

Time as Currency:
A Value Sensitive Design Exploration of
Crowdworkers' Temporal Flexibility

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I, Laura Lascău, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

Abstract

Over the past decade, there has been a rise in the number of people working on crowdsourcing platforms. Although those who work on crowdworking platforms (i.e., crowdworkers) value having autonomy over scheduling their own time, research suggests that they do not benefit from the temporal flexibility to choose *when* and *for how long* to work. Therefore, in this thesis, we aim to understand what limits the temporal flexibility of crowdworkers, and how this aspect impacts the workers. Our ultimate goal is to inform the design of future crowdsourcing platforms.

To achieve the aim of this thesis, we employ Value Sensitive Design (VSD) as our theory and design framework. Using the lens of VSD and a combination of qualitative and quantitative methods, we show that crowdworkers' temporal flexibility is limited by three different types of time constraints: (i) worker-imposed time constraints, (ii) client-imposed time constraints, and (iii) platform-imposed time constraints. These time constraints limit: (a) the temporal working preferences of workers, (b) the time workers have to make decisions, and (c) the work pace and work schedules of workers. Ultimately, we confirm that the existing features of crowdsourcing platforms do not fully support flexible temporal arrangements for workers; instead, these platforms favour clients' flexibility to workers' detriment.

In this thesis, we make three contributions to HCI and CSCW. The contributions are to the knowledge, practice, and design of crowdsourcing platforms. Firstly, we provide empirical evidence to show how time constraints impact crowdworkers. Secondly, we provide a conceptual framework of time constraints within crowdsourcing platforms. Finally, we provide a series of design goals that embody temporal flexibility as a value of central interest for crowdworkers.

Impact Statement

The work presented in this thesis offers a deep and probing examination of the working conditions of people who work on on-demand crowdsourcing platforms (i.e., the working conditions of the humans who power *human-in-the-loop* systems). In particular, the work presented in this thesis examined the temporal constraints of crowdwork and its impact on the people powering our A.I. systems.

The work presented in this thesis has an impact both inside and outside academia. Within academia, we published this work in top-tier publication venues. For example, we presented parts of this thesis at the ACM CHI Conference on Human Factors in Computing Systems conference in 2019. This work examined the multitasking behaviour of people who work on crowdsourcing platforms. Since its publication, this work has been cited over 40 times, indicating the measurable impact of this research. Extending this line of research, we also presented parts of this thesis at the ACM CHI Conference on Human Factors in Computing Systems conference in 2022. This work offered a rigorous and thorough review of how crowdsourcing platforms use ‘invisible mechanisms’ that coerce workers to sacrifice their temporal flexibility to cater to the demands of clients.

Outside of academia, the work presented in this thesis provides practical recommendations for how crowdsourcing platforms can be built to create a fairer workplace for crowdworkers. For example, this thesis contributes five design goals for the design of future crowdworking platforms that aim to support workers’ requirements for temporal flexibility. Overall, the practical recommendations presented in this thesis can also impact the future development of labour platforms within the wider on-demand platform economy.

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Terminology

clients The people who make jobs available on crowdsourcing platforms (e.g., ‘requesters’ on Amazon Mechanical Turk or ‘customers’ on Appen). 32

crowdsourcing platforms On-demand online platforms that provide short-term work opportunities to crowdworkers. 31

crowdworkers The people who complete jobs on crowdsourcing platforms (e.g., ‘Workers’ on Amazon Mechanical Turk or ‘collaborators’ on Appen). 31

jobs Short-term work available in high volume on crowdsourcing platforms. Examples of jobs include data entry tasks or survey completion tasks. 33

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Chapter 1

Introduction

1.1 Motivation

Over the past decade, there has been a rise in the number of people working on crowdsourcing platforms. Between 5% and 9% of adult European internet users work at least once a week on crowdsourcing platforms [1]. Further, participation on these platforms is expected to grow globally at an annual rate of 26% [2]. The rise in the number of people working on crowdsourcing platforms is due to a shift towards work individualisation. Work individualisation is characterised by solitary and precarious employment contracts, which enable paid work opportunities in places and at times that were previously inaccessible, such as in the home or on the move [3].

Crowdsourcing platforms are emblematic of precarious work, being characterised by short-term work opportunities that do not have a fixed place of work [3]. On these platforms, *crowdworkers* (i.e., the people who work on crowdsourcing platforms) complete jobs such as image tagging, dataset cleaning, or surveys [4], which *clients* (i.e., the people who make jobs available) make available in large quantities. These jobs can last anywhere between a few seconds to a few hours, and can be completed remotely by the workers.

Notably, crowdsourcing platforms are advertised as offering workers temporal flexibility in work hours due to their lack of formal work hours [5]. Temporal flexibility refers to having autonomy in *when* and *for how long* to work [6, 7, 8]. Temporal flexibility has been shown to have several benefits for traditional workers. For

example, temporal flexibility can result in increased job satisfaction [9], improved mental and physical health [10], and improved work-life balance [11]. Furthermore, flexible work arrangements provide traditional workers with an increased ability to integrate work with non-work circumstances [12]. People who can integrate work with non-work circumstances experience lower levels of work-life conflict, report lower levels of stress [9] and are more satisfied with their work arrangements [13].

Prior research shows that crowdworkers value having autonomy over scheduling their own time [14]. Far from being a pastime that workers engage with in their spare time, crowdsourcing platforms have become a primary employer for many who value the flexibility promoted by crowdsourcing platforms [15]. Crowdsourcing platforms grew in popularity in the mid-2000s for people who needed an income working at home or on the move [16]. Those who choose to work flexibly on crowdsourcing platforms do so for personal and financial reasons [17]. In some cases, workers' circumstances mean that working outside of the traditional workforce becomes one of the only options for employment. For example, some workers lack the physical mobility to search for work outside of their homes (e.g., are not able to travel to a workplace with a physical location); other workers are not available to work within rigid industrial hours (e.g., are not able to work the hours set by traditional jobs) [18, 19].

However, there is evidence to suggest that crowdworkers do not benefit from the temporal flexibility advertised by the platform. For example, workers have no protection from low demands in work [20]. As a result, they might not be able to conduct work *when* they prefer, despite valuing autonomy over scheduling their time. Thus, crowdworkers can end up having limited temporal flexibility [21].

In this thesis, we argue that it is imperative to understand to what extent workers benefit from the temporal flexibility advertised by crowdsourcing platforms. By and large, since participation on crowdsourcing platforms is expected to grow [2], an understanding of what contributes to the precarity of crowdsourcing platforms is now increasingly important [22]. We next outline the research questions we will address in this thesis, and the approach we will take to answer these questions.

1.2 Research Questions

Previous work suggests that although crowdworkers value the temporal flexibility advertised by the platform, they do not benefit from it. Thus, in this thesis, we aim to understand what limits workers' temporal flexibility, and how this aspect impacts the workers, with the goal to inform the design of future crowdsourcing platforms.

To achieve the aim of this thesis, we ask the following main research question (RQ): **How can crowdsourcing platforms constrain and support crowdworkers who value temporal flexibility?**

We address the RQ by answering the following subquestions across six studies:

- (i) How is the temporal flexibility of crowdworkers limited by time constraints imposed by workers' circumstances? (Study 1)
- (ii) How is the temporal flexibility of crowdworkers limited by time constraints imposed by clients? (Study 2)
- (iii) How is the temporal flexibility of crowdworkers limited by time constraints imposed by crowdsourcing platforms?
 - (a) How is the temporal flexibility of crowdworkers limited by the platform's lack of work assignment? (Study 3)
 - (b) How is the temporal flexibility of crowdworkers limited by the platform's unpredictable work availability? (Study 4)
- (iv) What other features of crowdsourcing platforms can further constrain workers' temporal flexibility? (Study 5)
- (v) What kind of future crowdsourcing platforms do workers who value temporal flexibility envision? (Study 6)

1.3 Research Methodology

To address the subquestions, we use Value Sensitive Design (VSD) as our design framework [23, 24]. VSD is a theoretically grounded approach to the design of

technology that accounts for human values [25]. We describe VSD in more detail in Chapter 2; we next describe how we used VSD in this thesis. Following VSD, the central *value* of this thesis is *temporal flexibility*. Prior work identified a set of nine values that crowdworkers share: access, autonomy, fairness, transparency, communication, security, accountability, making an impact, and dignity [14]. For the scope of this thesis, we focus on a single value held by crowdworkers: autonomy – conceptualised as *temporal flexibility*.

VSD employs an iterative methodology that integrates three types of investigations: (i) conceptual investigations, (ii) empirical investigations, and (iii) technical investigations. Following VSD, we first conduct a conceptual investigation as part of the literature review of this thesis. We conduct the conceptual investigation to identify: (a) key stakeholders in the ability of crowdworkers to exercise temporal flexibility; and (b) value tensions [24] – conceptualised as *time constraints* – that can limit workers’ temporal flexibility. Secondly, we conduct three empirical investigations to identify how the temporal flexibility of crowdworkers is limited by the time constraints identified in the conceptual investigation. In the investigations, we use a combination of qualitative and quantitative methods:

- (i) Study 1 is an empirical investigation, where we use survey and telemetry data.
- (ii) Studies 2 and 3 are two empirical investigations, in which we use video observations and qualitative data.
- (iii) Study 4 is an empirical investigation, in which we use survey, time-use diary, and interview data.

Finally, we conduct two technical investigations of crowdsourcing platforms to identify technical features that can constrain or support temporal flexibility:

- (i) Study 5 is a retrospective technical investigation, in which we conduct a feature analysis of crowdsourcing platforms.
- (ii) Study 6 is a proactive technical investigation, in which we conduct a series of remote co-design sessions. We describe the key results of each study in the next section.

1.4 Overview of Chapters

Figure 1.1: Overview of the Structure of this Thesis

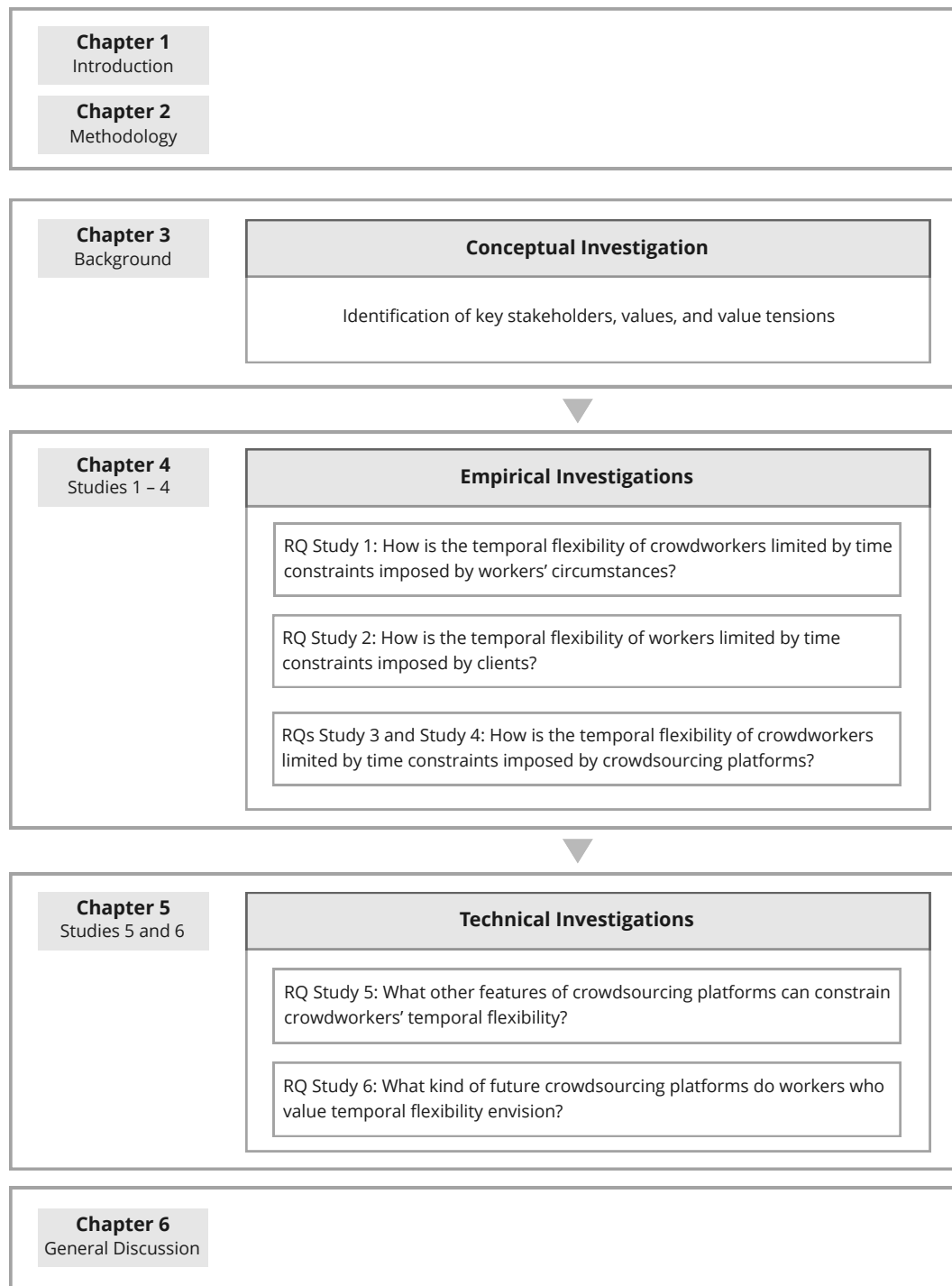


Figure 6.3 provides an overview of the structure of this thesis. This thesis consists of six chapters. Below is a summary of the key results of each chapter.

Chapter 2 presents the methodology of this thesis. We use VSD as our design framework to investigate the central value of this thesis: *temporal flexibility*.

Chapter 3 discusses related literature. Here, we review the literature on crowdwork in the context of temporal working arrangements, with a particular focus on crowdworkers' temporal flexibility. As part of the literature review, we identify three types of time constraints that can limit the temporal flexibility of crowdworkers: (i) time constraints imposed by workers' circumstances; (ii) time constraints imposed by clients; and (iii) time constraints imposed by the design of the platform. We investigate the impact of each of the three constraints in the next chapters.

Chapter 4 reports four empirical investigations of temporal flexibility on crowdsourcing platforms. Firstly, *Study 1* is an empirical investigation that uses surveys and telemetric data. Secondly, *Study 2* and *Study 3* are two empirical investigations that use video observations and qualitative data. Finally, *Study 4* is an empirical investigation that uses surveys, time-use diaries, and interviews.

Firstly, *Study 1* shows that time constraints imposed by crowdworkers' personal and work circumstances constrained the temporal working preferences of the workers. Namely, we find that participants' personal and work circumstances imposed certain time constraints that contradicted how workers actually preferred to use their time when working.

Secondly, *Study 2* shows that the time constraints imposed by clients limited the amount of time workers had in which crowdworkers could take decisions regarding their work. Namely, we find that since jobs clients posted on the platform had strict completion times, participants had to decide under time pressure: (a) which jobs to keep in their work queue, (b) which jobs to return, and (c) the order in which they should complete the jobs in their queue.

Thirdly, *Study 3* shows that the time constraints imposed by the design of the platform limited the pace at which crowdworkers worked and took breaks. Namely, we find that the platform's lack of work assignment impacted the pace at which participants worked and took breaks.

Finally, *Study 4* shows that the time constraints imposed by the design of the

platform limited the work schedules of crowdworkers. Namely, we find that having unpredictable work availability impacted participants' ability to schedule their time and stick to planned work hours.

Chapter 5 reports two technical investigations of temporal flexibility on crowdsourcing platforms. Firstly, *Study 5* is a retrospective technical investigation, in which we conduct a feature analysis of crowdsourcing platforms. Next, *Study 6* is a proactive technical investigation, in which we conduct a series of remote co-design sessions with crowdworkers.

Firstly, *Study 5* shows that crowdsourcing platforms can constrain workers' temporal flexibility through 19 technical features. Namely, we find that crowdsourcing platforms strongly favour features that promote clients' temporal flexibility over workers' by limiting workers' predictability in work hours and restricting paid time.

Next, *Study 6* shows that participants in the co-design sessions agree that to experience more temporal flexibility, the mechanisms behind crowdsourcing platforms should considerably change in the future. Namely, we find that the design of future crowdsourcing platforms ought to embody the following seven values in the long term: (1) predictability, (2) fairness, (3) flexibility, (4) integrity, (5) accountability, (6) transparency, and (7) identity.

Chapter 6 concludes the thesis. Here, we first summarise the key results of each study. Next, we present the thesis' contributions to knowledge, practice, and design. Finally, we reflect on the contributions of this thesis.

1.5 Research Contributions

In this thesis, we make three contributions to HCI and CSCW. The contributions are to the knowledge, practice, and design of crowdsourcing platforms. We describe each type of contribution below.

Firstly, the thesis contributes to knowledge by providing empirical evidence of how time constraints impact crowdworkers. We provide detailed qualitative and quantitative accounts of how time constraints imposed by (a) crowdworkers' personal and work circumstances, (b) clients, and (c) the design of the platform can

limit temporal flexibility (see Chapter 4).

Secondly, the thesis contributes to practice by providing a conceptual framework of temporal precarity within crowdsourcing platforms. We constructed the conceptual framework based on the time constraints identified in the literature review during the conceptual investigation phase (see Chapter 3), and based on the subsequent empirical investigations (see Chapter 4) and technical investigations (see Chapter 5) conducted throughout this study.

Finally, the thesis contributes to design by providing a series of artefacts that embody temporal flexibility as a value of central interest for crowdworkers. The artefacts presented reveal new design possibilities for future crowdsourcing platforms that account for workers' desire for autonomy over scheduling their own time (see Chapter 6).

Chapter 2

Methodology

2.1 Value Sensitive Design

In this thesis, we use Value Sensitive Design (VSD) as our theory and design framework [26]. We chose VSD over other design frameworks such as user-centred design (UCD) or human-centred design (HCD) because of VSD’s explicit focus on bringing human values to the forefront of the technical design process — this aim of VSD is in contrast to system usability metrics commonly used in UCD or HCD processes (e.g., effectiveness, efficiency or satisfaction), which do not explicitly account for values [26]. Furthermore, VSD positions people at the centre of the design process, making them active participants in the creation of technologies and information systems, which is unlike other frameworks that do not permit participants to take an active role in the design process. We next describe VSD, and how we applied the design framework to this thesis.

VSD emerged in the 1990s with the goal to develop a theoretically grounded approach to the design of technology that accounts for human values [23, 24]. Values are defined by Friedman et al. as “*what a person or group of people consider important in life*” [26, p. 349]. However, VSD acknowledges that technology is not value neutral [27] but instead embodies the ethical and political beliefs of its creators [28]. In this sense, VSD conceptualises values as an interactional product of technology and society, produced in the socio-technical gap [29]¹. When values are

¹Ackerman describes the social-technical gap as “the divide between what we know we must support socially and what we can support technically.” [29, p. 1]

not accounted for in the design process, they are often unconsciously embodied by technology, supporting the values held by the designers of the technology instead of the values of those impacted by the technology [30]. In the context of crowdsourcing platforms, examples of values that crowdworkers share include: *access, autonomy, fairness, transparency, communication, security, accountability, making an impact, and dignity* [14].

VSD employs a tripartite, integrative, and iterative commitment to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process [26]. Firstly, the *tripartite commitment* of VSD consists of three types of investigations: (i) conceptual investigation, (ii) empirical investigation, and (iii) technological investigation. Next, the *integrative commitment* of VSD requires all three types of investigations to be conducted in the lifetime of a project in order to inform each other. Further, the *iterative commitment* enables designers to begin the design process of a project with any of the three types of investigations. We next describe in detail the three types of investigations that ought to be conducted in the lifetime of a VSD project.

Firstly, *conceptual investigations* can be used to identify relevant stakeholders, values, and value tensions. Within VSD, stakeholders are individuals or groups of individuals who are impacted by the proposed technology. Stakeholder groups can identify their own list of values, or researchers and practitioners can use heuristic lists of human values. An example of a list of heuristics is Friedman et al.'s list of 13 human values with ethical import that are often implicated in system design (e.g., human welfare, ownership and property, privacy, trust, autonomy, accountability, etc.) [24]. Furthermore, value tensions are potential conflicts or tensions that can arise among key values. In the context of this thesis, we conduct a conceptual investigation in Chapter 3 to identify the key stakeholders and value tensions that can limit crowdworkers' ability to exercise the value of temporal flexibility. As part of the conceptual investigation, we conduct a literature review to explore the central value of this thesis (i.e., autonomy, conceptualised as *temporal flexibility*), and identify key stakeholders and value tensions (i.e., conceptualised as *time con-*

straints) that can limit workers' temporal flexibility. We describe the conceptual investigation in the next chapter of this thesis.

Secondly, *empirical investigations* can be used to explore human interaction with the technology, taking a non-prescriptive mixed-methods approach [24]. In this sense, empirical investigations explore the human context in which a technology is currently used (or will be used), as well as the social impacts of the technology [31]. The investigations draw on quantitative and qualitative methods traditionally used in the social sciences (e.g., observations, interviews, surveys, focus groups, etc.) [25, 24]. In the context of this thesis, we conduct four empirical investigations in Chapter 4 to explore what limits crowdworkers' temporal flexibility. As part of the empirical investigations, we use the following research methods: (a) surveys and telemetric data (in Study 1), (b) video observations and qualitative data (in Studies 2 and 3), and (c) surveys and time-use-diary studies (in Study 4). We describe each empirical investigation in the next chapters of this thesis.

Finally, *technical investigations* can be used to focus on the technology as a unit of analysis [24]. Within VSD, two types of technical analyses can be employed: *retrospective* analyses and *proactive* analyses. Firstly, retrospective analyses focus on how existing technical features underlying technology's mechanisms support or constrain human values. In other words, the emphasis of retrospective technical investigations is on understanding the value implications of an existing technology [24]. Secondly, proactive analyses focus on translating the stakeholder values identified during a conceptual investigation into technical features, with the goal of developing new technology. In other words, the emphasis of proactive technical investigations is on investigating new technological possibilities [24]. In the context of this thesis, we conduct two technical investigations in Chapter 5 to identify how crowdsourcing platforms can support crowdworkers' temporal flexibility. As part of the technical investigations, we use the following research methods: (a) feature analysis (in Study 5) and (b) co-design sessions (in Study 6). We describe each technical investigation in the next chapters of this thesis.

In summary, following VSD, we first conduct a conceptual investigation in

Chapter 3 to explore the central value of this thesis (i.e., temporal flexibility), and to identify key stakeholders and value tensions (i.e., conceptualised as *time constraints*) that can limit crowdworkers' ability to exercise temporal flexibility. Next, we conduct four empirical investigations in Chapter 4 to understand how the time constraints identified in the previous chapter can impact crowdworkers' temporal flexibility. Finally, we conduct two technical investigations in Chapter 5 to identify how crowdsourcing platforms can support crowdworkers' temporal flexibility.

2.2 Participant Recruitment

All the participants who took part in the studies presented in this thesis were recruited from crowdsourcing platforms. Given the research questions addressed throughout this thesis and the type of studies conducted, we decided to recruit all the study participants from crowdsourcing platforms rather than forums. We next describe the rationale behind this decision.

When studying crowdsourcing platforms, participants (i.e., crowdworkers) can be recruited directly from crowdworking platforms or indirectly from forums. Recruiting participants directly from crowdsourcing platforms can ensure they have first-hand experience with the platforms and thus provide timely insights. Recruitment can be done by posting a job on a platform and recruiting people who are interested in participating in the study (e.g., [32], [33], [34]). However, participants can also be recruited outside of crowdsourcing platforms, whereby crowdworkers might be discussing jobs and their experiences with different platforms. Similarly to recruiting participants directly from crowdsourcing platforms, recruiting crowdworkers from forums can be done by posting a recruitment call, inviting people who can provide additional insights into the challenges and rewards of working on crowdsourcing platforms (e.g., [35]).

Compared to recruiting participants from forums, posting jobs on crowdsourcing platforms ensured that we could recruit people who were actively working on crowdworking platforms and had a verifiable history of completed jobs. Recruiting participants repeatably from crowdsourcing platforms also helped build our repu-

tation and credibility. Furthermore, since crowdworking platforms allowed us to apply custom screening criteria, posting jobs on crowdsourcing platforms ensured that a diverse range of perspectives was represented in this thesis. However, recruiting participants from crowdsourcing platforms can perpetuate the financial and temporal inequalities of crowdsourcing platforms. For example, researchers who are unaware of the power imbalances between workers and clients might choose to set up jobs of the default pay and minimum duration recommended by crowdsourcing platforms. In other words, researchers unaware of the impact of low-paid jobs with short completion times can set up jobs that perpetuate the financial and temporal inequalities of crowdsourcing platforms.

With this in mind, having an increased awareness of the power imbalances of crowdsourcing platforms, we took the following two decisions: (1) to pay participants fairly, and (2) to give participants 24 hours to complete the work. Firstly, paying participants fairly (i.e., at an hourly rate of \$15 USD) ensured that participants were getting paid for all crowdworking-related activities, from reading information about the job to completing and submitting it. The hourly rate of \$15 USD was deemed suitable for the type of studies conducted throughout the study since it was high enough to pay participants fairly for their time but low enough not to cause any suspicions regarding our credibility. Secondly, giving participants 24 hours to complete the work ensured that we were not exacerbating or creating additional time constraints. Given that many of the jobs posted on crowdsourcing platforms are not time-critical — 89% of jobs posted by academic researchers in December 2015 were for surveys [36] — we argue that clients need to provide workers with an adequate amount of time to complete jobs, which is more than the minimum amount of time suggested by the platforms.

2.3 Researcher Stance

In their recommendations for evolving VSD, Borning and Muller [37] suggest making the researcher more visible in the writing of the investigations. One way to increase the researcher’s visibility is by providing self-disclosures. Through self-

disclosures, researchers can articulate their views, background, experiences, personal values, and relation to participants. As a result, disclosures make researchers' stance transparent throughout the research process. Therefore, we next present the researcher's stance, in the voice of the author of this thesis.

My cultural context has shaped my values, beliefs, and goals. Notably, my conceptualisation of temporal flexibility is strongly shaped by communication differences. As a stutterer, I live the politics of time every day. Living in a hyperfluent world [38] has made me attuned to how people can experience time. When I speak, I experience time in a non-linear manner, with letters, syllables, and words looping and finding their way back to where they had started. However, stuttering is seen as unproductive. In a world that values hyperfluency, disabled voices not meeting conventional expectations of productivity are highly constrained from participating in social and economic life [38]; hence, stutterers and crowdworkers alike are coerced into mastering cultural norms such as pace, rhythm, and time scheduling [39]. In the case of stutterers, any deviations from these cultural norms are considered a moral failure [39]. In the case of crowdworkers, any such failures further result in financial losses. Thus, the politics of time interweave for those whose time is objectified, as is the case for stutterers and crowdworkers. Consequently, epitomes such as "time is money" result in time theft of social and economic nature. For example, whilst normative speakers commodify stutterers' time, crowdsourcing platforms also commodify crowdworkers' time. This commodification of time is driven by neoliberal values such as efficiency and self-mastery [39], which the stutterer and crowdworker alike are pressured to master. Therefore, through this self-disclosure and overall research, my aim is to shed light to the oppressive social structures that can further perpetuate harm when kept invisible.

Finally, my conceptualisation of temporal flexibility is also shaped by my own experiences of it. Over the past four years, being a PhD student has allowed me to customise my time use around my needs. However, being a PhD student in Human-Computer Interaction has privileges such as predictable work schedules and relative financial security. These privileges can result in biases affecting my experiences of

temporal flexibility, and in turn, in biases affecting the design research process presented in this thesis. Nevertheless, by providing insights into my values, perspectives, and goals, I hope to have increased the transparency of my thesis.

Chapter 3

Background: Conceptual Investigation of Crowdworkers' Temporal Flexibility

Parts of this chapter have been published in:

Lascău, L.; Gould, SJJ; Brumby, DP; Cox, AL (2022) *Crowdworkers' Temporal Flexibility is Being Traded for the Convenience of Requesters Through 19 'Invisible Mechanisms' Employed by Crowdfunding Platforms*. In CHI Conference on Human Factors in Computing Systems Extended Abstracts.

This chapter contributes an initial investigation of the time constraints that can limit crowdworkers' temporal flexibility.

In this chapter, we begin to describe the *conceptual investigation* we conducted throughout this thesis. As part of this investigation, we reviewed relevant literature that helped us conceptualise the value of temporal flexibility within crowdsourcing platforms.

In reviewing relevant literature, we first identified the key *stakeholders* of crowdsourcing platforms. Second, we identified the central *value* of this thesis—temporal flexibility. Finally, we identified *value tensions* (i.e., conceptualised as *time constraints*) that can limit crowdworkers' ability to exercise temporal flexibil-

ity. We next describe the stakeholders, values, and value tensions explored as part of the conceptual investigation.

3.1 Stakeholders

The first component of a conceptual investigation is the identification of stakeholders. Within VSD, stakeholders are individuals or groups impacted by the technology investigated. As part of a conceptual investigation, the different stakeholders are identified, together with their values, roles, and relationships to one another and the technology investigated.

Two broad categories of stakeholders and their respective values can be largely accounted for in a VSD project: (1) *direct stakeholders* and (2) *indirect stakeholders*. Direct stakeholders are the individuals or groups impacted directly by the technology they interact with. In contrast, indirect stakeholders are the individuals or groups who are impacted indirectly by the technology [40].

In the context of this thesis, the direct stakeholders of crowdsourcing platforms that we have investigated as part of this conceptual investigation are the *crowdworkers* (i.e., the people who work on crowdsourcing platforms), the clients (i.e., private companies or individual consumers), and the *designers of these platforms*¹. Finally, the indirect stakeholders of crowdsourcing platforms are *crowdworkers' close relationships* (e.g., the family members, friends, or flatmates of crowdworkers).

We identified the direct stakeholders as part of the initial conceptual investigation conducted in this chapter. Finally, we identified the indirect stakeholders as part of the empirical investigations we conducted in the following chapters—in other words, the results of the empirical investigations refined our conceptual investigation and helped to identify key stakeholders of crowdsourcing platforms further.

We next explore the direct stakeholders of crowdsourcing platforms. We provide an overview of crowdsourcing platforms and their rising popularity within the on-demand platform economy. Then, we describe what motivates people to work

¹We acknowledge that designers of crowdsourcing platforms do not operate in a vacuum, but have to work with the business models of crowdsourcing platforms, as well as with stakeholders' objectives. We describe the role of platform designers in the next section, whereby we will present a number of *value tensions* that can limit crowdworkers' ability to exercise temporal flexibility.

on crowdsourcing platforms, and finally, what motivates private companies or individual consumers (i.e., clients) to access crowdsourcing platforms.

First, what has contributed to the rise in popularity of crowdsourcing platforms? By and large, the on-demand platform economy is disputedly seen as a flexible alternative to traditional job opportunities. For instance, a report published in 2016 by the World Bank describes working within the platform economy as a flexible earning opportunity, where people can work on online platforms from home and set their own schedules [41]. However, the narrative of ‘flexibility’ promoted by institutions such as the World Bank is a source of contention among scholars, who argue that platform work can perpetuate precarious working conditions for the workers on the pretext of flexibility [42].

Nevertheless, more people than ever have to work within the platform economy as the result of the COVID-19 pandemic [43]. Besides the obvious financial incentives, one of the main selling points of platform economy advocates is workers’ flexibility. More precisely, platform work is advertised as offering workers temporal flexibility. For example, Uber drivers reportedly value the ride-hailing service’s flexible work schedules and ability to adapt hourly to their time demands [44]. Another example of temporally-flexible platform work can be found on crowdsourcing platforms. Crowdsourcing platforms are touted as offering the people working on these platforms temporal flexibility because of the short temporal nature of the work [45], known as ‘crowdwork’, ‘microwork’ or ‘cloudwork’. Examples of work available on these platforms include data entry jobs such as receipt transcriptions, image or video tagging, data set cleaning, or survey completion [4].

Far from being a pastime that people engage in within their spare time, crowdsourcing platforms became a primary employer for many who require, or in some cases desire, the flexibility promoted by on-demand crowdsourcing platforms [15]. Crowdsourcing platforms grew in popularity in the mid-2000s for people who needed an income working at home or on the move [16]. Years later, crowdsourcing platforms have been criticized for their low wages [46], lack of transparency between workers and clients [47], and enablement of a ‘work-anywhere’ attitude

that has the potential to fragment workers' work-life boundaries [48]. The 'work-anywhere' element of crowdsourcing platforms, also observed in the case of digital nomads [49], is considered by proponents of the platform economy to offer people a great amount of flexibility [50].

What motivates crowdworkers to join the on-demand workforce? Those who work flexibly on crowdsourcing platforms do so for personal and financial reasons [17]. In some cases, workers' circumstances mean that working outside of the traditional workforce becomes one of the only options for employment. For example, some workers lack the physical mobility to search for work outside of their homes (e.g., are not able to travel to a workplace with a physical location) [18]; other workers are not available to work within rigid industrial hours (e.g., are not able to work the hours set by traditional jobs) [19]; finally, other workers are housed in prisons [51] or refugee camps [52]. Therefore, people unable to find work in formal labour markets have to work on crowdsourcing platforms.

Finally, what motivates clients to access crowdsourcing platforms? Crowdsourcing platforms can provide a convenient data collection service to researchers who want to conduct online studies at a low cost and with a quick data turnaround [53, 54]. Academic and industry researchers alike widely use crowdsourcing platforms in their work. For example, within CSCW and HCI, researchers have used crowdsourcing platforms to study privacy in online social networks [55] or to understand online news behaviours [56]. Within industry, Artificial Intelligence (AI) researchers extensively use crowdsourcing platforms to train machine learning (ML) algorithms. Large tech companies such as Amazon, Facebook or Google, as well as AI start-ups, temporarily hire people from crowdsourcing platforms to build and label large training data sets for ML applications, such as product recommendations, image or speech recognition, or traffic prediction [57]. Amid an expansion in the use of AI, the use of crowdsourcing platforms is expected to grow globally at an annual rate of 26% [58, 2].

3.2 Values

The second component of a conceptual investigation is identifying and defining relevant values. Values are defined as “what a person or group of people consider important in life” [26], p. 349]. Values are generally stable and broad goals, which express a person’s intentions that may or may not be reflected in their actions [59]. VSD conceptualises values as an interactional product of technology and society, produced in the socio-technical gap [29]. When values are not accounted for in the design process, they are often unconsciously embodied by technology, supporting the values held by the designers of the technology instead of the values of those impacted by the technology [30]. For example, designers might prioritise values such as speed (e.g., of interacting with the product), whilst those directly impacted by the technology (i.e., the users of the technology) might prioritise values such as usability, preferring to achieve a goal in less time but with more success.

Stakeholder groups can identify their own list of values, or researchers and practitioners can use heuristic lists of human values. An example of a list of heuristics is Friedman et al.’s list of 13 human values with ethical import that are often implicated in system design: human welfare, ownership and property, privacy, freedom from bias, universal usability, trust, autonomy, informed consent, accountability, courtesy, identity, calmness, and environmental sustainability [24].

In this thesis, we focused on a central value of interest to crowdworkers: autonomy, conceptualised as *temporal flexibility*. Autonomy, derived from the Greek words *auto* (“self”) and *nomos* (“law”), is defined by Stamps and Piedmonte as “the amount of job related independence, initiative, and freedom either permitted or required in dailywork activities” [60]. Autonomy in time scheduling, which we conceptualise in this thesis as temporal flexibility, describes the amount of self-government one has over scheduling their time. In this sense, both concepts of autonomy and temporal flexibility describe one’s ability to make decisions and have control over one’s work activities. Thus, temporal flexibility is a form of autonomy in that it allows individuals to have control over the timing of their work, which can impact their ability to manage their workload and balance work and non-work

demands. Conversely, a lack of temporal flexibility can limit an individual's autonomy and make it difficult to manage competing demands, lowering job satisfaction. We chose to focus on the concept of temporal flexibility because of its fundamental contribution to crowdworkers' job quality [61].

In the next sections, we first describe how crowdsourcing platforms have marketed flexibility to crowdworkers and clients alike, followed by describing the conceptual definition of *time* that we adopted in this thesis. We then conclude this section by defining and describing the value of temporal flexibility.

3.2.1 Flexibility

Flexibility is increasingly sold as a product for the convenience of consumers. Growing consumer demand has resulted in a plethora of on-demand services becoming available through online apps [62]. Due to a phenomenon known as 'liquid expectations' [63], the culture of 'on-demand expectations' has bled from consumer-facing products into business-facing products [64]. As a result, both individual and business consumers have developed new fluid expectations from on-demand services, from ordering food and watching TV shows, to collecting datasets and labelling images.

Whilst consumers enjoy the convenience of on-demand services, these services come at a cost for the people at the forefront of providing these services. In this sense, workers within the on-demand platform economy face poor working conditions [45], such as financial and temporal work precarity. The financial precarity of workers is reflected through low pay and lack of financial security [65], whereas temporal precarity is reflected through unpredictable work schedules and an intensified work pace [66]. Whilst workers' financial precarity has been a prominent topic of conversation among platform stakeholders, workers, regulators, trade unions, and academics [67], the temporal precarity of workers has received less attention [68]. We argue that temporal precarity contributes to the poor working conditions of workers because of its relationship to consumer conveniences such as *temporal flexibility*. In this regard, on-demand platforms trade the temporal flexibility of crowdworkers as a resource for the convenience of consumers, but to workers'

detriment [69].

Crowdsourcing platforms are a prime example of a product that sells flexibility to its consumers [70]; this flexibility is advertised as *temporal flexibility*. Because of the short temporal nature of the work, the consumers of these platforms—clients and workers—are advertised temporal flexibility twofold. First, clients can “access a global, on-demand, 24x7 workforce” [71] through the platforms, where they can hire workers for as little as a few minutes and “free up resources and time for the company” [71]. Second, workers can “benefit from having no set hours or schedules [...] and freedom to choose when and how much to work” [72]. Therefore, on crowdsourcing platforms, *time, capital, and labour* entwine [73].

Whilst ‘time and capital’ (e.g., [74]) and ‘capital and labour’ (e.g., [46, 74, 75]) have been of interest to advocates of fair working conditions for the people working on crowdsourcing platforms, ‘time and labour’ has received less interest due to the invisible nature of the work [68]. The invisibility of crowdwork is partly physical [68], since the work mainly takes place in the homes of workers [76], and partly conceptual [68], since crowdworking is an invisible aspect of A.I. production [77]. Consequently, *time and labour* are aspects of crowdworking that have been swept under the rug using the narrative of temporal flexibility [42]. In the next section, we describe the conceptual definition of *time* that we adopted in this thesis.

3.2.2 Time

Capitalism demands regularity and command of time. Within such an economic system, time is understood as *chunkable* (i.e. unitised and measurable), *single purpose* (i.e., oriented to a single purpose), *linear* (i.e., experienced linearly), and *ownable* (i.e., owned by individuals) [78]. This dominant and normative conceptualisation of time — also known as “circumscribed time” [78] — prescribes one to master the art of time management and to adopt (or create) new technologies that increase time control. However, this conceptualisation does not account for the complex relations between temporality, technology, and power.

First, temporality denotes the lived experience of time, where time is a particular experience within specific political and economic circumstances rather than

within a specific chronological calendar era [79]. In this sense, people's lived experiences of time are influenced by their political and economic social differences, such as labour. Within such political and economic contexts, one's time is not an individual experience but is relational (i.e., organised in relation to other people's time) and seen as a "collective entanglement" [79]. Subsequently, this conceptualisation of time raises questions about power inequalities.

Technologies meant to increase time control are commercialised for individuals to gain a competitive advantage in the '24/7' workforce [80]. However, the touted desire for increased time control frequently leads to greater institutional control over one's time, resulting in power inequalities. For example, time-management technologies allow people to synchronise their time with that of others and vice versa. In the context of crowdsourcing platforms, workers must constantly recalibrate their time to the clients' time, completing jobs that the clients have regarded as cost-ineffective pursuits of their own time. Thus, technology can surface time-related power inequalities when time is limited to conceptualisations such as circumscribed time (e.g., chunkable, linear, single purpose, and ownable).

Within CSCW, the conceptualisation of circumscribed time is extended by a typology called "porous time". Noting the limitation of circumscribed time of centering on time control, porous time provides ways of orienting to time that are *spectral, mosaic, rhythmic, and obligated* [78]. Specifically, this time orientation goes beyond the idea of one's control over their own time, seeing time as multiply "obligated" by the demands of those around us. In this thesis, we align our conceptualisation of time with that of "porous time", highlighting that crowdworkers must work under the time demands of the clients and the crowdsourcing platforms. Furthermore, we refrain in this thesis from prescriptions such as crowdworkers requiring better time management skills or technologies to help them control their time.

3.2.3 Temporal Flexibility

Crowdworkers value having autonomy over scheduling their own time [14]. Prior work identified a set of nine values that crowdworkers share: *access, autonomy, fairness, transparency, communication, security, accountability, making an impact,*

and dignity [14]. In this thesis, we focused on a single value held by crowdworkers: autonomy, conceptualised as *temporal flexibility*.

Temporal flexibility in work schedules, or schedule autonomy, describes the extent to which workers have autonomy over determining their hours and duration of work [81]. Work schedule autonomy is believed to minimise the disruptiveness of role blurring and, in turn, enhance work-home integration [82, 83]. In addition, flexibility enactment theory [84] and work-family border theory [85] state that when workers can exercise autonomy over how to schedule their time, they can better attend to the demands of the work and life domains. Increased schedule autonomy can minimise the negative effects of long hours on work-family relations [86]. Further, increased schedule autonomy such as limiting excessive working hours, can result in less fatigue and fewer sleep problems, workers matching their work hours with their circadian rhythms [87].

In the case of office-based traditional workers (i.e., workers with full-time roles in traditional employment; non-crowdworkers), Nijp et al. [88] identified two regulatory mechanisms that can explain the positive associations between temporal flexibility and wellbeing. The first mechanism is the “time-regulation mechanism”, which suggests that traditional workers who can exercise autonomy over their working time can better regulate the time demands imposed upon them by aligning their work hours with non-work commitments. Therefore, workers can experience decreased conflict between the work and non-work interface. The second regulatory mechanism that can explain the positive association is the “recovery-regulation mechanism”, which suggests that when workers have autonomy over their start and finish hours, break-taking, and time off, they are better able to reduce the fatigue accumulated from work [88]. Therefore, these two regulatory mechanisms can explain the positive associations between temporal flexibility and wellbeing.

Importantly, temporal flexibility can be increased in several ways. In the case of home-based traditional workers (e.g., teleworkers with full-time roles in traditional employment), Tietze and Musson [89] identified three main strategies that can increase workers’ temporal flexibility by drawing temporal boundaries around

work and non-work activities: (1) ‘clock-based’ strategies, (2) ‘task-based’ strategies, and (3) a combination of the two aforementioned strategies. First, clock-based strategies allowed teleworkers to divide their time between work and non-work periods. For example, teleworkers engaged solely in work activities in the first part of the day. In comparison, teleworkers engaged solely in household activities in the second part of the day. Furthermore, for some of the teleworkers in Tietze and Musson’s study, this approach also included separating work from non-work through physical spaces, such as working from home offices [89].

Second, task-based strategies allowed teleworkers to divide their time between different activities (i.e., jobs). Compared to teleworkers who adopted clock-based strategies, teleworkers who used task-based strategies did not have set times when they were available for work or non-work activities. Instead, these teleworkers were reactive to the needs of the two, making themselves always available for the two. Therefore, the boundaries between work and non-work of task-based teleworkers were more permeable than those of clock-based teleworkers. Finally, most teleworkers in Tietze and Musson’s study fluctuated between ‘clock-based’ strategies and ‘task-based’ strategies [89]. When combined, the two strategies allowed workers to cater to the demands of both the work and non-work domains. Further, clock-based and task-based combined allowed for a higher degree of temporal flexibility.

However, whilst we see that the temporal flexibility of home-based traditional workers can be realised through three main strategies, these strategies might not necessarily apply to people who work outside of ‘traditional’ employment, such as crowdworkers. In the case of crowdworkers, working on crowdsourcing platforms is a fragmented activity because clients decompose larger jobs into shorter jobs. Thus, the short temporal nature of the work [45] might not allow crowdworkers to employ the same temporal strategies as teleworkers with full-time roles in traditional employment.

Additionally, previous research suggests that although people who work on crowdsourcing platforms value the temporal flexibility advertised by the platform, they do not benefit from the flexibility to choose when and for how long to work

[21]. For example, since workers have no protection from low demands in work (i.e., a low supply of jobs) [20], they cannot complete jobs when they prefer; thus, they can end up having limited temporal flexibility [21]. Further, clients can benefit from temporal flexibility to the detriment of workers [69]. For example, clients can control the amount of time workers have to complete a job; thus, clients can also impose time constraints on the workers, further limiting temporal flexibility.

Nonetheless, the design of crowdsourcing platforms can also impose time constraints on workers. For example, a lack of available work means that workers cannot at times exercise temporal flexibility in working hours [21]. In this thesis, we refer to these time constraints imposed on crowdworkers' temporal flexibility as *value tensions*. We next define and describe the concept of value tensions.

3.3 Value Tensions

Finally, the third component of a conceptual investigation is the identification of value tensions. Within VSD, value tensions are potential conflicts or tensions that can arise among key values. For example, whilst crowdworkers value temporal flexibility, clients can benefit from temporal flexibility to the detriment of workers [69]. In this regard, on-demand platforms trade the temporal flexibility of crowdworkers as a resource for the convenience of consumers, to workers' detriment [69]. Thus, the value tensions describe constraints on the design space [24].

In this thesis, we conceptualised value tensions as *time constraints*. As part of this literature review, we identified three types of time constraints: (1) *worker-imposed time constraints*, (2) *client-imposed time constraints*, and (3) *platform-imposed time constraints*. Table 3.1 presents a list of the time constraints we have identified. We next describe each type of time constraint.

