80)	8 (88)	68 (94)	34 (93)	74 (86)
Vote revocation	62 (36)	13 (21)	10 (9)	4 (14)	1 (12)	4 (5)	2 (6)	7 (8)
Comments	17 (10)	1 (1)	12 (11)	0 (0)	0 (0)	0 (0)	0 (0)	3 (4)
Vote delegation	7 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Added candidate choices	9 (5)	2 (4)	3 (3)	2 (6)	0 (0)	1 (1)	1 (1)	1 (1)
Total	172	62	110	30	9	73	36	86

Findings

When asked whether they felt that their votes mattered in the decisions, 62% of participants agreed or strongly agreed, with 23% being neutral and 15% disagreeing. Participants were also asked to what extent they agreed that their votes changed the outcome of the poll, with the majority of responses following the same pattern (54% agree or strongly agree, 31% neutral and 15% disagree). Thus participants felt both the value and influence of their actions. However, when participants were asked whether they felt that the decisions made by the group were affected by the system, their responses were more evenly distributed from 'agree' to 'disagree' (30% agreed, 38% were neutral and 23% disagreed). Thus, although there appears to be a high level of self-efficacy (i.e. the perceived ability of an individual to succeed in their goals [4]), there are lower levels of collective efficacy (i.e. the belief that users are able to effect a change through their actions as a group [8]).

In this section, we explore the discrepancy between individual and collective efficacy through the thematic analysis of interview data. Based on this analysis, we identify significant drivers and limitations of individual and collective participation in the voting process. All names used in the results are aliases.

Social visibility

The design of BallotShare promotes the visibility of voting actions. However, more than this, the presence of BallotShare within the voting context reifies the decision-making process. Consequently, a reciprocal relationship exists between BallotShare and the social context. As Jack comments *"a lot of the times that I went and voted was because I had a conversation with someone* [in the lab]*"*. The visibility of the actions conducted on BallotShare and the capability of revisiting votes and monitoring voting as a process therefore drives engagement. For one participant the ability to observe others fostered participation:

"when I heard about it [a poll] *I was like, I have to get into this vote, to have a look of how is going see what people are voted so far"* George [M, 23].

The opportunity to observe the polling process could also drive those who would not directly benefit from the decision. Participants who were not motivated to vote enjoyed monitoring the results: *"I may not go to the pub certain weeks* […] *although I wasn't voting I would check who is winning* […] *I found that interesting"* [Jack, M, 30].

Social interaction during working hours was widely discussed by the participants, with quantitative data from the system indicating that all the activity (with just two exceptions) occurred during working hours. One participant suggested that this happened because a *"conversation that I had with people about things that we are voting on inspired me to look at the website and then mess around and fiddle with the vote* […] *I guess being around the people that are involved in the decision makes a big difference on how you engage with it and when"*.

Social inclusion

While operating within a social context, BallotShare was seen as a way of empowering group members', especially for new members of the group, to voice their opinions about certain topics. For example James, a relatively new member of the group, stated *"I think it's a nice way for people voicing their opinions, especially for people that are quite new* […] *nicer than necessarily voicing out to the group"*. Yet the potential for the system to support social inclusion also contributed to social exclusion. In addition to the empowerment of new group members, a contradictory feeling of disempowerment was observed for group members who normally had a say about social activities but had not initially been invited to the system. Sophia commented, *"I wasn't one of the people invited and* […] *I was like, I want to be involved* […] *I felt left out and I wanted to be involved so I asked for an account"*.

In this regard, BallotShare could be used to destabilize existing social hierarchies. Another new member suggests that although social activities *"might usually be decided by a few* […] *by having this polling system* […] *it gives more opportunity for other people have a say for a new* [activity]*"*. However, on other accounts some participants did not believe that the polls were effective. As Jack clearly identifies: *"...people were saying we will not go to the pub that wins anyway"*. Other participants questioned whether the choice of social events was truly a democratic process.

Alexia suggested that *"I don't think we really have a choice […] we go for the most convenient option and we are not really affected by the vote"*.

Commitment and delegation

Participants regularly cited a reduced sense of efficacy as one of the main reasons for their decreased participation in the recurring social activity polls. At times, polls were completed, with uncertainty about whether the outcomes would be followed:

"...the Friday one [scheduled poll] *was a bit annoying in a way, because we made these votes without knowing if we will actually go"* Jack, M, 30.

Furthermore, Dennis believes that the dynamics of the group effected the efficacy achieved through the system. For him, the system also needed someone to enforce the decisions: *"we need a leading voice* […] *I don't remember if somebody looked at the poll when we went on a Friday"*. Delegation of responsibility for the decision, rather than of the votes, was seen to achieve greater accountability. However, for others the issue was individual commitment. When commenting on limitations of the polls, Albert comments: *"I think negative voting is a bad thing* [in more important decisions]*, but I think more important than that is your vote has to be definitive"*.

