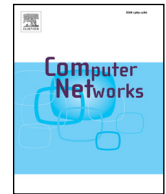




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Motivating participation and improving quality of contribution in ubiquitous crowdsourcing

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ABSTRACT

Ubiquitous crowdsourcing, or the crowdsourcing of tasks in settings beyond the desktop, is attracting interest due to the increasing maturity of mobile and ubiquitous technology, such as smartphones and public displays. In this paper we attempt to address a fundamental challenge in ubiquitous crowdsourcing: if people can contribute to crowdsourcing anytime and anywhere, why would they choose to do so? We highlight the role of motivation in ubiquitous crowdsourcing, and its effect on participation and performance. Through a series of field studies we empirically validate various motivational approaches in the context of ubiquitous crowdsourcing, and assess the comparable advantages of ubiquitous technologies' affordances. We show that through motivation ubiquitous crowdsourcing becomes comparable to online crowdsourcing in terms of participation and task performance, and that through motivation we can elicit better quality contributions and increased participation from workers. We also show that ubiquitous technologies' contextual capabilities can increase participation through increasing workers' intrinsic motivation, and that the in-situ nature of ubiquitous technologies can increase both participation and engagement of workers. Combined, our findings provide empirically validated recommendations on the design and implementation of ubiquitous crowdsourcing.

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1. Introduction

Crowdsourcing work and the associated distribution of micro-tasks across large numbers of individuals are becoming increasingly popular in settings beyond the desktop, thus enabling a wide range of applications. Ubiquitous technologies, such as smartphones and public displays, are now mature enough to allow users to contribute to crowdsourcing tasks wherever and whenever. While the increased ease with which it is now possible to participate in crowdsourcing work

raises new possibilities, it also raises an important question of motivation: if people can contribute to crowdsourcing anytime and anywhere, *why would they choose to do so?*

While the issue of motivation has been a long-standing concern in the design of computer systems and online services, new technologies require that *new motivational approaches are developed, adapted, and validated*. In terms of crowdsourcing, research in psychology, sociology, management and marketing provide a solid theoretical basis on human motivation [36]. However, these theoretical approaches typically have to be adapted and fine-tuned for a crowdsourcing setting. At the same, by motivating workers to contribute more, task requesters can unwillingly make them more susceptible to quality control issues [36] so careful motivational considerations have to be taken into account.

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In addition to accounting for human behaviour, a motivational approach also needs to account for the technologies and context of use. Ubiquitous technologies are particularly challenging as they are typically in the hands of users, away from the controls of a lab setting, and normally lack any identification mechanisms. Therefore, crowdsourcing using these technologies may produce “noisy” results due to unpredictable behaviour or misappropriation from users [28,59]. Thus, prior work further emphasizes the importance of appropriate motivational approaches to address these challenges.

In this paper we adapt, present and validate motivational approaches for *ubiquitous crowdsourcing* by drawing on extensive literature and leveraging our own results from four case studies. These approaches draw on prior literature in human behaviour, account for ubiquitous technologies, and are validated in field trials to establish their effect on *participation* and *quality* of contribution. We answer four important questions on the motivational aspects of ubiquitous crowdsourcing regarding the possibility of eliciting altruistic contributions, the effectiveness of various motivational approaches, the potential advantage that ubiquitous technologies can offer for crowdsourcing, and finally on the situated nature of ubiquitous crowdsourcing:

1. *Can ubiquitous crowdsourcing work altruistically?* We answer this through a case study where we experimentally compare results obtained between ubiquitous and online crowdsourcing. Specifically, we establish a baseline assessment showing that performance in ubiquitous settings without payment is comparable to online settings with payment, and worthy of further investigation.
2. *Can psychological empowerment motivate ubiquitous crowdsourcing?* We answer this by validating psychological empowerment approaches as motivators for participation in ubiquitous crowdsourcing. Specifically, we validate how 3 types of psychological empowerment affect participation and contribution in crowdsourcing on mobile phones.
3. *Can contextual cues motivate ubiquitous crowdsourcing?* To answer this we test the effect of presenting contextual information on engagement. Specifically, we evaluate how the presentation of location cues affects participation in a “crowd-mapping” setting.
4. *Can situatedness motivate ubiquitous crowdsourcing?* Specifically, we investigate how the situatedness of ubiquitous technology can motivate people to participate in in-situ feedback collection.

We conclude the paper with the lessons learned throughout our case studies, discussion of other potential motivational approaches in ubiquitous crowdsourcing and empirically validated recommendations on the design and implementation of ubiquitous crowdsourcing.

2. Related work

2.1. Technological opportunities for ubiquitous crowdsourcing

Crowdsourcing with ubiquitous technologies is increasingly gaining researchers’ attention [64,65], especially on mobile phones. This has allowed researchers to push tasks

to the workers, anywhere and anytime. Most of these platforms have been deployed in developing countries targeting low-income workers providing them with simple tasks, e.g. [15,25]. Recent advances in mobile technologies have also allowed for more intricate and creative tasks. For instance, *Wallah*, a mobile crowdsourcing platform for Android OS implements caching for offline situations and aims to minimize the impact of different screen sizes of smart phones [40]. More broadly, the location-based distribution of crowdsourcing tasks has allowed its workers to perform real-world tasks in a peer-to-peer fashion. Some examples of this include providing location-aware recommendations for restaurants [1], providing instant weather reports [1], or authoring news articles by requesting photographs or videos of certain events from workers [63].

Recently, another community has developed around the topic of crowdsourcing measurements and sensing. This participatory sensing movement is also referred to as “Citizen Science” [49] and relies on mobilizing large parts of the population to contribute to scientific challenges via crowdsourcing. Often this involves the use of smartphones for collecting data [6] or even donating computational resources while the phone is idle [2].

Despite the appeal of mobile phones, using them for crowdsourcing requires workers’ *implicit* deployment, configuration and utilising users’ own hardware. For example, in SMS-based crowdsourcing, participants need to explicitly sign up for the service, at the cost of a text message exchange. This challenges recruitment of workers, as a number of steps need to be performed before a worker can actually start contributing using their device. Alternatively, a passive approach of crowdsourcing tasks to workers is to embed public displays into a physical space and leveraging workers’ serendipitous availability. Crowdsourcing using public displays requires little effort from the worker to contribute [19,24], lowering the barriers to contribution from a workers’ perspective by minimising the initial effort. Furthermore, it allows for a geofenced and more contextually controlled crowdsourcing environment [24], thus enabling targeting certain individuals [19,20], leveraging people’s local knowledge [21,28] or simply reaching an untapped source of potential workers [27,29].

A reflection on the effective facilitation mechanism for public displays to motivate users to deliver reliable and meaningful feedback is lacking but also imperative. Most prior research has reported the use of public displays for hedonic services (e.g., games, opinion disclosure) or information-based services (e.g., information boards) that offer instant benefits to users [5,38]. There is a lack of deliberation on the possibility of using public displays in an altruistic manner, such as for non-paid crowdsourcing. Pragmatically, a successful demonstration of the potential of public displays for altruistic services implies a possible future direction for public displays research and practice.

Despite the various benefits of public displays for crowdsourcing, there are some serious drawbacks. For instance, the walk-up-and-use nature of public displays can result in limited usability and accessibility of tasks, with less rich interface controls than a standard desktop environment or a mobile phone. This means that not all types of tasks can be crowdsourced on a public display. Another drawback is that the maintenance of public displays is more difficult than

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