3.3.1 Time Constraints Imposed by Crowdworkers' Circumstances

Firstly, in this thesis, we argue that the time constraints imposed by the crowdworkers' circumstances contribute to their limited temporal flexibility. Whilst crowd-

Worker-Imposed Time Constraints	Description of Time Constraints
W1. Working Practices	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may multitask when working on the platform. W1.3 Workers may switch among jobs frequently whilst working.
Client-Imposed Time Constraints	Description of Time Constraints
R1. Inflexibility of Time Use	R1.1 Clients can set strict job completion times.
Platform-Imposed Time Constraints	Description of Time Constraints
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers.
P2. Unpredictable Work Availability	P2.1 The platform has no set hours when clients can post jobs. P2.2 The platform has no set hours when workers can complete jobs. P2.3 The platform has no limit to the number of hours workers can spend working.

Table 3.1: Time constraints imposed on workers found on crowdsourcing platforms. The time constraints were identified as part of the literature review conducted in this chapter.

sourcing platforms promote the idea of flexible working arrangements due to workers being able to complete jobs from their homes [90], crowdworkers' circumstances have the potential to limit temporal flexibility. For example, working practices such as frequently having to monitor the platform for new work [48] could increase multitasking and task switching and might not always align with how workers prefer to use their time when working. Thus, as part of the conceptual investigation conducted in this thesis, we have identified three time constraints imposed on the **working practices** of crowdworkers:

- (a) W1.1 Workers mainly work on the platform from their homes;
- (b) W1.2 Workers may multitask when working on the platform; and
- (c) W1.3 Workers may switch among jobs frequently whilst working.

We focus on these three time constraints because of their potential to limit workers' temporal flexibility. We next describe the three time constraints.

W1.1 Workers mainly work on the platform from their homes. Firstly, we argue that the location of crowdwork can impose time constraints on the workers. Due to the omnipresence of technology that enables remote working, the usual 9-to-5 working hours have expanded throughout the day [91]. As a result, today's workplaces have been transformed from physical locations to spatial-temporal flexible

environments [92]. Therefore, work and leisure are co-located and, as a result, have more chances to be interposed.

In the case of crowdworking, the majority of crowdworkers complete jobs from their homes [90]—some workers also complete jobs on the go, such as on their mobile phone, in internet cafés or between classes [93, 90]. However, whilst crowdsourcing platforms promote the idea of flexible working arrangements due to workers being able to complete jobs from their homes, the working preferences of crowdworkers might not be supported. Thus, in Study 1 (Chapter 4), we aim to investigate how specific workspaces can influence workers' temporal flexibility.

W1.2 Workers may multitask when working on the platform. Secondly, we argue that multitasking can also impose time constraints on the workers. Multitasking is an integral part of most working contexts [94, 95, 96, 97, 98]. When multitasking, people can use their time more flexibly and effectively [99], and also have more flexibility over their schedules [100]. Whilst multitasking has been found to increase feelings of entertainment and relaxation [101], multitasking is more widely known for its negative effects on task performance [102, 96, 98]. In safety-critical environments such as in aviation [95], whilst driving [96] or in healthcare [97], the effects can be life-changing. In other environments, such as the office, multitasking can have negative effects on productivity levels [98]. Such negative effects can include slower reaction time, increased error, and extended job completion time.

In the case of crowdworking, crowdworkers report engaging in other activities whilst taking part in online experiments [103]. Gould, Cox and Brumby's [104] investigation of multitasking activity among crowdworkers found that workers switched jobs every five minutes, sometimes in the middle of jobs. Further, Chandler, Mueller and Paolacci [105] also report that many of the crowdworkers in their study watched TV or listened to music while working on the platform. Finally, Gupta notes that working on the platform is managed through instances of multitasking and "finding time and space within their lives" [93]. Thus, in Study 1 (Chapter 4), we aim to investigate how multitasking can influence workers' temporal flexibility.

W1.3 Workers may switch among jobs frequently whilst working. Finally, we argue that task switching can impose further time constraints on the workers. Whilst task switching can provide adequate relief from more complex jobs [106], task switching induced by interruptions can also increase feelings of frustration and stress [107, 108]. Rapid shifts in attention like the ones in multitasking could mean that people are in a state of shallow information processing [109] and continuous partial attention [110]. Whilst people may appear to be engaged and focused on multiple activities, they are in fact not paying full attention to any of them, which can in turn increase stress levels.

In the case of crowdworking, crowdworkers use *scripts* (i.e., web applications and browser plugins that help workers earn a better wage [111]), which notify them when clients post new jobs on the platform. When they received a notification about a new job, participants in Lehdonvirta's study [21] reported stopping and putting everything aside to attend to the notification and work on the new job. As a result, Lehdonvirta suggests that the design of crowdsourcing platforms makes them a competitive workplace, in which jobs can disappear in moments, and only the fastest and most alert workers get to work on the better-paid jobs [21]. Thus, in Study 1 (Chapter 4), we aim to investigate how task switching can influence workers' temporal flexibility.

3.3.2 Time Constraints Imposed by Clients

Secondly, in this thesis, we argue that the time constraints imposed by clients also contribute to crowdworkers' limited temporal flexibility. Despite the fact that some workers might be attracted by the temporal flexibility that crowdsourcing platforms appear to offer [17], there is a lack of worker-controlled temporal flexibility on these platforms [21].

Instead, it is clients who have flexibility: they control the 'when' and 'for how long' aspects of jobs. For example, each client provides their own completion times on jobs, which workers must adhere to [112]. Thus, as part of the conceptual investigation conducted in this thesis, we have identified one time constrain imposed

on crowdworkers: *clients can set strict completion times on their jobs*. We focused on this time constraint because of its potential to limit workers' temporal flexibility. We next describe the time constraint.

R1.1 Clients can set strict completion times on jobs. clients can also influence workers' behaviour through the time they give workers to complete a job and the amount of pay that clients offer. Each client can set their own job completion times, which workers must adhere to. The amount of time varies from job to job and client to client. If the worker does not manage to complete the jobs in the allocated amount of time, the job expires, and the worker might receive no pay. Thus, a worker must adapt their multitasking strategy to each job; this is especially the case for jobs where there is a lot of work to be done in a small window. Further, pay rates also vary greatly because clients have the freedom to decide on their pay rates. For example, a client could ask a worker to complete a job worth \$5 in 10 minutes or 1 hour. This can create variations in hourly wage for the workers [113]. As a result, workers might be inclined to take on several jobs of shorter duration with higher pay. To create support that helps workers and make helpful recommendations for clients, we need to know more about how the potentially naïve choices clients make about their jobs constrain workers' ability to work in the way they prefer. Thus, in Study 2 (Chapter 4), we aim to investigate how setting strict completion times can influence workers' temporal flexibility.

3.3.3 Time Constraints Imposed by Crowdsourcing Platforms

Finally, in this thesis, we argue that the time constraints imposed by the design of crowdsourcing platforms contribute to workers' limited temporal flexibility. Whilst prior work suggests that the temporal flexibility of people working on crowdsourcing platforms is limited by both workers' working practices and client-imposed constraints, we explore an additional contributor to workers' limited temporal flexibility: the design of crowdsourcing platforms.

Specifically, we have identified two categories of time constraints imposed on workers by the design of the platform: (1) lack of work assignment and (2) un-

predictable work availability. First, some crowdsourcing platforms do not assign workers jobs to complete; instead, workers have to accept jobs as clients make them available. The lack of job assignment is considered to be one of the roadblocks in achieving prosperous crowd workplace [114]. Second, workers have no predictability over the availability of the work because the platform has no set hours when clients can post jobs. Thus, as part of the conceptual investigation conducted in this thesis, we first focused on the time constraint imposed on the workers by a **lack of work assignment**: P1.1 The platform does not assign jobs to the workers. Next, we focused on three time constraints imposed on the workers by the platforms' **unpredictable work availability**:

- (a) P2.1 The platform has no set hours when clients can post jobs;
- (b) P2.2 The platform has no set hours when workers can complete jobs; and
- (c) P2.3 The platform has no limit to the number of hours workers can spend working.

We focused on these two categories of platform-imposed time constraints because of their potential to limit workers' temporal flexibility. We next describe the two categories of time constraints and their respective constraints.

P1. Lack of Work Assignment. *P1.1 The platform does not assign jobs to the workers.* Firstly, we argue that the lack of work assignment is due to the jobs being made available to most workers online, rather than workers being matched by the platform with suitable jobs. While some on-call work within parts of the platform economy is assigned to workers algorithmically (e.g., Uber) [115], workers on crowdsourcing platforms such as Amazon Mechanical Turk, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, or Microsoft's UHRS (Universal Human Relevance System) are not assigned work [116]. Instead, crowdworkers have to accept work from the pool of jobs available [114].

In the case of crowdsourcing platforms, clients recruit workers on an as-needed basis to work on jobs. Recruiting participants quickly, also known as lowering

crowd recruitment latency (i.e., the time until a worker accepts a job that was just posted [117]), has been of interest to researchers wanting to optimise on-demand real-time crowdsourcing [118]. Workers can be recruited either using *on-demand recruiting* (i.e., workers are recruited by clients when needed) or using *retainers* (i.e., workers are added to a waiting pool and are assigned jobs when needed) [119]. For example, on-demand recruiting of crowdworkers has been used to pre-recruit workers with a latency of two minutes [120]. In contrast, the retainer model for recruitment has been used to pre-recruit workers within two seconds [121]. Because crowdworkers are not assigned work, they have to accept available jobs before other workers. Thus, in Study 3 (Chapter 4), we aim to investigate how not having work assigned to them can influence workers' temporal flexibility.

P2. Unpredictable Work Availability: Secondly, we argue that the lack of predictable work availability is mainly due to an oversupply of labour on crowdsourcing platforms, which makes jobs scarce [122]. The oversupply of labour generates a labour force that competes for the better-paid jobs [42]. Within the wider platform economy, labour platforms also have an oversupply of workers [122], which makes the workers a 'disposable labour force' that platforms can quickly replace [123]. The oversupply of labour means that there are more workers completing jobs on these platforms than available jobs, resulting in competition between workers.

In other words, there are more workers completing jobs on the platform than available jobs. Consequently, a lack of predictable work availability results in workers not knowing 'when' clients will post jobs on the platform. Further, workers do not know 'for how long' work will be available on the platform [21]. Thus, in Study 4 (Chapter 4), we aim to investigate how not having predictable work availability can influence workers' temporal flexibility by looking at the following three time constraints imposed on the workers: (1) the platform has no set hours when clients can post jobs; (2) the platform has no set hours when workers can complete jobs; and (3) the platform has no limit to the number of hours workers can spend working. We describe the three time constraints next.

P2.1 The platform has no set hours when clients can post jobs. Firstly, there are no formal working hours in the case of crowdsourcing platforms. Crowdworkers are, in theory, offered a fairly flexible working schedule. However, clients can make jobs available on the platform at any time [77] and benefit from having the flexibility of workers completing jobs at any time of the day [124]. Thus, in Study 4 (Chapter 4), we aim to investigate how the fact that the platform has no set hours when clients can post jobs can influence workers' temporal flexibility.

P2.2 The platform has no set hours when workers can complete jobs. Secondly, over 50% of the participants in the ethnographic study conducted by Gupta et al. [93] mentioned working on crowdsourcing platforms whenever they can find the time. Participants managed to work on these platforms through instances of multitasking and by "finding time and space within their lives". Furthermore, the findings of the ethnographic study also indicated that working on crowdsourcing platforms was heavily dictated by the availability of jobs [93]. Thus, in Study 4 (Chapter 4), we aim to investigate how not having set hours when workers can complete jobs can influence workers' temporal flexibility.

P2.3 The platform has no limit to the number of hours workers can spend working. Finally, prior work has shown that workers spend a considerable amount of time completing jobs on crowdsourcing platforms. For example, compared to workers on other platforms, workers on Amazon Mechanical Turk tend to spend more days and more hours per week working on the platform [44]; crowdworkers can also be found working on the platform on both weekdays and weekends [44]. Thus, in Study 4 (Chapter 4), we aim to investigate how workers' temporal flexibility can be restricted because some crowdsourcing platforms do not limit the number of hours workers can spend working.

3.4 Summary

In this thesis, we aim to answer the following main RQ: "*How can crowdsourcing platforms constrain and support crowdworkers who value temporal flexibility?*". In

the absence of traditional workplaces, people are motivated to work on crowdsourcing platforms by the temporal flexibility that the platforms advertise. However, the temporal flexibility these crowdsourcing platforms advertise is limited by several time constraints imposed on the crowdworkers. As part of the initial conceptual investigation conducted in this chapter, we identified three types of time constraints that can limit crowdworkers' temporal flexibility: (1) *worker-imposed time constraints*, (2) *client-imposed time constraints*, and (3) *platform-imposed time constraints*. Now that we have a better idea of the time constraints crowdworkers are under, we can begin to investigate the impact of these time constraints and ways to mitigate the impact. Thus, in the first part of the thesis (i.e., Chapter 4), we aim to understand how the three types of time constraints impact crowdworkers' temporal flexibility. In the second part (i.e., Chapter 5), we aim to explore how the design of future crowdsourcing platforms can increase the temporal flexibility. We begin by presenting four empirical investigations that explored how the three types of time constraints impact crowdworkers' temporal flexibility.

Chapter 4

Empirical Investigations of Crowdworkers' Temporal Flexibility

Parts of this chapter have been published in:

Lascău, L; Gould, SJJ; Cox, AL; Karmannaya, E; Brumby, DP (2019) *Mono-tasking or Multitasking: Designing for Crowdworkers' Preferences*. In CHI Conference on Human Factors in Computing Systems.

This chapter contributes a new understanding of the time constraints that can limit the temporal flexibility of crowdworkers, and refines the conceptual investigation conducted throughout this thesis.

VSD employs a tripartite, integrative, and iterative approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process [26]. VSD consists of three types of investigations: (1) conceptual investigation, (2) empirical investigation, and (3) technological investigation. So far in this thesis, we presented a conceptual investigation in which we identified three time constraints imposed by the working practices of crowdworkers. Next, in this chapter, we present three empirical investigations that explore how these time constraints can limit the temporal flexibility of workers.

Empirical investigations explore human interaction with the technology, taking a non-prescriptive mixed-methods approach [24]. The investigations involve

exploring the human context in which the device is currently used (or will be used), as well as the social impacts of the technology [31]. Furthermore, the investigation draws on any quantitative and qualitative methods traditionally used in the social sciences that fit the context of the work (e.g., observations, interviews, surveys, or focus groups) [25, 24]. In this chapter, we used quantitative and qualitative methods as part of our three empirical investigations. We begin by presenting the first empirical investigation.

4.1 Study 1: Time Constraints Imposed by Crowdworkers' Circumstances

N.B.: Study 1 study was designed by Dr Sandy J. J. Gould, who also collected the data in October 2016. I, Laura Lascău, completed the data analysis in May 2018.

4.1.1 Introduction

In Chapter 3, we identified a list of time constraints imposed on crowdworkers by their working practices. In this study, we aimed to explore the impact of these time constraints on workers' temporal flexibility. We set the following RQ to guide our study: *How is the temporal flexibility of crowdworkers limited by time constraints imposed by workers' circumstances?* To answer this RQ, we conducted an empirical investigation that used surveys and telemetric data, which we present next.

As part of the empirical investigation, we surveyed 317 crowdworkers about their temporal working preferences and working practices. We first asked participants about their temporal working preferences, such as polychronicity preferences (i.e., preferences for multitasking or monotasking) and their work-home boundary management preferences (i.e., preferences for overlapping work and personal time). Next, we asked participants about their working practices, such as working from home or multitasking and task switching. Finally, we wanted to examine whether our participants' multitasking preferences (i.e., self-reported behaviours) aligned with participants' multitasking practices (i.e., observed behaviours). Thus, whilst participants worked through the survey questions, we collected telemetric

data, such as key touches, scrolling behaviours and tab switches.

Overall, we learnt that the time constraints imposed by participants' working practices limited participants' temporal working preferences. We first found that a large number of the participants in our study had polychronic preferences, meaning that they preferred to do several jobs at once by switching between segmentations of time; further, most participants preferred to overlap their work and personal time. However, we next found misalignment between participants' temporal working preferences and working practices. For instance, participants' physical and digital work environments came with certain degrees of interruptions, resulting in participants with more monochronic preferences struggling to stay focused. In turn, this misalignment limited: (a) the time of the day when participants could work on the crowdsourcing platform, and (b) the type of jobs they could complete without being interrupted. Finally, we found that participants' multitasking preferences did not fully align with participants' multitasking practices. Taken together, the results of the study showed that crowdworkers' working practices can impose time constraints on the workers, contradicting how they might prefer to use their time when working.

4.1.2 Background

There are individual differences in how people prefer to use their time when working. For example, some people might be more likely to prefer to multitask (e.g., [125, 126, 127, 128]), whilst some people might be more likely to prefer to overlap their work time and personal time (e.g., [129]). These individual differences do not arise from job constraints, but rather from an individuals' natural propensity to use their time doing several things at the same time multitask. In this study, we focus on two temporal working preferences of crowdworkers:

1. Workers may prefer multitasking over monotasking; and
2. Workers may prefer to overlap their work and personal time.

We focus on these two individual differences because of their potential to limit workers' temporal flexibility by influencing multitasking and task switching be-

haviours. We next describe the individual differences and explore them in the context of crowdworkers' temporal working preferences:

1. Workers may prefer multitasking over monotasking. Here, we aim to explore workers' polychronicity preferences. Polychronicity describes the preference for doing several things at the same time. Köning and Waller [130] note that the term 'polychronicity' should be used to describe people's *preferences* for doing multiple things at once, whereas people's actual *behaviors*, rather than attitudes, should be referred to as 'multitasking'.

Polychronicity is believed to be linked to job prosperity in domains that require high levels of multitasking, such as air traffic control [131, 132]. People with higher polychronic preferences (i.e., polychronics) have a preference for multitasking, whereas people with lower polychronic preferences (i.e., monochronics) prefer monotasking (i.e., executing jobs in sequence).

In the case of crowdworkers, a preference for multitasking might mean that workers do not mind switching between jobs in a short period of time. However, it might also mean that workers take longer to complete their work, which can reduce people's flexibility over their schedules.

2. Workers may prefer to overlap work and personal time. Here, we aim to explore workers' work-home boundary management preferences. Just as people have preferences for multitasking or monotasking, they also have preferences for how they balance work and non-work as they try to find work-life balance. Perhaps unsurprisingly, the concepts of work-life balance and polychronicity are related: Benabou [133] found that people with high polychronic preferences are more likely to overlap work and personal time.

Crowdworking is of interest in this study because it does not fit standard conceptualisations of work-life balance. One aspect of crowdworking that we are particularly interested in therefore is the extent to which people maintain boundaries between work and leisure in crowdworking settings, where work and leisure are co-located and have more chance to be interposed.

The term ‘work-life balance’ is defined as a situation in which “an individual is simultaneously able to balance the temporal, emotional and behavioral demands of both paid work and family responsibility” [134, p. 49] in order to achieve an ideal equilibrium of wellbeing in all aspects of one’s life [92]. This is an area in which people exhibit individual differences. Understanding work-life balance is important because we know from boundary theory research that one of the factors that influences people’s satisfaction with their work-life balance is the extent to which they perceive that they are able to control the mixing of work and non-work activities [135]. Without control over boundaries, unwanted mixing of work and non-work activities can make people less productive [136, 137].

As defined by boundary theory, there are different boundary management styles for when the boundary between work and private life becomes blurred: people with high boundary control feel that they have control over managing work and personal matters and tend to keep the two separated. On the other hand, people with lower boundary control have a lower degree of command over keeping work and personal matters separate and are more likely to experience work-life boundary crossovers [138].

In the case of crowdworking, crowdworkers might be more likely to experience work-life boundary crossovers [138] since the majority of crowdworkers complete jobs from their homes [90]. On the one hand, working from home can give people more flexibility over their schedules, but, on the other hand, working from home presents more possibilities for people to engage in work-family multitasking activities [139], which can make people more likely to experience work-life boundary crossovers [138]. We next describe the data collection methods used in this study.

4.1.3 Methods

This study is an empirical investigation in which we used surveys and telemetric data to answer our RQ. We next describe how we collected the surveys and telemetric data.

4.1.3.1 Design

An online survey was administered on a large crowdsourcing platform. The questionnaire was administered in 36 batches of jobs at various times of the day over a two-month period.

4.1.3.2 Procedure

The job was advertised with a rate of pay of approximately \$6 USD for 30 minutes of work. Participants were also told that they would be paid an extra \$2 USD bonus for responses that showed a degree of thought and consideration. In practice, all work was accepted without precondition, and all participants received a \$2 USD bonus regardless of how they responded; this brought the hourly rate to approximately \$16 USD, including working on the questionnaire and reading instructions and debriefings.

Before agreeing to complete the job, workers were presented with an information page that contained all study information. They were told that they had one hour to fill out the questionnaire. After the participants accepted the job, they were taken to the main study and presented with the questionnaire. The participants were debriefed at the end of the job and email addresses were collected for future studies. Participants were paid within 24 hours of completing the job.

4.1.3.3 Participants

A sample of 317 crowdworkers were recruited. Participation was restricted to experienced U.S.-based crowdworkers. Participants were required to have completed a minimum of 10,000 jobs, and to have a job acceptance rate of at least 98%. The participation of the workers was voluntary and informed consent was obtained from all participants.

First, in terms of age, the 303 participants included in the analysis ranged in age from 20 to 69, with a mean of 37 ($SD = 11$) and a median of 34. In terms of gender, 161 participants (52%) identified as men and 143 (47%) as women; one worker preferred not to disclose their gender. In terms of location, all workers were residents of the USA. 294 workers identified as being from the USA, two from

Canada, one from Germany, one from Guyana, one from Hong Kong, one from Saint Kitts and Nevis, one from Pakistan, one from Panama, and one from Uruguay.

Next, in terms of education level, 145 (47%) of the participants reported holding bachelor's degrees. A further 138 reported holding high school diplomas (45%), nineteen reported holding master's degrees and two participants had doctorates.

Finally, in terms of work experience, the average amount of time that the workers spent on the platform is two and a half years ($M = 2.42$, $SD = 1.55$). The workers estimated spending on average five hours and ten minutes ($M = 5.24$, $SD = 3.22$) per session working on the crowdsourcing platform in a day. Finally, of the 303 participants, 184 (60%) had other jobs apart from working on the crowdsourcing platform, while 119 (40%) only worked on the crowdsourcing platform. Those who worked on the crowdsourcing platform from their workplaces said they managed to squeeze in a few jobs during quiet times or during lunch breaks.

4.1.3.4 Measures

The first part of the questionnaire contained questions about the participants (i.e., demographics) and their normal routine and habits while working on the crowdsourcing platform. This included workers' ages, nationalities, educational attainment. This kind of data has been collected before (e.g., [140, 141, 142]). We additionally collected data on where people worked and the kinds of equipment they were using to work. Examples of questions include: 'Most of the time where do you complete jobs?' and 'Which software items from the list do you use to aid your work on the platform?'. The final part of the study was a mix of standard questionnaires and questions specific to the study, focused on personality, multitasking preferences and working context, which we describe below.

Before we ran the study, three highly experienced crowdworkers critically reviewed the questionnaire to ensure the questions were accessible and that the proposed remuneration was fair. The crowdworkers were paid an agreed rate of \$20 USD. The reviews led to the adjustment of ambiguous language, but no major changes were made.

Working Preferences. We next describe the questionnaires used in the study

to learn about the temporal working preferences of the participants:

Polychronicity: In order to learn about workers' multitasking habits and preferences we measured polychronicity with the 14-item Multitasking Preference Inventory (MPI) [143]. Sample items from the scale include, 'I prefer to work on several projects in a day, rather than completing one project and then switching to another' and 'I would rather switch back and forth between several projects than concentrate my efforts on just one'. Polychronicity scores can range from 1 (Strongly Disagree) to 5 (Strongly Agree). The score is measured continuously by summing the scores. Possible scores range from 14 to 70, with higher scores indicating more polychronic behaviors and attitudes. We deployed the questionnaire with one modification, which was replacing the word 'project' with 'task' throughout the scale, to make it more relevant to the workers, e.g. 'I would rather switch back and forth between several jobs than concentrate my efforts on just one.'

Work-Life Indicator: We administered the Work-Life Indicator Scale (WLI) [144] to measure boundary management strategies. This is a 17-item 5-point Likert scale is split into five subsections and is comprised of five factors. The first two sections of the questionnaire, (1) 'Nonwork interrupting work behaviors' (NWIW) and (2) 'Work interrupting nonwork behaviors' (WINW) focus on the extent to which people find their personal lives interrupt their working lives and vice versa. Example statements include 'I respond to personal communications (e.g., emails, text, and phone calls) during work' and 'I allow work to interrupt me when I spend time with my family or friends.'

The other three sections of the questionnaire cover broader aspects of boundary management and family and work identities: (3) 'Boundary control' (BC) measures perceived boundary control over boundary crossing, e.g. 'I control whether I am able to keep my work and personal life separate'. Next, (4) 'Work Identity' (WI) and (5) 'Family Identify' (FI) measure the degree of identity with work and family roles. Sample statements include 'People see me as highly focused on my work' and 'I invest a large part of myself in my family life'. We administered the questionnaire to all participants and asked them to consider 'work' to be any crowdsourcing work.

WLI scores can range from 1 (Strongly Disagree) to 5 (Strongly Agree), and the score for each factor is calculated individually by taking the mean of the items.

Working Practices. Finally, we next describe the data collected in the study to learn about the working practices of the participants.

Workspaces: We explored the relationship between the space in which people work and the equipment they use. We asked the participants to think about the equipment that they use for work (e.g., ‘Which software items from this list do you use to aid your crowdwork?’) and to think more broadly about the space they work in. In particular, we wanted to understand whether participants are happy with their working environment and equipment or have to put up with them of necessity. Do they have to work in a busy space with roommates chatting or do they have somewhere quiet to work? Which workspace do they prefer?

Task management practices: Participants were asked to indicate on a five-point Likert scale whether they agree or disagree with 18 statements about their job management routines and habits. Statements included: ‘I feel that I have the best strategy for managing multiple jobs’, ‘I switch in the middle of jobs to check my progress on other jobs’, and ‘If a job is difficult I tend to switch to working on an easier job instead’. Further, as part of the survey, we also asked participants two open-ended questions regarding their job management strategies: ‘What advice would you give about effective job management to someone just starting on [name of crowdsourcing platform]?’ and ‘Do you have any particular strategies that help you focus on your work?’.

Switching behaviours: While our participants worked through the scales that comprise the questionnaire, we also collected behavioral activity measures (telemetric data, i.e. key touches, scrolling behavior and tab switches). In this way we were able to examine whether our participants’ self-reported behaviors aligned with observed behaviors. For example, were participants who self-reported high preferences for multitasking more likely to switch between tabs when completing the study than participants who self-reported as having low polychronic preferences?

4.1.3.5 Analysis

In terms of the quantitative data analysis, we analysed the data collected from the structured fields descriptively using SPSS, reporting frequencies of responses. In terms of the qualitative data analysis, we analysed the data collected from the unstructured fields iteratively using Reframer¹, an online qualitative research tool. For each data column, we coded participants' responses and created a set of codes. We mainly focused on the survey answers to the following four open-ended questions:

1. "Tell us what you would change about your workspace."
2. "How does the space your work in affect your level of focus?"
3. "Do you have any particular strategies that help you focus on your work?"
4. "What advice would you give about effective job management to someone just starting on [name of crowdsourcing platform]?"

Qualitative survey data pose a particular challenge in that the researcher does not only have to look for codes and themes within the questions addressed, but across the whole dataset. A good practice is to firstly gain a good understanding of the entire data before beginning to code it, as coding should happen across the entire dataset instead of at an individual questions level. As suggested by Braun and Clarke [145], to get a better sense of the narrative and to also detach ourselves from the structure imposed by the survey questions, we kept the data collated by participant, rather than by question.

We began by familiarising ourselves with the dataset's content through a process of reading and re-reading each item of the dataset. Before starting to work with the data, we made a few remarks about the issues and things that we were noticing while reading the items, such as the experience of the workers with losing their focus in spaces where they can be interrupted by noise.

After familiarising ourselves with the responses, we coded the four questions presented above. Example codes include: (a) distractions from people, (b) distractions from digital devices, (c) adjustments to the workspace, (d) need for privacy, (e)

¹<https://www.optimalworkshop.com/reframer>

desire for quiet spaces, (f) using additional monitors, (g) finding work via scripts, and (h) overseeing multiple jobs at once. We next present the results of the analysis.

4.1.4 Results

4.1.4.1 Preparing the Data for Analysis

Of the 317 participant responses collected from the crowdsourcing platform, 303 responses have been used in our analysis. We discarded responses from 14 workers who exhibited very high degrees of inattentiveness. To determine the degree of participants' attentiveness we used reversed questions. Reverse questions are delivered in pairs; for instance, the questionnaire contained two questions about the effect of people's devices on their work:

“The device I used limits how effectively I can work”

“The device I use does not limit how effectively I can work”

We had six pairs of these reversed questions in the study. Each of the six pairs was given a 'badness' rating. In the example given, answering 'Strongly agree' or 'Strongly disagree' to both of the questions gives a maximum 'badness' rating of 15. Less diametrically opposed responses were assigned lower badness scores. The maximum possible badness score was 90 (six sets, maximum of 15 points).

In our responses, the median badness score was 2, with a maximum of 42, including outliers. The mean badness score was 5.32 ($SD = 6.96$). Scores greater than 20 were excluded from the analysis. We used 20 as a cut-off point for identifying inattentive participants as it is approximately equal to two standard deviations from the mean. All participants were paid regardless of whether we used their data.

4.1.4.2 Working Preferences

Polychronicity. To learn about participants' polychronicity preferences (i.e., preferences for multitasking or monotasking), we administered the Multitasking Preference Inventory (MPI) scale as part of the survey. [143]

Polychronicity scores from our data ranged from 14 to 69 (M MPI Score = 38.01, $SD = 12.54$). The mean score in our sample is comparable to samples from other studies: a sample of 89 college students ($M = 36$, $SD = 10$) [146], a sample of

crowdworkers ($M = 42.42$, $SD = 10.92$) [147], and a sample of undergraduates ($M = 38.36$, $SD = 11.20$) [148]. Furthermore, 60% of our sample tended toward polychronicity and the remainder preferred monochronic working. The results suggest that whilst our participant sample contained both people who preferred monotasking and people who preferred multitasking, a large number of participants preferred multitasking over monotasking.

Work-Life Indicator. To learn about participants' work-life boundary management preferences (i.e., preferences for overlapping work and personal time), we administered the Work-life Indicator Scale (WLI) [144] as part of the survey.

We found that our participant sample looked like the 'Family guardians' identified by Kossek et al. [144]. 'Family guardians' is one of the six clusters ('Work warriors', 'Overwhelmed reactors', 'Family guardians', 'Fusion lovers', 'Dividers', 'Nonwork-eclectics'), which describe boundary management patterns. 'Family Guardians' are characterized as family-centric individuals who identify strongly with their families and workplaces alike – they have fairly equal scores for work identity ($M = 3.56$) and family identity ($M = 3.80$), which are both above the mean. They also have high control over their work-life boundaries ($M = 4.16$).

Finally, there was no evidence in our sample of a relationship between polychronicity and perceived boundary control ($r_s = -.037$, $p = .519$). The results suggest that these concepts can be treated independently when designing support solutions.

4.1.4.3 Working Practices

We next present the participants' working practices and report how these can constrain participants' temporal working preferences.

Workspaces. We first describe the physical workspaces in which the participants completed jobs, together with the time constraints imposed by these spaces. After that, we describe the digital workspaces of the participants and their corresponding time constraints.

Physical workspaces: First, in terms of the physical workspaces, 296 partici-

pants (97%) worked on from their homes. In the home, work was spread across the home office, bedroom and living room. For example, 19 of the participants (6.22%) split their time equally working from both home and work. Furthermore, 10 participants (3.27%) said they complete jobs solely from work, and a small number of participants said they complete jobs on the move or from the library.

Over half of the participants reported working on the crowdsourcing platform from private spaces (60%). The remaining participants reported working on the platform from shared spaces (40%). In terms of working from private spaces, 55% of the participants ($n = 168$) worked on the platform from their home offices. We observed that participants who had higher instances of personal matters interrupting their work (*NWIW* on the WLI scale) were more likely to work on the crowdsourcing platform from shared spaces. Results of an independent-samples t-test indicated that, on average, those working from shared spaces scored higher on *NWIW* ($M = 3.68$, $SE = 0.09$) than those working from private spaces ($M = 3.39$, $SE = 0.06$). This difference was significant ($t(301) = 2.63$, $p = .009$) and represented a reasonable effect ($d = .32$). This result is expected, as shared spaces are known to invite more distractions and interruptions.

In the shared spaces, monochronic participants (i.e., those who preferred monotasking rather than multitasking) described having to tune out any environmental noises to concentrate on their work. For example, Participant 225 described that they only engaged in completing one job at a time when working on the crowdsourcing platform. Further, they mentioned having to schedule their working time when the shared space was quiet, rather than working when other people were also around:

“I use noise canceling headphones. I tune out environmental noises or activities. I remain focused on what I am doing. I do not engage in more than one activity at a time unless the jobs require me to do so. I do not eat or listen to music while I work on jobs. I tend to work when the environment is calm rather than when I know those around me will be active.” — P225, MPI Score = 18

The results suggest that participants with more monochronic preferences did not always have a suitable workspace for crowdwork that aligned with their temporal working preferences. Further, working from shared spaces led to interruptions from those in the same shared area, such as from participants' family members. However, being interrupted by other people seemed to lower participants' focus levels. For instance, Participant 195 described missing out on working on certain types of jobs on the crowdsourcing platform, such as jobs that required using a microphone, because of the noise levels and frequent interruptions in their workspaces. In their case, the participant had to work from a space they shared with their husband. However, the participant mentioned that they would like to work in a private space, which would be quieter and allowed them to work on any types of job that became available:

“I work in a corner of my living room, where my husband sits most often. He likes to ask questions at times or he will turn the tv on too loudly causing distractions; he also likes to yell at the tv. Usually, if I remind him that I am working, he'll quiet down. However, there are jobs that require sound, video or the use of a mic that would not be available to me, because of my current environment. I would like to have a quiet, more private, dedicated work space where I wouldn't be interrupted and would allow me to do any type of job that becomes available.” — P195, MPI Score = 36

Participant 195 was not the only one who wished to work on the crowdsourcing platform from a private workspace. When asked what changes they would make to their workspaces, out of the participants who did not already work at home from private spaces (n = 128), half of the participants (70, 55%) said that they would like to have a separate room in their home because of noise issues and interruptions. Similarly to the previous participant (P195), Participant 92 mentioned missing out on certain types of jobs because of the noise levels in their environment:

“I would first and foremost move it into a private room. I miss out on numerous jobs because I am unable to record audio or video due to

the fact others are making noise around me or would be in the webcam video. It also provides many distractions since it's in the front room. A personal private room would be the best upgrade.” — P92, MPI Score = 40

Participants further felt that it was important for their family members to understand that their online work was “real work” (P321). Some participants also wanted others to know that they were unavailable when working on the crowdsourcing platform even though they were physically present in the home. For example, Participant 92 described being frequently interrupted because he appeared not to be working. Being frequently interrupted reduced the participants' focus levels, making them wish they could work from a private space:

“It breaks my focus constantly when people come in and out the door, or my baby cries since her crib is in the same room, or people just come right up and try to have full on conversations with me while I am working. My workspace is too ‘public’ and out in the open, no one seems to understand that I am actually working and trying to make my living with it because they constantly interrupt. [...] I need quiet, calm, organization, peaceful music to make my work space better and promote more focus.” — P92, MPI Score = 41

The results suggest that participants with more monochronic preferences who had to work from shared workspaces (rather than private workspaces) reported varying degrees of interruptions whilst working on the crowdsourcing platform. Being frequently interrupted whilst working resulted in lower concentration levels for the participants. In this sense, we saw that shared workspaces could impose certain time constraints, such as the time of the day when participants could work on the crowdsourcing platform or the type of jobs they could complete without being frequently interrupted.

However, not all participants would like a separate space to work on the crowdsourcing platform or eliminate interruptions altogether. For a large number of par-

ticipants, being able to work from their homes provided them with the opportunity to be close to their families:

“Well, there’s things I could change to make working easier with less distractions, but I watch my 3-year-old daughter full time at home. As you can imagine, there are plenty of interruptions, but it’s not like I want to eliminate them. My daughter is more important than my work at [name of platform], so I strive for a good balance between the two.”

— P104, MPI Score = 58

The results of the WLI scale suggest that most of the participants in our study were family-centric individuals who allowed non-work to interrupt work but not the reverse. In this sense, some of the participants’ temporal working preferences aligned with their work-life boundary management preferences and polychronic preferences, as was the case for the participant above (P104). Further, whilst the results suggest that whilst having to work from shared spaces limited the temporal flexibility of some participants—by imposing time constraints such as the time of the day when participants were able to work—other participants benefited from working in shared spaces. For instance, working from shared spaces suited those participants who preferred overlapping their work and personal time (as measured by the WLI Scale) and doing several jobs at once by switching between segmentation of time (as measured by the MPI Scale).

Digital workspaces: Next, in terms of the digital workspaces, out of the 296 participants who work from home, 145 of them (48.98%) used a desktop PC as their device of choice, and 125 crowdworkers (42.22%) used a laptop, while 2 participants (0.67%) said that they work on tablets. A large number of participants also agreed that the devices they work on provide opportunities for interruptions. For example, one participant with monochronic preferences reported using their devices only to complete jobs and search for work on the crowdsourcing platform but refrained from listening to music in order to maintain their focus levels:

“I could have many distractions if I wanted, but aside from searching

for jobs and responding to other crowd-source work I concentrate on my work. I don't listen to music as it seems to dull my concentration. If it is a slow day I will take breaks to clean house, etc. while my computer searches for jobs via [name of script] and email alerts, and [name of script]." — P143, MPI Score = 30

When asked, most participants reported that the device they work on sends them important notifications frequently, which are relevant to their crowdwork and job management. In particular, a few participants made a few remarks about how the tools they used to search for jobs alerted them about new work. For instance, P231 mentioned that the scrapers (i.e., the tools that collect data from the crowdsourcing platform about new work) that they use present some distractions in the form of sound notifications: *"I work in my bedroom, and I am usually alone. The only distractions tend to be the notification sound from [name of script] or [name of script] or other scrapers I use to find jobs."* (P231, MPI Score = 44)

Overall, the results suggest that both the physical work environments and the digital work environments of the participants in our study came with certain degrees of interruptions or distractions. For example, participants with more monochronic preferences reported concentrating less in spaces that presented interruptions. In turn, these interruptions limited: (a) the time of the day when participants could work on the crowdsourcing platform, and (b) the type of jobs they were able to complete without getting interrupted. We next report how these types of imposed working practices can limit the temporal flexibility of participants with more polychronic preferences.

Task management practices. The results of the MPI Scale suggest that 60% of our sample tended toward polychronicity. In other words, over half of the participants preferred to use their time multitasking rather than monotasking, i.e., doing several jobs at once by switching between segmentation of time.

For the participants with more polychronic preferences, working in the presence of certain distractions meant that they could align their temporal working pref-

erences and working practices. For example, Participant 50 mentioned working on the crowdsourcing platform whilst listening to talk radio. This arrangement provided the participant with a certain degree of distractions, but without interrupting them from their work: *"I often turn on talk radio to keep me from turning on the television. It provides a distraction, but it rarely steals all my focus away from [name of platform]."* (P50, MPI Score = 47)

When asked what advice they would give about effective job management to someone just starting, a large number of the participants who scored high on the polychronicity scale (e.g., 54, 57, and 58) mentioned that new workers should learn to monitor the time limits of jobs in their queue. By keeping an eye out on the time limits of the jobs, new workers should manage to work on all the jobs they had lined up before they expire. Participant 153 further suggested that new workers should check on forums how long jobs are actually likely to take to complete:

"Tasks are timed so make sure that you're always aware to how much time you have to do them. Always give yourself more time than you think it'll take just to be on the safe side. Follow forums where people will give you more accurate times on how long the jobs actually take."

— P153, MPI Score = 54

The time pressure of completing jobs before they expire, which was described earlier by Participant 153, was not the only type of time constraint participants who had polychronic preferences experienced. Additionally, a participant mentioned that any new crowdworkers should avoid a specific type of multitasking: working on multiple jobs at once. By not working on multiple jobs at once, Participant 123 mentioned that new workers could avoid having jobs in their work queue expire before they managed to work on them:

"To someone just starting on [name of platform], I recommend resisting the temptation to get carried away with doing too many jobs at once. I have had instances where multiple jobs 'timed out' on me because I had them waiting in the queue and couldn't get to them quickly enough. So pacing oneself is important." — P123, MPI Score = 57

Whilst the suggestion to not multitask might not align with participants' polychronicity preferences, a participant further described opportunities crowdworkers have to engage in task switching. For example, Participant 104 mentioned that since jobs disappear from the platform in seconds, crowdworkers have to respond quickly to the notifications they receive from scripts (i.e., scrapers) to accept jobs. In this sense, workers are under the time pressure to accept jobs before other workers and have to switch among jobs frequently whilst working not to miss out on new jobs:

"I always have Worker-written scripts that notify me for new jobs when they go up. Many jobs will be gone in a matter of seconds, so it's important to be fast and accept first rather than doing the research to see if it might be a good job rather than later. The 20 seconds spent scanning reviews is more than enough time for all of the jobs to be accepted by other Workers by the time I get back to accept it. " —

P104, MPI Score = 58

Overall, the results suggest that participants with a preference towards multitasking have developed strategies that help them maintain awareness of the time limits of the jobs in their work queues. Further, they also developed strategies that helped them 'pace themselves'. By pacing themselves, participants made sure they did not work on too many jobs and mistakenly had jobs expire before they managed to complete them. We next describe the switching behaviours of the participants whilst working through the survey questions in this study.

Switching behaviours. As well as asking for participants' subjective experience, we also measured their task switching behaviour. Participants logged 2,283 tab switches in total. The average switch count per person was 7.53 ($SD = 7.54$, $median = 5$), with a range of 0 to 45 switches. In comparison, in Mark, Volda and Cardello's study [149], information workers switched screen windows 37.1 times an hour on average ($SD = 31.4$). Furthermore, in our study, 12 participants did not switch at all from our job, or their switches were undetectable to us. Finally, we observed that participants with higher polychronic preferences did not switch more

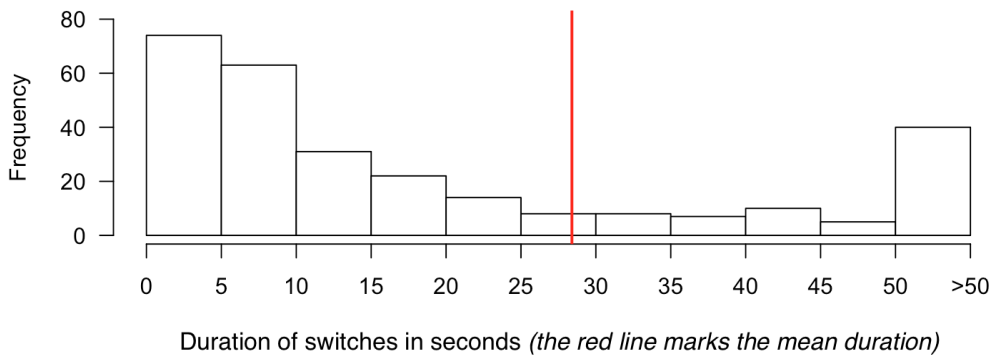


Figure 4.1: Distribution of switching durations

times than participants with more monochronic preferences. Therefore, the results suggest that multitasking preferences do not always reflect multitasking behaviour, as participants might have reported lower preferences towards multitasking when reflecting on their behaviours.

Figure 4.1 presents the distribution of participants' switching durations. The red line on the graph marks the mean duration. In our study, participants switched for an average of 28.40 seconds. The shortest duration was 0.58 seconds, and the longest duration was 11.5 minutes. The distribution was positively skewed with a long tail: 77% of the switches were under 28 seconds, but the longest switch was greater than 10 minutes, which highlights occurrences where participants were likely distracted. To scale the distribution in one histogram, switches longer than 50 seconds are grouped as one bar.

Finally, in terms of the data quality (quantified with the 'badness' rating), participants who switched more did not perform worse than workers who avoided switching. Furthermore, participants with higher polychronic preferences did not perform worse than monochronic participants. However, the participants scoring higher on the polychronicity scale were more likely to spend a longer time away from the job per switch. A Spearman correlation coefficient was computed to assess the relationship between the length of job switches undertaken by our participants and their score on the polychronicity scale. There was a small positive correlation

between the two variables ($r_s = .136$, $p = .018$). The results suggest that despite the time pressures that participants were under, polychronic participants felt able (to some degree) to break from jobs and engage with them later fully.

4.1.5 Discussion

In this study, we aimed to answer the following RQ: *How is the temporal flexibility of crowdworkers limited by time constraints imposed by workers' circumstances?* To answer the RQ, we conducted an empirical investigation in which we surveyed 317 crowdworkers about their temporal working preferences and working practices, and we collected telemetric data to examine if the multitasking preferences aligned with multitasking practices.

4.1.5.1 Summary of Results

Taken together, the results of this study described how the working practices of crowdworkers can limit workers' temporal flexibility. We showed that the working practices of the workers did not always align with their temporal working preferences. This misalignment meant that certain working practices could impose time constraints on the workers that contradicted how workers actually preferred to use their time. We next consider the implications of the results and summarise the time constraints identified in this study.

4.1.5.2 Implications

In theory, crowdworking provides workers with the flexibility, autonomy and control that enables them to align their behavior to their preferences [61]. People who enjoy polychronic working could switch frequently. People who like to keep their work and non-work time separated could keep them entirely separate. In reality, crowdworkers are subject to a number of different time constraints that mediate the relationship between people's preferences and their behaviours. In crowdwork, we have identified so far one major sources of constraints: working practices. We found that workers' ability to align their working practices with their temporal working preferences can be constrained by: (a) the location of their workspaces, and (b) multitasking or task switching behaviours. We summarise next participants' tem-

poral working preferences, followed by their working practices.