Accountability

Features of the poll may contribute to the lack of finalized votes. For instance, multiple voting led participants to question the fairness of the final decision with one participant saying *"when I see a lot of votes for one option I don't know if a lot of people voted for that or it was just one person who thinks that this is a very good option"*. Thus, although through the process of voting the system reveals individuals' actions, the completed poll does not. In this way, the final decision is not attributable to a due process.

This due process was also understood to necessitate open discussion. Some participants viewed BallotShare as opening up discussion: *"it* [BallotShare] *is a process and voting - usually at least in my head - isn't a process [it] is something I do once"*. For others though, it was not: *"in the comment I tried to start an argument* […] *I wasn't talking to anybody just making a statement* […] *no discussion happening"*.

Feelings of dishonesty also kept some of the users from employing BallotShare's features to influence decisions. However these feelings would probably be diminished if the actions were completely private. This observation could be found in some users such as James, who did not use any strategies or use influence tactics. James stated: *"having it more anonymous would probably tempt me even more and be more inclined to[...] put coins to different things, rearrange stuff"*. In addition, Alexia believed that *"if it was more anonymous people would be more adventurous with it"* even though *"in this circumstance nobody would be embarrassed to put anything in because we know each other"*.

While discussing one of his tactics to save votes for later decisions, one participant suggested *"it seemed to have an unfair advantage. I think I would prefer if I had certain amount of coins for each poll. I think the equality aspect appeals to me more"*.

After saving some votes from previous polls, participants stated that they felt they had the power to completely affect the final result, even though they chose not to. This contradicts previous findings and literature regarding the negative impact that low self-efficacy of participants can have on participation. It seems that increasing self-efficacy is fundamental when attempting to encourage participation, but simultaneously may present too much power to change the final decision.

Exerting Influence

In addition to the implications for social interaction at a wider level, participants were also aware of - and sometimes directly involved in - social manipulation of the poll. In most cases participants tried to influence others by using BallotShare's features, including multiple voting and resetting. For example, Jack explained how he used multiple voting and resets to influence others and save votes for other polls:

"I was introducing new options to the poll and voting heavily for them and waiting to see if someone would actually go with it [...] I was just thinking if whatever it is that I am voting for has a chance to win [...] another thing I did one time was just before the vote got sealed I reset my votes and just added back the least amount needed to make it win".

Being able to see the results before the end of the poll generally influenced participants to vote tactically. For example, taking back votes that would not influence the final result or redistributing votes in order to have an effect. It was very common for polls that were open for a couple of days to have votes distributed to all the options, but to have votes distributed between only a small number of options by the time the poll closed.

Many features of BallotShare promoted tactical voting and participants used various strategies to change the outcome of the polls, including coalitions with other participants and attempts to influence others through voting and commenting. Coalitions were the less common tactic and took place either through agreements to vote for the same options or attempts to convince participants to send their votes to others. One of the participants reported that another voter *"emailed me saying 'I really want to go to this pub can you send me your votes', so it was like an insider externalized trading"*.

Although users enjoyed voting tactically, they were pensive about applying these strategies to more important decision-making and political polls. For example, Albert mentioned, *"it depends what the vote is for. If it's something that as a group we want to agree on, seeing the results and being able to negate votes is useful but if it is something you want to know the individuals opinion then it won't be so useful"*. In addition, Jack, who was one of the most strategic 'players' of the game, said, *"I wouldn't do the same* [for a more important poll] *because it has a different kind of consequence"*. Although during the interviews most of the participants mentioned issues that would probably arise in more important polls or elections, when asked how much they agree that the system could be used in more important decisions 69% "agreed" or "strongly agreed", with only 14% disagreeing.

Contextual privacy

Participants had diverse opinions about the privacy of the system, with 46% disagreeing or strongly disagreeing that the system is private, 31% agreeing or strongly agreeing, and the final 23% being neutral. Although the questionnaires indicated that participants tended to agree that the system violated the privacy of individuals—because most of the users' actions were publicly displayed and the content of someone's vote could be disclosed by combining actions of users and preliminary results—this tendency was not replicated in the interviews.