We first found that over half of the participants in our study preferred to use their time doing several work-related jobs at once and overlapping work and personal time. In this sense, the results of the study suggest that a large number of the participants scored highly on a measure of polychronicity, suggesting that they prefer doing several jobs at once by switching between segmentation of time. We also found that most participants were family-centric individuals who allowed non-work to interrupt work but not the reverse.

Next, we found that the participants' physical and digital work environments came with certain degrees of interruptions, resulting in some participants struggling to stay focused. We know reducing the frequency of interruptions can improve well-being and performance in workplaces [107]. Thus, we wanted to know if specific workspaces can have an influence on workers' levels of focus, since lack of focus can be detrimental to productivity [98]. Our results suggest that participants who worked on the crowdsourcing platform from private spaces had good levels of focus, and that over half of the workers who work from a shared space would like to have a separate space in their home for uninterrupted crowdwork. For some people, it is not a lack of space that is the challenge, but balancing their other commitments with what would be best for work. In this sense, participants with more monochronic preferences reported not concentrating well in spaces that presented interruptions. In turn, this misalignment between participants' temporal working preferences and working practices limited: (a) the time of the day when participants could work on the crowdsourcing platform, and (b) the type of jobs they could complete without getting interrupted.

Finally, we found that participants' multitasking preferences did not fully align with participants' multitasking practices. In this sense, the results suggest that self-reported behaviours, such as polychronicity preferences, do not always reflect observed multitasking behaviour. The misalignment observed in our study could be because participants reported lower preferences towards multitasking when reflecting on their behaviours. Furthermore, this misalignment could also be because we

paid participants fairly.

Summary of Implications. Table 4.1 lists the implications of the time constraints we explored in this study. We identified these time constraints initially as part of the conceptual investigation conducted in the Background chapter (Chapter 3). In this chapter, we identified three additional time constraints as part of the empirical investigation we conducted. We next describe each time constraint and their corresponding implications for crowdworkers.

W1.1 Workers mainly work on the platform from their homes. We identified this time constraint as part of the conceptual investigation conducted in the previous chapter. The results suggest that working from home can invite distractions and interruptions, which can lower focus levels.

W1.2 Workers may complete jobs from shared spaces. We identified the time constraint in this study. The results suggest that working from shared spaces can limit: (a) the time of the day when participants could work on the crowdsourcing platform, and (b) the type of jobs they could complete without being interrupted.

W1.3 Workers may multitask when working on the platform. We identified this time constraint as part of the conceptual investigation conducted in the previous

Time Constraints	Implications for Workers
W1.1 Workers mainly work on the platform from their homes. (Bkgd.)	1. The home can invite distractions and interruptions, which can lower focus levels.
W1.2 Workers may complete jobs from shared spaces. (This study)	2. Shared spaces can limit when people can work or the type of jobs they can complete.
W1.3 Workers may multitask when working on the platform. (Bkgd.)	3. Jobs in the work queue might expire before workers manage to complete them.
W1.4 Workers may switch among jobs frequently whilst working. (Bkgd.)	5. Frequent switching might reduce the overall quality of the work.
W1.5 Workers have to monitor the time limits of the jobs in their queues. (This study)	4. Having to be aware of the time limits can increase time pressure.
W1.6 Workers may use tools that provide frequent interruptions. (This study)	6. Interruptions can increase task switching and reduce focus levels.

Table 4.1: Worker-imposed time constraints found on crowdsourcing platforms. The time constraints were identified as part of conceptual investigation conducted in the Background chapter (Chapter 3). The items listed in red and marked with the words “**This study**” represent the new time constraints that we identified as part of the empirical investigation conducted in this study.

chapter. The results suggest that multitasking can result in workers having jobs in their work queues expiring before they manage to complete them.

W1.4 Workers may switch among jobs frequently whilst working. We identified this time constraint as part of the conceptual investigation conducted in the previous chapter. The results suggest that frequent switching between work jobs might reduce the overall quality of the work.

W1.5 Workers have to monitor the time limits of job in their queue. We identified the time constraint in this study. The results suggest that having to be aware of the time limits can increase feelings of time pressure.

W1.6 Workers may use tools that provide frequent interruptions. We identified the time constraint in this study. The results suggest that interruptions can increase task switching and reduce focus levels.

4.1.5.3 Conceptual Investigation

Worker-Imposed Time Constraints	Description of Time Constraints
W1. Personal Circumstances (This study)	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces. (This study)
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. (This study) W2.4 Workers may use tools that provide frequent interruptions. (This study)
Client-Imposed Time Constraints	Description of Time Constraints
R1. Inflexibility of Time Use	R1.1 Clients can set variable job completion times.
Platform-Imposed Time Constraints	Description of Time Constraints
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers.
P2. Unpredictable Work Availability	P2.1 The platform has no set hours when clients can post jobs. P2.2 The platform has no set hours when workers can complete jobs. P2.3 The platform has no limit to the number of hours workers can spend working.

Table 4.2: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

Table 4.2 presents a refined list of time constraints found on crowdworking platforms. The time constraints were identified as part of conceptual investigation conducted in the Background chapter (Chapter 3) and as part of the empirical investi-

gation presented in this chapter. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study. Finally, we created a new category of time constraints based on the newly identified time constraints: *Personal Circumstances*.

4.1.5.4 Limitations and Future Work

This first study is not without limitations. Firstly, our study focused solely on crowdworkers who are based in the U.S.. Our sampling strategy might have omitted potential participants from different locations. Any omitted participants might have to work under different time constraints, particularly in terms of the devices they use and the workspaces they can access.

Secondly, our study focused on experienced crowdworkers with histories of producing high-quality work, which can bias their experiences. To be successful, workers must have discovered strategies for managing the tensions between preferences and constraints. This form of survivorship bias in the data could be ameliorated by recruiting very new workers without any restrictions on their track record.

Finally, our study relies on self-report. This method could potentially limit the amount of information crowdworkers were willing to share with us. Also, there could have been an element of social desirability bias, meaning that the workers might have provided us with answers that made them be viewed favourably. This bias can especially be the case on platforms such as the crowdsourcing platform, where clients have the power to reject the workers' work. Further, workers could have been biased by their feelings towards the crowdsourcing platform. For example, if workers felt negatively about the platform, they could have produced more negative answers.

4.1.6 Conclusion

This study presented an empirical investigation that explored how the time constraints imposed by the working practices of crowdworkers limited workers' temporal flexibility. The results of the study refined the conceptual investigation conducted throughout this thesis and contributed a new understanding of the time con-

straints that can limit the temporal flexibility of crowdworkers. In particular, the results of this study described how the working practices of crowdworkers could limit workers' temporal flexibility.

Using surveys and telemetric data, we showed that the working practices of crowdworkers did not always align with their temporal working preferences. In this sense, the misalignment between participants' temporal working preferences and practices meant that certain working practices could impose time constraints on the workers, contradicting how they preferred to use their time when working. First, whilst the data suggested that a large number of participants in our study preferred to do several jobs at once by switching between segmentations of time and overlapping work and personal time, participants with more monochronic preferences struggled to stay focused in shared workspaces that presented interruptions. In turn, the misalignment limited: (a) the time of the day when participants could work on the crowdsourcing platform, and (b) the type of jobs they could complete without being interrupted.

Finally, whilst many participants preferred to do several jobs at once, we learnt that certain multitasking activities such as monitoring the time limits of the jobs in participants' work queues could increase feelings of time pressure. Given that we identified in the conceptual investigation conducted in Chapter 3 that clients can set strict job completion times, in the following study, we plan to explore further how this type of time constraint can limit the temporal flexibility of crowdworkers.

4.2 Study 2: Time Constraints Imposed by Clients

4.2.1 Introduction

In Chapter 3, we identified one time constraint imposed by clients of crowdsourcing platforms (i.e., strict job completion times). In this study, we aimed to explore the impact of this time constraint on workers' temporal flexibility. We set the following RQ to guide our study: *How is the temporal flexibility of workers limited by constraints imposed by clients?* To answer this RQ, we conducted an empirical investigation that used video observations and qualitative data, which we present next.

As part of the empirical investigation, we collected twelve 90-minute working sessions from workers on a large crowdworking platform to investigate how having to work with jobs that have strict completion times can limit crowdworkers' temporal flexibility. Using the screen recordings, we first analysed how the participants in the study were managing their work queue (i.e., the list of jobs to complete during the working session). Next, to better understand the activities observed in these videos, we sent follow-up questions to the participants in which we asked them to elaborate on the activities we observed in the videos.

Overall, we learnt that having to work on jobs with strict completion times limited the amount of time that participants had in which they could make work decisions. We first found that since the jobs clients posted on the platform had strict completion times, participants had to decide under time pressure which jobs to keep in their work queue to complete during the working session. We next found that participants also had to decide under time pressure which jobs to return from their job queue, thus not complete. Finally, we learnt that participants had to decide under time pressure in which order they should complete the remaining jobs in their queue. Taken together, the results of the study showed that the time constraints imposed by clients limited the amount of time participants had to make decisions regarding their work.

4.2.2 Methods

This study is an empirical investigation in which we used video observations and qualitative data. We next explain how we collected the data².

4.2.2.1 Design

We conducted a video observation study to investigate how the completion times of jobs can limit workers' temporal flexibility. Inspired by previous research that studied the workflows of crowdworkers [150], we gathered 18 hours of screen recordings of participants working on the crowdsourcing platform. The screen recordings provided us with a rich dataset of the participants' behaviours on the crowdsourcing platform. Compared to diary studies, screen recordings require little effort on participants' side [151]. Further, compared to direct observation or shadowing, screen recordings do not require researchers to be physically present in the same room with the participants. Therefore, instead of relying on participants' notes during a diary study or on researchers' notes during direct observations or shadowing, the screen recordings enabled us to capture a comprehensive picture of the participants' behaviours. Finally, in our study, we annotated each screen recording to describe the activities we saw participants doing (e.g., working on a job, searching for new jobs to work on, switching between windows, taking breaks). Furthermore, to better understand the events in these videos, we sent follow-up questions to participants to elaborate on their actions recorded in the videos.

4.2.2.2 Procedure

A job was advertised on the crowdsourcing platform with a maximum completion time of 24 hours, meaning that the participants had 24 hours to record their screens, upload the screen recordings and submit the job. Before agreeing to complete the job, we presented participants with an information page that contained details about the study. On the information page, we mentioned that:

1. We ask participants in the study to record their screens for 90 minutes using Lookback³, a remote usability testing platform.

²N.B.: Study 3 revisits a subset of the video data collected.

³<https://lookback.io/>

2. We will hold everything that appears on participants' screens under strict confidentiality, and we will delete the recordings after data analysis.
3. We expect participants to take breaks during the 90-minute recording, and ask them to inform us if they are about to take any breaks by leaving a message on their screens.

After participants accepted the job, they were taken to the usability testing platform to record their computer screen for 90 minutes. Where participants were asked by the platform to enter their full names and email addresses to begin recording their screens, we instructed participants to enter the usernames they used on the crowdsourcing platform and a random email address (e.g., address@email.com). All participants complied with our instructions. We paid participants within 24 hours of submitting the job.

After watching each video, we identified brief video clips which we wanted to learn more about. The selection of these clips focused on moments when we could see participants readjusting their work activities once a new job became available on the platform. We identified 98 clips in total, and after identifying these, we sent follow-up messages to each participant to provide detailed comments on three of their video clips. We contacted participants via an API that supported messaging the workers using only their usernames, as we did not collect participants' email addresses. In the message, we included our questions and links to the video fragments. We hosted the video fragments on Microsoft OneDrive. For security purposes, we scheduled the links to the videos to expire two weeks after we had sent them to the participants. Participants received an additional \$5 USD for answering these follow-up questions. We received detailed annotations on 18 video clips from six participants.

Each of the three clips that we sent to participants to comment on covered different types of interactions with the crowdsourcing platform: interactions with the platform, productivity tools, or other tools such as forums. The following is an example of the kind of question we sent to a participant: *“Looking back at how you went about completing your work, I was wondering how come you chose to check*

the platform while you were completing a job? Here is the secure link to a fragment of the video recording where you can see the job I'm referring to: [...]"

4.2.2.3 Participants

Table 4.3 reports the demographics of the participants who took part in this study. We recruited 12 participants to take part in our study. We compensated the participants with \$10 for their time; participants could then receive an additional \$5 USD for answering our follow-up questions, bringing the pay for the study to \$15 USD. All of the participants were based in the U.S., and the total number of jobs participants completed ranged from 525 to 125,778 ($M = 34,465$, $SD = 37,917$). The study was open to both experienced workers ($n = 9$), i.e., workers with over 10,000 jobs completed [74], and novice workers ($n = 3$), i.e., workers with under 1,000 jobs completed [74]; this is because we wanted to capture workers' activities regardless of their experience.

Of the 12 participants, 7 participants (58%) identified as men and five (42%) as women; this is in line with previous studies reporting a mixed workforce [152]. Participants' age range was 27 to 51 years ($M = 37.3$ years, $SD = 7.0$ years); this is in line with previous studies reporting that the majority of crowdworkers population is between the ages of 30 and 39 [153]. In terms of education level, five (42%) had some college/technical training, four participants (33%) reported holding a University undergraduate program degree (e.g., Bachelor's), two participants

Table 4.3: Study 2 Participant Demographics

P#	Gender	Age	Highest education level	# jobs
P1	M	35 - 44	Univ. post-graduate programme (e.g., Master's)	Under 1,000
P2	M	35 - 44	Some college/technical training	10,000 - 25,000
P3	W	24 - 34	Some college/technical training	25,000 - 50,000
P4	W	24 - 34	High school diploma	100,000 - 150,000
P5	M	24 - 34	High school diploma	Under 1,000
P6	M	45 - 54	Some college/technical training	25,000 - 50,000
P7	W	35 - 44	Univ. undergraduate programme (e.g., Bachelor's)	10,000 - 25,000
P8	M	35 - 44	Some college/technical training	10,000 - 25,000
P9	W	45 - 54	Univ. undergraduate programme (e.g., Bachelor's)	25,000 - 50,000
P10	M	24 - 34	Univ. undergraduate programme (e.g., Bachelor's)	25,000 - 50,000
P11	M	35 - 44	Some college/technical training	75,000 - 100,000
P12	F	35 - 44	Some college/technical training	1,000 - 5,000

reported holding high school diplomas (17%), and one a University post-graduate program degree (e.g., Master's); this is in line with previous studies reporting that worker are likely to have a college degree [153].

4.2.2.4 Ethical Considerations

There are, naturally, several privacy concerns over collecting the kind of video data necessary for this study. We took two main measures to mitigate as best as possible any potential risks to the participants. First, we held extensive conversations with the departmental and faculty ethics committees of our University. We obtained the appropriate ethical review committee approval prior to conducting the study and complied with all aspects of the approval—the study had institutional research ethics approval: UCLIC/1718/013/Staff Cox/Lascau/Brumby. Before taking part in the study, we briefed participants about the study's purpose and data confidentiality practices. The participation of the workers was voluntary, and informed consent was obtained from all participants. Further, we committed to giving participants control over the recordings: participants could start, pause or restart the screen recordings at any point. The recordings were stored on participants' computers until they had decided to upload and share them with us.

Second, we obtained the appropriate data protection registration approval prior to conducting the study and adhered to the institutional data management requirements. In this sense, we maintained the participants' privacy and that of the clients by keeping the screen recordings secure and removing any confidential information. Further, we were aware of the risks of participants accidentally disclosing confidential information in the screen recordings and therefore prompted participants not to reveal any sensitive information. Where personal information such as clients' usernames appeared in the videos (e.g., where a worker was completing a job posted by a client), we anonymised the information within the job by blurring it out, unlinking it from the videos, and discarding it alongside the original videos. We also removed any other screen recordings not relevant to our study (e.g., screen recordings of non-crowdwork).

4.2.2.5 Analysis

We next give an overview of how we analysed the video data collected. We begin by describing how we measured the activities recorded in the video data, followed by describing how we analysed these activities.

A. Preparing the data for analysis. As this study is only concerned with participants' behaviour whilst working on the crowdsourcing platform, we initially reviewed the recordings to discard any sections where the participants were not engaging in crowdwork activities. Furthermore, as this study is only concerned with participants' behaviours, we additionally discarded any sections where the contents of the jobs were showing.

Once we discarded these sections we familiarised ourselves with the screen recordings by initially independently viewing the recordings to gain a good understanding of the entire data; this process was comparable to a thematic analysis [154, 155]. Specifically, since we aimed in this study to investigate how strict job completion times can limit workers' temporal flexibility, we initially annotated one key work activity that participants had to engage in whilst working on the crowdsourcing platform: *managing the queue of jobs*. We chose to annotate this activity because the results of Study 1 suggested that multitasking activities such as monitoring the time limits of the jobs in participants' work queues had the potential to increase feelings of time pressure. Furthermore, as part of their work on the crowdsourcing platform, participants had to manage the jobs they had 'queued' up to work on. Specifically, participants had to line up jobs to complete in the queue of jobs and then filter out any unsuitable jobs that they would not complete (e.g., fraudulent jobs or low-paying jobs) [156].

We observed the number of jobs participants had in their queue by examining the workers' job queues right before they started working on a job. The queue of jobs was displayed either on the crowdsourcing platform's queue of jobs or as part of the external tools that participants were using to catch jobs and maximise their earnings. For ten of the participants, the queue of jobs was displayed on the crowdsourcing platform's jobs queue, whereas for the remaining two participants,

the queue was displayed as part of their external tools. For the participants who had the queue displayed on the crowdsourcing platform's queue of jobs and had the "auto-accept next job" feature on, we subtracted the number of jobs they were completing (or returning) one after the other, as participants were working their way through the queue.

B. Analysing the activities recorded. In addition to measuring how participants in our study were *managing the job queue*, we also measured and subsequently analysed five additional activities: (1) Waiting for new jobs; (2) Searching for jobs; (3) 'Catching' new jobs; (4) Actively working on jobs; and (5) Doing other unpaid work. We hereby describe the five additional activities.

(1) **Waiting for new jobs.** We measured the amount of time participants were waiting for new jobs to become available on the platform. Crowdworkers have to spend time waiting for new jobs because of the crowdsourcing platform's lack of predictable work availability (i.e., workers do not know when clients are going to make new jobs available [65]). We observed when participants were waiting for new jobs by annotating the instances in which participants were not interacting directly with the crowdsourcing platform or any crowdwork-related work (e.g., unpaid work such as contacting clients, tracking earnings, reading forums or reviews, or checking qualifications). Whilst waiting for work, participants filled their time with activities resembling break-taking (e.g., playing video games, browsing the internet or watching Netflix). In this study, we differentiated between 'activities resembling break-taking' and actual breaks, by asking participants to inform us during the screen recordings if they were about to take any breaks (we report the number of breaks participants took in the Results section).

(2) **Searching for jobs.** We measured the amount of time participants were searching for jobs to complete. We observed when participants searched for jobs by annotating the instances in which participants visited the crowdsourcing platform's main page (i.e., the page where jobs appear as they are posted), and when participants visited their external tools to adjust observable param-

eters in the tools [150].

- (3) **‘Catching’ new jobs.** We observed whether participants were ‘catching’ new jobs as they became available on the crowdsourcing platform. Crowdworkers have to ‘catch’ new jobs as they become available on the platform [48, 112]—this is because of the crowdsourcing platform’s lack of work assignment (i.e., the crowdsourcing platform does not assign workers jobs to complete). We measured the number of jobs participants caught by recording the frequency with which participants were (a) manually accepting new jobs and (b) the frequency with which participants’ external tools were ‘catching’ jobs on their behalf. We excluded from the analysis jobs that did not meet participants’ criteria and that they, therefore, did not attempt to ‘catch’; it was possible to record participants’ criteria when they adjusted observable parameters in their external tools.
- (4) **Actively working on jobs.** We measured the amount of time participants were actively working on jobs. We observed the number of jobs participants completed by annotating the video data to define: (a) when participants started working on a job (i.e., the moment participants clicked on the ‘Work’ button to begin working on a job) and (b) when participants stopped working on a job (i.e., the moment participants clicked on the ‘Submit’ or ‘Return’ buttons to stop working on a job). As part of measuring the amount of time participants were actively working on jobs, we also included (a) any amount of time spent on jobs that were started but then returned, as well as (b) any amount of time spent on jobs that eventually timed out [156]—in comparison, Toxtli et al.’s [156] categorised these two measures as ‘unpaid work’. However, in our study, we included these other two activities to measure the amount of *paid* time participants spent working.
- (5) **Doing other unpaid work.** Finally, we observed whether participants were engaging in any other unpaid work. Crowdworkers have to engage in a variety of unpaid work just to secure paid work [156] (in addition to activities

such as waiting, searching, and catching jobs, or managing the queue of jobs, which we excluded from this measure). We defined unpaid work to include a wide variety of unpaid activities such as: (a) contacting clients, (b) tracking earnings, (c) reading forums or reviews, and (d) checking their qualifications. This list of unpaid activities is consistent with Gupta's [150] description of crowdworkers' workflows and with the invisible labour activities examined by Toxtli et al. [156]. We next describe how we observed each unpaid activity. We first observed when participants contacted clients by annotating the instances in which participants sent clients messages using the contact form provided by the platform. We next observed when participants tracked their earnings by annotating the instances in which they visited the crowdsourcing platform's earnings section. Further, we observed when participants read forums or reviews by annotating the instances in which they visited worker forums or read client or job reviews left by other workers. Finally, we observed when participants checked their job qualifications by annotating the instances in which they visited the platform's Qualifications page.

We independently coded all instances related to the six activities observed within the 18 hours of video recordings. We coded the video data deductively (i.e., top-down). In this sense, we deductively generated initial codes based on the RQ asked, the initial viewing of the recordings, and existing literature (e.g., 'catching' new jobs [48] or managing the queue of jobs [156]). Based on the codes, we developed a preliminary codebook to help guide the analysis of the study; we refined the codebook throughout the analysis of the video data.

This analysis resulted in 14 codes grouped into six main categories: (1) Managing the queue of jobs (e.g. code, 'checking the work queue on the platform'); (2) Waiting for new jobs (e.g. code, 'playing video game'); (3) Searching for jobs (e.g. code, 'searching for job on main page'); (4) 'Catching' new jobs (e.g. code, 'catching job manually'); (5) Actively working on jobs (e.g. code, 'starting to complete job'); and (6) Doing other unpaid work (e.g. code, 'contacting clients'). We annotated the video data iteratively, until no other notable instances related to the

six activities were identified. Through the process of annotating the data, we were able to generate a robust list of all of the instances of activities we were interested in measuring in this study.

Throughout the coding process, we collaboratively examined in detail the six activities recorded and shared our own understandings of these activities and discussed any disagreements. In this sense, we collaboratively discussed the activities recorded and asked probing questions to build a shared understanding of the video data. Throughout these group discussions, we explored the meaning of the data, and reflected on how their biases and subjectivity might be affecting the reading of the data [155].

Additionally, we inductively translated the codes into observable patterns (i.e., comparable to the themes of thematic analysis [154, 155]). During this process, we looked for patterns of activities across the whole dataset rather than only within each video recording. Further, we sought patterns across the activities by combining the annotations made and observing relationships between them, instead of contrasting the instances of the six activities in a direct manner [157]. This approach enabled us to examine the relationship between the instances and measure the amount of time participants engaged with them. We next present the results of the study.

Finally, after coding the video data, we contacted the participants with follow-up questions: participants were asked to describe some of the behaviours recorded in the videos. The following is an example of the kind of question we sent to a participant: *“Looking back at how you went about completing your work, I was wondering how come you chose to check the crowdwork queue while you were completing a job? Here is the secure link to a fragment of the video recording where you can see the job I’m referring to: [...]”*. Following up with the participants allowed us to check and refine our codes against their descriptions. We next present the results of the study.

4.2.3 Results

To present the activities observed in the video data, we report both descriptive statistics and qualitative data. The descriptive statistics help us to build a detailed picture

of how participants were working on the platform. Additionally, to give a more nuanced understanding, we describe examples from specific video clips along with the detailed comments that the participants provided to qualitatively explain what was happening.

4.2.3.1 Deciding under time pressure which jobs to keep

First, we learnt that participants had to decide under time pressure which jobs to keep in their work queues. We observed in the screen recordings that participants frequently switched to their work queues (i.e., the jobs Queue page on the crowd-sourcing platform) whilst working on jobs. In total, participants switched their attention to the work queue 26 times during the 18 hours of screen recordings. We measured the number of times participants switched to the work queue by annotating the instances in which participants had the jobs Queue page in focus right after actively working on a job. We also followed up with the participants to ask them about the switching activity we had observed. In the follow-up questions, we asked participants to describe how they managed the new jobs added to their queue.

We learnt from the participants that they had to switch to the work queue whilst completing a job to manage their work queue. In this sense, participants had to check if any new jobs had been automatically added to their work queue by the scripts that they were using. If so, participants had to check the completion times of the jobs in their work queues. Based on the completion times of the jobs, participants had to be quick to decide which jobs to keep in their work queue.

In terms of the participants checking whether new jobs have been automatically added to their work queue, we observed in the video data that a third of the participants (i.e., P7, P10, P11, and P12) used scripts that automatically accepted any jobs posted by clients. In other words, the scripts automatically accepted any new jobs that became available on the platform on behalf of the workers and added them to their work queues. Therefore, during the working sessions we observed, participants had to check their work queues for any new jobs that their scripts could have automatically added.

Participant 10 (P10) succinctly explained that since the scripts they use auto-

accept the jobs posed by clients, they frequently have to switch their attention to the work queue to check the completion times of the jobs and plan their work from there: *“Script I use auto-accepts jobs so I often have to flip back and forth to keep an eye on timers for new jobs and plan my work accordingly.”*

Additionally, scripts made the participants aware that they had added a new job to their queues. The scripts notified them visually, through sound, or both about new jobs (e.g., P8, P10). As a result of being notified about the new work, participants had to switch their attention to the work queues quickly and decide whether they should keep the new jobs in the work queue or not. For example, when asked about switching their attention to the work queue, Participant 11 (P11) described using two scripts that notified them through sound about new jobs they had recently added to their work queue. In P11’s case, the scripts also displayed information about the jobs, such as the amount of money they paid and the amount of time participants had for completing them:

“I personally use [name of script] and it’s set to play 5 sec of music with a pop-up notification [...] that shows the job name, the amount paid, client and time allowed at the bottom [...] I also have job Catcher set to notify by voice announcement.” — P11

Finally, Participant 10 (P10) also mentioned being notified via sound about any new jobs that their scripts had automatically added to the work queue. When asked about switching their attention to the work queue (a behaviour we had observed in the video data), the participant described that they had to check the work queue to ensure they had not missed out on new jobs. Importantly, since the completion times of newer jobs began counting down from the moment the scripts added them to the queue, P10 mentioned that they wanted to be aware of the completion deadlines of all of the jobs they had in their queues; hence not risking jobs expiring. Thus, participants had to check the completion times of the jobs in their work queues once new jobs had been automatically added to their work queue by the scripts that they were using:

“[...] to make sure I hadn’t missed any audio cues from the script

accepting a job since I was multi-tasking at that point and I didn't want to have any jobs counting down that I was aware of.” — P10

In terms of switching their attention to the completion times of the jobs in their work queues, Participant 13 (P13) further described having to check the completion times of the jobs to make sure they were able to complete the jobs in the amount of time provided by clients. P13 describes having encountered jobs with very short completion times that did not allow them to complete the job after they had finished working on the job at hand. Thus, P13 mentioned quickly checking the completion times of the new jobs added to their queue in the hope that the job is long enough for them to complete at a later point:

“[...] I need to know how much time does the new job have before it expires. Sometimes you get jobs that say “10 minute decision study” for example but it could have only a 15 or 20 minute timer on it. (yeah they do that!) If I am in the middle of doing a job and I hear that I caught a job I go to my job Queue Tab just to check real quick and hopefully it will have a 60 minute or more timer.” — P13

Participant 7 (P7) also mentioned checking the completion times of the jobs recently accepted to their work queue: *“I was checking timers to make sure I'd have time to complete all the jobs my script had accepted while I was working on the auditing one.”* Thus, based on the completion times of the jobs, participants had to be quick to decide which jobs to keep in their work queue, and which to return, thus not complete.

4.2.3.2 Deciding under time pressure which jobs to return

Next, we learnt that participants had to decide under time pressure which jobs to return from their work queue. Participants described in the previous section that once scripts added new jobs to their work queues, they had to become aware of the completion times of the jobs rather quickly; this was because the completion times of the jobs varied from one job to the next and were most frequently short. As a result, participants had to decide under time pressure which jobs to keep in their

work queue, and thus complete. In turn, participants also had to decide which jobs to return from their work queue quickly, which we describe next.

We further observed in the 18 hours of screen recordings that participants frequently returned jobs ($M = 3.82$, $SD = 3.73$) from their work queues. We measured the number of jobs participants returned by counting the instances in which participants clicked a job's 'Return' button on the crowdsourcing platform. We followed up with the participants to ask about the jobs they frequently returned from their work queues—we shared a fragment of the screen recordings with the participants. Participants told us that they most frequently returned jobs because they did not believe they could submit them within the jobs' completion times.

For instance, Participant 8 (P8) told us that the hourly pay of a job was one of the main aspects they minded when evaluating their queue of jobs. In this sense, P8 checked the reviews of certain jobs to decide whether they should return a job that had a short completion time or not. In particular, P8 mentioned that if the hourly pay of a job was too low—perhaps because the client estimated the completion time of that job incorrectly—they would return the job from their work queue:

“I look at the hourly rate/pay rating. If the pay is too low, or the reported times for the job are longer than stated, I might return it, especially if I have a bunch of other things in my queue. [. . .]. Clients will usually provide a time estimate for their jobs, but they are often wildly inaccurate ('30 minute job' that takes 5 minutes, or '5-10 minute job' that takes 30), so looking at reviews is especially helpful.” — P8

Similarly to P8, Participant 7 (P7) also mentioned checking job reviews to decide whether they should return a job with a short completion time or not. P7 added that since they generally work at a slower pace, they also read the reviews to check the hourly rate of the job. Since the hourly rate of the job was too low, P7 chose to return it from their work queue:

“I was checking what the lower range bound wage was since I tend to be slower. I was also trying to estimate if I could finish the job with a

completion time that would keep my hourly over minimum wage. [...] The information that was available from those that had returned the job made me wonder if the job was worth it.” — P7

Finally, Participant 11 (P11) provided a detailed account of what it is like to have to decide which jobs to keep in their work queue and which to discard. We included P11’s description of their experiences in its entirety to exemplify how the time limits imposed by clients (i.e., short completion times) can limit the time that workers had to make work decisions. In summary, they describe a situation in which they had to decide under time pressure if they should continue working on the job they were already completing, when a new job with a longer completion time became available. We use P11’s account to exemplify the type of decisions participants had to make in a limited time frame because of the short completion times of jobs:

“When jobs are recently added to the queue like the one in the video, then again time is the biggest factor in deciding what to do next. So, hopefully I have plenty of time to finish what I’m working on and plenty of time to do the jobs in my queue. Of course, it doesn’t always work out so neatly. Let’s say for example: I’m working on a job that has a 2-hour timer on it and is expected to take 35-40 minutes and I have probably 20 more minutes to go on it. Now a new job comes in that is expected to take 40 minutes and has a 1 hour timer. Now I have to decide if I want to finish the job I’m currently on and so when I go to the next job I only have 40 minutes left to do the 40 minute job. (I’ve done this many times and always hope that the client’s time estimate is way over which it usually is by at least 10 minutes or even more.) That really is cutting it too close for me. Another option is to stop working on my current job and start the new one. When it is finished, I can return back to the previous job and have plenty of time to finish it.” — P11

Overall, we learnt that participants frequently switched to their work queues whilst working on jobs. Participants had to decide under time pressure which jobs

to keep in their work queue to complete and which not to keep because the jobs posted on the platform had short completion times. In turn, participants also had to decide under time the order of jobs. Specifically, participants had to check if any new jobs had been automatically added to their work queue by their scripts. If so, they had to further check the completion times of the jobs in their work queues. Thus, we learnt that participants had to decide quickly which jobs to keep in their work queue and which not to keep, thus not complete.

4.2.3.3 Deciding under time pressure the order of jobs

Finally, we learnt that participants also had to decide under time pressure the order in which they should complete the jobs in their queue. The nature of the crowd-sourcing platform work did not allow participants to closely examine the available jobs on the platform. For example, Participant 12 (P12) told us that they usually quickly check the jobs' completion times in their work queue and decide to work on the job with the shortest completion times:

“On [name of platform] you usually don't have the luxury of carefully looking over and evaluating jobs, deciding if you like them and then accepting them (they will often already be gone). You pretty much immediately accept what pops up, then see if you want to work on it, or return it. For this job [...] it was at the top of my queue and had little time remaining so I had to either work on it or return it.” — P12

On a different occasion, we learnt from a participant that they had chosen to work firstly on the highest-paying job in their work queue instead of the job with the shortest completion time. In this sense, Participant 8 (P8) had decided which jobs to complete by considering the time it would take them and the pay they would receive for their time and effort. They described rushing to complete a well-paid job that did not have much time remaining:

“[...] if you look at my work screen? It was really tight! Everything is on a timer and I was confident that 22 minutes was enough to finish that \$2 job. I also realized I had high paying \$2-\$10 jobs in my que but

they all had plenty of time left to complete them. It was a priority to put all my focus and energy on making that quick \$2 with only 22 minutes on its timers.” — P8

Finally, similarly to the previous participant, Participant 13 (P13) also decided which jobs to complete by looking out for the highest-paying job in their work queue. They further described that working on the crowdsourcing platform involves efficiently managing their time, making the most money in the time available, whilst still keeping to the time limits of the jobs in their work queue:

“[...] my strategy is to look for high-paying jobs and then whatever else that looks good. I think like all the other workers we all try to use our time wisely and efficiently to make the most money we can out of each minute. So, basically as many jobs as I can fit in to my queue that can be reasonably done within their time limits.” — P13

Overall, we learnt that participants also had to decide under time pressure the order in which they should complete the jobs in their queue. Most participants told us that when examining the work queue, they chose to work on the highest-paying job in their queue with the shortest completion times. In other words, participants examined the list of jobs to find which job paid the most out of the jobs that were soon expiring. Thus, participants had to decide which jobs to complete first by considering the remaining time that it would take them to complete the job and the pay they would receive for their time and effort.

4.2.4 Discussion

In this study, we aimed to answer the following RQ: *How is the temporal flexibility of workers limited by constraints imposed by clients?* To answer the RQ, we conducted an empirical investigation in which we analysed 18 hours of screen recordings.

4.2.4.1 Summary of Results

Taken together, the results of the study described how the time constraints imposed by clients can limit workers' temporal flexibility. In particular, the results suggest

that having to work on jobs with strict completion times limited the amount of time that workers had in which they could make work decisions. We first found that participants had to decide under time pressure which jobs to keep in their work queue to complete during the working session. Second, we found that participants had to decide under time pressure which jobs to return from their job queue, thus not complete. Third, we found that participants had to decide under time pressure in which order they should complete the remaining jobs. We next consider the implications of the results and summarise the time constraints identified in this study.

4.2.4.2 Implications

Participants in this study had different strategies for managing their work. For example, participants maintained awareness of jobs' completion times to ensure they did not expire. Furthermore, based on the jobs' completion times, participants decided which jobs to keep and which to return. Thus, participants had different strategies for scheduling and prioritising their work. Time awareness, together with job scheduling and job prioritisation are three concepts connected to time urgency [158]. We next discuss these concepts in the context of our results.

Time urgency is a concept explored in organisational behaviour and considered to be—similarly to the concept of polychronicity explored in Study 1—an individual difference or preference that motivates multitasking [159]. Time urgent individuals tend to fit numerous activities into a small period of time [160]. First, in terms of time awareness, time urgent individuals tend to hold higher time awareness than non-time urgent individuals. For example, time-urgent individuals check more frequently the time remaining on the activities they are engaged in [160]. In the case of crowdworkers, switching to the work queue to check the expiry times of jobs was common among the workers in our study. Workers had to employ this practice because of the time pressures of working with strict completion times. Working under time pressure can decrease job satisfaction and general well-being by increasing stress and fatigue levels [161].

Second, in terms of job scheduling, this activity appeared to be a dynamic activity for the workers because of the strict completion times of jobs appearing on

the platform. Workers mainly scheduled jobs into their work queue as they became available. In doing this, workers evaluated the jobs according to their completion times and pay. Workers returned the job when the pay of a job was incongruent with the time required. In Kaplan et al.'s [111] survey responses, 44% (n = 161) of crowdworkers perceived returning jobs as a "Very Time Consuming" or "Extremely Time Consuming" activity. Thus, having to return jobs could potentially be another time constraint crowdworkers have to juggle. Finally, how workers choose to work on jobs has been explored previously by [162]. They have identified that workers: (1) choose to work for the clients they have worked for in the past, (2) prefer batch work to individual jobs, and (3) specialise in a particular type of job to complete. We add to this prior knowledge by identifying that workers evaluate the time required to complete a job and the pay of the job.

Finally, in terms of job prioritisation, the way workers prioritised which jobs to complete (and which to return) can be described using information foraging theory [163]. Information foraging theory describes how humans collect and make sense of information online. This theory uses the analogy of animals in the wild gathering food, and it explains online information seeking using three primary constructs: (1) information patches, (2) information scent, and (3) information diet [163]. First, we observed that workers used scripts when they needed to find suitable jobs to complete. Based on Pirolli and Card's theory, jobs represent the 'information' that workers sought, whilst scripts represent the 'information patches' that workers used to find work. Second, whilst using scripts to find work, workers searched for cues about the length and pay of jobs. Further, workers also looked at reviews written by other workers to see how much time they had spent completing those jobs. These strategies represent the 'information scent' described by information foraging theory. Lastly, based on the information gathered, workers chose to keep (or return) jobs in their work queue. Deciding which job to work on from the work queue represents the 'information diet' of the workers; we identified in this study that crowdworkers mainly decided to work on jobs with the shortest completion times.

Summary of Implications. Table 4.4 lists the implications of the time con-

straints we explored in this study. We initially identified one time constraint as part of the conceptual investigation conducted in the Background chapter (Chapter 3). In this chapter, we identified three additional time constraints as part of the empirical investigation we conducted. We next describe each time constraint and their corresponding implications.

R1. Clients can set strict job completion times. We identified this time constraint as part of the conceptual investigation conducted in the Chapter 3. The results suggest that setting strict job completion times can lead to workers having to make work decisions under time pressure.

R2. Clients can underestimate the completion times of jobs. We identified the time constraint in this study. The results suggest that underestimating the completion times of jobs can lead to workers having jobs expire before they submit them, thus losing time and money.

R3. Clients can post jobs that do not work. We identified the time constraint in this study. The results suggest that posting jobs that do not work might lead to workers losing time and money by having to return the jobs.

R4. Clients can choose to pay workers poorly. We identified the time constraint in this study. The results suggest that choosing to pay workers poorly can lead to workers spending their time closely examining the jobs posted on the platform.

Time Constraints	Implications for Workers
R1. Clients can set strict completion times. (Bkgd.)	R1. Workers have to make work decisions under time pressure.
R2. Clients can underestimate the completion times of jobs. (This study)	R2. Workers can have jobs expire before they submit them, thus losing time and money.
R3. Clients can post jobs that do not work. (This study)	R3. Workers lose time and money by having to return the jobs.
R4. Clients can choose to pay workers poorly. (This study)	R4. Workers have to spend their time closely examining the jobs posted on the platform.

Table 4.4: Client-imposed time constraints found on crowdsourcing platforms. The first time constraint was identified as part of conceptual investigation conducted in the Background chapter (Chapter 3). The items listed in red and marked with the words “This study” represent the new time constraints that we identified as part of the empirical investigation conducted in this study.

Additionally, in this study, we identified one new time constraint imposed on

the workers by their working practices. Table 4.5 summarises the implications of the worker-imposed time constraint we identified in this study. We next describe the time constraint and its corresponding implication.

W1. Workers have to maintain high levels of time awareness when working on the platform. We observed that the platform requires workers to be highly aware of the time remaining on the jobs they are completing. Thus, workers experience time urgency as a result of working on the platform.

Time Constraints	Implications for Workers
W1. Workers have to maintain high levels of time awareness when working on the platform. (This study)	W1. Workers experience time urgency as a result of working on the platform.

Table 4.5: Time constraints imposed by the working practices of the workers. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

Finally, in this study, we identified one new time constraint imposed on the workers by the design of the platform. Table 4.6 summarises the implications of the platform-imposed time constraint we identified in this study. We next describe the time constraint and its corresponding implications.

P1. The platform does not require clients to pay workers a minimum hourly wage. First, we observed that the platform allows clients to post jobs that do not pay the workers a local minimum wage or above. Thus, workers might not be getting paid fairly for the time they spend completing jobs.

Time Constraints	Implications for Workers
P1. The platform does not require clients to pay workers a minimum hourly wage. (This study)	P1. Workers might not be getting paid fairly for the time they spend completing jobs.

Table 4.6: Time constraints imposed by the design of the platform. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

4.2.4.3 Conceptual Investigation

Table 4.7 presents a refined list of time constraints found on crowdworking platforms. The time constraints were identified as part of conceptual investigation con-

ducted in the Background chapter (Chapter 3) and as part of the empirical investigation presented in this chapter. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study. Finally, we created a separate category for one of the new platform-imposed time constraint identified in this study: *Unpaid Time*.

Worker-Imposed Time Constraints	Description of Time Constraints
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. (This study)
Client-Imposed Time Constraints	Description of Time Constraints
R1. Inflexibility of Time Use	R1.1 Clients can set strict completion times. R1.2 Clients can underestimate the completion times of jobs. (This study) R1.3 Clients can post jobs that do not work. (This study) R1.4 Clients can choose to pay workers poorly. (This study)
Platform-Imposed Time Constraints	Description of Time Constraints
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers.
P2. Unpredictable Work Availability	P2.1 The platform has no set hours when clients can post jobs. P2.2 The platform has no set hours when workers can complete jobs. P2.3 The platform has no limit to the number of hours workers can spend working.
P3. Unpaid Time (This study)	P3.1 The platform does not require clients to pay workers a minimum hourly wage. (This study)

Table 4.7: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

4.2.4.4 Limitations and Future Work

We conducted a detailed video analysis. A strength of video data is that you can actually see what is happening; therefore, nuances and details can be expected. The nuanced data meant that we could identify interesting clips of activity and share these with the participant to get more information about what was going on. There are, however, also limitations of the video study. Video is intensive to gather and analyse. As a result, this was a relatively small study with 12 participants recording only 90 minutes of activity. While small in size ($N = 12$), it allowed us to generate

a rich set of data to investigate the work practices of workers.

In terms of methods, one limitation of the study is that we could not record all of the activities of four participants who were using a second screen in their work. This limitation is because the screen recording tool we asked participants to use for the screen recordings (i.e., Lookback) only allowed participants to record one screen at a time. Thus, while we could tell when a worker switched from one screen to the other (i.e., the windows on the first screen became inactive), we could not record the activities displayed on the screens of four participants. Alternative screen recording software that allows recording multiple screens would have improved our ability to capture working contexts fully.

Another methodological challenge in this study is that, throughout, participants were working on our job by recording their screen and other jobs. This situation made setting the rate of pay difficult; we wanted to pay fairly, but at the same time, too high a rate of pay might have affected participants' behaviour in terms of work rate and job-finding behaviour. Thus, calibrating pay to be fair but does not unduly influence participants' behaviour is a difficult question for future work. Furthermore, we observed most activity during sessions to take place in an internet browser. It could be possible for future work to corroborate these findings by automatically recording browser activity. Indeed, such activity log studies have been useful in other areas to learn about large-scale patterns of users over extended periods of time (e.g., [164, 165, 166]). Logging is not quite this simple, though; we saw that not all work on the job occurred within the job's browser tab. For example, participants sometimes switched from the job tab to search and find information in a different tab. This switch meant that they were doing a Google search or reading a webpage. This activity may appear for a logger unrelated to the job, but in video, we can see that these searches are clearly being done as part of the job.

A final methodological limitation is that we asked participants to record their screens at random points throughout the day for 90 minutes. While the results of Study 1 suggest that crowdworkers tend to work in blocks of around 90 minutes, survey studies have indicated that full-time crowdworkers report longer typical work

of approximately 300 minutes [167]. Thus, future work could ask workers to record their screens for more extended periods. The challenge, of course, is to develop ways to measure aspects of behaviour that retain some of the fidelity of video coding (without the labour involved in coding it) without ending up with telemetry-based measures that might misclassify (e.g., work vs non-work) activity.

4.2.5 Conclusion

This study presented an empirical investigation that explored how the time constraints imposed by clients limited workers' temporal flexibility. The results of the study refined the conceptual investigation conducted throughout this thesis and contributed an extended understanding of the time constraints that can limit the temporal flexibility of crowdworkers. In particular, the results of this study described how client-imposed time constraints can limit workers' temporal flexibility.

Using video and qualitative data, we showed that working with strict completion times meant that participants had to make decisions under time pressure. In this sense, we saw in this study that participants had different strategies for working under time pressure. For example, participants kept their eyes on the completion times of the jobs to make sure that they will not expire. Once participants had an idea of how long they had left to complete the jobs, they decided which jobs to keep and which to return based on the time left to complete the job and the pay. Thus, participants had different strategies for scheduling and prioritising their work.

However, we also learned in this study that the time constraints of working on the crowdsourcing platform did not allow participants to closely examine the jobs available on the platform. In this sense, participants had to make decisions such as prioritising or scheduling their work under time pressure. Given that we identified in the conceptual investigation conducted in Chapter 3 that crowdworkers have to work on the platforms under time constraints imposed by the design of the crowdsourcing platform itself, in the following two studies we plan to explore how these time constraints can limit workers' temporal flexibility.

4.3 Study 3: Time Constraints Imposed by Crowdsourcing Platforms (I)

In Chapter 3, we identified two categories of time constraint imposed on crowdworkers by the design of the platform: (1) there is a *lack of work assignment*, and (2) there is a *lack of predictable work availability*. In this thesis, we aimed to explore the impact of these two time constraints on workers' temporal flexibility. We set the following overarching RQ to guide our studies: *How is the temporal flexibility of workers limited by constraints imposed by the design of the platform?* To answer this RQ, we conducted two studies, which we present next. We begin by presenting Study 3, followed by presenting Study 4.

4.3.1 Introduction

In Study 3, we investigated the impact of the platform's *lack of work assignment* on the temporal flexibility of crowdworkers. We set the following RQ to guide our study: *How is the temporal flexibility of workers limited by the platform's lack of work assignment?* To answer this RQ, we conducted an empirical investigation that used video observations and qualitative data, which we present next.

As part of the empirical investigation, we collected twelve 90-minute working sessions from workers on a large crowdworking platform to investigate how the platform's lack of work assignment can limit participants' temporal flexibility. Using the screen recordings, we first analysed how the twelve participants spent their unpaid time—e.g., waiting to 'catch' new jobs. Next, we analysed how participants spent their paid time—e.g., 'catching' additional jobs whilst also working on jobs. To better understand the activities observed in the twelve working sessions, we sent follow-up questions to the participants in which we asked them to elaborate on the activities we observed in the videos.

Overall, we learnt that the platform's lack of work assignment impacted the pace at which participants worked and took breaks. We observed that working on the platform was overall characterised by three distinct periods of work intensity: periods of low, moderate, and high work intensity. For example, during periods of

low work intensity, participants worked at a slower pace, filling their unpaid time with activities resembling break-taking due to a lack of available work, such as browsing the internet whilst waiting to ‘catch’ new jobs. In contrast, participants worked at a higher pace during periods of high work intensity, such as engaging in task switching to quickly ‘catch’ new work but not taking any breaks. Taken together, the results of this study showed that the time constraints imposed by the platform’s lack of work assignment can reduce workers’ temporal flexibility by impacting the pace at which they work and frequency with which they take breaks.

4.3.2 Methods

This study revisits a subset of the video data presented in Study 2. We refer the reader to Section 4.2.2.2 of Study 2 for a description of the study’s *Procedure*; Section 4.2.2.3 for a description of the *Participants* who took part in the study; Section 4.2.2.4 for a description of the study’s *Ethics Considerations*; and Section 4.2.2.5 for a description of the *Analysis* of the video data. We next describe the results of this study.

4.3.3 Results

Similarly to Study 2, we report both descriptive statistics and qualitative data to present the activities observed in the video data. The descriptive statistics help us build a detailed picture of the video data. Additionally, to give a more nuanced understanding of the data, we describe examples from specific video clips along with the detailed comments that the participants provided to qualitatively explain what was happening during the twelve working sessions recorded.

4.3.3.1 Activities undertaken

What follows is an account of how participants spent their time working under the time constraints imposed by the platform during the twelve working sessions recorded. We first describe how participants spent their *unpaid* time, followed by describing how participants spent their *paid* time.

First, in terms of how participants spent their *unpaid* time on the platform, participants spent on average 13 minutes ($M = 12$ min 49 sec, $SD = 9$ min 52 sec)

waiting for new jobs. Additionally, participants spent on average 16 minutes ($M = 16 \text{ min } 14 \text{ sec}$, $SD = 2 \text{ min } 50 \text{ sec}$) searching for jobs. Taken together, participants spent on average 17% of their unpaid working time waiting and searching for jobs whilst working on the platform; we calculated this value by summing up all of the unpaid time participants in our study spent waiting and searching for jobs during the twelve 90-minute working sessions recorded. In other words, participants spent on average 17% of their working time on unpaid activities such as waiting and searching for new jobs. Finally, participants spent on average seven minutes doing other unpaid work ($M = 6 \text{ min } 56 \text{ sec}$, $SD = 2 \text{ min } 45 \text{ sec}$).

Second, in terms of how participants spent their *paid* time on the platform, participants managed to catch new jobs approximately every eight minutes on average ($M = 8.22$, $SD = 7.73$). Participants ‘caught’ a total of 110 jobs during the 18 hours of recordings ($M = 4.58$, $SD = 3.19$). Additionally, participants submitted 64 jobs in total ($M = 5.33$, $SD = 2.46$); we use the term ‘submitted’ to differentiate between jobs that participants worked on and submitted for review, and jobs that participants worked on but had to return or had expired. In total, participants returned 46 jobs ($M = 3.83$, $SD = 3.71$); therefore, participants returned on average 42% of the total number of jobs caught. Finally, participants spent on average 40 minutes ($M = 40 \text{ min } 1 \text{ sec}$, $SD = 35 \text{ min } 44 \text{ sec}$) working on the 64 jobs.

Interestingly, we observed variability in work intensity over the twelve 90-minute periods recorded. The variability suggests that, for the participants in our study, working on the crowdsourcing platform was characterised by three distinct periods of work intensity, which was influenced by the number of jobs participants had in their work queue:

1. Periods of *low* work intensity, in which participants had zero or only one job lined up to complete in the queue;
2. Periods of *moderate* work intensity, in which participants had between two and five jobs lined up; and
3. Periods of *high* work intensity, in which participants had six or more jobs

lined up. We used six jobs as the cut-off point for periods of high work intensity as it is approximately equal to 2 standard deviations from the overall mean.

On average, we identified four ($M = 4.22$, $SD = 1.96$, *range*: 0–8) distinct periods of work intensity of the three types described above (i.e., low, moderate, and high). We observed the number of jobs participants had in their queue by examining the workers' queues right before they started working on a job. Participants had on average two jobs in their queues whilst working ($M = 1.75$, $SD = 1.81$). We chose to focus on the number of jobs participants had in their queues as these can be an indicator of work intensity on the crowdsourcing platform. Since each queued job has a time limit, crowdworkers report having to monitor the time limits of the jobs to ensure they get to complete all the queued jobs without the jobs expiring or timing out when working on them [112]. Moreover, if workers are not near their work spaces, monitoring the queue of jobs is one of the most common mobile job for the workers [48]. Therefore, we argue that the more jobs workers have in their queue, the more their work intensifies (i.e., the workers' pace increases). We used the three distinct periods of work intensity to describe how the platform's lack of work assignment limited participants' control over the pace at which they worked. We next describe the three periods of work intensity across the whole dataset.

4.3.3.2 Periods of Low Work Intensity

We observed that participants spent 39% of their time in periods of low work intensity, for an average of 33 minutes ($M = 33$ min 22 sec, $SD = 16$ min 9 sec). First, during periods of low work intensity, participants spent on average 25 minutes ($M = 25$ min 14 sec, $SD = 16$ sec) waiting for new jobs. Second, participants on average 15 minutes ($M = 15$ min 6 sec, $SD = 1$ min 54 sec) searching for jobs. Third, participants managed to catch new jobs approximately every 17 minutes on average ($M = 17$ min 5 sec, $SD = 10$ min 55 sec). Fourth, participants had zero or only one job lined up in the queue of jobs to complete. Fifth, participants spent on average ten minutes doing unpaid work ($M = 10$ min 5 sec, $SD = 47$ sec). Sixth, participants spent on average 20 minutes working on jobs ($M = 19$ min 57 sec, SD

= 1 min 36 sec). Finally, during these periods of low work intensity, we observed that participants were working at a slow pace during these periods, working on one job or on no jobs whatsoever. Participants were left waiting for new jobs that met their selection criteria to become available on the platform. In this time, participants filled their unpaid time with activities resembling break-taking (e.g., browsing the internet or watching TV shows). We next describe these activities.

Since only a low amount of work was available on the platform during these periods, participants had to spend a large amount of time searching for new jobs. To automatically search the platform for new jobs, participants used open-source external tools. We observed each participant using on average three different external tools each ($M = 3.28$, $SD = 1.64$). We observed participants frequently switching between different external tools as they were waiting for work ($N = 15$). For example, we observed participant P9 using a dual-monitor setup and switching between three different tools over 30 seconds in one clip. When asked about this clip, the participant said that they used this setup to manage their work:

“I use two monitors because it is advantageous for [name of platform] (and productivity in general while doing any number of computer based jobs). [name of platform]’s own interface is limited, and many people, myself included, find it necessary to use various [tools] and extensions that help find, sort, filter, organize, and accept jobs. Thus, at any given time I might have a number of different windows running for these purposes, so having two monitors is extremely helpful to manage my work flow.” — P9

Participants programmed their external tools to help them monitor the platform for new jobs that met their selection criteria (e.g. setting a minimum payment amount for a job). We observed participants actively changing the parameters of their external tools based on the availability of jobs on the platform over time. For example, participant P8 initially set their external tool to only alert for new jobs that paid more than \$2.99 USD. After not ‘catching’ any jobs for 10 minutes, the participant changed the parameters in their tool to return jobs paying more than \$1.99

USD. After 12 minutes of making this change, the tool had auto-accepted five jobs paying more than \$1.99 USD, and the participant worked on these jobs. When we asked P8 to elaborate on this video clip, they said that: “*while waiting for work. [Tool] will automatically grab anything that is \$1.99 and above . . . I still count this as working*”.

4.3.3.3 Periods of Moderate Work Intensity

We observed that participants spent 35% of their time in periods of moderate work intensity, for an average of 32 minutes ($M = 32$ min 9 sec, $SD = 15$ min 47 sec). First, during periods of moderate work intensity, participants spent on average nine minutes ($M = 9$ min 4 sec, $SD = 1$ min 36 sec) waiting for new jobs. Second, participants spent on average 16 minutes ($M = 16$ min 12 sec, $SD = 2$ min 51 sec) searching for jobs. Third, participants managed to catch new jobs approximately every five minutes on average ($M = 4$ min 50 sec, $SD = 3$ min 39 sec). Fourth, participants had between two and five jobs ($M = 2.96$, $SD = 1.78$) lined up in the queue of jobs to complete. Fifth, participants spent on average five minutes doing unpaid work ($M = 4$ min 39 sec, $SD = 49$ sec). Sixth, participants spent on average 20 minutes working on jobs ($M = 19$ min 41 sec, $SD = 11$ min 12 sec). Finally, during these periods of moderate work intensity, we observed that participants were working at a moderate pace, actively working on jobs, as well as doing activities that are necessary for work (e.g., contacting clients, tracking earnings, reading forums or reviews, or checking qualifications). Unlike during periods of lower work intensity, participants were able to take a few breaks. We next describe these activities.

Since a moderate amount of work was available on the platform during these periods, participants had to increase their work pace to find and evaluate new work. We observed participants frequently ($N = 16$) switching between different external tools to catch jobs. Once participants caught a new job, they had to quickly decide if they wanted to keep it or return it. We observed participants using community-based reviews to find out more information to help evaluate the jobs in their queue. Furthermore, we frequently observed participants returning jobs ($M = 3.82$, $SD = 3.73$) from their queue of jobs. We measured the number of jobs participants returned by

counting the instances in which participants clicked a job's 'Return' button on the crowdsourcing platform. There are many reasons why the participant might want to return a job. We learnt about the reasons from the responses we received from the participants. For example, participants returned jobs because they did not think they could finish them before the completion time expired, or because they were not sure that the work they did would be accepted, or because of a problem with the job. We also observed cases ($N = 6$) in which participants stopped working on a job because a new, better-paid job became available to work on instead. To give an example, P8 returned a job that paid \$2.00 USD. P8 had eight jobs in their jobs queue (including ours). In their jobs queue, the most recent job they caught (which also happened to have the shortest time remaining) paid \$2.00 USD. The job did not have an estimated completion time, so P8 turned to a tool to check the hourly rate of the job for other workers who completed the same job. Other workers reviewed the job as "underpaid" (at a pay rate of \$5.25/hour), and as a result, P8 returned the job. When asked about this clip, the participant said that they usually swap lower-paying jobs for higher-paying jobs:

"One other factor that I should mention is money. By that, I mean it can matter sometimes what the new job is paying and what the current job you're working on is paying. Usually this is a decider in jobs that you haven't started yet. If I was working on a low paying job like \$.50 and the new job that came in was higher paying like \$4 you might think that I would return the \$.50 job and forget about it and just start on the \$4 job since it pays more and I won't have to worry about [not] having enough time. ... if my queue starts filling up and the time limits are conflicting then I will return lower-paying jobs for the higher paying jobs but that is because I haven't started any of the jobs yet." — P8

As well as working on the crowdsourcing platform and doing activities that are necessary for crowdsourcing, participants took a few breaks ($M = 1.57$, $SD = 0.78$, range: 1–3), for an average of 5 minutes each ($M = 4$ min 46 sec, $SD = 3$ min 52 sec). The most common reason reported by participants for taking a break

was to get a drink. Other break activities included checking social media (e.g., Twitter, Facebook, Reddit), spending time with children or pets, or doing other non-crowdwork.

4.3.3.4 Periods of High Work Intensity

We observed that participants spent 26% of their time in periods of high work intensity, for an average of 23 minutes ($M = 23$ min 33 sec, $SD = 16$ min 19 sec). First, during periods of high work intensity, participants spent on average three minutes ($M = 2$ min 36 sec, $SD = 18$ sec) waiting for new jobs. Second, participants spent on average 17 minutes ($M = 17$ min 25 sec, $SD = 1$ min 49 sec) searching for jobs. Third, participants managed to catch new jobs approximately every three minutes on average ($M = 2$ min 46 sec, $SD = 3$ min 43 sec). Fourth, participants had at least six jobs ($M = 6.23$, $SD = 1.26$) lined up in the queue of jobs to complete. Fifth, participants spent on average seven minutes doing unpaid work ($M = 6$ min 39 sec, $SD = 47$ sec). Sixth, participants spent on average 15 minutes working on jobs ($M = 14$ min 58 sec, $SD = 11$ min 46 sec). Finally, during these periods of high work intensity, we observed that participants were working at a faster pace, engaging in task switching to ‘catch’ new work. During these periods, participants in our study did not take any breaks. We next describe these activities.

Since a high amount of work was available on the platform during these periods, notifications for new jobs often came at points when participants were already working on a job. There were 34 occasions in the video data in which we observed participants switching away from the job they were currently working on to catch a new job that had just become available. Participants configured their external tools to notify them when new jobs became available that met their personal selection criteria to avoid missing out on jobs. For example, some of the external tools use pop-up visual notifications that give information on the name of the job, the name of the client, the payment amount as well as the time expected to complete the job. While these notifications helped participants be fast at grabbing new jobs, they could also distract them from working on an active job. To give an example of how these external tools could distract participants, in one video clip, participant P6 was

halfway through working on a job when they were alerted of a new one job by one their external tools. When asked about this clip, the participant said they switched away from working on the job because the tool notified them that a new job had become available via a sound alert. After switching, checking, and accepting this new job, the participant returned to the job they had previously been completing:

“...you mentioned [the tool] and I am glad you did! The reason I keep checking that so aggressively is there is an Alarm that sounds whenever a job is available that meets my preset criteria. So in the video it may seem like I am beyond obsessively checking it but in reality it was a really busy day and that’s why you see me click it sometimes in a millisecond. I just glance at what made it beep and resume my work ...” — P6

As new jobs became available at a faster pace, we observed participants using community-based reviews to find out more information to help evaluate the jobs in their queue ($N = 12$). For example, participants used scripts to check the client’s history and the estimated hourly pay of the job. When asked to elaborate on one of these clips, participant P11 said that they were looking at the number of reviews a client had, and the time and hourly wage information of the job:

“[I] usually look at the number of reviews and whether there are any rejections or blocks. I then look at the hourly average ... I use time and hourly wage information to decide if I should do a job or will I miss something more lucrative.” — P11

Unlike during periods of lower work intensity, participants did not take breaks during periods of high work intensity. One reason for this is that participants had at least five jobs lined up in their queue of jobs during these high availability periods, and these jobs often had short completion deadlines. For example, in one video clip, participant P7 started working on a job that only had 20 minutes left until the completion deadline. Despite the job being advertised as needing 40 minutes to be completed, the participant proceeded to check one of the external tools that they

were using and discovered that other crowdworkers had reported completing this job in around 18 minutes. After checking this information, participant P7 decided to work on the job. After 10 minutes of working on the job, a message was displayed: ‘Feel free to take a break before the next round’. At this point, the participant switched back to their tool to check how much time they had left on the job, where they learnt that they only had 9 minutes and 43 seconds remaining. At this point, P7 exclaimed: “*I don’t really have time for a break . . . oh god . . . I’m tired . . .*”. P7 then immediately returned to the job and resumed working on it. Eventually, the job expired. P7 did not manage to submit it on time and did not get paid for working on it. When asked about this clip, participant P7 elaborated that because of the time limits on the job, they were unable to take a break while working:

“ . . . Sometimes I have to rush to complete and submit [the jobs] within like 10 minutes, than [sic] oh my god, I have to go do that, and sometimes it’s like putting the track in front of the rushing train sort of situation where the moment I am done with one job, the amount of time that I have left to complete the job in the queue is just barely enough to get that done, and then the amount to get the third one in the queue done is barely enough. So it keeps like this, one thing after another, after another, after another, until several hours have passed and I barely have time to pee or get something to drink. It’s not the best situation to be in, but this is the situation I am in right now . . . ” — P7

4.3.4 Discussion

In this study, we aimed to answer the following RQ: *How is the temporal flexibility of workers limited by the platform’s lack of work assignment?* To answer the RQ, we conducted an empirical investigation in which we analysed twelve 90-minute working sessions on a crowdsourcing platform.

4.3.4.1 Summary of Results

Taken together, the results of the study described how one of the main time constraints imposed by the design of the platform can limit workers’ temporal flexibil-

ity. In particular, the results suggest that the platform's lack of work assignment can reduce workers' temporal flexibility by impacting the pace at which they work and frequency with which they take breaks. We observed that during the twelve 90-minute working sessions recorded, participants spent on average 17% of their working time on unpaid activities such as waiting and searching for new jobs. In addition, working on the platform was overall characterised by three distinct periods of work intensity: periods of low, moderate, and high work intensity. For example, during periods of low work intensity, participants worked at a slower pace, filling their unpaid time with activities resembling break-taking due to a lack of available work (i.e., browsing the internet or watching TV shows), whilst monitoring the platform for new jobs. In contrast, participants worked at a higher pace during periods of high work intensity, engaging in task switching to quickly 'catch' new work, but not taking any breaks. This study suggests that a lack of work assignment can reduce workers' temporal flexibility by impacting the pace at which they work and frequency with which they take breaks. We next consider the implications of the results and summarise the time constraints identified in this study.

4.3.4.2 Implications

We saw in this study that the platform's lack of work assignment impacted the pace at which participants were able to work. Because the platform did not assign jobs to the workers, it was easy for the work pace of the workers in our study to increase during busy moments because they had to 'catch' available work. During the periods of high intensity times, workers had multiple jobs queued up. To manage these fragments of work, workers had to switch between jobs and external tools to keep on top of everything. However, the 'quiet' periods when job stacks are empty also have knock-on effects, fragmenting the rest of the day. Having planned to set aside time to work on the crowdsourcing platform, workers were keen to make the most of this time. However, this time is not necessarily fungible; if there are few jobs, workers do not necessarily have the option to simply stop work and 'make it up' later. Instead, they remained 'on call', neither actively working on jobs but unable to turn off from searching and waiting for new jobs. Thus, workers were

hoping to make as much as possible in the time available.

Conversely, if there were plenty of available jobs, workers were reluctant to take breaks as planned and continue working without breaks. We argue that this situation was made possible because the platform did not have predictable work availability. This finding fits with prior work that reports that crowdworkers are not able to take breaks because of the time demands they were under [167]. Our study suggests that the time demands workers reported in prior work were likely due to workers having to work under the time pressures of ‘catching’ work before other workers and not taking breaks when work is available. Furthermore, the variable availability of work can increase workers’ task switching and multitasking activities and decrease their ability to take breaks and disconnect from work. In Williams et al.’s [48] study, some of the participants reported difficulties detaching from crowdwork and the process of searching for jobs. In particular, a participant reports difficulties detaching from work to take breaks because of fear they might miss out on potential earnings when work suddenly became available. In addition, a prior investigation of break-taking among crowdworkers also reveals that workers had concerns that taking breaks would decrease their earnings [167]. Evidence suggests that having control over taking breaks at the right time from working at a high pace can provide workers relief [168, 169]. However, a small number of breaks, or a lack of breaks, can result in sedentary behaviour and musculoskeletal symptoms [170], and depletion of cognitive resources, which leads to fatigue and burnout [171].

The results of this study are important because they suggest that the platform’s lack of work assignment can limit crowdworkers’ control over their work pace. A high work pace can increase the time pressures under which workers have to work. We know that when under time pressure, people tend to gather less information and to act quickly when making decisions [172]. Time pressure affects human judgement, and decision-making [173], calling into question the validity of data—used in both industry and academic publications—provided by crowdworkers. Future work will be required to assess the impact of time pressure on crowdworkers’ judgement

and decision-making. Furthermore, a high work pace can increase fatigue [174] and exhaustion [175] for the workers. Taking regular breaks can alleviate feelings of fatigue and exhaustion [168, 169] and replenish their energy resources [176]. However, participants in our study were not able to take breaks during periods of high work intensity. Lack of break-taking is of interest to the ongoing conversation about the working conditions of crowdworkers [77]. For example, crowdworkers based in the U.S. do not benefit from state law paid rest breaks at work (“a paid 10-minute rest period for each 4-hour work period” [177]) since crowdsourcing platforms are in large part unregulated. In comparison, drivers on Uber’s on-demand ride-hailing service can work up to a maximum of ten hours before having to take a six-hour break from completing trips [178]. Thus, the results of our study extend prior work examining the invisible work of crowdworkers by showing that participants in our study were not able to take breaks during periods of high work intensity.

In terms of unpaid time, the results of the study suggest that workers in our study spent on average 17% of their working time on unpaid activities such as waiting and searching for new jobs. Additionally, we observed that workers had to return 42% of the total number of jobs caught and had to continue waiting and searching for jobs to secure paid work. Waiting and searching for work is a form of work itself, unpaid and largely invisible [179]. There are no wage guarantees on crowdsourcing platforms [20], and workers are also not paid for the time they are doing essential admin and ‘meta-work’. Therefore, as there are generally more low-paying jobs than high-paying jobs on crowdsourcing platforms [46], crowdworkers have to compete against each other for the higher-paying jobs whilst ‘on call’ for work. Furthermore, for each 90 minutes of video recordings, workers in our study spent an average of twelve minutes on unpaid work activities (i.e., contacting clients, tracking earnings, reading forums or reviews, and checking qualifications) and on waiting and searching for jobs. In Berg’s [65] survey study, for every 60 minutes spent on the crowdsourcing platform, workers spent 18 minutes searching for jobs and performing unpaid preparatory work (i.e., unpaid work). In comparison, in our study, for every 60 minutes of ‘at work’ time, participants spent on

average eight minutes on unpaid work.

Additionally, Toxtli et al.'s [156] study identified that crowdworkers spend 33% (i.e., a median of 33 minutes) of their time daily on unpaid work. We note that the aforementioned study categorised as 'unpaid work' two activities that we considered to be part of actively working on jobs (see Section 4.1.5), rather than part of unpaid work: (1) "Starting jobs but then returning them" and (2) "Doing jobs that eventually timeout" [156, p. 9]. The latter activity (i.e., "Doing jobs that eventually timeout") was the most time-consuming activity observed in Toxtli et al.'s [156] study (for a median of 4.5 minutes and 37% of workers), whereas the first activity (i.e., "Starting jobs but then returning them") was the second most time consuming activity observed in their study (for a median of 4.2 minutes and 92% of workers).

However, in our study, we did not categorise these two activities as unpaid work, but instead we categorised them as 'Actively working on jobs', since the aim of our study was not to measure the amount of time workers have to take part in unpaid work activities, but to observe the impact of the platform's lack of work assignment on workers' temporal flexibility. Thus, since we did not categorise these two uttermost time-consuming activities as unpaid work, it is difficult to compare the amount of unpaid time reported in our study with the amount of unpaid time reported in [156]. Nevertheless, we hope that by reporting the amount of unpaid time workers spent in our study (an average of twelve minutes over 90 minutes of work), we can help further quantify the amount of time crowdworkers spent on unpaid work. Unpaid work ultimately impacts workers' wages—workers' already low hourly wages [46] go down from \$3.76 USD to \$2.83 USD when accounting for unpaid work [156]. Thus, paying workers at a rate for jobs that gives them 'slack' for unpaid work (i.e., the non-task aspects of taking on jobs) would provide recognition of this invisible work, but could also provide the platform and clients with an incentive to reduce the time and effort involved in doing unpaid meta-work (e.g., with better tooling, robust and reliable jobs).

Summary of Implications. Table 4.8 lists the implications of the time con-

straints we explored in this study. We initially identified two platform-imposed time constraints as part of the conceptual investigation conducted in the Background chapter (Chapter 3). In this chapter, we identified one additional platform-imposed time constraint as part of the empirical investigation we conducted. We next describe each time constraint and their corresponding implications.

Time Constraints	Implications for Workers
P1 The platform does not assign jobs to the workers.	P1. Workers' work pace and frequency of breaks can be impacted.
P2. The platform does not limit the maximum number of workers completing jobs at any given time. (This study)	P2. Workers might not have work available to complete for long periods of time; hence, workers have to spend 17% of their working time on waiting and searching for new jobs.

Table 4.8: Platform-imposed time constraints found on crowdsourcing platforms. The first time constraint was identified as part of conceptual investigation conducted in the Background chapter (Chapter 3). The items listed in red and marked with the words “This study” represent the new time constraints that we identified as part of the empirical investigation conducted in this study.

P1. The platform does not assign jobs to the workers. We identified this time constraint as part of the conceptual investigation conducted in the Chapter 3. The results suggest that not assigning jobs to the workers can impact the pace at which workers complete jobs and the frequency with which workers take breaks.

P2. The platform does not limit the maximum number of workers completing jobs at any given time. We identified the time constraint in this study. The results suggest that not limiting the number of workers completing jobs can lead to workers not having work available to complete for long periods of time; hence, workers have to spend 17% of their working time on waiting and searching for new jobs.

Additionally, in this study, we identified two new time constraints imposed on the workers by their work practices. Table 4.4 summarises the implications of the worker-imposed time constraints we identified in this study. We next describe each time constraint and their corresponding implications.

Time Constraints	Implications for Workers
W1. Workers have to rely on community-based reviews to evaluate jobs. (This study)	W1. Workers have to spend time on unpaid activities such as reading or writing job reviews.
W2. Workers might not always be able to take breaks. (This study)	W2. Workers can experience feelings of tiredness due to a lack of break-taking.

Table 4.9: Time constraints imposed by the working practices of the crowdworkers. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

W1. Workers have to rely on community-based reviews to evaluate jobs; First, we observed that participants spent time reading reviews to learn more about the jobs that became available on the platform. Thus, participants had to spend time on unpaid work activities such as reading or writing job reviews.

W2. Workers might not always be able to take work breaks. Second, participants were not always able to take work breaks during moments of high work intensity. Thus, participants experienced feelings of tiredness due to the lack of break-taking.

Finally, in this study, we did not identify any additional client-imposed time constraints. We next present the refined version of the table of time constraints found on the crowdsourcing platform, which we have been developing in this thesis as part of the conceptual investigation.

4.3.4.3 Conceptual Investigation

Table 4.10 presents a refined list of time constraints found on crowdworking platforms. The time constraints were identified as part of conceptual investigation conducted in the Background chapter (Chapter 3) and as part of the empirical investigation presented in this chapter. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study. Finally, we created a separate category for one of the new platform-imposed time constraint identified in this study: *Oversupply of Workers*.

Worker-Imposed Time Constraints	Description of Time Constraints
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. W2.6 Workers have to rely on community-based reviews to evaluate jobs. (This study) W2.7 Workers might not always be able to take breaks. (This study)
Client-Imposed Time Constraints	Description of Time Constraints
R1. Inflexibility of Time Use	R1.1 Clients can set strict completion times. R1.2 Clients can underestimate the completion times of jobs. R1.3 Clients can post jobs that do not work. R1.4 Clients can choose to pay workers poorly.
Platform-Imposed Time Constraints	Description of Time Constraints
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers.
P2. Unpredictable Work Availability	P2.1 The platform has no set hours when clients can post jobs. P2.2 The platform has no set hours when workers can complete jobs. P2.3 The platform has no limit to the number of hours workers can spend working.
P3. Unpaid Time	P3.1 The platform does not require clients to pay workers a minimum hourly wage.
P4. Oversupply of Workers (This study)	P4.1 The platform does not limit the maximum number of workers competing jobs at any given time. (This study)

Table 4.10: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

4.3.4.4 Limitations and Future Work

We discussed the limitations of using screen recordings in Study 2. In summary, the main limitations of our research method are: (1) we had a small sample size of 12 participants; (2) we might have omitted potential participants because of privacy concerns; (3) we were not able to record the activities on participants’ second screens; (4) it was difficult to set a fair pay rate for the study since we also recorded non-crowdwork work; and (5) we recorded participants’ working sessions for 90 minutes instead of the ‘typical’ working session length of 300 minutes observed.

4.3.5 Conclusion

This study presented an empirical investigation that explored how the time constraints imposed by the platform’s lack of work assignment limited workers’ tem-

poral flexibility. The results of the study refined the conceptual investigation conducted throughout this thesis and contributed an extended understanding of the time constraints that can limit the temporal flexibility of crowdworkers. In particular, the results of this study described how platform-imposed time constraints can limit workers' temporal flexibility.

Using video and qualitative data, we showed that the lack of work assignment can reduce workers' temporal flexibility by impacting the pace at which they work and frequency with which they take breaks. In this sense, we saw in this study that working on the platform was overall characterised by three distinct periods of work intensity: periods of low, moderate, and high work intensity. During this time, participants adjusted their work pace, and task switching and break-taking behaviours in relation to the intensity of the work. For example, during periods of high work intensity, participants increased their work pace and took fewer breaks to 'catch' the jobs that clients posted on the platform. Finally, given that we identified in the conceptual investigation conducted in Chapter 3 that crowdworkers experience unpredictable work availability because of platform-imposed time constraints, in the following study, we plan to explore how these time constraints can limit workers' temporal flexibility.

4.4 Study 4: Time Constraints Imposed by Crowdsourcing Platforms (II)

4.4.1 Introduction

In this study, we investigated the impact of the platform's *lack of predictable work availability* on the temporal flexibility of crowdworkers. We set the following RQ to guide our study: *How is the temporal flexibility of workers limited by the platform's unpredictable work availability?* To answer this RQ, we conducted an empirical investigation that used time-use diaries, qualitative surveys, and semi-structured interviews, which we present next.

As part of the empirical investigation, we triangulated subjective self-report (i.e., surveys and interviews) and objective measures (i.e., time-use diary entries) to investigate how unpredictable work availability can limit crowdworkers' temporal flexibility. We first surveyed 48 workers about their experiences of planning their work and non-work schedules. Next, we asked 19 survey respondents to keep a time-use diary through which we explored how much control participants had over their schedules. Finally, we interviewed seven diary participants to understand what difficulties they had sticking to their work schedules during the diary day.

Overall, we learnt that the platform's lack of predictable work availability impacted participants' ability to schedule their time and stick to their planned work hours. First, the results of the pre-diary surveys suggest that despite participants' efforts to learn when clients post jobs on the platform, they found it difficult to predict 'when' and 'for how long' work was going to be available on the crowdsourcing platform. As a result, participants reported difficulties planning and sticking to their non-work schedules. Next, the results of the time-use diaries suggest when it came to planning and sticking to their schedules during the diary day, whilst participants started and finished work roughly when they intended to, they worked on average two hours less than planned. In addition, the data suggest that participants' work-days were significantly more fragmented (i.e., broken into more work sessions) than participants planned, with work distributed across twice as many periods of work

as desired. Finally, the results of the post-diary interviews suggest that most participants could not stick to their planned work schedules during the diary day because a few well-paid jobs unexpectedly became available outside of their planned work hours. Taken together, the results of the study show that participants' ability to schedule their time and stick to planned hours of work was in particular impacted by the lack of predictable work availability on the crowdsourcing platform.

4.4.2 Methods

Data collection was conducted in three stages: (1) the qualitative survey stage, (2) the time-use diary study stage, and (3) the interview stage. First, in the qualitative survey stage, we used the surveys data to recruit participants for the time-use diary study stage; in the surveys, we asked 48 crowdworkers to describe their experiences of planning their work and non-work schedules. In the second stage of the study, we asked 19 survey respondents to keep two time-use diaries through which we explored how much control participants had over their schedule: (1) a time-use diary of planned paid work time, and (2) a time-use diary of everyday life activities. Finally, in the third stage of the study, we interviewed seven participants who took part in the diary study to ask further questions about participants' entries in the diaries; specifically, we were interested to learn how the lack of predictable work availability on the platform caused participants to deviate from their planned schedules. We next describe how we conducted the qualitative surveys.

4.4.2.1 Pre-diary survey

Design. We conducted the qualitative survey to recruit participants for the time-use diary study. In this sense, we used the survey to identify:

1. Participants who report earning a significant amount of their income (over 50%) from working on crowdsourcing platforms;
2. Participants who provided high-quality responses (in order to eliminate responses generated by 'bots' [180]); and
3. Participants who were interested in taking part in the follow-up time-use diary study.

We also used the surveys to gain an initial understanding of crowdworkers' experiences of planning their time for work and non-work activities. In this sense, we asked the survey respondents to think about the last day they worked on the crowdsourcing platform and to describe in minimum 400 words how they planned their work and non-work schedules. We told participants that we specifically wanted to learn about how they planned their time for the crowdsourcing platform work and non-work activities (such as family time, hobbies, etc), and about any challenges they faced when planning their work and non-work time.

Procedure. We advertised a job on a large crowdsourcing platform at an hourly rate of \$12 USD. Before agreeing to complete the job, workers were presented with an information page that contained all the information about the study. After the workers accepted the job, they were taken to Qualtrics, where they were presented with the qualitative survey in which we asked them provide a description of their experiences planning their work and non-work schedules. At the end of the survey, we asked participants four demographic questions and whether they would like to participate in a diary study in which they would be paid \$20 USD to document a day in their lives. We mentioned that the study looked at everyday life to find out what activities most contribute to people's wellbeing. Finally, once participants finished the survey on Qualtrics, we provided them with a completion code, and we asked them to submit the code into the job on the crowdsourcing platform. We paid participants within 24 hours of submitting the job. After analysing the survey responses, we identified 19 crowdworkers who were suitable to participate in the time-use diary study stage of this study. We describe the time-use diaries in Section 4.4.2.2.

Participants. 48 participants based in the U.S. took part in our survey. The participants were recruited through convenience sampling. We did not set any pre-screening criteria (e.g., Masters qualification), minimum job approval rates or minimum job completion rates. 30 participants (63%) identified as women, 17 (35%) as men, and one (2%) as non-binary; our sample had more women than the average population of crowdworkers reported in previous studies, which had a more bal-

anced workforce [152]. Most of the participants were in the age range of 35 to 44 and comprised 31% of participants; this is in line with previous studies reporting that the majority of the crowdworkers population is between the ages of 30 and 39 [153]. They were followed by participants between the ages of 45 and 54 (27%), participants in the age range of 24 to 34 years (25%), and participants in the age range of 55 to 64 (13%). Two participants were over the age of 65 (4%). In terms of education level, 20 of the participants (42%) reported having some college/technical training, and 19 participants (40%) reported holding a University undergraduate programme degree (e.g., Bachelor's); this is in line with previous studies reporting that crowdworkers are more likely to have a college degree [153]. A further three participants (6%) reported holding a University post-graduate programme degree (e.g., Master's), five participants (10%) a high school diploma, and one participant (2%) a Doctoral degree (e.g., PhD). On average, participants earned 59% of their personal income from working on crowdsourcing platforms ($SD = 37$).

Analysis. Our analytic approach is built upon Braun and Clarke's [154] thematic analysis. We began by familiarising ourselves with the 48 qualitative surveys by reading and re-reading each survey. We coded the surveys iteratively using NVivo 12. After familiarising ourselves with the surveys, we identified 84 code categories which we grouped into three themes. We present the themes in the Results section of this study (Section 4.4.3).

4.4.2.2 Time-use diaries

Design. We conducted a time-use-diary study to investigate how much control participants had over their work schedules. Time-use diaries are a multi-disciplinary research method used within the social sciences (e.g., [181]), psychology (e.g., [182]), and sociology (e.g., [183]) to capture how people use their time and document the time spent on daily activities. Time-use diaries have been used in the past to explore daily patterns of work and flexibility of work [184].

In this study, we used two time-use diaries. Firstly, we used the '7-day Work Schedule' diary to get an overview of when participants planned to work during the upcoming week. As shown in Figure 4.2, participants could mark with an 'X' each

15-minute interval when they plan to work on the crowdsourcing platform in the next seven days. Participants could also tick the ‘No work’ box if they did not plan to work on the crowdsourcing platform on a particular day.

Secondly, we used the ‘24-hour Everyday Activities’ diary to get a detailed record of participants’ activities over a single 24-hour period. As can be seen in Figure 4.3, participants were asked to record a detailed description of their activities every 10 minutes throughout the day. In addition, we used the ‘24-hour Everyday Activities’ diary to understand how well crowdworkers could stick to the schedule they had previously made at the start of the week using the ‘7-day Work Schedule’ diary. We based these two time-diaries of the United Kingdom 2014-2015 Time Use Survey [185]. We conducted the time-use diary study over a period of three weeks. Each week, we had ten participants complete the two diaries. Each week, we asked the participants to fill in the first diary on Sunday evening, and the second diary on the next day, on Monday. Participants were sent three reminders during the day to complete the second diary. After each week, we contacted the participants to arrange follow-up interviews. We present the interviews in the upcoming section.

We hosted the two diaries online using Microsoft Excel Online. We created separate files for each diary participant (DP), and we assigned each participant a unique link to their files. The links could only be accessed by the participants and the researchers. Participants were able to access the files containing the two diaries in their browsers (e.g., on a computer or phone) using the online spreadsheet software Microsoft Excel Online or on their desktop using the Microsoft Excel desktop application.

Once recruited, we asked participants to first complete the ‘7-day Work Sched-

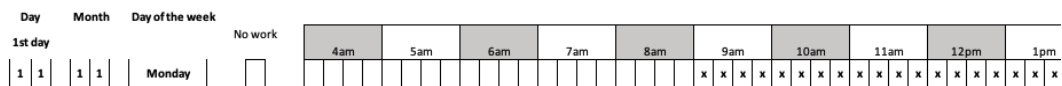


Figure 4.2: Example of a filled-in ‘7-day Work Schedule’ time-use diary from Diary Participant 1. Participants were asked to mark with an ‘X’ each time interval when they had planned to work on the crowdsourcing platform over the next seven days. Participants could tick the ‘No work’ box if they did not plan to work on the crowdsourcing platform on a particular day.

Please record your activity below

Time	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Were you alone or with somebody you know? Mark all relevant boxes					
					Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people
Early Morning										
10am-10.10	Transferred money from		X	" "	X					
10.10-10.20	Reading stuff online and waiting for work	Listening to podcasts	X	" "	X					
10.20-10.30	" "	" "	X	" "	X					
10.30-10.40	" "	" "	X	" "	X					
10.40-10.50	" "	" "	X	" "	X					
10.50-11am	" "	" "	X	" "	X					
11am-11.10	Completed some data entry type survey w/ bonus on		X	" "	X					
11.10-11.20	Checking email and taking care of anything that needs my attention	" "	X	" "	X					
11.20-11.30	Handled some computer issues and ordered some things	Listened to stream on Twitch	X	" "	X					
11.30-11.40	" "	" "	X	" "	X					

Figure 4.3: Example of a filled-in ‘24-hour Everyday Activities’ time-use diary from Diary Participant 1. The diary included columns for participants to enter main and secondary activities, as well as locations in their own words. Participants were asked to write down their activities throughout the day.

ule’ diary (Figure 4.2). We asked participants to mark with an ‘X’ each time interval when they had planned to work on the crowdsourcing platform in the next seven days. We used this diary to gather data on when participants *planned* to work during the week. On the following day, we asked participants to complete the ‘24-hour Everyday Activities’ diary (Figure 4.3). We asked participants to write down a description of their activities throughout the day. Participants were sent three reminders during the day to complete the ‘24-hour Everyday Activities’ diary. We used this diary to gather data on when participants *actually* worked during the week. In this way, it was possible to see how well participants were able to stick to the plans that they made the previous day.

Participants. Table 4.11 reports the demographics of the participants who took part in this study. We recruited 19 participants to take part in our study. We compensated the participants with \$20 USD for their time. Participants were required to earn a significant amount of their income (over 50%) from working on crowdsourcing platforms to participate in the study. We recruited participants who

Table 4.11: Study 1 Participant Demographics

DP#	Gender	Age	Highest education level	% of income from online work
DP1	M	24 - 34	Some college/technical training	100%
DP2	W	24 - 34	Some college/technical training	100%
DP3	W	55 - 64	University undergraduate programme (e.g., Bachelor's)	98%
DP4	W	35 - 44	University undergraduate programme (e.g., Bachelor's)	100%
DP5	W	45 - 54	University undergraduate programme (e.g., Bachelor's)	95%
DP6	W	45 - 54	Some college/technical training	60%
DP7	W	35 - 44	University undergraduate programme (e.g., Bachelor's)	90%
DP8	M	24 - 34	University undergraduate programme (e.g., Bachelor's)	90%
DP9	M	24 - 34	University undergraduate programme	90%
DP10	W	35 - 44	Some college/technical training	100%
DP11	M	65 years or over	University undergraduate programme (e.g., Bachelor's)	55%
DP12	M	35 - 44	Some college/technical training	100%
DP13	M	45 - 54	Some college/technical training	100%
DP14	W	45 - 54	Some college/technical training	70%
DP15	W	45 - 54	University post-graduate programme (e.g., Master's)	70%
DP16	W	35 - 44	Some college/technical training	100%
DP17	W	45 - 54	University undergraduate programme (e.g., Bachelor's)	100%
DP18	W	45 - 54	Some college/technical training	100%
DP19	Non-binary	24 - 34	University post-graduate programme (e.g., Master's)	95%

made a large portion of their income through crowdsourcing platforms; this is because crowdworkers who depend on online work for their living can spend a sizable portion of their workday being online for work to appear, compared to workers who have other sources of income [21]. All of the participants were based in the U.S., and, on average, participants earned 90% ($SD = 15$) of their income from working on crowdsourcing platforms. Of the 19 participants, 11 (58%) identified as women, 6 (32%) as men, and 1 (5%) as non-binary; our sample had more women than the average population of crowdworkers reported in previous studies, which had a more mixed workforce [152]. Sixteen (84%) participants were in the age range of 24 to 54 years; our sample was therefore consistent with the average population of crowdworkers, which ranges between the ages of 30 and 39 [153]. In terms of education level, 10 participants (53%) reported having some college/technical training, and 8 participants (42%) reported holding a University undergraduate degree (e.g., Bachelor's); this is in line with previous studies reporting that crowdworkers are likely to have a college degree [153]. A further 2 participants (11%) reported holding University post-graduate program degrees (e.g., Master's).

Ethical Considerations. Before taking part in the study, we briefed participants about the study's purpose and data confidentiality practices. The participation

of the workers was voluntary, and informed consent was obtained from all participants. The study had institutional research ethics approval: UCLIC/1718/013/Staff Cox/Lascau/Brumby.

Throughout the ‘24-hour Everyday Activities’ diary, we regularly prompted participants to avoid disclosing sensitive information. For example, we noted in the diaries that if there was something they felt was too private to record, participants should write ‘personal’ in the text fields. Furthermore, we pseudonymised the entries and separated workers’ usernames from the diaries to preserve confidentiality.

Analysis. The analysis is based on diary data from 18 participants. Out of the 19 participants recruited, we excluded the data from one participant (i.e., DP2) from the analysis. This is because DP2’s ‘24-hour Everyday Activities’ diary revealed that they did not engage in any crowdsourcing-related activities (e.g., completing jobs or waiting for work), except for filing in the diary itself. To code the remaining participants’ diary entries, we used the coding schema provided in the NatCen report [186] of the United Kingdom 2014-2015 Time Use Survey [185]. For example, sleeping activities were marked with ‘110’, and actively working on jobs on the crowdsourcing platform were marked with ‘1110’. We excluded from the last measure the amount of time during which participants filled in the diary.

4.4.2.3 Post-diary interviews

Design. We conducted seven interviews to ask further questions about participants’ entries in the time-use diaries. Specifically, we were interested to learn what caused participants to deviate from their planned schedules. In this sense, we asked the participants questions about critical incidents identified in the diary data.

Procedure. We conducted the seven interviews within a week of the end of the diary study. We scheduled the interviews to last 30 minutes and rewarded participants with \$5 USD for 30 minutes of their time. Additionally, we rewarded any interviews that took longer than 30 minutes at a base rate of \$10 USD per hour.

We conducted the seven interviews over instant messaging (IM). Being aware from Study 1 that some crowdworkers complete jobs in noisy environments, we gave interviewees the option to conduct the interviews verbally, or via IM [187,

188]. All seven participants chose to conduct the interviews over IM (i.e., over Skype). We began each interview by asking participants general questions about their experiences working on the crowdsourcing platform. After the more general question, we then asked participants specific questions based on their answers in the pre-diary survey. Finally, we asked participants a few questions about their diary entries. We provided participants with screen captures of their diaries to enable recall and reflection during the interviews.

We prepared the interview questions in advance, and, during the interviews, we pasted the questions (with any modifications, if required) into the chatbox. However, we allowed for a short amount of time to pass between pasting the text into the chatbox and sending it so that the post's timing and the interview's flow would not be impacted by sending the questions too quickly [187]. Conducting interviews over IM had its benefits. For example, interviewing IM allowed us to recruit participants who might otherwise have not been able to participate in the discussions for various reasons. Reasons include working in noisy environments, having specific communication differences, or feeling they could have expressed themselves better in writing [145].

However, conducting interviews over IM also had its downsides. For example, conducting interviews via IM can take longer than conducting interviews verbally. However, IM interviews are considered to be more time-effective than verbal interviews because of the lack of transcription required [145]. Furthermore, not only interviewing over IM can take longer to complete, but they can also generate fewer words. However, in a comparative study between verbal face-to-face and IM interviews, Shapka et al. [188] reported that the amount and type of themes that were generated during the interviews conducted over IM were not different compared to the amount and type of themes generated by the verbal interviews. Therefore, data quality is not affected when conducting interviews via IM. Finally, a potential disadvantage of interviews over instant messaging is that participants can edit their responses; therefore, interviews can appear less 'natural' when compared to verbal interviews. As a result, as suggested by Braun and Clarke [145], we reassured inter-

viewees that correct spelling and grammar were not important. We also encouraged them to use any emoticons (e.g., :) to signal smiling), abbreviations (e.g., 'lol' for laughing out loud), or even CAPSLOCK to convey importance [145].