According to the interviews, participants did not feel their privacy had been violated. However, they did report that perception of privacy is directly related to the environment and context of the polls. These observations can be summarized by Jack's comment: *"I didn't really have a problem, I knew that someone could figure out by seeing the ridiculous amount of votes I put in one go sometimes but I didn't really feel any privacy concerns; that might be different if the votes were a lot more sensitive or they had wider implications".* Most of the participants agreed that the context of the polls and the social dynamics of the group are tightly related to the appropriation of measures to ensure privacy. There was a feeling that even for more important decisions, familiarity of participants in the group would make strict privacy measures somewhat unnecessary—possibly due to the fact that interaction with the group would lead to the disclosure of group members' favorite candidates. For example, when asked about possible privacy issues, Albert said, *"because we know each other that's not an issue* […] *even for more important decisions".*

Discussion

The goal of BallotShare was to explore how a carefully configured e-voting system can support participation in decision-making practices in a workplace environment. BallotShare allowed participants to revoke their votes; to vote multiple times both positively and negatively; to add candidate options dynamically; to delegate votes to other members of the group; and to check intermediate results and other participants' actions. In this section we reflect on the outcomes of the deployment of BallotShare with regard to the proposed design framework.

Eligibility

In terms of eligibility, the small number of users initially registered raised objections in some of the rest of the group, as they felt socially excluded from the decisions being made. The initial allocation of voting power to a random set of people (by using a mailing list) and the discussions that followed in the workplace environment, revealed hierarchical structures that were not visible in the group before. As the system was designed not to support these hierarchical structures – every participant had the same number of coins to use across the polls – the decisions were not followed by a group of people either because they opposed the decided action or because of a lowered perceived efficacy. In contrast, new members of the group perceived the system

as a socially non-invasive way to have their opinions assimilated into the group and were more active in the decision-making and subsequently the social activities. Future work is needed to further explore the impact that specially configured voting systems can have on hierarchical structures within an organization.

The closing poll condition, which in this case was time based, didn't have any impact on participation as nearly all the activity happened during working hours where the participants were collocated.

Fairness

The ability to own and cast multiple votes both negatively and positively, in combination with the publicity of the results during the voting period, resulted in undermining the perceived fairness of the system by some participants (who were directly affected by the outcome of a poll). In general, even though multiple and negative voting increased self-efficacy of the participants, our findings suggest that if the voting system provides too much power over the final decision, participation is negatively impacted. This is due to the perception that an individual could use that power to undermine the result. For more important spontaneous decisions that were polled, a conventional configuration (one vote per person) was perceived as more appropriate as the decision would have a personal effect on someone in the group.

Finally, even though verifiability of the voting process will be necessary for more critical decisions, due to the publicity of the actions, intermediate results and the collocation of the participants, unscrupulous acts become visible to the group and appear less likely.

Secrecy

As discussed, intermediate results affected perceptions of the fairness of the voting process. In combination with other characteristics such as vote revocation and offline discussions, intermediate results contributed to a more playful voting experience. Privacy concerns were not prominent in the study, even though users' voting choices were visible on the system. Clearly such concerns are contingent upon the context and familiarity of the group members. Overall, inconsistent attitudes towards privacy were uncovered, with more senior members of the group claiming that the partial violation of privacy engaged them to participate and to announce their views, whereas less affiliated members saying that total anonymity would have been more appropriate. Further research is required to understand how manipulation of the design to provide privacy in the poll according to the context's hierarchy could support participation.

Expression

Multiple voting and voting both positively and negatively was widely used and was one of the most important determinants of increasing self-efficacy. Voting against candidate options was used for tactical reasons (i.e. lowering an opposing candidate's total) or for publicly showing dissent from the rest of the group. Adding candidate

options dynamically was used less than expected, however when used, the added candidate options had a significant affect over the outcome of the poll.

Some qualities of BallotShare, such as commenting and vote delegation, were included with the intention of motivating discussions online, but neither supported this process despite our expectations. The interviews highlighted the need for a way to better support online argumentation; however the collocation of participants in the same workplace setting motivated offline discussions that later stimulated users to revisit their options online. Vote revocation in combination with these offline discussions allowed for a playful experience, as conversations during the day led people to revisit the polls, revoke their votes and recast them accordingly. We perceive that a number of expression features contributed to creating the experience that voting was a process, rather than a single action, thus engaging participants in a more meaningful democratic process.

Vote delegation was not used, as according to participants there was no reason to delegate your votes when they can be kept for future decisions. A future deployment of the system should either expire non-casted votes after the closing of a poll or allow requests for additional votes.

Conclusion

In this paper we proposed a framework that explores the design space of digital voting from the perspective of participation. We then designed a voting system as a first configuration of this framework to support the qualities of a workplace environment. After five weeks of deployment, we uncovered several aspects in its configuration that drove participation. Through the proposed design framework and the configuration of any poll on the design categories of *eligibility*, *fairness*, *secrecy* and the method of *expression*, we open up the discussion of designing digital voting for participation.

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