Participants. Seven participants (out of the 19 who took part in the diary studies) participated in the post-diary interviews (i.e., DP4, DP5, DP8, DP12, DP15, DP16, and DP19). The seven participants were based in the U.S.. Out of the seven participants, four (57%) identified as women, two (29%) as men, and one (14%) as non-binary. Most of the participants were in the age range of 35 to 44 and comprised of 43% of participants. They were followed by participants between the ages of 24 and 34 (29%), and participants in the age range of 45 to 54 years (29%). In terms of education level, three of the participants (43%) reported holding a University undergraduate programme degree (e.g., Bachelor's). A further two participants (29%) reported having some college/technical training, and another two participants (29%) reported holding a University post-graduate programme degree (e.g., Master's). On average, participants earned 93% of their personal income from working on crowdsourcing platforms ($SD = 11$).

Analysis. Our analytic approach is built upon Braun and Clarke's [154] thematic analysis. We began by familiarising ourselves with the interviews by reading and re-reading each transcript. We coded the surveys iteratively using NVivo 12.

4.4.3 Results

In the next sections, we present the results of this study. We first report the results of the pre-diary surveys, followed by the results of the time-use diaries. Finally, we report the results of the post-diary interviews. We begin by describing the results of the pre-diary surveys.

4.4.3.1 Pre-diary survey

We generated three themes based on the results of the qualitative surveys. We present the themes below.

Theme 1: Attempting to learn the patterns of work availability. Initially, participants tried to learn when jobs became available on the platform in order to

align their work hours with the times of the day when jobs usually became available. In this sense, participants experimented with being available for work at different times of the day and for different periods of time. In time, participants learnt the times of the day when jobs became available in their region (e.g., mornings) or the days of the week when jobs were less likely to be available on the platform (e.g., weekends). For example, when it came to learning about the availability of work on the crowdsourcing platform, Participant 1 (P1) stated that *“knowing when there will actually be work, as well as whether or not the work pays a decent wage takes quite a bit of learning”*.

One way participants learnt when work was available on the platform was by tracking their earnings. For example, Participant 35 (P35) learnt which times of the day were most fruitful over the years. As a result, P35 was able to adjust their schedules to work when they were more likely to make money:

“My greatest challenge working on [name of platform] is earning a respectable rate per hour. After working on [name of platform] for a few years, productivity software told me I earn the bulk of my [name of platform] income during very specific hours, which are different each day of the week. I adjusted my daily schedule to reflect this [...]” — P35

Participants additionally learnt that there were certain times of the day when clients were more likely to post jobs on the platform. For example, when they had first started working on the crowdsourcing platform, Participant 43 (P43) made themselves available on the platform at all times of the day. However, in time, they learnt that mornings and early afternoons were the times of the day when clients were most likely to make jobs available:

“I tried different things when I first started, like working all day, but I stopped this when I learned how to make better use of my time on [name of platform]. I decided that in the morning and early afternoon were the best times to be on [name of platform] because that’s when a lot of jobs are posted.” — P43

In turn, participants also learnt when clients were less likely to post jobs on the platform, such as the weekend. In this sense, participants learnt that there was a decrease in work availability during weekends. Therefore, since participants knew that work would be slower on weekends, they did not actively plan to work during those days. However, some participants left their computers running in the background in case any well-paid jobs came up. For example, Participant 36 (P36) stated that they did keep an eye out for well-paid jobs at the weekends. However, they did not set themselves any financial goals during those days—any additional jobs they completed were a bonus:

“The weekends are a little different. I will work here and there and keep a lookout for any good jobs, but I have no daily goal on the weekends and anything I make is just extra on top of my planned income weekly. It’s harder to make money on the weekends because there are less good jobs being posted.” — P36

However, some participants reported putting in more hours of work at the weekends. For example, Participant 5 (P5) worked on the platform during the weekends as a way of compensating for the lack of available work during the workweek: “[...] Unless I miss my goals during the week, and when I do, I do crowdwork during the weekend as well. Its called compensating for time lost because I am not comfortable if I don’t reach a goal.”

Theme 2: Facing difficulties predicting the work availability. However, despite participants’ efforts to learn when clients post jobs on the crowdsourcing platform, the unpredictability of work availability meant that participants found it difficult to predict when and for how long they would be able to work on the platform. However, unlike the participants who learnt which days and times to dedicate to crowdwork, some participants spent their entire days working on the platform. For instance, P24 stated that they “*plan to spend as much time as possible on [name of platform] throughout the day, starting from the time [they] get up until the point where work stops coming in regularly, usually in the early to mid evening*”.

Participants reported spending long hours on the platform because they were finding it difficult to predict when work would be available. As a result of not knowing when work would be available, some participants found it difficult to relax. For example, Participant 24 (P24) mentioned that although they had roughly learnt when clients might post jobs, they found it stressful not knowing precisely when work would be made available on the platform. There, P24 reported having difficulties relaxing knowing that they might have been losing out on potential earnings:

“The biggest challenge in scheduling is that, with very few exceptions, you never know when good work is going to drop. There are, as I mentioned, times of day where there is more likely to be a heavy concentration of work, but there are still outliers where sometimes something really good will show up at 10 pm, or 3 am, etc. So for me that means that it’s hard to ever really relax because at any time when I’m doing something else I’m potentially losing out on money. It’s like always being on call. [...] It’s a bit stressful and makes me feel always a bit on edge.” — P24

Participants also found it difficult to balance their time working with the time they spent on non-work activities because they did not know when work would be available on the platform. For example, Participant 2 (P2) struggled to plan both their work and non-work schedules as a result of the lack of predictable work availability:

“As far as relevant issues go the biggest one I can think of is the fact that you never really know when work is going to be posted. Sure, you can get a rough idea once you’ve been doing work from a client for a long enough period of time, but still nothing is guaranteed. Not only do I not know what time of day a specific client is going to post work for us to do - I don’t even know what day of the week it’ll appear if it even does. [...] This uncertainty can really fuck with my ability to

effectively plan my time while working which in turn affects how I plan my non-work time.” – P2

Theme 3: Planning and sticking to non-work schedules. As a result of not being able to predict when work would be available, participants reported facing difficulties planning and sticking to their non-work schedules. In this sense, many participants reported finding it challenging to plan ‘when’ and ‘for how long’ they would be able to engage in non-work activities because jobs were made available at irregular times on the platform. Furthermore, some participants also found it challenging to schedule time for non-work activities such as spending time with friends because of the financial instability of crowdworking. For example, Participant 30 (P30) stated that planning time with friends was difficult because they did not know if they would reach their daily financial goals. Importantly, P30 also mentioned that the risk of burning out was a downside of the ‘flexibility’ that crowdworking provided:

“This type of work does allow freedom but at a cost. I try not to cancel times with friends but it is hard to schedule due to not always knowing whether I will be at my goal when I plan to meet them. I miss having weekends off and greater job security. There is a high burnout rate for crowd work in general.” — P30

A different participant also reported cancelling or postponing activities they had planned with family or friends if they were busy working. In the case of Participant 26 (P26), one aspect of cancelling or postponing their non-work activities had to do with whether they had managed to make enough money for the day or not:

“At times when a friend asks me if I want to hang out and I am busy completing jobs on [name of platform] I will just tell the friend that it has to be a bit later as I am busy. If there will not be another chance to hang out with my friends later than I may or may not stop working on [name of platform] to go hang out with them. This kind of depends on a

couple of things: How much money do I have saved at the moment, am I working towards a purchase, how ahead of my bills am I and just how much do I feel like hanging out with people at the moment.” — P26

Additionally, Participant 42 (P42) described a particular evening where they found it challenging to fit non-work activities into their schedules. In their situation, P42 did not know how long it would take them to complete their queued jobs. Thus, the participant did not know when their workday would end. This situation made them feel stressed over the plans they had made for the rest of the day:

“It was challenging, and always is, to find time to fit in my chores and personal jobs. It is hard to tell how long jobs may take and it is hard to leave just the right amount of time to be productive with work and jobs. [...] This last day I worked I was almost stressed by my evening plans because I really needed to get the house tidy and have myself ready to go as I had plans to be somewhere at a certain time.” — P42

However, the people in P42’s life did not show much understanding of their situation because they believed that P42 had a flexible schedule since they worked from home:

“Few people in my life really understand my work and they do not like it if I am late or something, especially because I think to others it seems like I just work from home so I could have budgeted time better or something.” — P42

A few other participants mentioned being unable to stick to their non-work plans because of not knowing when their workday would end. For example, Participant 14 (P14) mentioned missing out on plans they had made with friends or family members because of new work becoming available on the platform at the end of the day:

“Occasionally one of my closed quals pops up with a great pay rate. In those rare instances, I might consider changing my schedule so that I

can earn extra money quickly. That can be a challenge because not all my friends and family understand the extra work I do and why I would need to cancel my plans to sit in front of a computer and work on jobS.”

— P14

Overall, participants struggled to plan non-work activities into their schedules because of the platform’s unpredictable work availability. In this sense, not knowing how much work there would be available for the day made participants’ non-work schedules unpredictable. Furthermore, when participants did manage to make plans for non-work activities, they struggled to stick to their plans because of the fluctuating availability of work on the platform. Therefore, the platform’s unpredictable work predictability meant that participants struggled to plan and stick to their non-work schedules.

4.4.3.2 Time-use diaries

Table 4.12 provides an overview of the observed differences between how participants *planned* to work for a given day on the crowdsourcing platform, as captured by the ‘7-day Work Schedule’ diary, compared to how they *actually* worked, as captured by the ‘24-hour Everyday Activities’ diary. For all statistical analysis, we used a paired sample *t*-test since the data were normally distributed as assessed by the Shapiro-Wilk test ($\alpha = .05$). We judged effects significant if they reached a 0.05 significance level. We explain each of the measures in more detail in the following sections.

Measure	Difference of the Means (<i>Actual–Planned</i>)	95% CI	<i>t</i> -value
Start time of workday	15 min	-8 min, 38 min	1.37
End time of workday	37 min	-36 min, 1 hr 50 min	1.07
Number of periods of work	3.11	1.30, 4.92	3.62*
Duration of periods of work	-1 hr 58 min	-2 hr 54 min, -1 hr 01 min	5.32**
Duration of total hours worked	-2 hrs 03 min	-3 hr 30 min, -36 min	2.99*

Table 4.12: Difference between actual and planned the crowdsourcing platform work from Study 1 diaries. A period of work is defined as a block of contiguous work that is separated from another period of work by a break of at least 10 minutes. *Note:* $df = 17$, * $p < .01$, ** $p < .001$.

Start and End Time of Workday. We first consider the time of day that participants planned to start and end their workday, and whether our participants then actually kept to these plans on a given day. We found that participants planned to start their workday in the morning at around 8 am ($M = 08:06$, $SD = 1$ hr 35 min). In reality, participants actually started their workday a little later than planned ($M = 08:21$, $SD = 2$ hr). However, a paired sample t -test found there to be no significant difference between planned and actual start time of the workday, $t(17) = 1.37$, $p = .19$, 95% CI = [-8 min, 38 min]. Participants planned to end their workday in the evening at around 6:30 pm ($M = 18:23$, $SD = 3$ hr 14 min). In reality, participants actually stopped a little later than planned ($M = 19:00$, $SD = 3$ hr). A paired sample t -test again found there to be no significant difference between the planned and actual end time of the workday, $t(17) = 1.07$, $p = .30$, 95% CI = [-36 min, 1 hr 50 min]. These results show that participants planned to work what can be considered traditional working hours, starting work in the morning and finishing work in the early evening. There was, therefore, no evidence that participants did not keep to their planned start and finish times.

Number of Hours Worked. We next consider whether participants were able to actually work the number of hours planned within their working day. We found that while participants planned to work on average for 8 hr 17 min ($SD = 2$ hr 45 min), they were only able to actually work 6 hr 13 min ($SD = 2$ hr 33 min). A paired sample t -test found that participants actually worked significantly fewer hours (-2 hr 03 min) than planned, $t(17) = 2.99$, $p = .008$, 95% CI = [-3 hr 30 min, -36 min]. Therefore, results of the diary study show that our participants worked on average two hours less than planned. Furthermore, out of the total time worked, participants spent on average 1 hr 23 min ($SD = 3$ hr 30 min) waiting and searching for work. In other words, participants spent on average 22% of their daily working time on unpaid activities such as waiting and searching for new jobs.

Fragmentation of Workday. To better understand why participants were not able to work as many hours as planned despite starting and ending their workday as planned, we next drill down to consider *periods of work*. We define a period

of work as a block of contiguous work (either planned or actually reported) that is separated from another period of work by a break of at least 10 minutes. For example, participant DP17 planned to work across two distinct periods of work: (1) 08:30-13:00 and (2) 14:00-17:30. However, participant DP17's actual work pattern was far more fragmented than planned, with work being done in many more shorter periods of work than planned: (1) 08:00-09:10, (2) 09:50-10:50, (3) 11:00-11:10, (4) 11:40-12:50, (5) 14:20-17:00. From this example, we can see that the reason participant DP17 worked 1 hour 90 min less than planned is because work was done over five periods of work instead of two, and that each of these work periods was far shorter in duration than planned. In other words, participant DP17's workday was far more fragmented than they had planned.

To examine whether participants' workdays were more fragmented than planned, we consider both the frequency and the duration of the periods of work throughout the workday. While participants planned to work across only three distinct periods in the day ($M = 3.06$, $SD = 1.63$), they actually worked across six periods ($M = 6.17$, $SD = 3.37$). A paired sample t -test found this difference to be significant, $t(17) = 3.62$, $p = .002$, 95% CI = [1.30, 4.92], suggesting that participants' work schedules were far more fragmented than planned. Therefore, the results of the diary study show that our participants' workdays were more fragmented than planned, with work distributed across twice as many work periods as planned. In terms of the duration of these work periods, we found that participants planned for each period of work to be on average 3 hr 22 min ($SD = 1$ hr 57 min). In reality, each period of work was actually only 1 hr 24 min ($SD = 1$ hr 11 min), which was significantly shorter in duration than planned, $t(17) = -4.42$, $p < .001$, 95% CI = [-2 hr 54 min, -1 hr 01 min]. Therefore, results of the diary study show that the work periods our participants worked were far shorter than planned.

4.4.3.3 Post-diary interviews

We next report the results of the analysis of the post-diary interviews. Overall, the interviews suggested that participants could not stick to their work schedules

because well-paid jobs became available outside their planned work hours. For example, DP5 (P11) reported working later in the evening of the diary study than they had initially planned. During the day, there were not enough well-paid jobs for DP5 (P11) to reach their daily financial goals; therefore, they worked during the time scheduled for spending time with family:

“[...] if something really good is posted and I can make a lot of money I will turn off the TV or excuse myself from what ever I was doing to do that but for me the reward has to be a little higher in the evening to pull me away from family time if that makes sense” — DP5 (P11)

A further participant had to work later than they had initially planned because a series of jobs that paid well became available in the evening of the diary study. As a result of the work becoming available in the evening, DP12 (P24) mentioned altering their sleeping schedule and going to sleep four hours later than initially planned:

“[...] I was about to go to sleep and a batch drops and I end up having to go to sleep 4 hours later than I intended because otherwise I feel like I'm leaving money on the table. For a while there were a couple clients that posted regularly at 1-2 am so I'd get up in the middle of the night when job monitor went off. You have to do the work when its available, you don't really get any say in it” — DP12 (P24)

Finally, on a few occasions, participants also worked on the crowdsourcing platform during the day, during times that they had scheduled for non-work activities. For example, DP4 (P10) reshuffled their non-work schedule to fit in several jobs that unexpectedly became available on the platform outside their planned work hours. As a result, DP4 (P10) rescheduled the non-work activities they had planned for the day:

“Well, I try to balance working and getting the kids out to play as well.. but there have been times that I have to have them wait because something good popped up, I may rearrange the time I was going to go to

the store..dinner could be later than normal.. it just kind of depends on what is going on". — DP4 (P10)

When we asked participants what would make it easier for them to stick to their schedules, a few participants mentioned *closed qualification jobs*. Closed qualification jobs were jobs that had been specifically assigned to a particular worker to complete (rather than being available to all the workers on the platform). To qualify for this type of job, workers had to complete an unpaid job through which they would be granted a custom qualification based on their performance. Participants preferred closed qualification jobs because they often had longer completion times compared to ‘regular’ jobs. The longer completion times gave participants more flexibility in terms of when they worked, which in turn allowed them to stick to their schedules better. For example, DP5 (P11) mentioned that working on a number of closed qualification jobs that were posted regularly helped them have more control over their schedules:

"I don't have control over when good work is posted and that will always be an issue but I can choose not to do it there is always of course the financial consequence of that choice so I can see how some people would feel they don't have control especially when starting out but at this point I have several closed qualifications from clients who post regularly so it gives me a little more freedom I haven't been chasing penny jobs so to speak for years" — DP5 (P11)

However, closed qualification jobs were not always the solution to increasing the predictability of participants' schedule. For example, DP4 (P1) mentioned missing out in the past on the initial jobs they needed to complete prior to qualifying for a closed qualification job, hence missing out on the chance to work on a closed qualification job: *"[...] it sucks if you happen to miss the qual to begin with lol [...] usually the client puts a qual job out first.. so if you miss that.. you dont get in on the qualled jobs"*.

Overall, during the diary day, some participants had to work outside of their planned work hours because well-paid jobs became available on the platform out-

side of the planned work times. Thus, participants adjusted their work and non-work schedules to fit in the extra work during the day or at night. Further, closed qualification jobs had the potential to increase participants' schedule control, but only if participants were lucky enough to 'catch' the qualifying job for this type of job.

4.4.4 Discussion

In this study, we aimed to answer the following RQ: How is the temporal flexibility of workers limited by the platform's unpredictable work availability? To answer the RQ, we conducted an empirical investigation that used time-use diaries, qualitative surveys, and semi-structured interviews.

4.4.4.1 Summary of Results

Taken together, the results of the study described how the second time constraint imposed by the platform's design can limit workers' temporal flexibility. In particular, the results suggest that the platform's unpredictable work availability impacted participants' ability to schedule their time and stick to their planned work hours. First, the results of the pre-diary surveys suggest that despite participants' efforts to learn when clients post jobs on the crowdsourcing platform, they found it difficult to predict 'when' and 'for how long' work was going to be available. Next, the results of the time-use diaries suggest that participants worked on average two hours less than planned and spent on average 22% of their daily working time on unpaid activities such as waiting and searching for new jobs. In addition, participants' workdays were significantly more fragmented (i.e., broken into more work sessions) than participants planned, with work distributed across twice as many periods of work as desired. Finally, the results of the post-diary interviews suggest that participants could not stick to their planned work schedules during the diary day because a few well-paid jobs unexpectedly became available outside of their planned work hours. We next consider the implications of the results and summarise the time constraints identified in this study.

4.4.4.2 Implications

The results of the diary study show that our participants' workdays were far more fragmented than they had planned: there were on average twice as many work periods as planned, and each of these was far shorter than planned. Moreover, this increased fragmentation of the workday meant that participants were on average working for two hours less than planned despite starting and ending their workday roughly when they had planned. These findings are interesting because most of our participants wanted to work a 'shift' on the crowdsourcing platform, setting out clear start and end times when they wanted to work on the platform and generally sticking to them—thus, they were responding to the imperatives of the platform within this constraint, not just 'jumping to attention' at any point jobs arrived. However, as suggested by the results of Study 1, this fragmentation of the work day can result in multitasking and task switching, which has its costs.

Our results also suggest that participants worked on average for two hours less than planned. In contrast, participants in Lehdonvirta's [21] interview study report having to frequently work longer hours than planned. However, it is unclear if participants in the aforementioned study were speaking about the amount of time they had to work (i.e., for how long) or the times of the day at which they were working (i.e., when). In our study, we aimed to differentiate between the two concepts and provide objective measures. It could be that participants in Lehdonvirta's [21] study were speaking about both scenarios. Nevertheless, the fact that in our study participants worked two hours fewer than they had planned illustrates the issue with the lack of predictable work availability on crowdsourcing platforms: with participants having set aside time to work a 'shift', the data suggest they could not 'fill' this time and maximise their earnings. This situation indicates a paucity of work available on the platform that meets workers' requirements, meaning that workers end up using the time already assigned inefficiently trying to find work. Lack of suitable work at a given time can also be seen in the case of platform workers on freelancing platforms, such as Upwork, where freelancers report spending a high number of unpaid hours on finding jobs [189].

This study also yields new insights into the relationship between the flexibility and fragmentation of work in crowdsourcing platforms. Our results paint a picture of workers seeking to develop some kind of routine, but where the platform's architecture prevents them from doing so. At a workday level, this leads to high temporal fragmentation of workers' schedules. The temporal fragmentation makes it harder for workers to schedule their time across the day in a way that balances demands on their time. Irregular and unpredictable schedules of work can disrupt daily or weekly routines [190], and personal relationships [191], and thus reduce control over work-life boundaries [192]. Furthermore, non-standard work schedules are associated with anxiety and irritability [193], decreased sleep quality [194], and can have adverse effects on mental health [195]. However, it is not just unpredictability in working time that can worsen the working conditions of crowdworkers, but also the economic instabilities, as evidence suggests that unpredictable and unstable work schedules can lead to economic insecurity [196, 197].

In summary, the schedule-level data tells us something about the temporal fragmentation of the working day within the 'shifts' that workers plan to fit in around their other commitments. Even when workers set aside time to work (rather than simply being continuously available), scheduling in the face of a 'flexible' platform with variable availability of work is almost impossible, and workers end up fitting life around the times when work is available. The fact that workers miss out on almost two hours of work in a given 'shift' but do not attempt to 'catch up' on this time at the end of the shift, might imply that workers are aware that after a certain hour they will not find work on the platform; or they are simply not keen to make use of the 'flexibility' that the platform offers.

Summary of Implications: Table 4.13 lists the implications of the time constraints we explored in this study. We initially identified three platform-imposed time constraints as part of the conceptual investigation conducted in the Background chapter (Chapter 3). In this chapter, we identified one additional platform-imposed time constraint as part of the empirical investigation we conducted. We next de-

scribe each time constraint and their corresponding implications.

P1. The platform has not set hours when clients can post jobs. We identified this time constraint as part of the conceptual investigation conducted in the Chapter 3. The results suggest that not having set hours when clients post jobs can lead to workers spending a long amount of time waiting and searching for work.

P2. The platform has no set hours when workers can complete jobs. We identified this time constraint as part of the conceptual investigation conducted in the Chapter 3. The results suggest that not having set hours when workers can complete jobs leads to workers having difficulties predicting their work and non-work hours.

P3. The platform has no limit to the number of hours workers can spend working. We identified this time constraint as part of the conceptual investigation conducted in the Chapter 3. The results suggest that not limiting the number of hours workers can spend working can result in the workers spending long hours working on the platform.

P4. The platform has no control over the completion times of jobs. We identified the time constraint in this study. The results suggest that not having a degree of control over the completion times of jobs made it more difficult for workers to plan their work and non-work schedules.

Time Constraints	Implications for Workers
P1. The platform has not set hours when clients can post jobs.	P1. Workers have to spend a long time waiting and searching for work.
P2. The platform has no set hours when workers can complete jobs.	P2. Workers can have difficulties predicting their work and non-work hours.
P3. The platform has no limit to the number of hours workers can spend working.	P3. Workers can end up working long hours on the platform.
P4. The platform has no control over the completion times of jobs. (This study)	P4. Workers can have difficulties planning their work and non-work schedules.

Table 4.13: Platform-imposed time constraints found on crowdsourcing platforms. The first time constraint was identified as part of conceptual investigation conducted in the Background chapter (Chapter 3). The items listed in red and marked with the words “This study” represent the new time constraints that we identified as part of the empirical investigation conducted in this study.

Worker-Imposed Time Constraints	Description of Time Constraints
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. W2.6 Workers have to rely on community-based reviews to evaluate jobs. W2.7 Workers might not always be able to take breaks.
Client-Imposed Time Constraints	Description of Time Constraints
R1. Inflexibility of Time Use	R1.1 Clients can set strict completion times. R1.2 Clients can underestimate the completion times of jobs. R1.3 Clients can post jobs that do not work. R1.4 Clients can choose to pay workers poorly.
Platform-Imposed Time Constraints	Description of Time Constraints
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers.
P2. Unpredictable Work Availability	P2.1 The platform has no set hours when clients can post jobs. P2.2 The platform has no set hours when workers can complete jobs. P2.3 The platform has no limit to the number of hours workers can spend working. P2.4 The platform has no control over the completion times of jobs. (This study)
P3. Unpaid Time	P3.1 The platform does not require clients to pay workers a minimum hourly wage.
P4. Oversupply of Workers	P4.1 The platform does not limit the maximum number of workers competing jobs at any given time.

Table 4.14: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

4.4.4.3 Conceptual Investigation

Table 4.14 presents a refined list of time constraints found on crowdworking platforms. The time constraints were identified as part of conceptual investigation conducted in the Background chapter (Chapter 3) and as part of the empirical investigation presented in this chapter. The items listed in red and marked with the words “This study” represent the new time constraints that we identified in this study.

4.4.4.4 Limitations and Future Work

We recruited participants who made a large portion of their income through crowdsourcing platforms, as they are known to spend a significant proportion of their time waiting for work [21]. However, we did not set any other pre-screening cri-

teria when we recruited the participants, such as minimum job completion rates or minimum earnings. Therefore, we cannot know if any of the participants in our study were highly experienced workers. Observing more experienced workers could have created potential biases towards the interpretation of our results as the workers might have developed specific strategies to schedule their time. Nevertheless, for this work, a general understanding of planning and fragmentation is sufficient. Still, it could be that a more focused or stratified sample based on experience rather than time might yield insights into whether planning effectiveness develops with experience, and whether there are ceiling effects (i.e., a point at which experience cannot overcome the fundamental architecture of the platform). Furthermore, we asked 19 workers to keep the two time-use diaries, whereas time-use diaries are usually administered to larger samples of hundreds or thousands of participants (e.g., [185]). Therefore, results in the study might not necessarily be generalisable to the wider population of crowdworkers. However, the results provide an initial overview of the limitations workers encounter when scheduling their time. Future work should consider administering the diaries to a larger sample of participants to examine the scale and significance of the issues observed in our study.

We asked participants in the time-use-diary study to record their work activities throughout the day, in line with prior studies that have asked participants to keep diaries of their work activities (e.g., [198, 199, 200]). Asking participants to record their activities every ten minutes throughout the day could have been disruptive to participants' work. The potential disruptiveness is a common disadvantage of diary studies [199]. However, the *in-situ* and in-the-moment nature of these kinds of diaries is an important advantage [201, 151]. We have reason to think that in this working context, the disruptive effects of the diaries may have been less apparent. Working on crowdsourcing platforms is a fragmented activity; as larger jobs are decomposed into short jobs, the disruptions to participants' work should have been minimal. The disruption should have been minimal because filling in the diaries could be done quickly, which should have made recovering from the interruption easier [202]. Moreover, the interruptions were relevant to the participants' main

jobs (e.g., working on the crowdsourcing platform), an aspect which should have also made it easier for the participants to recover from the interruptions [203, 204]. Despite the additional workload, participants in our study engaged with the diaries throughout the diary day and completed all the required fields. Subsequent studies could employ alternative methods (e.g., Experience Sampling Method [205, 206]) and alternative time frames (e.g., hourly reports) to examine the extent to which workers encounter difficulties in planning and sticking to their schedules. It might be that a lower fidelity of data might still serve the purpose.

4.4.5 Conclusion

This study presented an empirical investigation that explored how the time constraints imposed by the platform's lack of predictable work availability limited workers' temporal flexibility. The results of the study refined the conceptual investigation conducted throughout this thesis and contributed an extended understanding of the time constraints that can limit the temporal flexibility of crowdworkers. In particular, the results of this study described how platform-imposed time constraints can limit workers' temporal flexibility.

Using subjective self-report (i.e., surveys and interviews) and objective measures (i.e., time-use diary entries), we showed that the platform's lack of predictable work availability impacted workers' control over scheduling their time and sticking to planned work hours. In this sense, we saw in this study that participants had difficulties predicting their work hours as a result of the platform's lack of predictable work availability. For example, participants had to spend on average 22% of their daily working time on unpaid activities such as waiting and searching for new jobs. Furthermore, participants' workdays were significantly more fragmented than planned, with work distributed across twice as many work periods as desired. Finally, we learnt that participants had to readjust their work and non-work schedules during the diary day to fit a few well-paid jobs that unexpectedly became available outside their planned work hours. We next conclude the two studies we presented in this chapter.

4.5 Chapter Conclusion

In this chapter, we investigated how the time constraints imposed by workers' circumstances, clients, and the design of crowdsourcing platforms can impact crowdworkers' temporal flexibility. Using the lens of VSD, we were able to investigate how each type of value tension (i.e., worker-, client-, and platform-imposed constraints) can influence the amount of temporal flexibility crowdworkers experience.

In particular, the results of Studies 3 and 4 suggest that platform-imposed time constraints can limit workers' control over their work pace and work schedules—in turn decreasing temporal flexibility and, importantly, increasing temporal precarity. Work pace and work scheduling are two components of temporal precarity. As highlighted in Chapter 3, temporal precarity is defined as the unpredictability, uncertainty, and insecurity workers experience with respect to work scheduling and work pace [66]. Prior research exploring the sustainability of platform work has criticised the exacerbation of work precarity that platform workers experience [207, 208] and has asked for an investigation of the work precarity of platform work [22]. Thus, the results of Studies 3 and 4 extend the current understanding of how platform workers experience temporal precarity.

Given the interaction we have observed in Studies 3 and 4 between temporal precarity and platform-imposed time constraints, we argue that platform-imposed time constraints have the potential to limit workers' temporal flexibility most. In other words, platform-imposed time constraints have the potential to create the most value tensions that limit crowdworkers' ability to exercise temporal flexibility. We argue that whilst all the three types of time constraints explored so far in this thesis (i.e., worker-, client-, and platform-imposed constraints) can influence the amount of temporal flexibility workers experience, platform-imposed time constraints have the potential to limit workers' temporal flexibility most. Therefore, in the following two studies (i.e., Studies 5 and 6), we aim to investigate how the properties of crowdworking platforms can increase workers' temporal flexibility and decrease temporal precarity.

Chapter 5

Technical Investigations of Crowdworkers' Temporal Flexibility

Parts of this chapter have been published in:

Lascău, L.; Gould, SJJ; Brumby, DP; Cox, AL (2022) *Crowdworkers' Temporal Flexibility is Being Traded for the Convenience of Requesters Through 19 'Invisible Mechanisms' Employed by Crowdfunding Platforms*. In CHI Conference on Human Factors in Computing Systems Extended Abstracts.

This chapter contributes a new understanding of the features of crowdsourcing platforms that can support crowdworkers' temporal flexibility.

From the lens of VSD, technical investigations examine how existing technological features and underlying mechanisms promote or constrain human values [25]. VSD conceptualises *values* as an interactional product of technology and society, produced in the socio-technical gap [29]. According to VSD, when values are not accounted for in the design process, they are often unconsciously embodied by technology, supporting the values held by the designers of the technology instead of the values of those impacted by the technology [30]. We next present two technical investigations that aim to explore how the design of crowdsourcing platforms can increase crowdworkers' temporal flexibility, whilst decreasing the temporal precarity crowdworkers experience.

5.1 Study 5: Retrospective Technical Investigation of Temporal Flexibility

5.1.1 Introduction

So far in this thesis, we identified a list of platform-imposed time constraints that can limit crowdworkers' temporal flexibility. We first identified the time constraints as part of the Background chapter (Chapter 3), and we refined them subsequently based on the results of the empirical investigations (Chapter 4). In this study, we widen our focus to existing crowdsourcing platforms to explore how widespread the platform-imposed time constraints identified so far are and to identify additional time constraints that can limit workers' temporal flexibility. Therefore, this study presents a retrospective technical investigation, in which we identified how existing crowdsourcing platforms constrain workers' temporal flexibility. We set the following RQ to guide our study: *What other features of crowdsourcing platforms can further constrain workers' temporal flexibility?* To answer the RQ, we conducted a retrospective technical investigation, which we present next.

As part of the retrospective technical investigation, we used the time constraints identified so far in the thesis to create a list of technical features of crowdsourcing platforms that can constrain workers' temporal flexibility. Next, we used the list of features to conduct a feature analysis of nine existing crowdsourcing platforms. As part of the feature analysis, we reviewed the platforms' descriptions, list of Frequently Asked Questions (FAQs), Documentation, and Terms of Service (TOS) against the list of features. We also analysed the platforms through our own experiences of interacting with the platforms, as workers and clients.

Overall, we identified 19 technical features of existing crowdsourcing platforms that can constrain workers' temporal flexibility. We used the features to refine our existing conceptual investigation, and to propose recommendations for the design of future crowdsourcing platforms. Taken together, the retrospective technical investigation presented in this study furthers our understanding of the time constraints imposed on crowdworkers by the design of crowdsourcing platforms.

5.1.2 Methods

5.1.2.1 Retrospective Technical Investigation

Retrospective technical investigations are a type of technical investigations that examine how existing technical features underlying the mechanisms of technology support or constrain human values. Retrospective technical investigations are informed by the results of a prior conceptual investigation [24] (e.g., conducted as part of this thesis' Background chapter, in Chapter 3). Furthermore, within VSD, retrospective technical investigations centre the technology as the unit of analysis, rather than the people who use the technology [25], which is the focus of empirical investigations (e.g., conducted in Chapter 4). In other words, the emphasis of technical investigations is on understanding the value implications of technology [24]. For example, Friedman et al. conducted a retrospective technical investigation to study informed consent online in the context of cookies and web browser security [209]. The results of their investigation led to the development of a browser plug-in (as part of a subsequent proactive technical investigation), which was afterwards formally evaluated with direct stakeholders (as part of an empirical investigation).

As part of our retrospective technical investigation, we analysed nine crowdsourcing platforms to identify which platforms employ the highest number of features that constrain workers' temporal flexibility. Our work was inspired by Wisniewski et al. [210], who used the lens of value sensitive design to reverse engineer a subset of values embedded in the design of 75 mobile apps. We describe below how we conducted the feature analysis of nine crowdsourcing platforms.

5.1.2.2 Technical Features Analysis

Table 5.1 presents a list of five categories comprising of seven technical features of crowdsourcing platforms that can constrain temporal flexibility. The features were derived from the platform-imposed time constraints identified so far in the thesis. The list includes features such as 'Platforms do not require clients to pay workers a minimum hourly wage'. We derived the features from the platform-imposed constraints identified so far—e.g., 'The platform does not require clients to pay workers

Categories	Technical Features
1. Lack of Work Assignment	1.1 Platforms do not assign jobs to the workers.
2. Unpredictable Work Availability	2.1 Platforms have no set hours when clients post jobs. 2.2 Platforms have no set hours when workers can complete jobs. 2.3 Platforms have no limit to the number of hours workers can work. 2.4 Platforms allow clients to set the completion times of jobs.
3. Unpaid Time	3.1 Platforms do not require clients to pay workers a minimum hourly wage.
4. Oversupply of Workers	4.1 Platforms do not limit the maximum number of workers completing jobs at any given time.

Table 5.1: Technical features of crowdsourcing platforms that can constrain workers' temporal flexibility. The time constraints were identified as part of the Background chapter (Chapter 3) and in the previous three empirical investigations (Chapters 4, 5, and 6).

a minimum hourly wage'.

For the purpose of this feature analysis, we were only interested in exploring platform-imposed time constraints (e.g., Lack of Work Assignment). We were not interested in exploring client-imposed time constraints (e.g., Inflexibility of Time Use) since clients' behaviour is subjective. Furthermore, we were not interested in exploring worker-imposed time constraints (e.g., Work Circumstances) because these types of constraints would not be reflected in the platforms' design. We describe next the seven technical features included in the analysis.

1. Lack of Work Assignment *1.1 Platforms do not assign jobs to the workers.* The first technical feature we generated for this study derives from one of the platform-imposed time constraints identified in the Background chapter (Chapter 3) (i.e., "The platform does not assign jobs to the workers."). We learnt from Study 3 that workers have to spend their time waiting next to their computers to 'catch' jobs as a result of this constraint. Thus, we aim to identify whether the crowdsourcing platforms analysed assign jobs to the workers. For example, on some platforms, workers could be assigned specific jobs to work on.

2. Unpredictable Work Availability. *2.1 Platforms do not have set hours when clients post jobs.* The second technical feature we generated for this study

5.1. Study 5: Retrospective Technical Investigation of Temporal Flexibility 150

derives from one of the platform-imposed time constraints identified in the Background chapter (Chapter 3) (i.e., “The platform has no set hours when clients can post jobs.”). We learnt from Study 4 that workers have to spend a long amount of time waiting and searching for work on the platform. Thus, we aim to identify whether the crowdsourcing platforms analysed have set hours when clients post jobs. For example, on some platforms, workers could be made aware that clients make work available between certain hours.

2.2 Platforms do not have set hours when workers can complete jobs. The third technical feature we generated for this study derives from one of the platform-imposed time constraints identified in the Background chapter (Chapter 3) (i.e., “The platform has no set hours when workers can complete jobs.”). We learnt from Study 4 that workers have difficulties predicting their work and non-work hours as a result of this constraint. Thus, we aim to identify whether the crowdsourcing platforms analysed have set hours when workers can complete jobs. For example, on some platforms, workers could have an 8-hour window in which they could complete jobs [48].

2.3 Platforms do not limit the number of hours workers can work. The fourth technical feature we generated for this study derives from one of the platform-imposed time constraints identified in the Background chapter (Chapter 3) (i.e., “The platform has no limits to the number of hours workers and spend working.”). We learnt from Study 4 that workers can spend long hours working as a result of this constraint. Thus, we aim to identify whether the crowdsourcing platforms analysed limit the number of hours workers can work. For example, on some platforms, workers could only be allowed to work for a maximum of 10 hours, such as in the case of drivers on Uber’s on-demand ride-hailing service, who can only work up to a maximum of 10 hours before having to take a 6-hour break [178].

2.4 Platforms do not have any degree of control over the completion times of jobs. The fifth technical feature we generated for this study derives from one of the platform-imposed time constraints identified in Study 4 (i.e., “The platform has no control over the completion times of jobs.”). We learnt from Study 4 that workers

have difficulties planning their work and non-work schedules as a result of this constrains. Thus, we aim to identify whether the crowdsourcing platforms analysed have a degree of control over the completion times of jobs.

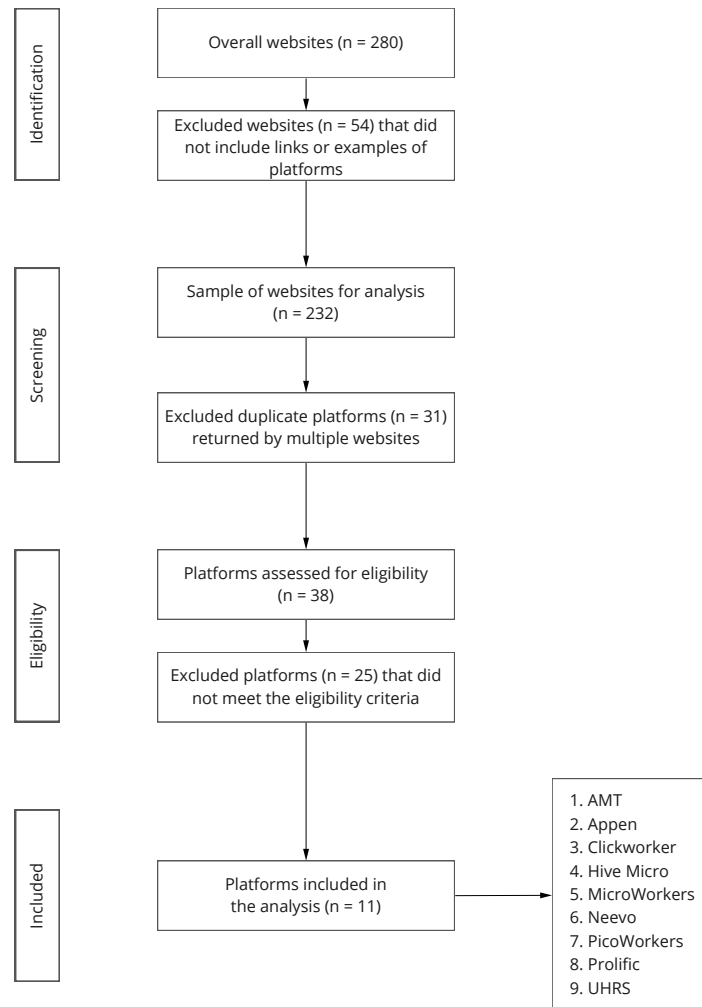
3. Unpaid Time. *3.1 Platforms do not require clients to pay workers a minimum hourly wage.* The sixth technical feature we generated for this study derives from one of the platform-imposed time constraints identified in the Background chapter (Chapter 3) (i.e., “The platform does not require clients to pay workers a minimum hourly wage”). We learnt from Study 2 that workers workers might not be getting paid fairly for the time they spend completing jobs. Thus, we aim to identify whether the crowdsourcing platforms analysed require clients to pay workers at least a minimum hourly wage. For example, on some platforms, clients could strictly only be able to publish a job if it pays workers above a local minimum wage.

4. Oversupply of Workers. *4.1 Platforms do not limit the maximum number of workers completing jobs at any given time.* The seventh technical feature we generated for this study derives from one of the platform-imposed time constraints identified in Study 3 (i.e., “The platform has no limit to the maximum number of workers completing jobs at any given time.”). We learnt from Study 3 that workers can find themselves without any work available for long periods as a result of this constraint. Thus, we aim to identify whether the crowdsourcing platforms analysed limit the number of workers completing jobs at any given time. For example, on some platforms, only a pre-defined number of workers could work on jobs at any given time, based on the number of jobs available.

5.1.2.3 Platform Selection

We next describe how we selected the nine crowdsourcing platform that we analysed as part of this study. Figure 5.1 illustrates using a flow diagram the platform inclusion strategy, in which we followed the PRISMA statement [211].

To identify candidate crowdsourcing platforms for our feature analysis, we

Figure 5.1: PRISMA flow diagram of the platform inclusion strategy.

used the search engine DuckDuckGo¹. We chose to use DuckDuckGo because it does not tailor search results to users' preferences or search history, unlike other search engines (i.e., it does not record IP addresses) [212]. Therefore, using DuckDuckGo for our feature analysis allowed us to avoid 'filter bubbles', a type of personal bias introduced by search engines such as Google [213]. By avoiding 'filter bubbles,' we aimed to ensure the reproducibility of the results when we conducted the searches [214]. Additionally, to ensure reproducibility, we next describe the period when we conducted the searches, what search terms we used, and how we eventually selected the search results.

¹<https://duckduckgo.com/>

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We conducted the searches in October 2021. In our search, we used the following four keywords: “crowdwork”, “crowd work”, “microwork”, and “micro work”. We chose these keywords because they were consistent with the terminology commonly used by workers [77]. We first searched these keywords in isolation and then in combination with the following seven keywords: “AI jobs”, “data entry”, “make money”, “work from home”, “list of”, “hire people”, and “find workers”; this combination resulted in 28 searches. As research shows that more than 70% of internet users only tend to explore the first page of search engines [215], we decided to examine only the first page returned (i.e., in the case of DuckDuckGo, the results above the “More Results” button), totalling 280 search results. As such, the results are not an exhaustive list of crowdsourcing platforms.

Out of the 280 search results, we identified: (a) 44 websites that directly linked us to crowdsourcing platforms, (b) 188 websites that included links to crowdsourcing platforms or provided examples of such platforms, and (c) 54 websites that described crowdsourcing as a concept but did not include links or provided examples of platforms. We discarded the 54 websites that did not include links or examples of crowdsourcing platforms; this left us with 232 websites for the analysis.

After excluding duplicate platforms ($n = 31$) returned by multiple websites, the search identified 38 crowdsourcing platforms. From the initially identified platforms, we excluded 27 platforms that:

1. Were reported as ‘spam’ by workers on multiple websites ($n = 8$; e.g., online-microjobs.com);
2. Did not have any jobs available at the time of the study ($n = 5$; e.g., Cloud-Crowd);
3. Were location-based crowdsourcing platforms that advertised jobs in specific geographical areas, rather than web-based crowdsourcing platforms [216] ($n = 5$; e.g., local microtasking platforms such as AppJobber or Streetspotr);
4. Were not available to workers based in the U.S. ($n = 3$; e.g., Crowdtask); we excluded these platforms because in the three studies we conducted so far in

this thesis we have solely recruited workers based in the U.S.;

5. Were only available on mobile devices (n = 1; i.e., microwork); we excluded these platforms because workers based in the Global North are less likely to work on their phones compared to workers in the Global South [76];
6. Were not accepting new participant sign-ups at the time of the study (n = 1; i.e., Sequence);
7. Did not accept our application to work on the platform (n = 4; e.g., Toloka).

The final number of crowdsourcing platforms that we included in the analysis was nine. We analysed the following platforms: Amazon Mechanical Turk (AMT), Appen, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, Prolific², and Universal Human Relevance System (UHRS, accessed via Teemwork).

5.1.2.4 Platform Analysis Process

We conducted the analysis by reviewing each of the nine platforms against the list of technical features that we developed based on the time constraints identified so far in this thesis (see Table 5.1). For each technical feature, the nine platforms were scored on a dichotomous scale (i.e., Applicable; Not applicable). The scoring allowed us to identify key differences and similarities between the platforms, which we describe in the Results section.

We began the analysis of each technical feature by first reviewing the platforms' descriptions. Reviewing the platforms' descriptions provided us insights into the ways the platforms were advertised to the workers and clients. Next, if the platforms' descriptions did not provide us with a definitive score (i.e., Applicable; Not applicable), we reviewed the platforms' list of FAQs, Documentation, and TOS.

²Although the focus of this study was on crowdsourcing platforms that provide human labour that powers A.I., we decided to also include the platform Prolific in our analysis. We took this decision because Prolific is one of the five platforms included in ILO's major survey of working conditions on crowdsourcing platforms [216], together with AMT, Clickworker, CrowdFlower (now Appen), and Microworkers. Further, the type of jobs Prolific provides can be performed remotely and using a computer, which is in line with ILO's working definition of crowdsourcing platforms. Therefore, for the purpose of this study, we decided to also include Prolific in our analysis.

Reviewing the three resources provided us with insights into the ways the platforms were documented to work.

Finally, if the platforms' FAQs, Documentation, or TOS did not provide us with a definite score, we continued analysing the platforms through the author's interaction with the features. We first interacted with the features from a worker's perspective and afterwards from a client's perspective. Creating worker and client accounts enabled us to interact with the platforms' features: for example, as a worker, we were able to review jobs, whereas, as a client, we were able to create jobs.

We conducted the analysis twice. Firstly, as described above, we reviewed the platforms based on the existing list of technical features (see Table 5.1). Next, we conducted the analysis a second time by incorporating the new technical features and following the same process as outlined above. As part of the second round of analysis, 30% of the platforms were reviewed by a second rater, with a good degree of inter-rater reliability ($\kappa = .79$). We present the results of the analysis below.

5.1.3 Results

5.1.3.1 Descriptive Characteristics and Feature Analysis

Table 5.2 below presents the analysis of features of crowdsourcing platforms that can constrain the temporal flexibility of crowdworkers. The list of technical features is based on: (i) the platform-imposed time constraints identified so far in the thesis as part of our conceptual investigation (see Table 5.1), and (ii) the new technical features we identified as part of this study across the nine platforms analysed.

The table shows that the crowdsourcing platform UHRS achieved the highest temporal inflexibility score (17/19), followed by Hive Micro (15/19) and PicoWorkers (15/19); this suggests that the three platforms trade workers' temporal flexibility the most. In comparison, Appen achieved the lowest temporal inflexibility score (8/19), followed by Prolific (9/19); this suggests that compared to UHRS, Hive Micro or PicoWorkers, these two platforms constrain workers' temporal flexibility the least. We next describe the technical features within each feature category.

Feature Categories	Technical Features	UHRS	Hive M.	PicoW.	AMT	Clickw.	Neevo	Microw.	Prolific	Appen
1. Lack of Work Assignment	1.1 Platforms do not assign jobs to the workers.	■	■	■	■	■	■	■		
	1.2 Platforms do not reserve jobs for the workers.	■	■	■			■			
2. Unpredictable Work Availability	2.1 Platforms do not have set hours when clients post jobs.	■	■	■	■	■	■	■	■	■
	2.2 Platforms do not have set hours when workers can complete jobs.	■	■	■	■	■	■	■	■	■
	2.3 Platforms do not limit the number of hours workers can work.	■	■	■	■	■	■	■	■	■
	2.4 Platforms do not have any degree of control over the completion times of jobs.	■	■	■	■	■	■	■		
	2.5 Platforms do not provide clear payment timelines to workers.	■	■		■		■			
3. Unpaid Time	3.1 Platforms do not require clients to pay workers a minimum hourly wage.	■	■	■	■	■	■	■		
	3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments or training.	■	■		■	■	■	■		■
	3.3 Platforms ask workers to complete unpaid qualification tests to register on the platform.								■	
	3.4 Platforms allow clients to keep the data from rejected jobs.	■	■	■	■	■		■	■	
	3.5 Platforms allow clients to reject workers who completed jobs ‘too quickly’.	■	■	■	■	■	■	■		■
	3.6 Platforms do not require clients to provide timely feedback about rejected work.	■	■	■		■	■	■		■
4. Oversupply of Workers	4.1 Platforms do not limit the max. no. of workers completing jobs at any given time.	■	■	■	■	■	■	■	■	■
	4.2 Platforms do not limit the no. of workers who can register on the platform.	■	■	■		■	■	■		■
	4.3 Platforms limit the max. no. of jobs workers can complete in a day, week, or month.	■		■	■				■	
	4.4 Platforms limit the max. amount of money workers can earn in a day, week, or month.	■		■	■				■	
5. Inflexibility of Time Use	5.1 Platforms do not allow workers to complete multiple jobs at once.	■	■			■			■	
	5.2 Platforms require workers to wait a certain amount of time between submitting jobs.			■			■			
<i>Temporal Inflexibility Scores</i>		17/19	15/19	15/19	13/19	13/19	13/19	12/19	9/19	8/19

■ = Platform features that increase temporal inflexibility; The blank spaces represent features not present on the platforms at the time of the study

Table 5.2: Analysis of the features of crowdsourcing platforms that can constrain the temporal flexibility of crowdworkers.

1. Lack of Work Assignment Table 5.3 presents the features of the first category. This category was the fourth most constrained feature category, where we found only seven instances out of the two features that did not constrain workers' flexibility; in other words, workers' flexibility was constrained across 61% of the features within this category. We next describe the two features within this category.

Technical Features	N (%) Platforms
1.1 Platforms do not assign jobs to the workers.	7 (78%)
1.2 Platforms do not reserve jobs for the workers.	4 (44%)

Table 5.3: Lack of Work Assignment Features

1.1 Platforms do not assign jobs to the workers. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. Only two of the nine platforms assigned jobs. In contrast, seven platforms required workers to claim jobs on a first-come, first-serve basis. For example, whilst Prolific assigned jobs to specific workers, Microworkers did not assign jobs, workers having to claim jobs before other workers. Furthermore, Appen was the second platform that assigned jobs to the workers. In the case of Appen, the platform assigns workers jobs by inviting them via email to work on new projects that they are eligible to participate in. In comparison, AMT, Clickworker, Hive Micro, Microworkers, PicoWorkers, and UHRS did not assign jobs to the workers. For example, in the case of Clickworker, jobs listed on the platform are described as “a momentary situation” [217]. In this sense, Clickworker explains that workers might see at one point 100 jobs available in the list of jobs; however, after workers completed a few jobs and returned to the list of available jobs, there might not be any remaining jobs available for the worker [217].

1.2 Platforms do not reserve jobs for the workers. We identified this technical feature in this study. Five of the nine platforms analysed reserved jobs. In contrast, four platforms did not reserve jobs. For example, whilst AMT reserved jobs for workers for the allotted time set by clients, Neevo did not reserve jobs to specific workers, any worker having access to the same jobs. Furthermore, Hive Micro, Pi-

Technical Features	N (%) Platforms
2.1 Platforms do not have set hours when clients post jobs.	9 (100%)
2.2 Platforms do not have set hours when workers can complete jobs.	9 (100%)
2.3 Platforms do not limit the number of hours workers can work.	9 (100%)
2.4 Platforms do not have any degree of control over the completion times of jobs.	7 (78%)
2.5 Platforms do not provide clear payment timelines to workers.	4 (44%)

Table 5.4: Unpredictable Work Availability Features

coWorkers, and UHRS also did not reserve jobs to workers. In comparison, Appen, Clickworker, Microworkers, and Prolific did reserve jobs to workers. For example, in the case of Prolific, jobs were reserved for workers for a specific period of time that was calculated based on the amount of time estimated by the client. To provide an example, if a researcher estimated that workers will take approximately 10 minutes to complete a job, the platform reserved the job for workers for a maximum period of time of 44 minutes. If workers did not manage to complete the reserved job in the 44 minutes, the job timed out, and workers missed out on the job.

2. Unpredictable Work Availability Table 5.4 presents the features of the second category. This category was the most constrained by the nine platforms. Across this category, we found only seven instances out of the five features that did not constrain workers' flexibility; in other words, workers' flexibility was constrained across 85% of the features within the 'Unpredictable Work Availability' category. We next describe the five features in this category.

2.1 Platforms do not have set hours when clients post jobs. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. None of the platforms analysed had set hours when clients could post jobs.

2.2 Platforms do not have set hours when workers can complete jobs. We

identified this technical feature as part of the conceptual investigation conducted throughout this thesis. None of the platforms had set hours.

2.3 Platforms do not limit the number of hours workers can work. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. None of the platforms limited work hours.

2.4 Platforms do not have any degree of control over the completion times of jobs. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. Only two of the platforms analysed had a degree of control over the completion times of jobs posted by clients. In contrast, most platforms ($n = 7$) could not make adjustments to the completion times. For example, whilst Appen had a mechanism that could increase the completion times of jobs slower than predicted, AMT could not overwrite the times allotted by clients. Furthermore, Prolific was the second platform that had a degree of control over the completion times of jobs. In the case of Prolific, the platform automatically set the completion times of jobs, based on the estimated completion times set by clients in the process of creating jobs. If workers went above the completion times of jobs, but were still active on the platform (rather than inactive), they were still able to work on that job unless they had gotten replaced by other participants [218]. In comparison, AMT, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, and UHRS did not have any degree of control over the completion times of jobs.

2.5 Platforms do not provide clear payment timelines to workers. We identified this technical feature in this study. Five of the nine platforms provided clear timelines to workers regarding when they will get paid for their work. In contrast, four platforms did not provide clear timelines. For example, whilst Clickworker aimed to pay workers within seven days, Neevo did not provide a clear payment timeline, claiming it paid workers within two weeks or longer. Furthermore, AMT, Hive Micro, and UHRS also did not provide workers with clear payment timelines. For example, in the case of AMT, the platform stated that it did not estimate when a job will have to be approved by clients and payments made; clients had to pay workers define approximately within 30 days after workers submitted a job. In comparison,

Appen, Microworkers, PicoWorkers, and Prolific did provide workers with clear payment timelines. For example, in the case of Appen, the platform claimed it paid workers within 30 days of receipt of a valid invoice of the time they worked.

3. Unpaid Time. Table 5.5 presents the features of the third category. This category was the second most constrained feature category, where we found only 17 instances out of the six features that did not constrain workers’ flexibility; in other words, workers’ flexibility was constrained across 69% of the features within this category. We next describe the six features within this category.

Technical Features	N (%) Platforms
3.1 Platforms do not require clients to pay workers a minimum hourly wage.	8 (89%)
3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments or training.	7 (78%)
3.3 Platforms ask workers to complete unpaid qualification tests to register on the platform.	1 (11%)
3.4 Platforms allow clients to keep the data from rejected jobs.	7 (78%)
3.5 Platforms allow clients to reject workers who completed jobs ‘too quickly’.	8 (89%)
3.6 Platforms do not require clients to provide timely feedback about rejected work.	7 (78%)

Table 5.5: Unpaid Time Features

3.1 Platforms do not require clients to pay workers a minimum hourly wage. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. Only two of the nine platforms analysed required clients to pay workers at a minimum hourly wage rate. In contrast, most platforms (n = 6) did not have this requirement. For example, whilst Appen uses machine learning and statistical models to ensure workers are paid local minimum wages, UHRS did not prevent workers from earning below a minimum wage. Furthermore, Prolific was the second platform that required clients to pay workers a minimum hourly wage. In the case of Prolific, they imposed that clients paid a minimum hourly rate of £5

/ \$6.50 for their studies through their interface. Moreover, in their Documentation, Prolific recommend that clients paid workers at least £7.50 / \$9.60 per hour—they referred to their payment requirements as “ethical rewards”. In comparison, whilst Neevo (owned by Defined.ai³) also claimed that their workers “*are paid fair wages in accordance with legal requirements*” on their webpage [219]; furthermore, in their Documentation, Neevo claimed that their ‘contributors’ earn on average \$20 per hour. However, when we interacted with the platform, we completed jobs that did not average a local hourly wage. Finally, the remaining platforms (i.e., AMT, Clickworker, Hive Micro, MicroWorker, and PicoWorkers) did not have any mentions about paying workers a minimum hourly wage in the platforms’ descriptions, list of FAQs, Documentation, or TOS.

3.2 *Platforms allow clients to ask workers to complete lengthy unpaid assessments.* We identified this technical feature in this study. Only two of the nine platforms analysed did not enable clients to ask workers to complete lengthy unpaid assessments or training. In contrast, most platforms (n = 7) did not prevent clients from posting such assessments or training. For example, whilst PicoWorkers does not enable clients to create unpaid training jobs for workers, UHRS did not prevent workers from completing unpaid mandatory training before working on clients’ jobs. Further, Prolific was the second platform that did not enable clients to ask workers to complete lengthy unpaid assessments or training. In the case of Prolific, clients cannot create assessments (e.g., to recruit participants) or training. Instead, Prolific incorporates “*a wide range of prescreening filters that can be applied to studies. If our in-built prescreening filters don’t quite meet your needs then you’re always welcome to recruit a custom sample*” [220]. In comparison, AMT allows clients to create unpaid assessments (i.e., ‘qualifications’) for the purpose of prescreening participants as part of the recruitment process. Moreover, Appen allowed workers to complete unpaid *training*, whilst Clickworker allowed workers to complete unpaid *base assessments* and *project assessments* in order to access

³<https://www.defined.ai/>

jobs. Finally, the remaining platforms (i.e., Hive Micro, MicroWorker, and Neevo) required workers to complete unpaid *qualification tests* to access specific jobs.

3.3 Platforms ask workers to complete unpaid qualification tests to register on the platforms. We identified this technical feature in this study.

This technical feature was the most widely supported feature across the nine platforms. Most platforms (n = 8, i.e., AMT, Appen, Clickworker, Hive Micro, Neevo, PicoWorkers, and UHRS) did not ask workers to complete unpaid qualification tests to register on the platforms. In contrast, only one platform required workers to complete unpaid qualification tests to register on the platform. In the case of Prolific, workers have to take an unpaid mock test as part of the registration process. The mock test is described as “*a practice study from Prolific for you to see what it’s like to take part*” [221]. The mock test incorporates attention checks [222], which increases the effort level workers have to put into passing the test.

3.4 Platforms allow clients to keep the data from rejected jobs. We identified this technical feature in this study. Only two of the nine platforms analysed did not allow clients to keep the data from rejected jobs. In contrast, most platforms (n = 7) allowed clients to keep the data from rejected jobs. For example, whilst Appen paid workers for the rejected jobs before removing them from those jobs, AMT did not prevent clients from keeping the data and not paying the workers. Furthermore, Neevo was the second platform that did not allow clients to keep the data from rejected jobs. In the case of Neevo, their TOS state “*In the event of termination of this Agreement, the Company shall pay you on a pro-rata basis any Fees then due and payable for any Services completed up to and including the date of such termination*” [223], meaning that even if workers were no longer allowed to work on one or multiple jobs, they were still paid for the work they had completed, and clients kept the data. In comparison, platforms that allowed clients to use external software to collect data⁴, i.e., AMT, Clickworker, Microworkers, and Prolific, could not prevent clients to keep data from rejected jobs. Finally, in a similar manner,

⁴For example, external survey tools such as Qualtrics (<https://www.qualtrics.com/>).

platforms that allowed clients to download the data locally to assess it⁵, i.e., Hive Micro, PicoWorkers, and UHRS, could not prevent clients from keeping the keep in the event of rejecting the jobs.

3.5 Platforms allow clients to reject workers who completed jobs ‘too quickly’.

We identified this technical feature in this study. Only one of the nine platforms analysed did not allow clients to reject workers who completed jobs faster than expected. In the case of Prolific, the platform only allowed rejections based on speed for jobs that were identified as statistical outliers in the data. In contrast, most platforms (n = 8) did not prevent clients from rejecting workers who completed jobs too fast. For example, AMT, Appen, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, and UHRS had no mechanism in the place to restrict clients from rejecting workers they perceive have completed jobs in a shorter amount of time than they had expected.

3.6 Platforms do not require clients to provide timely feedback about rejected work.

We identified this technical feature in this study. Only two of the nine platforms analysed required clients to provide workers timely feedback about rejected work. In contrast, most platforms (n = 7) did not require clients to provide such feedback. For example, whilst AMT required clients to include a feedback message with any rejected work, Hive Micro did not support a feature of this type. Furthermore, Prolific was the second platform that required clients to provide workers timely feedback about rejected work. In the case of Prolific, clients are required to explain why rejections are made when rejecting work. The platform provides a number of common pre-defined rejection reasons for clients to choose from, and also allows clients to write their own reasons. In comparison, Appen, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, and UHRS do not require clients to provide workers feedback for rejected work.

⁵For example, downloading the data in a CSV file before ‘accepting’ or ‘rejecting’ it.

Technical Features	N (%) Platforms
4.1 Platforms do not limit the max. no. of workers completing jobs at any given time.	9 (100%)
4.2 Platforms do not limit the no. of workers who can register on the platform.	7 (78%)
4.3 Platforms limit the max. no. of jobs workers can complete in a day, week, or month.	4 (44%)
4.4 Platforms limit the max. amount of money workers can earn in a day, week, or month.	4 (44%)

Table 5.6: Oversupply of Workers Features

4. Oversupply of Workers. Table 5.6 presents the features of the fourth category. This category was the third most constrained feature category, where we found 12 instances out of the four features that did not constrain workers' flexibility; in other words, workers' flexibility was constrained across 62% of the features within this category. We next describe the four features within this category.

4.1 Platforms do not limit the maximum number of workers completing jobs at any given time. We identified this technical feature as part of the conceptual investigation conducted throughout this thesis. None of the platforms analysed limited the number of workers who can complete jobs at any given time.

4.2 Platforms do not limit the number of workers who can register on the platform. We identified this technical feature in this study. Only one of the nine platforms analysed limited the number of workers who can register on the platform. In the case of Prolific, the platform had a waiting list for people who wanted to register to work on the platform. In contrast, most platforms ($n = 8$) did not have any mechanisms in place to limit the number of workers who can register on the platform. For example, AMT, Appen, Clickworker, Hive Micro, Microworkers, Neevo, PicoWorkers, and UHRS did not appear to limit the number of workers who can register on the platforms.

4.3 Platforms limit the maximum number of jobs workers can complete in a

day, week, or month. We identified this technical feature in this study. Five of the nine platforms analysed did not limit the maximum number of jobs workers can complete in a day, week, or month. In contrast, four platforms did limit the number of jobs workers can complete. For example, whilst Clickworkers does not limit the number of jobs, AMT limits workers to 3,800 jobs per day. Furthermore, PicoWorkers also limited the maximum number of jobs workers can complete. In the case of PicoWorkers, workers whose ‘temporarily success rates’ went below 75%, were restricted from completing any more jobs until their success rate went above 75% again (i.e., until clients approved new jobs). In comparison, Hive Micro, Neevo, Microworkers, and Appen did not appear to have any mechanisms in place to limit the number of jobs workers can complete.

4.4 Platforms limit the maximum amount of money workers can earn in a day, week, or month. We identified this technical feature in this study. Five of the nine platforms analysed did not limit the amount of money workers can earn in a day, week, or month. In contrast, four platforms did limit the amount of money workers can earn. For example, whilst Microworkers did not set such limits, Prolific employed a mechanisms that limited workers from earning above a certain threshold. Furthermore, AMT also employed a mechanisms that limited workers from earning above a certain threshold by limiting the maximum number of jobs workers can complete in a day to 3,800 jobs. Moreover, PicoWorkers and UHRS also limited the maximum amount of money workers can earn. In the case of PicoWorkers, workers were restricted from completing any more jobs until their success rate went above 75% again (i.e., until clients approved new jobs). In comparison, Appen, Clickworker, HiveMicro, and Neevo did not limit the amount of money workers can earn in a day, week, or month.

5. Inflexibility of Time Use. Table 5.7 presents the features of the final category. This category was the fifth most constrained by the nine platforms. Across this category, we found twelve instances out of the two features that did not constrain

Technical Features	N (%) Platforms
5.1 Platforms do not allow workers to complete multiple jobs at once.	4 (44%)
5.2 Platforms require workers to wait a certain amount of time between submitting jobs.	2 (22%)

Table 5.7: Inflexibility of Time Use Features

workers' flexibility; in other words, workers' flexibility was constrained across 33% of the features within the 'Inflexibility of Time Use' category. We next describe the two features within this category.

5.1 Platforms do not allow workers to complete multiple jobs at once. We identified this technical feature in this study. Five one of the nine platforms analysed allowed workers to work on multiple jobs at once. In contrast, four platforms limited the number of jobs workers can complete simultaneously. For example, whilst PicoWorkers allowed workers to complete an unlimited number of jobs at once, Prolific limited workers to completing only one job at once. Furthermore, Clickworker, Hive Micro, and UHRS, did not allow workers to complete multiple jobs at once. For example, in the case of Clickworker, the platform hid any projects from workers until they had either completed or cancelled the previously claimed job. Furthermore, Hive Micro, imposed a limit of four 'tabs' opened across all browsers; this means that workers were limited to maximum four tabs (i.e., projects). Finally, in the case of UHRS, workers were not allowed to work on two jobs (i.e., HITApps) simultaneously. In comparison, Appen, Microworkers, Neevo, and AMT, did allow workers to complete jobs simultaneously. For example, in the case of Neevo, workers were able to 'Start' multiple jobs and then 'Continue' them in parallel or at a later date. Similarly, Appen, Microworkers and AMT also allowed workers to work on multiple jobs at once.

5.2 Platforms require workers to wait a certain amount of time between submitting jobs. We identified this technical feature in this study. Most platforms (n = 7) did not require workers to wait between submitting jobs. In contrast, two plat-

forms required workers to wait a certain amount in between submitting jobs. For example, whilst UHRS allowed workers to start working on a new job immediately after finishing one, PicoWorkers and Neevo required workers to wait a certain amount before working on a new job. For example, in the case of PicoWorkers, new workers were required to wait for 180 seconds between completing jobs; each rejected job added an extra 20 seconds to this waiting time, whilst each accepted job reduced the waiting time by ten seconds. However, workers were only able to withdraw their earnings when the waiting time was zero seconds. In comparison, AMT, Appen, Clickworker, Hive Micro, Microworkers, and Prolific, did not require workers to wait a certain amount of time between submitting jobs. For example, in the case of these six platforms, workers were able to start completing a new job as soon as they had submitted a previous one.

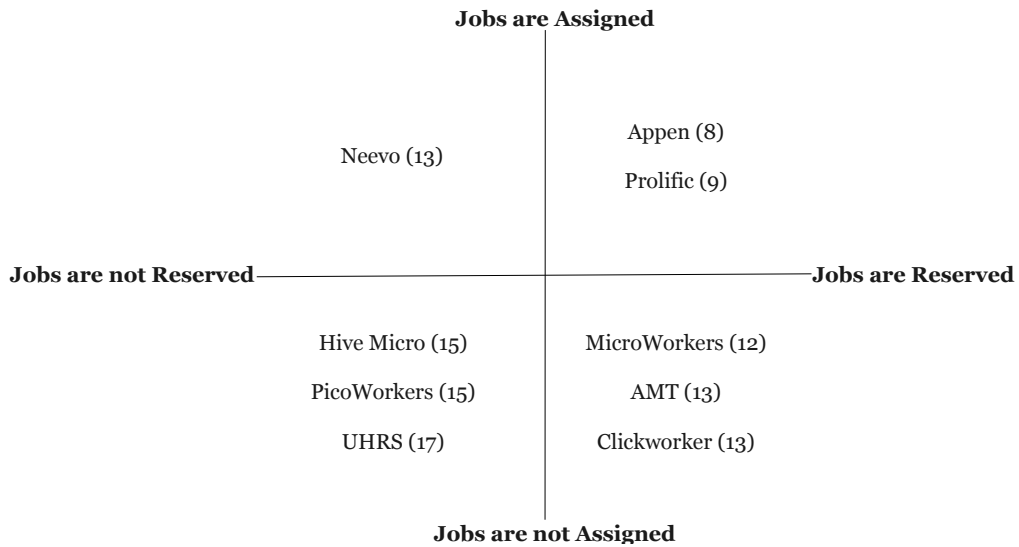
5.1.3.2 Temporal Inflexibility Scores

We describe below the analysis of the temporal inflexibility scores. After scoring the nine platforms on a dichotomous scale (i.e., Identified; Not identified) to identify key differences and similarities between the platforms, we next assigned the platforms *temporal inflexibility scores*. We used the scores to rank the platforms based on the number of features employed that constrain workers' temporal flexibility with the highest-ranking platforms constraining workers' temporal flexibility most. We next describe the results of the analysis.

First, using the temporal inflexibility scores, we identified which platforms employed the highest number of features that constrain workers' temporal flexibility. Table 5.2 (on page 156) shows that the crowdsourcing platform UHRS achieved the highest temporal inflexibility score (17/19), followed by Hive Micro (15/19) and PicoWorkers (15/19); this suggests that the three platforms constrained workers' temporal flexibility the most. In comparison, Appen achieved the lowest temporal inflexibility score (8/19), followed by Prolific (9/19); this suggests that compared to UHRS, Hive Micro or PicoWorkers, Appen and Prolific constrained workers' temporal flexibility the least.

Second, using the temporal inflexibility scores, we further found that technical

Figure 5.2: The two technical features comprising the ‘Lack of Work Assignment’ category (i.e., *job assignment* and *job reservations*) indicate a broader trading pattern.



features such as assigning and reserving jobs for workers could indicate how likely a crowdsourcing platform is to constrain workers’ temporal flexibility. Figure 5.2 illustrates the distribution of platforms’ inflexibility scores within this category. The matrix suggests that platforms that scored higher on the scale of temporal inflexibility (e.g., UHRS: 17/19) might be more likely to constrain workers’ temporal flexibility by not assigning or reserving jobs. In contrast, platforms that scored lower on the temporal inflexibility score (e.g., Appen: 8/19) might be less likely to constrain workers’ temporal flexibility by assigning and reserving jobs. Therefore, we identified that the two technical features comprising the ‘Lack of Work Assignment’ category (i.e., *job assignment* and *job reservations*) indicate a broader support pattern that could indicate how likely a crowdsourcing platform is to constrain workers’ temporal flexibility.

5.1.4 Discussion

In this study, we aimed to answer the following RQ: *What other features of crowdsourcing platforms can further constrain workers’ temporal flexibility?* To answer the RQ, we conducted a retrospective technical investigation in which we analysed nine existing crowdsourcing platforms.

5.1.4.1 Summary of Results

Taken together, the results of the study showed that the crowdsourcing platforms constrained workers' temporal flexibility through at least 19 technical features. We find that crowdsourcing platforms strongly favour features that promote clients' temporal flexibility over workers' by limiting the predictability of workers' working hours and restricting paid time. Furthermore, using the temporal inflexibility scores, we identify which platforms available to crowdworkers employ the highest number of features that facilitate the trade of temporal flexibility from workers to clients (i.e., UHRS, Hive Micro, and PicoWorkers), consequently increasing the temporal precarity of workers. We next consider the implications of the results and summarise the time constraints identified in this study.

5.1.4.2 Implications

First, we find that crowdsourcing platforms strongly favour technical features that promote clients' temporal flexibility over workers' by limiting the predictability of workers' working hours and restricting paid time. In this sense, the results of the study suggest that 'Unpredictable Work Availability' was the category of features most constrained by the nine platforms. Across this category, we found only seven instances out of the five features that did not constrain workers' flexibility; in other words, workers' flexibility was constrained across 85% of the features within the 'Unpredictable Work Availability' category. Moreover, the second least supported category was 'Unpaid Time', where we found 17 instances out of the six features that did not constrain workers' flexibility; in other words, workers' flexibility was constrained across 69% of the features within the 'Unpaid Time' category. Therefore, the results suggest that clients benefit from temporal flexibility by limiting the predictability of working time and pay. In other words, we found that crowdsourcing platforms strongly favour features that promote clients' temporal flexibility over workers' by limiting the predictability of workers' working hours and restricting paid time.

These results are important because of the temporal and economic precarity crowdworkers face [65, 66]. In this sense, this study extends the current under-

standing of the reasons for platform workers experiencing work precarity, by showing that features of crowdsourcing platforms that are meant to support workers' predictability of working time and pay are in fact the most constrained features.

Second, using the temporal precarity scores, we identified which platforms employed the highest number of features that constrained the temporal flexibility of workers, consequently increasing workers' temporal precarity. In this sense, the highest temporal precarity score achieved by one of the nine crowdsourcing platforms was 17 points out of 19 (i.e., UHRS), whereas the lowest was eight points out of 19 (i.e., Appen). Nevertheless, the results suggest that even the lowest-scoring platform, which obtained eight points out of 19, managed to constrain the temporal flexibility of the workers through eleven different technical features.

These results are important because they provide an initial understanding of the mechanisms of crowdsourcing platforms that constrain temporal flexibility. In line with van Dijck's approach to platforms as socio-technical structures [224], we show that analysing technical features can expose the techno-cultural and socioeconomic logics underlying crowdsourcing platforms [224]. In this sense, the platforms become mediators that shape socioeconomic acts between workers and clients, rather than just intermediaries that facilitate these acts. Thus, this study makes some of the invisible mechanisms used for trading temporal flexibility more visible and enables further scrutinising of platforms' technology, users, governance, and business models [224]. Moreover, using VSD, we conceptualised temporal flexibility as an interactional product of technology (i.e., crowdsourcing platforms) and society (i.e., workers and clients), produced in the socio-technical gap [29]. The results of our study show the different ways in which the values held the customers of the technology (i.e., clients), instead of the values of those impacted by the technology (i.e., workers), can be embodied consciously or unconsciously by technology [30].

Summary of Implications: Table 5.8 lists the implications of the time constraints we explored in this study. We identified the platform-imposed time constraints so far in this thesis. In this study, we identified nine additional platform-imposed time constraints as part of the technical investigation we conducted. We

Time Constraints	Implications for Workers
P1. Platforms do not reserve jobs for the workers. (This study)	P1. Thus, prior work suggests that workers have to be ‘on call’ for work [21].
P2. Platforms do not provide clear payment timelines to workers. (This study)	P2. Thus, prior work suggests that workers risk not knowing when they will be paid [225].
P3. Platforms allow clients to ask workers to complete lengthy unpaid assessments. (This study)	P3. Thus, prior work suggests that workers risk not getting paid for their time [226].
P4. Platforms can ask workers to complete unpaid qualification tests to register on the platform. (This study)	P4. Thus, prior work suggests that workers have to spend time working on unpaid qualification tests before they can begin working [46].
P5. Platforms allow clients to reject workers who completed jobs ‘too quickly.’ (This study)	P5. Thus, prior work suggests that workers risk not getting paid for their time [226].
P6. Platforms have no limit to the maximum number of jobs workers can complete in a day, week, or month. (This study)	Thus, prior work suggests that workers cannot complete additional jobs once they reached the limit, despite clients still making jobs available [227].
P7. Platforms have no limit to the maximum amount of money a worker can earn in a day, week, or month. (This study)	P7. Thus, prior work suggests that workers cannot complete additional jobs once they reached the limit, but spend time finding other revenue sources [228].
P8. Platforms do not allow workers to complete multiple jobs at once. (This study)	P8. Thus, Study 1 suggests that workers can be restricted in how they use their time by being required to monotask rather than using their time as preferred.
P9. Platforms require workers to wait a certain amount of time between submitting jobs. (This study)	P9. Thus, Study 3 suggests that workers might be limited in terms of the pace at which they work.

Table 5.8: Platform-imposed time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints that we identified as part of the technical investigation conducted in this study.

next describe each time constraint and their corresponding implications.

P1. Platforms do not reserve jobs for the workers. We identified the time constraint in this study. Prior work suggests that clients get a large pool of workers that compete for completing jobs on a first-come, first-served basis [68]. Thus, workers have to be ‘on call’ for work [21].

P2. Platforms do not provide clear payment timelines to workers. We identified the time constraint in this study. Prior work suggests that clients can pay workers whenever it is suitable for the clients [229]. Thus, workers risk not knowing when they will get paid (and how much) [225].

P3. Platforms allow clients to ask workers to complete lengthy unpaid assessments. Prior work suggests that clients can ask workers to pass assessments (e.g., ‘qualifications’) or training before working [46]. Thus, workers can spend long pe-

riods of unpaid time without the guarantee of future jobs [156], whilst clients get to keep the data [230].

P4. Platforms can ask workers to complete unpaid qualification tests to register on the platform. We identified the time constraint in this study. Prior work suggests that clients get a guarantee that the workers are of “good quality” [231] and will not lose time posting jobs on the platform. Thus, workers have to spend time working on unpaid qualification tests before they can begin working [46].

P5. Platforms allow clients to reject workers who completed jobs ‘too quickly’. We identified the time constraint in this study. Prior work suggests that clients can refuse paying workers that they believe have not spent an adequate amount of time working [232]. Thus, workers risk not getting paid for their time [226].

P6. Platforms have no limit to the maximum number of jobs workers can complete in a day, week, or month. Prior work suggests that clients have a variety of workers completing jobs on-demand [233]. Thus, workers cannot complete additional jobs once they have reached the platforms’ limits, even if clients are still making jobs available [227].

P7. Platforms have no limit to the maximum amount of money a worker can earn in a day, week, or month. Prior work suggests that clients have a variety of workers completing their jobs [124]. Thus, workers cannot complete additional jobs once they reached the platforms’ limits, but spend time time finding other revenue sources [228].

P8. Platforms do not allow workers to complete multiple jobs at once. We identified the time constraint in this study. Prior work suggests that clients get a guarantee that the workers are not multitasking and are spending time on the job [234]. Thus, the results of Study 1 suggest that workers can be restricted in their time use by being required to monotask rather than using the time as preferred.

P9. Platforms require workers to wait a certain amount of time between submitting jobs. Prior work suggests that clients get a guarantee that the workers are of “good quality” [231] and will not lose time making jobs available on the platform. Thus, the results of Study 3 suggest that workers might be limited in terms of the

pace at which they work.

5.1.4.3 Conceptual Investigation

Worker-Imposed Time Constraints	Description
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. W2.6 Workers have to rely on community-based reviews to evaluate jobs. W2.7 Workers might not always be able to take breaks.
Client-Imposed Time Constraints	Description
R1. Inflexibility of Time Use	R1.1 Clients set the completion times of jobs. R1.2 Clients can underestimate the completion times of jobs. R1.3 Clients can post jobs that do not work. R1.4 Clients can choose to pay workers poorly.
Platform-Imposed Time Constraints	Description
P1. Lack of Work Assignment	P1.1 Platforms do not assign jobs to the workers. P1.2 Platforms do not reserve jobs for the workers. <i>(This study)</i>
P2. Unpredictable Work Availability	P2.1 Platforms have no set hours when clients post jobs. P2.2 Platforms have no set hours when workers can complete jobs. P2.3 Platforms have no limit to the number of hours workers can spend working. P2.4 Platforms do not have any degree of control over the completion times of jobs. P2.5 Platforms do not provide clear payment timelines to workers. <i>(This study)</i>
P3. Unpaid Time	P3.1 Platforms do not require clients to pay workers a minimum hourly wage. P3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments. <i>(This study)</i> P3.3 Platforms can ask workers to complete unpaid qualification tests to register on the platform. <i>(This study)</i> P3.4 Platforms allow clients to reject workers who completed jobs 'too quickly' <i>(This study)</i>
P4. Oversupply of Workers	P4.1 Platforms have no limit to the maximum number of workers completing jobs at any given time. P4.2 Platforms have no limit to the maximum number of jobs workers can complete in a day, week, or month. <i>(This study)</i> P4.3 Platforms have no limit to the maximum amount of money a worker can earn in a day, week, or month. <i>(This study)</i>
P5. Inflexibility of Time Use <i>(This study)</i>	P5.1 Platforms do not allow workers to complete multiple jobs at once. <i>(This study)</i> P5.2 Platforms require workers to wait a certain amount of time between submitting jobs. <i>(This study)</i>

Table 5.9: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the new time constraints we identified in this study.

Table 5.9 presents a refined list of time constraints found on crowdsourcing platforms. The time constraints were identified as part of the Background chapter (Chapter 3), the subsequent empirical investigations (Chapter 4), and the retrospective technical investigation presented in this study. The items listed in red and marked with the words “This study” represent the new time constraints we identified in this study.

5.1.4.4 Limitations and Future Work

Within VSD, retroactive technical investigations are limited to researchers’ interpretations of the technologies analysed. First, we—as researchers—were unable to investigate the decisions behind the 19 technical features included in this study, made by various indirect stakeholders of the platforms. Therefore, we had to rely on our interpretation of each feature. Furthermore, the list of technical features included in this study is not exhaustive, and other features of crowdsourcing platforms could be considered. Therefore, interviewing indirect stakeholders (e.g., product owners) might help clarify any knowledge gaps and provide insights into the decisions behind the functionalities of the platforms.

Second, whilst the purpose of this study was to explore how existing crowdsourcing platforms currently support or limit workers’ temporal flexibility, it did not benefit from the insights of direct stakeholders (i.e., workers); hence, our results are limited to our interpretation of the platforms’ technical features. Therefore, in our next study (i.e., Study 5) we aim to conduct a *proactive* technical investigation with crowdworkers, to further explore how the design of crowdsourcing platforms can mitigate the time constraints imposed on the workers. Proactive analyses focus on translating stakeholder values into technical features for the development of new technology [24]. In other words, the emphasis of proactive technical investigations is on investigating new technological possibilities.

5.1.5 Conclusion

This study presented a retrospective technical investigation that explored other features of crowdsourcing platforms that can further constrain the crowdworkers’ tem-

poral flexibility. The results of this study refined the conceptual investigation conducted throughout this thesis and contributed an extended understanding of the platform-imposed time constraints that can limit the temporal flexibility of crowdworkers. In particular, the results of this study described key differences and similarities between nine crowdsourcing platforms.

Using the list of platform-imposed time constraints identified so far in the thesis, we showed that crowdsourcing platforms constrained the temporal flexibility of crowdworkers for the convenience of clients' flexibility through 19 technical features. In this sense, we found that crowdsourcing platforms strongly favour features that promote clients' temporal flexibility over workers' by limiting the predictability of workers' working hours and restricting paid time. Further, we identified the crowdsourcing platforms that employ the highest number of features that constrain workers' temporal flexibility. Overall, the results of this study suggest that existing crowdsourcing platforms do not fully support flexible temporal arrangements for the workers. Instead, the platforms benefit clients' temporal flexibility.

Since the results of this study are limited to our interpretation of the platforms' technical features, in the next study we aim to conduct a *proactive* technical investigation with stakeholders of crowdsourcing platforms (i.e., crowdworkers) to investigate how the design of future crowdsourcing platforms can evolve so that workers can experience more temporal flexibility.

5.2 Study 6: Proactive Technical Investigation of Temporal Flexibility

5.2.1 Introduction

In the previous study, we presented a retrospective technical investigation in which we analysed nine crowdsourcing platforms. Having taken a closer look in the previous study at the features of existing crowdsourcing platforms, the focus of the final study of this thesis is on the design space of future crowdsourcing platforms. We set the following RQ to guide our study: *What kind of future crowdsourcing platforms do workers who value temporal flexibility envision?* To answer the RQ, we conducted a *proactive* technical investigation, which we present next.

As part of the proactive technical investigation, we conducted a couple of remote co-design sessions with seven direct stakeholders of crowdsourcing platforms (i.e., crowdworkers). In the co-design sessions, we applied the Value Sensitive Action-Reflection Model [235], which provided a space for co-design [236] and a set of materials to function as design prompts. Throughout the sessions, we asked participants to envision the design of future crowdsourcing platforms one year, five years, and 20 years from now.

Overall, the results of the co-design sessions describe a set of values that ought to be reflected in the design of future crowdworking platforms. We generated these values based on the changes participants proposed during the co-design sessions. In particular, three main values emerged from our analysis of the future of crowdsourcing platforms one year from now: *predictability*, *fairness*, and *flexibility*. Next, thinking about the future of crowdsourcing platforms five years from now, one main value that emerged was *integrity*. Finally, thinking about the future of crowdsourcing platforms 20 years from now, three main values emerged from our analysis of the co-design sessions: *accountability*, *transparency*, and *identity*. Taken together, the proactive technical investigation presented in this study contributes a series of practical design recommendations generated by crowdworkers for the design of future crowdsourcing platforms.

5.2.2 Methods

5.2.2.1 Proactive Technical Investigations

Within the VSD design framework, proactive technical investigations focus on new technical possibilities that can support people's values. In this thesis, the proactive investigation follows the retroactive technical investigation presented earlier in this chapter, in which we explored how the properties of current crowdsourcing platforms can constrain workers' temporal flexibility. Thus, having taken a closer look in the previous study at the properties of existing crowdsourcing platforms, the proactive technical investigation presented in this study focuses on the design space of future crowdsourcing platforms.

As part of this study, we invited crowdworkers to participate in a couple of co-design sessions to envision the future of crowdsourcing platforms. We ran the co-design sessions with crowdworkers since they are direct stakeholders of crowdworking platforms. Additionally, we applied the Value Sensitive Action-Reflection Model [235], which provided a space for co-design [236], and a set of materials to function as stakeholder and designer prompts. In this sense, the model provided materials such as *value scenarios* [237] or the *multi-lifespan co-design activities* [238], which we used to encourage participants to think about the future of crowdsourcing platforms. We present the materials we used in the co-design sessions in Section 5.2.2.3.

5.2.2.2 Remote Co-design Sessions

Co-design is an approach of directly and intentionally including people in the design and development process of technology [239]. Compared to user-centred design, where the user is a "passive object of study", observed or interviewed and not playing an active role in idea generation or concept development [239], in co-design sessions designers and people untrained in design collaborate to generate creative ideas or reflect on their ideas [236]. In this respect, co-design goes beyond observing or interviewing people about their requirements, but instead engages people and their lived experiences within the design process. Engaging people directly in the

design process has been shown to outperform non-co-designed approaches, such as conventional focus groups, in terms of generating innovative ideas [240]. We next describe the co-design sessions we conducted in this study.

In this study, we conducted two online remote co-design sessions in which we engaged with seven participants (a group of four and a group of three participants) to find creative solutions to designing crowdsourcing platforms that could support crowdworkers' requirements for temporal flexibility. Each of the two remote co-design sessions lasted for two hours, and were conducted one day apart, for a total of two days. In between the two sessions, we reflected on the outcomes of the sessions and planned the subsequent sessions. We delivered the remote co-design sessions online using Microsoft Teams⁶ (i.e., a video conferencing software) and Miro⁷ (i.e., a visual collaboration platform).

The intended outputs of the remote co-design sessions were a set of practical design recommendations generated by crowdworkers for the design of future crowdsourcing platforms. The design recommendations aimed for positive systems change and creative, but practical, ways of advancing the future of crowdsourcing platforms.

5.2.2.3 Procedure

One day before each remote co-design session, we emailed the participants to share information about the structure of the upcoming sessions. We also shared information about the composition of the groups in order to increase predictability. Additionally, we shared information on how to install and use Microsoft Teams and Miro, together with the two links to the Microsoft Teams call and Miro board.

Next, on the days of the co-design sessions, the sessions followed the same structure:

- i. a 5-minute introduction;
- ii. a 10-minute reflection exercise;

⁶<https://www.microsoft.com/en-us/microsoft-teams/>

⁷<https://www.miro.com>

- iii. a 10-minute affinity clustering exercise;
- iv. a 15-minute creative writing exercise;
- v. a 10-minute break;
- vi. a 25-minute card sorting exercise; and
- vii. a 25-minute design exercise.

First, during the *introduction*, we provided participants with an overview of: (a) the research, (b) the concepts of participatory design and co-design sessions, (c) the purpose and goals of the current co-design sessions, (d) the role of the participants in the co-design sessions, and (e) the implications of our outsider statuses as researchers.

Next, during the *reflection exercise*, we asked participants to reflect and take notes on the Miro board of their experiences with organising their work and non-work time. As part of this exercise, we first asked participants to think individually about the last day they worked on a crowdsourcing platform—we asked participants three supporting questions to aid in their reflection: “How did you plan your work time? How did you plan your non-work time? For example, time with family, friends, or hobbies? Did you encounter any difficulties in managing your time? If so, what were those?”. This exercise is similar to the essay question we asked participants in Study 4 (i.e., the time-use-diary study) to complete. We allocated participants five minutes to individually reflect on their experiences. Next, after participants reflected upon their experiences, we asked them to spend the next five minutes choosing three reflections they considered meaningful to them. We asked participants to use a *star* symbol to mark their ‘top three’ reflections, which we provided on the board. We used these reflections in the exercise that followed.

Next, during the *affinity clustering exercise*, we asked participants to collaboratively cluster together their ‘top three’ reflections from the previous exercise (i.e., the reflections they considered to be of utmost significance). Affinity clustering is a technique used to group similar items to generate patterns within the data. By

asking the participants to cluster their reflections collaboratively, we wanted to encourage them to spot patterns and similarities throughout their notes and ultimately establish rapport and find common ground. We allocated participants 15 minutes to work together as a group on this exercise.

Next, during the *creative writing exercise*, we asked participants to envision the future of crowdsourcing platforms short-term. As part of this exercise, we used a design prompt called value scenarios [237] to encourage participants to think about the future of crowdsourcing platforms *one year from now*. Value scenarios are short stories that help surface human values, emphasising social and value considerations of new technologies [241]. Value scenarios have been used as both a values-elicitation method (e.g., [242]), as well as a values-representation method (e.g., [243]). In our study, we used value scenarios to elicit values from participants. Similarly to Woelfer et al. [243], in order to elicit ideas for how future crowdsourcing platforms could support workers' flexible time arrangements, we asked participants to write a value scenario using the following prompt: "Some people work on crowdsourcing platforms because they need flexibility in their time schedules. Please write a story about what an ideal day would look like for you one year from now if the creators of crowdsourcing platforms addressed the issues we discussed in the previous exercises. There are no right answers. The story can be as long or short as you like. It can be about a real situation or a fictional situation." We allocated participants five minutes to individually write the story and another ten minutes to share their reflections with the group.

Next, during the *card sorting exercise*, we asked participants to envision the future of crowdsourcing platforms medium-term. As part of this exercise, we used as design prompts the 19 technical features we generated in Study 5 (i.e., the retroactive technical investigation) to encourage participants to think about the future of crowdsourcing platforms *five years from now*. We displayed the 19 technical features on 19 post-its, in which we told participants that describe features of crowdsourcing platforms that could give them more flexibility or control over their time. Firstly, we asked participants to individually sort these cards into three categories

— high, medium, and low priority — according to which features they would like to see adopted in the next five years by crowdsourcing platforms. We allocated participants ten minutes to sort the cards into the three categories. Next, after participants sorted the cards individually, we asked them to spend the next 15 minutes collaboratively sharing their reflections with the group.

Finally, during the *design exercise*, we asked participants to envision the future of crowdsourcing platforms long-term. This final activity was a multi-lifespan co-design activity [238]. Multi-lifespan co-design activities intend to stimulate multi-lifespan design thinking [244], that is, focusing on the “design and deployment of information systems to support long-term solutions to significant societal problems that are unlikely to be solved within a single human lifespan” [244]. Therefore, this activity aimed to encourage participants to think long-term during the co-design activities. In our co-design sessions, we asked participants to envision the crowdsourcing platforms of *20 years from now*. As part of this exercise, we also asked participants to envision their future selves in 20 years using the platform, as well as their children becoming their age and using the platform. We allocated participants 25 minutes to work together as a group on this exercise.

5.2.2.4 Recruitment

We recruited seven participants using a popular crowdsourcing platforms. We sought to recruit participants who worked on crowdsourcing platforms because they needed flexible working hours. When recruiting participants, we mentioned that they would have an opportunity to influence the design of future crowdsourcing platforms and receive \$85 USD.

The crowdsourcing platform we used to recruit the participants allowed us to display our study advert to prospective participants who did not participate in traditional employment (i.e., were unemployed or not in paid work) and worked on multiple crowdsourcing platforms. This approach is similar to our recruitment strategy in Study 3 (i.e., the time-use diary study), whereby we recruited crowdworkers who made a large portion of their income from crowdsourcing platforms. Furthermore, the platform also allowed us to only display the study to participants who (a) were

willing to participate in a video or non-video focus group (i.e., co-design session in our case) and (b) were willing to have their audio or video recorded.

We asked the crowdworkers interested in participating in our study to complete a survey hosted on Qualtrics⁸. In the survey, we asked prospective participants to (a) read the information sheet, (b) complete a consent form, and (c) schedule a slot for the co-design session—participants could choose from two dates we had scheduled for the co-design sessions.

As part of the recruitment process, we also collected demographic information about participants' gender, age, education levels, and location. We collected this demographic information because we aimed for a diverse group of participants in the two remote co-design sessions. Having a diverse group of participants in co-design sessions is important in terms of participant matching: co-design groups ought to include participants with a wide variety of backgrounds to enable learning and reflection on each other's experiences. Otherwise, if participants' backgrounds or experiences are too similar, the outputs of the remote co-design sessions can be limited [245]. Thus, to elicit multiple perspectives, we aimed in the recruitment process for diversity in gender, age, education levels, and location.

Each participant received \$85 USD for participating in the co-design sessions. We chose to pay participants \$85 USD for participating in the co-design sessions because crowdworkers are often paid such minimal rates for their work that this is deemed unethical and something we wish to avoid. For the participants to earn something near a reasonable pay rate, they may try to do more than one job at a time. Thus, we wanted to offer a participation fee that competed favourably with their usual hourly pay rate. Furthermore, we asked participants to devote 100% of their time to taking part in our study by being in a quiet place for two hours, limiting their ability to earn on the platform whilst participating in our co-design session.

5.2.2.5 Participants

Table 5.10 reports the demographics of the participants who took part in this study. Seven participants took part in the two remote co-design sessions. First, in terms

⁸<https://www.qualtrics.com/>

Table 5.10: Study 6 Participant Demographics

P#	C.D. #	Gender	Age	Highest education level	Location
P1	C.D. 1	W	24 - 34	Univ. undergraduate programme (e.g., Bachelor's)	United States
P2	C.D. 1	W	35 - 44	High school diploma	Germany
P3	C.D. 1	W	35 - 44	Some college/technical training	United States
P4	C.D. 1	M	18 - 24	High school diploma	Italy
P5	C.D. 2	M	65 - 80	Univ. undergraduate progr. (e.g., Bachelor's)	United States
P6	C.D. 2	W	24 - 34	Univ. undergraduate progr. (e.g., Bachelor's)	Canada
P7	C.D. 2	W	45 - 54	Univ. undergraduate progr. (e.g., Bachelor's)	United States

of gender, five participants (71%) identified as women and two (29%) as men. In terms of age, participants ranged in age from 19 to 72, with a mean of 38 ($SD = 18$) and a median of 38. Next, in terms of education level, four (57%) of the participants reported holding bachelor's degrees, two participants (29%) reported holding high school diplomas, and one participant (14%) reported having some college/technical training. Finally, in terms of location, four participants were from the United States, one from Canada, one from Italy, and one from Germany. Compared to the previous studies in this thesis, whereby we only recruited participants located in the U.S., in this study, we decided to also recruit people who lived outside of the U.S. We took this decision because we wanted to ensure participant diversity in the co-design sessions.

5.2.2.6 Ethical considerations

We committed to having ongoing reflective discussions throughout the study about the power imbalances that might arise before, during, and after the co-design sessions. We next highlight the measures we took to remove the power imbalances characteristic of co-design sessions and ensure participants' privacy.

Before the remote co-design session, we asked participants to read the Code of Conduct we prepared for these co-design sessions. We also informed the participants that the sessions were audio and recorded and that the researchers would solely use the recordings for analytical purposes. Furthermore, we asked all the participants to provide written consent before the co-design sessions and oral consent at the beginning of the co-design sessions. We used Qualtrics to collect consent forms from the participants.

Next, during the remote co-design session, we aimed to create an informal, relaxed, and positive atmosphere, which enabled all participants to contribute equally. First, to create an informal atmosphere, we kept the sessions free of academic jargon. Further, we held the sessions online, a familiar and neutral space for the participants. Second, to create a relaxed atmosphere, we clarified with the participants that there is flexibility in setting a different agenda despite having a plan for running the sessions. This flexibility enabled participants to influence the co-design process in ways that benefited them directly. Further, we highlighted the importance of maintaining each other's privacy during and after the co-design sessions, and following the Code of Conduct for the co-design session. Finally, to create a positive atmosphere, we shared our outsider statuses as researchers at the beginning of the sessions with the participants. Further, we highlighted the role of the participants as primary contributors and owners of the ideas and designs generated during the co-design sessions.

Finally, after the remote co-design session, we revoked participants' access to the Microsoft Teams call and the Miro board as soon as the co-design sessions ended to prevent participants from downloading the recordings. We stored the recordings of the sessions (together with their corresponding transcriptions) in UK/EEA located servers (i.e., Microsoft Teams). Furthermore, we provided participants with the option to stay in touch about the study's outcomes. In this sense, we aimed to create a feedback loop that gave participants ownership over the implementations and evaluation of their ideas and designs.

5.2.2.7 Data Collection and Analysis

In total, we collected four hours of audio data and screen recordings. First, all remote co-design sessions were audio recorded. We also took screen recordings of the Miro board during the co-design sessions—participants were not video recorded. The sessions were also automatically transcribed using Microsoft Teams; however, we also had to manually correct some of the recordings.

Next, we coded all the data collected during the co-design workshops in Miro and analysed it thematically. The data included: (a) audio data, (b) screen record-

ings, and (c) participants' contributions in the five design exercises. The data analysis took a bottom-up approach. We initially read throughout the data to increase our familiarity with it. Next, we created a set of high-level codes, and coded the data using these initial codes. We added the codes that we generated to a codebook, which we used to analyse the rest of the data.

5.2.3 Results

5.2.3.1 The future of crowdsourcing platforms one year from now

Three values emerged from our analysis of the future of crowdsourcing platforms one year from now: (1) predictability, (2) fairness, and (3) flexibility.

Predictability. In discussing what the future of crowdsourcing platforms would look like one year from now, one of the major values that emerged from our data analysis was the need to support predictability. As part of the co-design sessions, we asked participants to reflect on their experiences managing their time whilst working on crowdsourcing platforms. Figure 5.3 shows images from participants' design whiteboards where they reflected on their experiences.

Participants acknowledged that the main challenges they faced were a lack of

Figure 5.3: A subset of participants' reflections during the co-design sessions



predictability. In particular, participants acknowledged that they faced a lack of financial and temporal predictability. Firstly, in terms of the lack of financial predictability, participants mentioned finding it challenging to know how much money they will be able to make during a week or month. In this respect, participants shared common questions when discussing the lack of financial predictability that comes with working on crowdsourcing platforms: *“Is there going to be enough work? Is there going to be enough good work, especially? Is this work going to be available at a time when I will be available?”* (P2). The lack of financial predictability that the participants experienced was also due to the amount of unpaid time they were required to put into crowdwork. For example, one participant who took part in the second co-design session expressed their frustration with having to fill in unpaid screening questionnaires:

“Some platforms are very frustrating because of time wasted answering questions only to be disqualified after many minutes of work. This interferes with my ability to maximize earning during the time I have to work.” — P7

A participant in the first co-design session also shared P7’s frustration. In this sense, P4 mentioned that because they do not generally know if the jobs they had completed will actually pay them, they had to be very careful when deciding which job to complete:

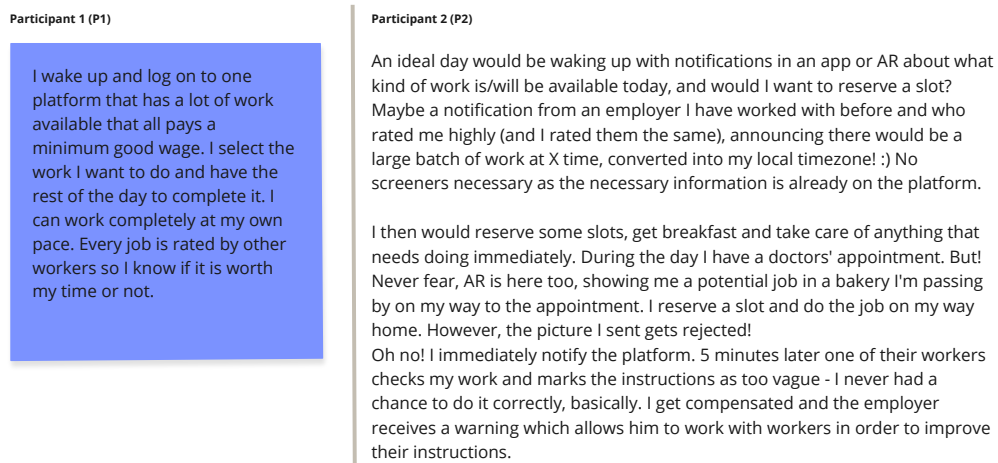
“You can work whenever you want to, but you also have to choose wisely what you want to do because there is a risk you waste your time and after all you are going to lose money doing something that maybe is going to underpay you, and you have to judge how much time something is going to take you.” — P4

In terms of the lack of temporal predictability, participants mentioned finding it challenging to predict when and for how long they might get to work or how much spare time they might have. Participants expressed thoughts such as *“Is there work now? Is there work now? I could have been doing something else, but I can’t*

because I need to be available.” (P2). These results confirm the findings of Study 4 (i.e., the time-use diary study), whereby participants mentioned experiencing difficulties predicting their work times and incomes; in turn, participants in Study 4 experienced difficulties planning and sticking to their time schedules.

Next, after reflecting on their experiences, we asked participants to envision the future of crowdsourcing platforms one year from now. To support participants in envisioning the future of the platforms, we asked them to write a story about what an ideal day would be like for them if the creators of crowdsourcing platforms addressed the issues we discussed in the reflection exercise. Figure 5.4 shows images from participants’ design whiteboards where they wrote their stories.

Figure 5.4: A subset of stories created by the participants in the co-design sessions



In discussing what the future of crowdsourcing platforms would look like one year from now, crowdworkers envisioned more predictable features. For example, parts of P5 and P3’s stories addressed some of the earlier challenges mentioned by the participants. These stories described near futures in which participants experienced more financial and temporal predictability in their lives by being able to schedule in advance work for specific times or days:

“A year from now my ideal day on my ideal platform would start over morning coffee. I would check my emails to see if a platform has requested me to fill out a survey or do a job. If so I would proceed. [...]

I would also be able to schedule surveys at specific times and days in advance, like this one.” — P5

“During an ideal day, [...] I would be able to have at least somewhat of an idea of what I would be making in a week, so that I could pay my bills, and know that I would be able to afford to pay the rent, pay the electricity, and everything else that needs to be paid.” — P3

Participants also envisioned a near future in which predictability would be increased by having potential jobs lined up at the beginning of the day. For example, P2 envisioned a future in which they would start their workday by being able to review a list of jobs that they are qualified to complete. In this scenario, the crowdsourcing platforms are aware of the jobs that P2 has completed before and can match the participant with jobs that they will be able to complete successfully:

“An ideal day would be waking up with notifications in an app or AR about what kind of work is/will be available today, and would I want to reserve a slot? Maybe a notification from an employer I have worked with before and who rated me highly (and I rated them the same), announcing there would be a large batch of work at X time, converted into my local timezone! :)” — P2

Additionally, participants also envisioned a near future in which work predictability would be increased by automatically being assigned jobs. For example, participants discussed being automatically assigned jobs they are qualified to complete. In this scenario, the platform would know which jobs to assign to the workers based on demographic questions workers had answered. This suggestion could increase crowdworkers' predictability and ease their decision-making process. In this sense, participants mentioned that being assigned jobs they are qualified to complete could eliminate the amount of unpaid time that goes into judging whether they are actually qualified to complete a job or not. Participants also agreed that being assigned jobs they are qualified to complete would also benefit the clients (e.g., researchers) using these platforms by collecting data quicker:

“[During an ideal day] I’d choose a time of day to work for a couple of hours. I would know I can fill those hours with work, because all the platforms I use will have great pre-screening and matching tools. No more answering of questions only to be turned away without pay. I will have often even lined up work for the morning, by browsing a day ahead of time and scheduling surveys for the next day’s work. [...] Yeah, and it is beneficial for the people who are trying to get their surveys can completed too, because the the platform did a better job of matching the participants who are gonna answer them. Then they get really good feedback much more quickly.” — P7

Finally, participants also envisioned a near future in which work crowdworkers’ predictability would be increased by being able to set a fixed number of work hours at the beginning of the day. In this sense, participants envisioned telling the platform how many hours of work they would like to do during a given day and, in turn, the platform allocating them jobs for this amount of time. This suggestion would increase crowdworkers’ predictability by knowing exactly how much time they were going to work during a day and how much money they would be making:

“I like that idea of the you log on and you say I’d like to work two hours and that would be between 2:00 and 4:00 and 5:00. And then you log back on at 1:00 o’clock and there’s your work.” — P5

However, not all participants were keen on this suggestion. Instead of following a fixed number of work hours they had set up at the beginning of the day, some participants preferred having more flexibility in their schedules to spontaneously work on the platform whenever they have some spare time. Overall, participants acknowledged that there would have to be a balance between the predictability of having work already assigned to them at the beginning of the day and the flexibility of working opportunistically on jobs that were not initially assigned to them:

P7: “I think it should be also remain flexible that there’s a stream of work. You can, you know, keep notifications on and get it as available. But the option to work that way would be, I think, really cool.”

P6: *“Yeah, I agree to have both ways, because sometimes I don’t really know when I’m free. I’m just studying all day and then if something comes up I’ll just take a break and do the study.”*

P7: *“Yeah. And I hope that I could work both ways, because even if I have a few surveys lined up, I’d still love the pop one in later.”*

Fairness. The next value that emerged from our analysis of the future of crowdsourcing platforms one year from now was fairness. Participants commented that crowdsourcing platforms do not necessarily have a scarcity of work available. Instead, participants mentioned that crowdsourcing platforms have a scarcity of actual fair pay and fair treatment.

First, in terms of fair pay, participants mentioned finding plenty of work available on crowdsourcing platforms that do not pay a fair wage. However, participants believed that if clients started paying workers higher rates, it could motivate workers to spend more time working on the platforms — in turn, clients would have a larger pool of workers from which to choose:

“Seeing that you actually have the opportunity to make money, and not just hope to do, could motivate you to do more work. It is not as motivating now if you don’t have offers and you are just sitting there waiting for the right opportunity.” — P4

Next, when asked to write a story about what an ideal day would look like for them one year from now, participants envision a near future in which they would be paid and treated fairly. For example, during an ideal work day, P4 would ideally find it relatively easy to find well-paid work at a time that works for them. Similarly, P6 and P7 would unsurprisingly also want to get paid fairly:

“The ideal day of work starts after having finished studying for uni. Without the problem of hardly finding work to earn some money, It would be far easier to choose which activity I want to take part in.”

This would help the market too, because underpaying employers would have to adapt to the market.” — P4

“The studies will have already done the pre-screening through the platform, and if something specific needs to be screened it will be the first questions. [...] The compensation for the studies should be fair and at least minimum wage. It should also be easy to receive payment.” — P6

“I will only have to be on two or three platforms, because each provides ample work for me to do 2 to 6 hours a day. The pay for the platforms I’m using will also be fair, consistent, and worthwhile, because there will have been more standardization of expectations. No more 15 minutes for 20 cents.” — P7

Nevertheless, participants mentioned that the lack of fair pay on crowdsourcing platforms was not something that researchers could solve by solely paying workers more money. Instead, this issue required policy interventions at a global level:

”[...] I think the the other problem is that there is there is a lack of like regulation about how much people are going to get paid. And I I think the problem is that this kind of market is international. So which regulation should you really follow like should you follow the US regulation, but if you’re working in India?” — P2

Participants also wondered during the two co-design sessions whether it was better to keep crowdsourcing platforms open to workers globally or to have the platforms locked for specific regions. Most participants agreed that having platforms locked for certain regions would be helpful in terms of having local laws protecting crowdworkers:

“Having platforms locked for certain regions could be useful because you would have more local laws protecting locals. I don’t feel like platforms really provide protection. for example, some researchers pay very little, if at all, but I think that the main problem to overcome is

to have people that can participate in that kind of market. Where I'm from, there are not that many platforms for people with my nationality. I think it's because there are not enough people educated about this kind of stuff, and it's still not something a lot of people know about. This could be a problem that would help expand the market.” — P4

Next, in terms of fair treatment, participants mentioned having their work rejected unfairly by clients on numerous occasions. For example, P4 described that “*employers can mistreat workers because there is no mechanism to dispute rejections on most platforms*”. Further, P2 described that the lack of standardisation across platforms meant that clients could create multiple accounts under different names on multiple platforms, “*perhaps because of the bad reviews they received on one of the platforms*”.

When asked to envision the future of crowdsourcing platforms one year from now, participants envisioned a near future in which they would have more protection from unfair rejections. In the future, participants envisioned crowdworkers collaborating to tackle work rejections:

“[...] However, the picture I sent gets rejected! Oh no! I immediately notify the platform. 5 minutes later one of their workers checks my work and marks the instructions as too vague - I never had a chance to do it correctly, basically. I get compensated and the employer receives a warning which allows him to work with workers in order to improve their instructions.” — P2

Participants also envisioned a near future in which crowdsourcing platforms would be more closely monitored. For example, P2 suggested that platforms could automatically take screenshots of workers completing jobs to prevent or, later on, dispute unfair rejections. P2 mentioned already keeping screenshots of work they had completed months ago in case clients rejected their work and the participant wanted to dispute the rejection. Thus, P2 envisioned a future in which they would not have to spend unpaid time gathering evidence for reversing unfair rejections:

“Why is the onus on us to keep video files and screenshots and everything for like months on end and have it assigned to the title or something else like so we can actually remember it because we do sometimes we do 100 jobs a day. How would we remember each single one? [...] Can’t they take a screenshot of you doing the thing? I don’t care if they wanna record record my keystrokes on my screen while I’m doing the survey. That’s fine. I don’t care! But but if that then gives me the ability to be like, hey, no, I did that correctly.” — P2

Flexibility. The last value that was prominent across our analysis of the future of crowdsourcing platforms one year from now was flexibility. As part of the co-design sessions, we asked participants to reflect on their experiences managing their time whilst working on crowdsourcing platforms.

Participants commented on how crowdsourcing platforms can offer them the temporal flexibility they need. For example, one participant mentioned that working on crowdsourcing platforms allowed them to plan their work time based on their energy level — the participant had a chronic illness that made them extremely tired all the time. Furthermore, another participant mentioned that working on crowdsourcing platforms allowed them to attend medical appointments whenever they needed. In addition, another participant mentioned being able to study for University at their own pace whilst earning an income on the side.

However, participants also encountered challenges in maintaining this flexibility. For example, participants were under the time pressure of starting to work on jobs immediately after accepting them, without being able to delay working on them to a more suitable time. These findings validate the results of Study 3 (i.e., the video observation study), whereby participants mentioned having to work under time pressure because of jobs with short completion deadlines.

“Sometimes I run into difficulties managing time because most work must be done within a short time frame. It would be easier to find and complete paying jobs if platforms offered the ability to schedule a job

for say, within 3 to 4 hours of accepting it.” — P7

Next, when asked to write a story about what an ideal day would like for them one year from now, participants envisioned a near future in which they would be able to work on the platform on high-quality jobs at their own pace whilst also being able to cater to their non-work schedules:

“I wake up and log on to one platform that has a lot of work available that all pays a minimum good wage. I select the work I want to do and have the rest of the day to complete it. I can work completely at my own pace. Every job is rated by other workers so I know if it is worth my time or not.” — P1

“I would have the computer on and open my crowd working platforms then get my errands and whatever I need to do done, but if I have studies available I would get an audio warning. The warning can also be adjustable to be visual instead. I can go work on the studies whenever I notice one appear. [...] Studies should give a reasonable amount of time to be started and finished.” — P6

Finally, when discussing further about the flexibility they would like to get from future crowdsourcing platforms, participants proposed the idea of reserving jobs from their smartphones. This idea can increase participants’ flexibility by allowing them to access the pool of available work on the go:

“Yeah. Especially like, even if you can’t do them right now, if you could be like, hey, I’m literally on my way home. Like, you know, kind of like reserving the slot, which is what we like had before in the brainstorming session.” — P2

5.2.3.2 The future of crowdsourcing platforms five years from now
Thinking about the future of crowdsourcing platforms five years from now, the main value that emerged from our analysis of the co-design sessions was integrity.

Figure 5.5: A subset of images of participants' outputs during the card sorting exercise



Integrity. The major value that emerged from our data analysis was the need for integrity in the future of crowdsourcing platforms five years from now. As part of the co-design sessions, we asked participants to sort 19 post-its that described features of crowdsourcing platforms that could give them more flexibility or control over their time in the next five years. Figure 5.5 shows images from participants' design whiteboards where they sorted the cards.

Overall, all participants agreed that crowdsourcing platforms should require clients to pay workers a minimum hourly wage in the next five years. In this sense, all participants categorised this card as ‘high priority’. Furthermore, in line with the results of the previous co-design exercise, participants acknowledged that another main challenge they faced was job rejections. Most participants agreed that crowdsourcing platforms should require clients to provide timely feedback about rejected work—most participants (i.e., six out of seven participants) categorised this card as ‘high priority’. Furthermore, most participants (i.e., six out of seven participants) also marked the feature “Platforms should not allow clients to ask workers to complete lengthy unpaid assessments” as a high priority in designing future crowdsourcing platforms five years from now.

Other high-priority features included: (i) “Platforms should not limit the maximum amount of money workers can earn in a day, week, or month” (i.e., five out of seven participants), (ii) “Platforms should reserve jobs for the workers” (i.e., four out of seven participants), (iii) “Platforms should not allow clients to keep the data from rejected jobs” (i.e., four out of seven participants), (iv) “Platforms should allow workers to complete an unlimited number of jobs at a time” (i.e., three out of seven participants), and (v) “Platforms should assign jobs to the workers” (i.e., three out of seven participants).

Regarding assigning and reserving jobs to workers, a few participants commented that crowdsourcing platforms should do a better job assigning work by pre-screening participants:

“I don’t know if I agree with them [the cards] exactly as they worded, but the way I’m looking at it is they [crowdsourcing platforms] should do better prescreening pre matches and in that sense you know these [jobs] are the workers that could do them and kind of have them pulled aside for them and assign them and say hey, we would like you to do these because you’re a great match.” — P2

In terms of the medium-priority features, most participants (i.e., five out of seven participants) ranked the feature “Platforms should have a degree of control

over the completion times of jobs” as medium-priority in the future crowdsourcing platforms five years from now. Furthermore, most participants (i.e., four out of seven participants) also ranked the following three features as medium-priority: (i) “Platforms should not limit the maximum number of jobs workers can complete in a day, week, or month”, (ii) “Platforms should not allow clients to reject workers who completed jobs too quickly”, and (iii) “Platforms should limit the number of workers who can register on the platform.” Other medium-priority features included: (i) “Platforms should provide clear payment timelines to workers” (i.e., three out of seven participants) and (ii) “Platforms should not require workers to wait between submitting jobs.” (i.e., three out of seven participants).

Regarding limiting the number of workers who can register on the platform, participants commented that platforms should limit access to work for those crowdworkers who submitted “consistently bad work with no good faith signs” (P2). Participants also added that whilst most crowdworkers want access to high-quality jobs, there will be less work available if more workers are added to the pool:

“Interesting dilemma as most workers want a lot of high-quality work available but the amount of work available will be less with every additional worker added to the pool.” — P2

In terms of the low-priority features, most participants (i.e., four out of seven participants) ranked the feature “Platforms should have set hours when clients post jobs” to be of low priority in the design of future crowdsourcing platforms five years from now. Similarly, most participants (i.e., four out of seven participants) also considered the feature “Platforms should not ask workers to complete unpaid qualification tests to register on the platform” to be of low priority. Finally, some participants (i.e., three out of seven participants) considered the feature “Platforms should limit the maximum number of workers completing jobs at any given time” to also be of low priority in designing future crowdsourcing platforms five years from now.

Surprisingly, most participants agreed that two of the cards we included in this exercise should not be considered in the future of crowdsourcing platforms. Par-

Participants commented that features such as (i) “Platforms should limit the number of hours workers can work” and (ii) “Platforms should set hours when workers can complete jobs” should not be features of crowdsourcing platforms altogether. Participants commented that such features would take away from the flexibility workers require from crowdsourcing platforms:

”Limiting certain hours and stuff that you can work and stuff like that. It’s a bit strange [...] Making it more similar to like where the platform has control over you like a regular job, and I don’t think that’s really the point. [...] Yeah, seems like they should be off the list.” — P6

Finally, when further asked to envision the future of crowdsourcing platforms five years from now, one participant envisioned a future in which crowdworkers would have their skills tested frequently. This suggestion is meant to ensure fairer wages for the workers and higher work quality for the clients:

“I find it really interesting that most of us had one or more of cards that were about like, it shouldn’t limit the hours. It shouldn’t limit the amount of jobs. It shouldn’t limit when we work, but on the other hand, we want work to always be available, which is an interesting dichotomy. So I wonder could it be that that platform would be made where you are basically tested a little bit in various ways. [...] then the employer can also be sure that this worker does wanna do good work. This worker isn’t just giving me nonsense answers. They have passed this testing paid and also have some security in that.” – P2

5.2.3.3 The future of crowdsourcing platforms 20 years from now

Finally, thinking about the future of crowdsourcing platforms 20 years from now, three main values emerged from our analysis of the co-design sessions: (1) accountability, (2) transparency, and (3) identity.

Accountability. The first value that emerged from our data analysis of the future of crowdsourcing platforms 20 years from now was the need for accountability. As part of the co-design sessions, we asked participants to think longer-term about

the future of crowdsourcing platforms. Thus, as a group, we asked participants to envision their future selves 20 years from now using crowdsourcing platforms, as well as their children becoming their age and using crowdsourcing platforms.

When thinking about the long-term future of crowdsourcing platforms, one recurring question was “Whose responsibility is it?”. In this sense, participants reflected on whom holds responsibility for driving change in the future of crowdsourcing platforms: the clients, platforms, or policymakers. For example, three participants agreed that crowdsourcing platforms are the ones that must be held responsible. In particular, participants commented that the platforms should be held responsible by the clients who use these platforms. In this sense, participants believed that if clients would hold the platform responsible, it could have a trickle-down effect on the clients, who would have to follow certain quality standards when posting jobs on the platform:

“I think that part of the change that has to happen is that platforms are held more accountable by the people that want to post jobs on them.”

— P2

“I think the platform should have some degree of like baseline just to protect people from being like exploited [...] Put it out to researchers next. Hey, if you want to go through our site, then these are the minimums we require. This is how we work.” — P6

“I think platforms could set the standard for the researchers and the workers, and that way I think it’s more the platforms’ responsibility and then the researchers would have to come along.” — P7

When further asked to envision the future of crowdsourcing platforms twenty years from now, one participant envisioned a future in which clients would receive more training. The participant mentioned having to spend a significant amount of unpaid time providing clients advice on setting up their studies in ways that would treat the workers fairly. Thus, they believed that crowdsourcing platforms should provide clients with more training:

“At the moment it’s up to us, the workers, to educate the people who employ us that, for example, they don’t need to limit your studies to U.S.-only. So in my day I have to consider how much energy do I have today to educate my employer [...] Yeah, like that’s why I would love for clients to basically like again like have to register or like a global platform and then go through training almost because like for example, there are platforms where request is literally ask workers, how do I design this job so it works like they have to like test it because it doesn’t actually work because you have to, you have to write code sometimes to make things work.” — P2

Transparency. The second value that emerged from our data analysis of the future of crowdsourcing platforms 20 years from now was the need for transparency. For example, when asked to envision the future of crowdsourcing platforms twenty years from now, one participant envisioned a future in which jobs posted on crowdsourcing platforms would be first vetted by other crowdworkers before being made available on the platform:

“I would love it if any job they wanna post goes through a a a person that like looks at it and is this too vague? Is this easy to understand? Does it even work? Can I submit the job and then it goes to the workers? That will be amazing like the. Then you have the accountability and you have some variables that are already fixed essentially.” — P2

When further asked to envision the future of crowdsourcing platforms twenty years from now, another participant envisioned a future in which workers would have insights into the earnings of the platforms compared to the earnings of the workers. In this sense, P7 envisioned a future in which if their children were to work on crowdsourcing platforms, they would be made aware of how much the platforms are profiting from their work:

“As it evolves, I’m always curious about, what is the platform making versus what are the workers making and how is that distributed? I

think there should be transparency and among and between platforms and two workers that if this survey is paying you \$3, that means we're making 20 or you know how's it working out? Is it fair to anybody, researchers or workers or are these platforms just making money while we see wheels spinning and not getting paid? [...] So for my kids, you know, I'd like to be able to say in the future, like, hey, if this is still a way to work, you really know who you're working for. You know what you're getting out of it. You know who's profiting. And you can make your choices about how you want to spend your time.” — P7

Identity. Finally, the last value that emerged from our data analysis of the future of crowdsourcing platforms 20 years from now was the need for identity. In this sense, participants suggested wanting to be able to choose from a pool of jobs that were tailored to their interests. Thus, participants envisioned a future in which they would not only be working on crowdsourcing platforms solely for the money but also because of personal interests. For example, one participant hoped that if their children were to work on crowdsourcing platforms, they could work on jobs related to their interests:

“If I think about my kids in the future too, you know, if they're gonna do this kind of work, be a part of their income in the future. If it grows to that point where it's not just a side gig or it's not just an additional income, you can't really survive on it this way. But maybe if there was some streamlining. Hey, my kid who gets interested in punk rock and music has a place to go to do all kinds of music studies that he's becoming an expert in and he could build something around that, you know versus.” — P7

Lastly, P7 also mentioned that having more crowdsourcing platforms with jobs related to workers' interests could also benefit the clients, who would have access to a pool of crowdworkers with particular interests or qualifications:

”And make it more interesting for researchers too. That way, if you develop a following. If you do surveys on those topics, you’ll get better answers than somebody who’s just a shopper who gets a political question or, you know, whatever. I think that would be fun for the future. Thinking about my kids maybe doing it.” — P7

5.2.4 Discussion

In this study, we aimed to answer the following RQ: *What kind of future crowdsourcing platforms do workers who value temporal flexibility envision?* To answer the RQ, we conducted a proactive technical investigation in which we facilitated a couple of remote co-design sessions with seven crowdworkers to envision the design of future crowdsourcing platforms.

5.2.4.1 Summary of Results

Taken together, the results of the study described a set of values that need to be reflected in the design of future crowdworking platforms. As part of the co-design sessions, we asked participants to envision the future of crowdsourcing platforms one year, five years, and 20 years from now. In particular, three main values emerged from our analysis of the future of crowdsourcing platforms one year from now: *predictability*, *fairness*, and *flexibility*. Next, thinking about the future of crowdsourcing platforms five years from now, the main value that emerged was *integrity*. Finally, thinking about the future of crowdsourcing platforms 20 years from now, three main values emerged from our analysis of the co-design sessions: *accountability*, *transparency*, and *identity*. This study suggests that the mechanisms behind crowdsourcing platforms should considerably change in the future if the platforms ought to continue to exist so crowdworkers can experience more temporal flexibility. We next consider the implications of the results and summarise the design values identified in this study.

5.2.4.2 Implications

The seven participants in the co-design sessions contributed concrete feature recommendations for the future of crowdworking platforms. Overall, the results of the

co-design sessions suggest that the design of future crowdworking platforms should reflect the following seven values: (1) predictability, (2) fairness, (3) flexibility, (4) integrity, (5) accountability, (6) transparency, and (7) identity.

First, in terms of the platforms supporting *predictability*, participants suggested changes to increase financial and temporal predictability, such as scheduling work in advance for specific times or days. Given that many of the jobs posted on crowdsourcing platforms are not time-critical — 89% of jobs posted by academic researchers in December 2015 were for surveys [36] — crowdsourcing platforms could schedule work in advance for specific jobs instead of expecting crowdworkers to be ‘on call’ to complete jobs.

Second, in terms of supporting *fairness*, participants suggested changes to increase fair pay and fair treatment, such as crowdworkers collaborating to tackle unfair rejections. Participants also suggested increased monitoring on crowdsourcing platforms to tackle rejections. In this sense, participants discussed the possibility of crowdsourcing platforms automatically taking screenshots whilst workers complete work. This feature suggestion is similar to Upwork’s time-tracker feature, which takes screenshots of freelancer’s screens every 10 minutes. However, such surveillance tools present privacy concerns [246]. Thus, the significant issue of unfair rejections would require crowdsourcing platforms to decentralise the process of reviewing rejections from platforms to crowdworkers, such as having crowdworkers collaborate to tackle rejections.

Third, in terms of supporting *flexibility*, participants suggested changes to maintain the flexibility they require, such as reserving jobs from their smartphones. As a step in this direction, Dutta et al. [247] developed a taxonomy for increasing the usability of jobs posted on crowdsourcing platforms by making jobs more mobile-friendly and thus accessible. However, participants in this study recognised the dichotomy between wanting to work flexibly and desiring work to be permanently available, even though this might attract more workers onto the platforms and thus result in lower incomes. For example, in Yin et al.’s study [17], crowdworkers reported being willing to trade a portion of their incomes to have more

control of their time. This dichotomy reflects potential further value tensions that exist among crowdworkers.

Fourth, in terms of supporting *integrity*, participants suggested changes such as clients being required to pay workers a minimum hourly wage and provide timely feedback about rejected work. Fifth, in terms of supporting *accountability*, participants suggested changes such as crowdworking platforms providing training to clients. Sixth, in terms of supporting *transparency*, participants suggested changes such as providing insights into the platforms' earnings compared to workers' earnings. Taken together, values such as fairness, accountability, and transparency (FAT) echo practitioners' growing interests in improving socio-technical systems by incorporating more ethical practices in AI and ML models [248].

Finally, in terms of supporting *identity*, participants suggested changes such as being able to work on more jobs that are related to their interests. Increasing workers' sense of identity is important given the invisible nature of crowdworking [77], which is reflected in the design choices of crowdsourcing platforms.

5.2.4.3 Conceptual Investigation

Table 5.11 presents a refined list of time constraints found on crowdsourcing platforms. The time constraints were identified as part of the Background chapter (Chapter 3), the subsequent empirical investigations (Chapter 4), and the proactive technical investigation presented in this study. The items listed in red and marked with the words "This study" represent the time constraints we refined in this study.

5.2.4.4 Limitations and Future Work

This final study is not without limitations. Firstly, our study only included direct stakeholders in the co-design sessions. VSD suggests that proactive technical investigations should also include indirect stakeholders. Future work should consider recruiting close family members, friends, or flatmates of crowdworkers as indirect stakeholders. Furthermore, direct stakeholders such as clients or platform designers could also be included in future co-design sessions. However, researchers should carefully mitigate the power imbalances that can arise from having crowdworkers, clients, and platform designers together in the same co-design sessions. Further-

Worker-Imposed Time Constraints	Description
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. W2.6 Workers have to rely on community-based reviews to evaluate jobs. W2.7 Workers might not always be able to take breaks.
Client-Imposed Time Constraints	Description
R1. Inflexibility of Time Use	R1.1 Clients set the completion times of jobs. R1.2 Clients can underestimate the completion times of jobs. R1.3 Clients can post jobs that do not work. R1.4 Clients can choose to pay workers poorly.
Platform-Imposed Time Constraints	Description
P1. Lack of Work Assignment	P1.1 Platforms do not assign jobs to the workers. P1.2 Platforms do not reserve jobs for the workers.
P2. Unpredictable Work Availability	P2.1 Platforms have no set hours when clients post jobs. P2.2 Platforms have no set hours when workers can complete jobs. (This study) P2.3 Platforms have no limit to the number of hours workers can spend working. (This study) P2.4 Platforms do not have any degree of control over the completion times of jobs. P2.5 Platforms do not provide clear payment timelines to workers.
P3. Unpaid Time	P3.1 Platforms do not require clients to pay workers a minimum hourly wage. P3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments. P3.3 Platforms can ask workers to complete unpaid qualification tests to register on the platform. P3.4 Platforms allow clients to reject workers who completed jobs ‘too quickly’.
P4. Oversupply of Workers	P4.1 Platforms have no limit to the maximum number of workers completing jobs at any given time. P4.2 Platforms have no limit to the maximum number of jobs workers can complete in a day, week, or month. P4.3 Platforms have no limit to the maximum amount of money a worker can earn in a day, week, or month.
P5. Inflexibility of Time Use	P5.1 Platforms do not allow workers to complete multiple jobs at once. P5.2 Platforms require workers to wait a certain amount of time between submitting jobs.

Table 5.11: Time constraints found on crowdsourcing platforms. The items listed in red and marked with the words “This study” represent the time constraints we refined in this study.

more, our study was limited to two co-design sessions with a total of seven participants. Whilst the number of sessions was small, the two co-design sessions generated valuable conversations regarding the future of crowdsourcing platforms.

5.2.5 Conclusion

This study presented a proactive technical investigation that explored the design of future crowdsourcing platforms. The results of this study refined the conceptual investigation conducted throughout this thesis and contributed an extended understanding of how the design of crowdsourcing platforms can increase crowdworkers' temporal flexibility. In particular, the results of this study described a series of practical design recommendations generated by crowdworkers for the design of future crowdsourcing platforms.

Using data collected from two co-design sessions, we showed that the design of future crowdworking platforms should reflect the following seven values to increase workers' temporal flexibility: (1) predictability, (2) fairness, (3) flexibility, (4) integrity, (5) accountability, (6) transparency, and (7) identity. To support these seven values, participants in the co-design sessions contributed concrete feature recommendations for the future of crowdworking platforms. Overall, the results of this study suggests that the mechanisms behind crowdsourcing platforms should considerably change in the future if the platforms ought to continue to exist so crowdworkers can experience more temporal flexibility.

Chapter 6

General Discussion

In this chapter, we summarise the results of the six studies presented in this thesis and discuss the contributions of the work. We also reflect on the work conducted throughout this thesis. We begin by summarising our results.

6.1 Summary of Results

In this thesis, we aimed to answer the following RQ: *How can crowdsourcing platforms constrain and support crowdworkers who value temporal flexibility?* To answer this RQ, we conducted six studies using VSD as our design framework.

Using a combination of qualitative and quantitative methods across the six studies, we found that crowdsourcing platforms constrain crowdworkers' temporal flexibility through three types of time constraints. These time constraints are imposed by: (i) workers' personal and work circumstances; (ii) clients; and (iii) the design of crowdsourcing platforms. These three types of time constraints limit: (a) the temporal working preferences of workers, (b) the time workers have to make decisions, and (c) the work pace and work schedules of workers.

To support crowdworkers who value temporal flexibility, we found that the mechanisms behind crowdsourcing platforms need to considerably change so that they favour crowdworkers' temporal flexibility rather than clients' temporal flexibility. We next describe the results of the six studies in more detail.

First, Study 1 shows that time constraints imposed by crowdworkers' personal and work circumstances constrained the temporal working preferences of the work-

ers. Namely, we find that participants' personal and work circumstances imposed certain time constraints that contradicted how workers actually preferred to use their time when working. The results of this study are important because crowdworkers receive no formal training for managing their time or working environment. Thus, understanding workers' temporal preferences and the constraints they are under is essential to developing tools that support them. Future work will be required to investigate how to develop these tools.

Second, Study 2 shows that the time constraints imposed by clients limited the amount of time workers had in which crowdworkers could take decisions regarding their work. Namely, we find that since jobs clients posted on the platform had strict completion times, participants had to decide under time pressure: (a) which jobs to keep in their work queue, (b) which jobs to return, and (c) the order in which they should complete the jobs in their queue. The results of this study are important because, under time pressure, people tend to gather less information and to act quickly when making decisions [172]. Furthermore, time pressure affects human judgement and decision-making [173], calling into question the validity of data—used in both industry and academic publications—provided by crowdworkers. Future work will be required to assess the impact of time pressure on crowdworkers' judgement and decision-making.

Third, Study 3 shows that the time constraints imposed by the platform's design limited the pace at which crowdworkers worked and took breaks. Namely, we find that the platform's lack of work assignment impacted the pace at which participants worked and took breaks. The results of this study are important because not having control over the pace of work can reduce job control [249]. Job control is defined as the perceived ability to exert some influence over one's work environment to make it more rewarding and less threatening [250]. A high work pace can increase fatigue [174] and exhaustion [175]. Taking regular breaks can alleviate feelings of fatigue and exhaustion [168, 169] and replenish their energy resources [176]. Future work will be required to further investigate how crowdworkers' job control can be increased.

Fourth, Study 4 shows that the time constraints imposed by the platform's design limited the work schedules of crowdworkers. Namely, we find that unpredictable work availability impacted participants' ability to schedule their time and stick to planned work hours. The results of this study are important because unpredictable work availability can reduce schedule control [81]. Schedule control involves the extent to which workers can determine the hours and duration of work [81]. Low levels of schedule control can result in work-life role blurring [83] and high fatigue levels [87]. Future work will be required to further investigate how crowdworkers' schedule control can be increased.

Fifth, Study 5 shows that crowdsourcing platforms can constrain workers' temporal flexibility through 19 technical features. Namely, we find that crowdsourcing platforms strongly favour features that promote clients' temporal flexibility over workers' by limiting the predictability of workers' working hours and restricting paid time. The results of this study are important because crowdsourcing platforms are expected to grow globally at an annual rate of 26% [2]. Thus, revealing the platform architectures that make the exploitation of workers possible is pivotal to changing the flexibility discourse of the platform economy (e.g., individual freedom and flexibility [42]), and demanding decent work standards [251] (e.g., realised temporal flexibility [216] and fair pay [75]). Future work will be required to further investigate which technical features of crowdsourcing platforms restrict fair pay.

Finally, Study 6 shows that crowdworkers agree that to experience more temporal flexibility, the mechanisms behind crowdsourcing platforms should considerably change in the future. Namely, we find that the design of future crowdsourcing platforms ought to embody the following seven values in the long term: (1) predictability, (2) fairness, (3) flexibility, (4) integrity, (5) accountability, (6) transparency, and (7) identity. The results of this study are important because if crowdsourcing platforms should continue to exist, the design of future platforms needs to support workers' requirements for temporal flexibility by accounting for these seven values. Future work will be required to investigate how these values can be embedded in the long term in the design of crowdsourcing platforms.

6.2 Contributions

Overall, this thesis makes three contributions in HCI and CSCW to knowledge, practice, and design. Firstly, we make an empirical contribution by showing how time constraints limit crowdworkers. Secondly, we provide a conceptual framework of temporal precarity within crowdsourcing platforms. Finally, we provide a series of design goals that embody temporal flexibility as a value of central interest for crowdworkers. We describe each type of contribution below.

6.2.1 Contributions to Knowledge

The first contribution of this thesis is an empirical contribution that describes the time constraints that contribute to crowdworkers' limited temporal flexibility. First, Table 6.1 presents a list of time constraints found on crowdsourcing platforms that contribute to crowdworkers' limited temporal flexibility. Second, Table 6.2 presents a summary of the impact of these time constraints on the crowdworkers. In summary, the time constraints and their corresponding implications were identified as part of the: (a) conceptual investigation presented in Chapter 3, (b) subsequent empirical investigations presented in Chapter 4, and (c) retrospective technical investigations presented in Chapter 5.

The empirical contribution of this thesis consists of detailed qualitative and quantitative accounts of the value tensions (i.e., time constraints) that contribute to crowdworkers' limited temporal flexibility. Overall, the results of this thesis suggest that crowdworkers' temporal flexibility can be limited by 29 time constraints. These time constraints are imposed by: (a) crowdworkers' circumstances, (b) clients, and (c) the design of the crowdsourcing platform. We explored the impact of these time constraints on crowdworkers throughout the six studies we have conducted in this study. The results of the studies suggest that the time constraints increase the temporal precarity that crowdworkers experience. We next situate the results of this thesis in the context of temporal precarity, and we describe how the empirical contribution of this thesis contributes to the topic of conversation about crowdworkers' working conditions among researchers, workers, clients, platform stakeholders, and policymakers.

Worker-Imposed Time Constraints	Description
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. W1.2 Workers may complete jobs from shared spaces.
W2. Working Practices	W2.1 Workers may multitask when working on the platform. W2.2 Workers may switch among jobs frequently whilst working. W2.3 Workers have to monitor the time limits of the jobs in their queues. W2.4 Workers may use tools that provide frequent interruptions. W2.5 Workers have to maintain high levels of time awareness when working on the platform. W2.6 Workers have to rely on community-based reviews to evaluate jobs. W2.7 Workers might not always be able to take breaks.
Client-Imposed Time Constraints	Description
R1. Inflexibility of Time Use	R1.1 Clients set the completion times of jobs. R1.2 Clients can underestimate the completion times of jobs. R1.3 Clients can post jobs that do not work. R1.4 Clients can choose to pay workers poorly.
Platform-Imposed Time Constraints	Description
P1. Lack of Work Assignment	P1.1 Platforms do not assign jobs to the workers. P1.2 Platforms do not reserve jobs for the workers.
P2. Unpredictable Work Availability	P2.1 Platforms have no set hours when clients post jobs. P2.2 Platforms have set hours when workers can complete jobs. P2.3 Platforms limit the number of hours workers can spend working. P2.4 Platforms do not have any degree of control over the completion times of jobs. P2.5 Platforms do not provide clear payment timelines to workers.
P3. Unpaid Time	P3.1 Platforms do not require clients to pay workers a minimum hourly wage. P3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments. P3.3 Platforms can ask workers to complete unpaid qualification tests to register on the platform. P3.4 Platforms allow clients to reject workers who completed jobs 'too quickly'
P4. Oversupply of Workers	P4.1 Platforms have no limit to the maximum number of workers completing jobs at any given time. P4.2 Platforms have no limit to the maximum number of jobs workers can complete in a day, week, or month. P4.3 Platforms have no limit to the maximum amount of money a worker can earn in a day, week, or month.
P5. Inflexibility of Time Use	P5.1 Platforms do not allow workers to complete multiple jobs at once. P5.2 Platforms require workers to wait a certain amount of time between submitting jobs.

Table 6.1: Time constraints found on crowdsourcing platforms. The time constraints were identified as part of: (a) the conceptual investigation presented in Chapter 3, (b) the subsequent empirical investigations presented in Chapter 4, and (c) the retrospective technical investigation presented in Chapter 5.

Worker-Imposed Time Constraints	Description of Time Constraints	Implications for Workers
W1. Personal Circumstances	W1.1 Workers mainly work on the platform from their homes. (Bkgd.)	W1.1 The home can invite distractions and interruptions, which can lower focus levels. (Study 1)
	W1.2 Workers may complete jobs from shared spaces. (Study 1)	W1.2 Shared spaces can limit when people can work or the type of jobs they can complete. (Study 1)
W2. Working Practices	W2.1 Workers may multitask when working on the platform. (Bkgd.)	W2.1 Jobs in the work queue might expire before workers manage to complete them. (Study 1)
	W2.2 Workers may switch among jobs frequently whilst working. (Bkgd.)	W2.2 Frequent switching might reduce the overall quality of the work. (Study 1)
	W2.3 Workers have to monitor the time limits of the jobs in their queues. (Study 1)	W2.3 Having to be aware of the time limits can increase time pressure. (Study 1)
	W2.4 Workers may use tools that provide frequent interruptions. (Study 1)	W2.4 Interruptions can increase task switching and reduce focus levels. (Study 1)
	W2.5 Workers have to maintain high levels of time awareness when working on the platform. (Study 2)	W2.5 Workers experience time urgency as a result of working on the platform. (Study 2)
	W2.6 Workers have to rely on community-based reviews to evaluate jobs. (Study 3)	W2.6 Workers have to spend time on unpaid activities such as reading or writing job reviews. (Study 3)
	W2.7 Workers might not always be able to take breaks. (Study 3)	W2.7 Workers can experience feelings of tiredness due to a lack of break-taking. (Study 3)
Client-Imposed Time Constraints	Description of Time Constraints	Implications for Workers
R1. Inflexibility of Time Use	R1.1 clients can set strict completion times. (Bkgd.)	R1.1 Workers have to make work decisions under time pressure. (Study 2)
	R1.2 clients can underestimate the completion times of jobs. (Study 2)	R1.2 Workers can have jobs expire before they submit them, thus losing time and money. (Study 2)
	R1.3 clients can post jobs that do not work. (Study 2)	R1.3 Workers lose time and money by having to return the jobs. (Study 2)
	R1.4 clients can choose to pay workers poorly. (Study 2)	R1.4 Workers have to spend their time closely examining the jobs posted on the platform. (Study 2)
Platform-Imposed Time Constraints	Description of Time Constraints	Implications for Workers
P1. Lack of Work Assignment	P1.1 The platform does not assign jobs to the workers. (Bkgd.)	P1.1 Workers' work pace and frequency of breaks can be impacted. (Study 3)
	P1.2 Platforms do not reserve jobs for the workers. (Study 5)	P1.2 Workers have to be 'on call' for work [21].
P2. Unpredictable Work Availability	P2.1 The platform has not set hours when clients can post jobs. (Bkgd.)	P2.1 Workers have to spend a long time waiting and searching for work. (Study 4)
	P2.2 The platform has set hours when workers can complete jobs. (Bkgd.)	P2.2 Workers can have difficulties predicting their work and non-work hours. (Study 4)
	P2.3 The platform limits the number of hours workers can spend working. (Bkgd.)	P2.3 Workers can end up working long hours on the platform. (Study 4)
	P2.4 The platform has no control over the completion times of jobs. (Study 4)	P2.4 Workers can have difficulties planning their work and non-work schedules. (Study 4)
	P2.5 Platforms do not provide clear payment timelines to workers. (Study 5)	P2.5 Workers risk not knowing when they will be paid [225].
P3. Unpaid Time	P3.1 The platform does not require clients to pay workers a minimum hourly wage. (Study 2)	P3.1 Workers might not be getting paid fairly for the time they spend completing jobs. (Study 2)
	P3.2 Platforms allow clients to ask workers to complete lengthy unpaid assessments. (Study 5)	P3.2 Workers risk not getting paid for their time [226].
	P3.3 Platforms can ask workers to complete unpaid qualification tests to register on the platform. (Study 5)	P3.3 Workers have to spend time working on unpaid qualification tests before they can begin working [46].
	P3.4 Platforms allow clients to reject workers who completed jobs 'too quickly. (Study 5)	P3.4 Workers risk not getting paid for their time [226].
P4. Oversupply of Workers	P4.1 The platform does not limit the max. number of workers completing jobs at any given time. (Study 3)	P4.1 Workers might not have work available to complete for long periods of time; hence, workers have to spend 17% of their working time on waiting and for new jobs. (Study 3)
	P4.2 Platforms have no limit to the max. number of jobs workers can complete in a day, week, or month. (Study 5)	P4.2 Workers cannot complete additional jobs once they reached the limit, despite clients still making jobs available [227].
	P4.3 Platforms have no limit to the max. amount of money a worker can earn in a day, week, or month. (Study 5)	P4.3 Workers cannot complete additional jobs once they reached the limit, but spend time finding other revenue sources [228].
P5. Inflexibility of Time Use	P5.1 Platforms do not allow workers to complete multiple jobs at once. (Study 5)	P5.1 Workers can be restricted in how they use their time by being required to monotask rather than using their time as preferred. (Study 1)
	P5.2 Platforms require workers to wait a certain amount of time between submitting jobs. (Study 5)	P5.2 Workers might be limited in terms of the pace at which they work. (Study 3)

Table 6.2: Time constraints found on crowdsourcing platforms.

The empirical contribution of this thesis extends the current understanding of how platform workers experience temporal precarity. Specifically, the results of this thesis contribute an understanding of the time constraints that contribute to crowdworkers' limited temporal flexibility. We conducted this work because prior research has asked for an investigation of the work precarity of platform work [22]. In this regard, prior research exploring the sustainability of platform work has criticised the growing 'Uberization' of the workforce [252]. Additionally, prior research has also criticised the exacerbation of work precarity that platform workers experience [207, 208]. Thus, since participation on crowdsourcing platforms is expected to continue to grow [2], we argue that an understanding of what contributes to the precarity of crowdsourcing platforms is now increasingly important [22].

Work precarity describes the financial and temporal precarity that platform workers experience. Financial precarity is defined as the unpredictability, uncertainty, and insecurity workers experience with respect to *money*, whereas temporal precarity is defined as the unpredictability, uncertainty, and insecurity workers experience with respect to *time* [66]. Prior research suggests that the financial precarity of platform workers is reflected through low pay and lack of financial security [65], whereas temporal precarity is reflected through unpredictable work schedules and an intensified work pace [66].

The results of this thesis suggest that a lack of temporal flexibility increases the work precarity that crowdworkers experience. Work time accounts for a significant amount of daily life and so can influence health and wellbeing [253]. In addition, essential health and wellbeing activities, such as nutrition, exercise, and sleep, need some degree of time management and planning [253, 254, 255]. However, the results of this thesis suggest that crowdworkers' temporal flexibility is limited by a total of 29 time constraints. A lack of temporal flexibility can limit crowdworkers' ability to manage and plan their time, affecting in turn their health and wellbeing. Furthermore, the results of this thesis suggest that a lack of temporal flexibility on crowdsourcing platforms can result in financial precarity for the crowdworkers.

The empirical contribution of this thesis contributes to the topic of conversa-

tion about crowdworkers' working conditions. For the past decade, the working conditions of crowdworkers have been a topic of conversation among researchers, workers, clients, platform stakeholders, and policymakers. First, researchers can benefit from our empirical contribution by building on our research, which extends the existing research examining the invisible labour of crowdworkers [77, 156]. Second, workers can benefit from our empirical contribution by having increased awareness about the exploitative time constraints that crowdsourcing platforms employ [256], although they might have little power to change them. Third, clients can benefit from our empirical contribution by reflecting on the power asymmetries perpetuated by crowdsourcing platforms [257, 258], particularly when choosing which platforms to use in their work. Fourth, the design of crowdsourcing platforms can benefit from our empirical contribution by adopting a worker-centred design approach [259] by exploring the service and business design possibilities of future platforms in view of the 29 time constraints identified in this study.

Finally, policymakers can benefit from our empirical contribution by continuing to design policies that improve the working conditions of crowdworkers [156]. In particular, we argue that policymakers need to be made aware of the potentially problematic working time arrangements perpetuated by some crowdsourcing platforms. Thus, this thesis contributes to the larger conversation about overlooked unpaid labour by defining, quantifying, and describing the time constraints existing on crowdsourcing platforms. Nevertheless, although the responsibility of improving crowdworkers' working conditions needs to be shifted away from the workers to crowdsourcing platforms and policymakers, crowdworkers themselves require financial and, consequentially, temporal support to cooperate and take collective action [260]. Thus, technologies that provide insights into crowdworkers' working conditions could support the collective voice and action of the workers [261]. For example, tools that reveal the platform architectures that make the temporal exploitation of crowdworkers possible (e.g., [156, 47]) could empower the workers, as well as partners and advocates (e.g., scholars, unions, the public, or designers) to further critique and protest poor working conditions [261].

6.2.2 Contributions to Practice

The second contribution of this thesis is a conceptual framework of temporal precarity within crowdsourcing platforms. Figure 6.1 presents the conceptual framework. We generated the conceptual framework as part of the conceptual investigation conducted throughout this thesis. The result of the conceptual investigation is a conceptual framework that describes and explains the factors at play in crowdworkers' limited temporal flexibility.

Conceptual frameworks are defined by Jabareen as: “*a network, or a «plane», of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena.*” [262, p. 2]. In this sense, conceptual frameworks are designed to aid in the understanding and interpretation of phenomena rather than their prediction [262]. The phenomenon in question in this thesis is the temporal flexibility of crowdsourcing platforms.

We developed the conceptual framework through a process of qualitative analysis. In line with Jabareen's process of a conceptual analysis [262], we conducted a conceptual investigation throughout the thesis that allowed us to qualitatively analyse survey data, video data, and interview data. The result of the conceptual investigation is a conceptual framework that describes the time constraints that can increase or decrease temporal flexibility on crowdsourcing platforms. Taken together, the conceptual framework of temporal temporal precarity within crowdsourcing platforms presented in Figure 6.1 shows that crowdsourcing platforms trade workers' temporal flexibility as a resource for the convenience of clients but to workers' detriment in the following ways:

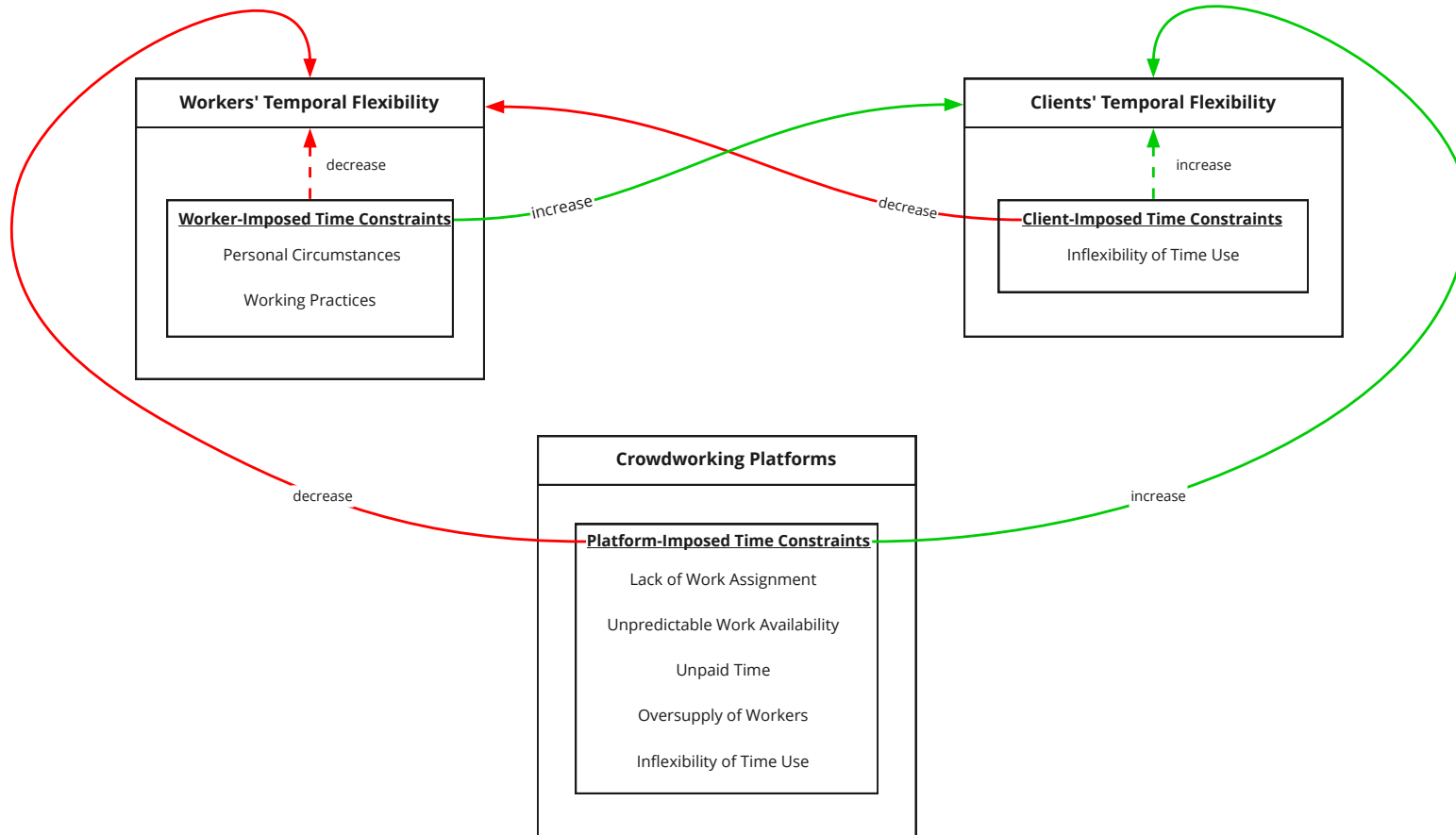
1. Platform-imposed time constraints can **decrease** the temporal flexibility of crowdworkers.
 - (a) However, platform-imposed time constraints can **increase** the temporal flexibility of clients.
2. Client-imposed time constraints can **decrease** the temporal flexibility of crowdworkers.

- (a) However, client-imposed time constraints can **increase** the temporal flexibility of clients.
3. Worker-imposed time constraints can **decrease** the temporal flexibility of crowdworkers.
- (a) However, worker-imposed time constraints can **increase** the temporal flexibility of clients.

The conceptual framework of temporal precarity within crowdsourcing platforms presented in this thesis can be used in three main ways: (i) for investigation, (ii) for design, and (iii) for advocacy. First, the conceptual framework can be used to drive further investigations of the issues of temporal precarity within the platform economy. In other words, the conceptual framework can be used to further extend the current understanding of how platform workers experience temporal precarity. Second, the conceptual framework can be used as a design blueprint. As our understanding of the phenomenon of temporal precarity within the platform economy evolves, researchers could reconceptualise or create a different conceptual framework altogether.

Finally, the conceptual framework can be used for advocacy work. Specifically, the conceptual framework contributes to the topic of conversation about the working conditions of platform workers. The conceptual framework can be used to describe and explain the phenomenon of temporal flexibility within the wider context of the platform economy. Ultimately, the goal of the advocacy work should be to find a *balance* between workers' desire for temporal flexibility, clients' desires for temporal flexibility, and the platforms' business interests. This balanced approach should prevent crowdsourcing platforms from trading workers' temporal flexibility as a resource for the convenience of clients but to workers' detriment [69].

Figure 6.1: Conceptual framework of temporal precarity within crowdsourcing platforms



6.2.3 Contributions to Design

The third contribution of this thesis is a series of *design goals* for the design of future crowdsourcing platforms. Using the lens of VSD, we contribute five design goals that embody temporal flexibility as a value of central interest for crowdworkers. The design goals present new possibilities for future crowdsourcing platforms that account for workers' requirements for temporal flexibility. By in large, this thesis contributes to the design of technology-mediated labour platforms by presenting a set of design goals aimed at decreasing workers' temporal precarity.

We next describe the design goals we propose for the design of future crowdsourcing platforms. The reader should note that we provide design goals for crowdsourcing platforms rather than clients because, ultimately, the responsibility of increasing workers' temporal flexibility cannot fall on clients, who might lack awareness of the structural constraints of crowdsourcing platforms and the working conditions of people completing jobs on these platforms.

We identified in this thesis that crowdworkers' temporal flexibility is limited by constraints imposed by: (a) workers' circumstances, (b) clients, and (c) the design of crowdsourcing platforms. We further identified that whilst all three types of time constraints can influence the amount of temporal flexibility workers experience, the platform-imposed time constraints have the potential to limit workers' temporal flexibility the most. Thus, from our retrospective and proactive technical investigations of crowdsourcing platforms, five primary goals emerged as central to the design of crowdsourcing platforms. We next present our five goals for designing future crowdsourcing platforms.

- (i) Design Goal 1: Assign jobs to the crowdworkers.
- (ii) Design Goal 2: Provide crowdworkers with predictable work hours.
- (iii) Design Goal 3: Pay workers for all activities related to crowdworking.
- (iv) Design Goal 4: Limit the oversupply of workers on crowdsourcing platforms.
- (v) Design Goal 5: Reduce the time pressure that crowdworkers have to work under.

Table 6.3 presents the five design goals we put forward in this thesis. Each design goal has a set of corresponding technical features for the design of future crowdsourcing platforms. The technical features are based on the results of the retrospective and proactive technical investigations presented in this thesis. We argue that the wider platform economy can benefit from auditing other on-demand labour platforms against the design goals. For example, researchers could further evaluate the temporal precarity of people working within the platform economy against our design goals. We next summarise the five design goals.

Design Goals	Proposed Technical Features
1. Assign jobs to the crowdworkers.	1.1 Platforms should assign jobs to the workers. 1.2 Platforms should reserve jobs for the workers.
2. Provide workers with predictable work hours.	2.1 Platforms should have set hours when clients post jobs. 2.2 Platforms should not set hours when workers can complete jobs. 2.3 Platforms should not limit the number of hours workers can work. 2.4 Platforms should have a degree of control over the completion times of jobs. 2.5 Platforms should provide clear payment timelines to workers.
3. Pay workers for all activities related to crowdworking.	3.1 Platforms should require clients to pay workers a minimum hourly wage. 3.2 Platforms should not allow clients to ask workers to complete lengthy unpaid assessments. 3.3 Platforms should not ask workers to complete unpaid qualification tests to register on the platform. 3.4 Platforms should not allow clients to keep the data from rejected jobs. 3.5 Platforms should not allow clients to reject workers who completed jobs ‘too quickly’. 3.6 Platforms should require clients to provide timely feedback about rejected work.
4. Limit the oversupply of workers.	4.1 Platforms should not limit the maximum number of workers completing jobs at any given time. 4.2 Platforms should limit the number of workers who can register on the platform. 4.3 Platforms should not limit the maximum number of jobs workers can complete in a day, week, or month. 4.4 Platforms should not limit the maximum amount of money workers can earn in a day, week, or month.
5. Reduce the time pressure that crowdworkers have to work under.	5.1 Platforms should allow workers to complete an unlimited number of jobs at a time. 5.2 Platforms should not require workers to wait between submitting jobs.

Table 6.3: Design recommendations for features of crowdsourcing platforms that can support the temporal flexibility of crowdworkers.

The first design goal (i.e., Assign jobs to the crowdworkers) is aimed at ensuring that crowdsourcing platforms reduce the competitiveness between workers of having to claim jobs before other workers, thus eliminating the need for workers to wait for jobs. We propose two technical features to help realise this design goal.

The second design goal (i.e., Provide workers predictable work hours) is aimed at ensuring that crowdsourcing platforms provide predictable, certain, and secure working hours, thus reducing the temporal precarity that workers experience. We propose five technical features to help realise this design goal.

The third design goal (i.e., Pay workers for all activities related to crowdworking) is aimed at ensuring that crowdworkers are paid for the time they spend working. We propose six technical features to help realise this design goal.

The fourth design goal (i.e., Limit the oversupply of workers on crowdsourcing platforms) is aimed at ensuring that there are sufficient jobs available on the crowdsourcing platforms, thus workers achieving the temporal flexibility of working when and for how long they require. We propose four technical features to help realise this design goal.

The final design goal (i.e., Reduce the time pressure crowdworkers are) is aimed at ensuring that crowdworkers benefit from flexibility in terms of how they use their time when working on crowdsourcing platforms. We propose two technical features to help realise this design goal. We next provide more detail about the five design goals.

6.2.3.1 Design Goal 1: Assign jobs to the crowdworkers.

The first design goal that we put forward is to straightforwardly assign workers jobs to complete. The results of the thesis suggest that a lack of work assignment impacts crowdworkers' temporal flexibility because workers compete against each other to 'catch' the higher-paying jobs. We argue that the lack of work assignment is because of the jobs being made available to most workers that are online, rather than workers being matched by the platform with suitable jobs. Assigning workers to jobs could reduce the amount of time workers spend searching for jobs [156].

Several methods for assigning jobs to crowdworkers have been suggested (e.g.,

[263], [4]). For example, workers could be assigned jobs based on skills, expertise, past experience, job preferences, or personal interests. Hettiachchi et al. [264] argue that if crowdsourcing platforms assigned compatible jobs to crowdworkers, workers would spend less time and effort finding jobs. Regardless of how workers would be assigned jobs, Jones makes the argument that job assignment should privilege the free time and autonomy of the workers [265].

Within some areas of the platform economy, platform workers are assigned work algorithmically. For example, in the case of Upwork, freelancers and clients are matched through algorithmic assignment; this matching is done based on a set of attributes that enables freelancers and clients to search for one another and get matched [266]. Upwork also notifies freelancers about potential jobs that might be a good match for their skill sets. However, algorithmic matching is not enough to match freelancers and clients on Upwork. Freelancers and clients can also use the platform's communication channels and evaluation metrics to supplement the match-making process [266].

However, assigning workers jobs algorithmically is not a quick fix. In the case of on-demand ride-hailing, drivers can end up spending longer hours than initially planned simply waiting to be assigned jobs [267]. For example, although Uber drivers are assigned trips algorithmically, they have to spend 40% of their working time waiting for a fare [44] due to the high competitiveness of the platform.

Furthermore, although Lyft drivers are also assigned trips algorithmically, drivers have a mere 15 seconds to assess the offer based on the information provided, reach the screen, and accept a trip [268]. However, if drivers do not want to accept a ride, their 'acceptance rate' drops and they risk deactivating their accounts. Therefore, whilst this form of algorithmic management employed by ride-sharing apps such as Uber or Lyft became the most common type of automation within the platform economy, this arrangement seems to be far from the paradise of individual freedom and flexibility [42] envisioned for the future of work [114].

6.2.3.2 Design Goal 2: Provide crowdworkers with predictable work hours.

The second design goal that we put forward is to provide crowdworkers with predictable work hours. The results of this thesis suggest that the lack of predictable work availability impacts crowdworkers' temporal flexibility since workers encounter difficulties planning their work and non-work time. Furthermore, crowdworkers also spend on average 22% of their daily working time on unpaid activities such as waiting and searching for new jobs. We argue that the lack of predictable work availability on crowdsourcing platforms is due to an oversupply of workers. Allowing workers to set predictable work hours could make it easier for the workers to plan their time.

Within the wider platform economy, labour platforms have an oversupply of workers [122], which makes the workers a 'disposable labour force' that can be quickly replaced [123]. As a result of the COVID-19 pandemic, platform economy services are facing an increase in labour supply [269]. The increase in labour supply has resulted in platform workers spending more time waiting for work. For example, in the case of Deliveroo, the largest on-demand food delivery service, riders began spending more time waiting for work as a result of the increase in labour supply [270, 271]. Whilst the number of riders working during the evenings increased, the number of orders stagnated. Consequently, riders spent more time waiting for work, and earnings dropped.

Furthermore, Uber drivers report spending 40% of their time waiting for fares [44]. In February 2021, the Supreme Court of the United Kingdom ruled that the time Uber drivers spend working is not restricted only to the time drivers are driving customers to their destination but also covers any time the driver is logged into the Uber app, waiting to accept trips [272]. In other words, Uber drivers ought to be paid for the time they spend waiting for a fare. The proposed Directive is a positive move in the right direction for improving the working conditions of people working in the platform economy. However, at the time of submission of this thesis, Uber is still yet to comply with the Supreme Court's ruling. Further, it remains to be seen

how crowdsourcing platforms will transpose the Directive into practice across the regions in which they operate.

Finally, the effects of the oversupply of workers within the platform economy can also be seen on freelancing platforms. For example, freelancers working on Upwork report spending a high number of unpaid hours waiting and searching for jobs because of a lack of available work [189]. As a result, freelancers have to adapt their tool and software usage to support the temporal rhythms of their work, which, although they grant freelancers high levels of temporal flexibility to find work at different times throughout the day, also blurs the lines between work and non-work [273]. Therefore, we see more and more examples of people working within the platform economy that are impacted by the narrative of flexibility and individual freedom [42].

6.2.3.3 Design Goal 3: Pay workers for all activities related to crowdworking.

The third design goal that we put forward is to pay workers for all activities related to crowdworking. The results of this thesis suggest that a lack of predictable work availability impacts crowdworkers' temporal flexibility since workers have no protection from low demands in work. We argue that having no protection from low demands in work results in crowdworkers not getting paid for their work. Paying workers for all activities related to crowdworking could reduce the financial precarity workers experience.

One way to achieve this goal is by reclassifying crowdworkers from 'Independent Contractors' to 'Employees'. Currently, some crowdsourcing platforms categorise the people who complete jobs on the platform as Independent Contractors rather than employees of these platforms. Furthermore, 'workers' are not classified as employees of the clients either. Because jobs are of short duration on crowdsourcing platforms, the lack of formal employment can fragment the employment statuses of the 'workers', oscillating between informal employment and unemployment in a matter of minutes. Furthermore, as Independent Contractors, the people working on crowdsourcing platforms are required to limit their working hours ac-

ording to the laws and regulations in their region. Therefore, the responsibility of ensuring fair working conditions, such as limiting the maximum number of hours workers can spend completing jobs on the platform, is shifted from the crowdsourcing platforms to the workers. Furthermore, as Independent Contractors, ‘workers’ are not entitled to vacation pay, sick leave, or health insurance.

We argue that crowdsourcing platforms should consider reclassifying crowdworkers from ‘Independent Contractors’ to ‘Employees’; this is much like the proposed European Commission directive that aims to improve the working conditions of people working in the platform economy. In December 2021, the European Commission proposed a new directive that would reconsider the employment status of platform workers, including those completing jobs on crowdsourcing platforms. The Directive states that people working on digital labour platforms should be reclassified as ‘workers’ in order to benefit from the labour and social rights of formal employment [274]. Thus, under the proposed Directive, platform workers would be classified as employees [274]. As employees, workers would be entitled to vacation pay, sick leave, insurance programs, and paid time for the time being ‘on call’ for work (i.e., stand-by time’) [274]. The proposed Directive is a positive move in the right direction for improving the working conditions of people working in the platform economy.

6.2.3.4 Design Goal 4: Limit the oversupply of workers on crowdsourcing platforms.

The fourth design goal that we put forward is to limit the oversupply of workers on crowdsourcing platforms. The results of this thesis suggest that the oversupply of workers impacts crowdworkers’ temporal flexibility since workers have to be close to their computers to compete with other workers for jobs. We argue that workers have to compete with others for jobs because of the platforms’ lack of predictable work availability. Limiting the oversupply of workers could increase work predictability.

We see that within the wider platform economy, on-demand labour platforms have an oversupply of workers [122]. This oversupply of workers makes workers

a ‘disposable labour force’ that platforms can quickly replace [123]. As a result, the oversupply of workers generates a disposable labour force that competes for the better-paid jobs [42]. Thus, the oversupply of workers means that more workers are completing jobs on these platforms than available jobs, resulting in competition between the workers. The results of this thesis suggest that the competitiveness between workers further limits workers’ temporal flexibility.

We argue that crowdsourcing platforms should limit the oversupply of workers on the platform. In other words, platforms should limit the number of workers who register on the platform. Additionally, platforms should limit the number of workers completing jobs at any given time. A practical example of how to limit the oversupply of workers comes from the crowdsourcing platform Prolific¹. In late 2021, Prolific introduced a waiting list for new participants due to the high number of people registering to work on the platform [275]. Crowdsourcing platforms could adopt a similar approach to limit the oversupply of workers.

6.2.3.5 Design Goal 5: Reduce the time pressure that crowdworkers have to work under.

The final design goal that we put forward is to reduce the time pressure that crowdworkers have to work under. The results of this thesis suggest that time pressures impact crowdworkers’ temporal flexibility since workers have little flexibility in how they use their time. We argue that a lack of flexibility in time use is because of the platforms’ strict completion times of jobs and unfair pay. Limiting time pressures could increase workers’ overall temporal flexibility.

The results of the thesis suggest that crowdworkers work under time pressure and at a high intensity to ‘catch’ jobs before other workers. Beyond work conditions, there may be additional implications of working under time pressure that affect wider culture: time pressures could lead to unconscious bias in AI and ML models. If we consider that crowdworkers are often the starting point for labelling culturally-sensitive data used for ML [248], working under time pressure could surface unconscious biases of workers, such as racial or gender biases [276], feeding

¹<https://prolific.co/>

into the models and making it harder to achieve algorithmic fairness. We know that when under time pressure, people tend to gather less information and to act quicker when making decisions [172]. Furthermore, under time pressure, people rely more on stereotypes and biases when evaluating others [277]. Therefore, time pressure affects human judgement and decision-making [173], calling into question the validity of data — used in both industry and academic publications — provided by crowdworkers. Future work will be required to assess the impact of time pressure on crowdworkers' judgement and decision making.

Crowdworking platforms could reduce workers' time pressures by allowing workers to increase the allotted completion times of jobs and by paying crowdworkers fairly. First, crowdsourcing platforms could reduce workers' time pressures by increasing the allotted completion times of jobs. The results of the thesis suggest that crowdworkers' ability to schedule their time and stick to planned hours of work was impacted by the lack of predictable work availability on the platforms. Given that many of the jobs posted on crowdsourcing platforms are not time-critical — 89% of jobs posted by academic researchers in December 2015 were for surveys [36] — we argue that the platforms should provide workers with an adequate amount of time to work on jobs, rather than expect results in a short amount time (e.g., the minimum amount of time suggested by the platform). Therefore, as workers encounter difficulties managing their time, we suggest that crowdsourcing platforms provide workers with adequate time to work on jobs.

Second, crowdsourcing platforms could reduce workers' time pressures by paying crowdworkers fairly. The results of this thesis suggest that crowdworkers spent 22% of their daily time waiting and searching for work. Therefore, we emphasise the importance of paying online workers a fair wage. As workers only get paid when working on jobs and not when waiting and searching for work, one potential road to creating fairer working conditions is to pay workers closer to a fair wage of \$15/hour [75]. Therefore, paying workers a fair wage could enable workers to compensate for unpaid time financially and shift the responsibility of improving working conditions away from the workers to the clients, the crowdsourcing plat-

forms, and policymakers.

6.3 Reflections

“Can we foresee a future crowd workplace in which we would want our children to participate?”, Kittur et al. [114, p. 1] called on the HCI community in 2013 to consider a longer-term perspective for the future of crowdsourcing platforms. In this sense, the community has been aiming toward a future of work in which tomorrow’s generation would participate in proudly. Alas, decent work standards such as realised temporal flexibility remain a great roadblock to achieving this aim.

We argue that it is challenging to make practicable design suggestions for increasing crowdworkers’ temporal flexibility. The challenge comes from the fact that the time constraints that lower temporal flexibility are effectively ‘features’ and not ‘bugs’ in these platforms, as other authors have noted (e.g., [112, 48, 21]). There may be room to mitigate some of the worst effects of the temporal flexibility issue, and we focus on these in this section.

However, according to VSD, designers of crowdsourcing platforms can be intentional and impactful with their work in *not* building new features on top of an existing technology or not building a new technology altogether if, ultimately, it may not be possible to ‘solve’ design ‘issues’ [24] unless significant changes are made to the platform architecture and the business model of crowdsourcing. In this sense, we acknowledge that designers of crowdsourcing platforms do not operate in a vacuum, but have to work with the business model of these platforms, as well as with stakeholders’ objectives—further, even when researchers have tried to ‘layer’ tools on top of these platforms, the platforms have often terminated their access [260, 261]. Thus, the ‘fix’ for these issues is a big and ongoing problem.

6.4 Conclusion

In this thesis, we contributed a new understanding of the time constraints within crowdsourcing platforms that enable invisible labour and limit crowdworkers from accessing fair working conditions. In this regard, the results of the six studies we presented in this thesis suggest that the temporal flexibility of crowdworkers is lim-

ited by 29 time constraints. Namely, we identified that the temporal flexibility of crowdworkers is limited by three types of time constraints: (i) time constraints imposed by workers' circumstances, (ii) time constraints imposed by clients, and (iii) time constraints imposed by the design of the platform. However, we argue that the mechanisms behind crowdsourcing platforms should considerably change in the future for crowdworkers to experience more temporal flexibility. Thus, in this thesis, we also contributed five design goals for the design of future crowdworking platforms that aim to support workers' requirements for temporal flexibility. Nevertheless, ultimately, it may not be possible to 'solve' these issues for workers on these platforms since the platform architecture and the business model of crowdsourcing platforms are inherently unfixable and overall a move in the wrong direction.

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Appendices

Appendix A: Materials for Study 1

Appendix B: Materials for Studies 2 and 3

Appendix C: Materials for Study 4

Appendix D: Materials for Study 6

Appendix A: Materials for Study 1

Participant Information Sheet

Introduction: Crowdfunding platforms do not provide any formal training. You have to find your own way and learn the ropes over time: how to be efficient, how to find good jobs, how to keep on top of everything. There is a great and helpful community of crowdworkers who can help, but what if there was a more simple way to get better at what you do?

Crowd workers don't get a lot of support and we want to change that. We are researchers interested in how people manage tasks in remote work settings like [name of platform]. One of our goals is to help people like you get better at managing tasks. We're not looking to force anyone to work in a particular way. But if you think you'd like to work more efficiently but don't know where to start, we are hoping to help you.

Before we can start building helpful tools, we need to get a good idea of how you actually manage tasks at the moment. We have created a survey to find out. In this job you will complete this survey. The responses you give us will directly

impact on what we produce afterwards – the better your responses are, the better our support tools will be!

Payment and bonuses: We know that you're busy and that there a million and one other things that you have to do. We want to give you a reason to take your time and give us good results.

We're going to pay you fairly for your time. In return we ask that you use the time to give genuine consideration to the questions.

With this in mind, we're structuring payment for this task like this:

- \$0 – If you randomly click your way through answers we'll reject your responses. This just makes extra work for us.
- \$6 – For completing the survey. We're not looking for you to respond in a certain way, just that you read the questions and respond honestly.
- +\$2 (\$8 total) – There are free-response fields in the questionnaire. We'll pay an extra \$2 bonus for responses that show a degree of thought and consideration.

We have no interest in cheating you out of your time and effort. If you read the questions and respond to them honestly your work will be accepted. If you do a particularly good job we'll pay a bonus. We have objective measures for determining whether work will be accepted. The bonus will be decided subjectively. We want to have to pay everyone who completes this job a bonus.

The task takes around 30 minutes (including reading this). The rate is therefore \$8-\$12/hr depending on whether you receive a bonus.

Technical information: This task has been tested on modern desktop browsers. Please ensure you are using an up-to-date version of your preferred browser (e.g., IE11, Edge, Firefox 30+, Chrome 40+ or Safari 6+). Internet Explorer 8, 9 and 10 will not function correctly with this task – do not use them.

Please make sure you complete the study - there is no partial credit

General information: This job is a questionnaire study. It contains 133 items. We have tried it out ourselves and, including reading these instructions, it should

take less than 30 minutes to complete.

Participation in this study is entirely voluntary. There is no penalty if you decide not to take part. You can withdraw from the study at any point without further explanation.

Please participate only once. There's a process in place to stop you accidentally participating more than once. Please do not try to work around the check: we can only pay you for your first time participation and data from additional participation will be discarded.

After you complete the questionnaire you will be given a debriefing (an explanation of the research) before returning to [name of platform].

All data generated as a result of your participation in this study are confidential and not personally identifiable. Future research may utilise this dataset, but only in a fully anonymised form. If you have any questions about this study (or would like to be informed of publications based on this study), please contact s.gould@cs.ucl.ac.uk.

Thank you for taking part in this study; your time is much appreciated. This study is being run by Sandy Gould has been approved by the UCL Research Ethics Committee, number: UCLIC/1415/006/Staff Cox/Gould

Survey Questions

Below are the questionnaires we have administered in this study.

1.1 What time is it right now where you are - please also specify your time zone multi response hours?

1.1 What time is it right now where you are - please also specify your time zone multi response minutes?

1.1 What time is it right now where you are - please also specify your time zone multi response am pm?

1.1 What time is it right now where you are - please also specify your time zone multi response time zone?

1.2 How old are you?

1.3 What is your gender?

1.4 Where would you say you were from?

1.5 Which country do you live in at the moment?

1.6 What level of education have you completed?

1.7 Please estimate your personal income from [name of platform] last year in united states dollars usd?

1.8 Please estimate your personal income from other sources last year in united states dollars usd?

1.9 Please estimate your annual household income in united states dollars usd?

1.10 Please indicate on the slider the proportion of your income you get from working on [name of platform]?

1.11 How long in years and months have you been working on [name of platform] multi response years?

1.11 How long in years and months have you been working on [name of platform] multi response months?

1.12 How long would you estimate your average session on [name of platform] is in hours and minutes multi response hours?

1.12 How long would you estimate your average session on [name of platform] is in hours and minutes multi response minutes?

1.13 Most of the time where do you complete [name of platform] tasks?

1.14 What kind of device do you usually use for working on [name of platform]?

1.15 What is your preferred browser for working in [name of platform]?

1.16 Do you keep your [name of platform] work and leisure activities in separate browsers?

1.17 In addition to a keyboard what pointing device do you usually use when you're working on [name of platform]?

1.18 Across all the devices you are using for [name of platform] work please count how many windows you have visible on screen right now?

1.19 Across all the browsers you have open now please count how many browser tabs you have open right now?

1.20 Across all the browsers you have open now please count the number of tabs that you have open that are part of your [name of platform] work?

1.21 How many computers do you typically use simultaneously for working on [name of platform]?

1.22 How many displays do you typically use simultaneously for working on [name of platform]?

PANAS Questionnaire Number 1

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word - indicate to what extent you generally feel this way that is how you feel on average:

Figure 6.2: PANAS Questionnaire Number 1 items

Indicate the extent you have felt this way over the past week.		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 2	Distressed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 3	Excited	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 4	Upset	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 5	Strong	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 6	Guilty	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 7	Scared	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 8	Hostile	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 9	Enthusiastic	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 10	Proud	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 11	Irritable	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 12	Alert	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 13	Ashamed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 14	Inspired	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 15	Nervous	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 16	Determined	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 17	Attentive	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 18	Jittery	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 19	Active	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 20	Afraid	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

PANAS Questionnaire Number 2

Now in the same way please indicate on the same scale to what extent you feel this way when working on [name of platform]:

Figure 6.3: PANAS Questionnaire Number 2 items

Indicate the extent you have felt this way over the past week.		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 2	Distressed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 3	Excited	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 4	Upset	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 5	Strong	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 6	Guilty	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 7	Scared	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 8	Hostile	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 9	Enthusiastic	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 10	Proud	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 11	Irritable	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 12	Alert	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 13	Ashamed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 14	Inspired	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 15	Nervous	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 16	Determined	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 17	Attentive	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 18	Jittery	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 19	Active	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 20	Afraid	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

Mindful Attention Awareness Scale (MAAS)

maas1. I could be experiencing some emotion and not be conscious of it until sometime later

maas2. I break or spill things because of carelessness not paying attention or thinking of something else

maas3. I find it difficult to stay focused on what's happening in the present

maas4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way

maas5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention

maas6. I forget a person's name almost as soon as I've been told it for the first time
maas7. It seems I am 'running on automatic' without much awareness of what I'm doing

maas8. I rush through activities without being really attentive to them

maas9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there

maas10. I do jobs or tasks automatically without being aware of what im doing

maas11. I find myself listening to someone with one ear doing something else at the same time

maas12. I go places on 'automatic pilot' and then wonder why I went there

maas13. I find myself preoccupied with the future or the past

maas14. I find myself doing things without paying attention

maas15. I snack without being aware that I'm eating

MAAS Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

Multitasking Preference Inventory (MPI)

mpi1. I prefer to work on several tasks in a day rather than completing one task and then switching to another

mpi2. I would like to work in a job where I was constantly shifting from one task to another like a receptionist or an air traffic controller

mpi3. I lose interest in what I am doing if I have to focus on the same task for long periods of time without thinking about or doing something else

mpi4. When doing a number of tasks I like to switch back and forth between them rather than do one at a time

mpi5. I like to finish one task completely before focusing on anything else

mpi6. It makes me uncomfortable when I am not able to finish one task completely before focusing on another task

mpi7. I am much more engaged in what I am doing if I am able to switch between several different tasks

mpi8. I do not like having to shift my attention between multiple tasks

mpi9. I would rather switch back and forth between several tasks than concentrate my efforts on just one

mpi10. I would prefer to work in an environment where I can finish one task before starting the next

mpi11. I don't like when I have to stop in the middle of a task to work on something else

mpi12. when I have a task to complete I like to break it up by switching to other tasks intermittently

mpi13. I have a 'one track' mind when I work on a task I think of nothing else

mpi14. I prefer not to be interrupted when working on a task

MPI Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

Task Management Strategies

- 3.15 I feel that I have the best strategy for managing multiple tasks
- 3.16 I often feel that I could be managing multiple tasks more effectively
- 3.17 If I am working on a difficult task I tend to switch to other tasks less often
- 3.18 If I am working on an easy task I tend to switch more to other tasks less often
- 3.19 I tend to switch tasks more if I am bored
- 3.20 If I find a task interesting I am less likely to switch to a different task
- 3.21 When working on [name of platform] I spend more time than I'd like watching out for good jobs
- 3.22 If a task is difficult I tend to switch to working on an easier task instead
- 3.23 I switch in the middle of tasks to check my progress on other tasks
- 3.24 I tend to finish the task I'm working on before I check my progress on other tasks
- 3.25 Please indicate on the slider the proportion of your time you spend on monitoring tasks versus working on jobs
- 3.26 I am an expert at juggling multiple tasks
- 3.27 I ignore interruptions that are not related to [name of platform] until I have finished the task I'm working on
- 3.28 I feel like I have a lot to learn about task management
- 3.29 I generally have a good idea of the tasks I need to focus on at any moment
- 3.30 In general I return tasks that I am not sure I can complete correctly
- 3.31 I generally know when I am able to manage a task at the same time I am doing something else
- 3.32 I am good at finding the best new jobs as soon as they appear
- 3.33 I enjoy difficult tasks they keep me focused

Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

Device Usage

- 4.1 The device I work on frequently gives me important notifications
- 4.2 The device I work on provides few opportunities for diversions or distractions
- 4.3 The device that I use limits how effectively I can work
- 4.4 If I could i'd replace the device I currently work on
- 4.5 What's holding you back from replacing the device you currently work on
- 4.6 The device I use does not limit how effectively I can work
- 4.7 I am content with the device I work on
- 4.8 The device I work on provides many opportunities for diversions and distractions
- 4.9 The device I work on frequently gives me notifications that are irrelevant to my [name of platform] work and task management
- 4.10 Which software items from this list do you use to aid your [name of platform] work
- 4.11 Which software items from this list are you aware of but do not currently use
- 4.12 which hardware items from this list do you use to aid your [name of platform] work
- 4.13 Which hardware items from this list would you like to have to aid your [name of platform] work but do not currently use
- 4.14 In the space I work in I am often interrupted by people while I am working
- 4.15 When I am working I just focus on [name of platform] tasks
- 4.16 I think that the space I work in is good for the kind of work that I do
- 4.17 The space I work in hinders how well I can work
- 4.18 If I could I would change lots of things about the space I work in
- 4.19 Tell us what would you change about your work space
- 4.20 When I am working other people in the space I work in leave me alone
- 4.21 I often do things while I am doing [name of platform] work that is not related to my [name of platform] work

- 4.22 I work in a calm space
- 4.23 When I'm working [name of platform] tasks are a high priority for me
- 4.24 If I could work in a different space I would
- 4.25 The space I work in encourages me to multitask more
- 4.26 There's nothing I would change about the space I work in
- 4.27 I choose this space for working but I also have other places I could work if I needed to
- 4.28 The space I work in is a good place to work
- 4.29 The space I work in helps me to stay focused on one task at a time
- 4.30 How does the space you work in affect your level of focus
- 4.31 I consider other workers on [name of platform] to be colleagues
- 4.32 The space I work in is not a good place to work
- 4.33 I communicate frequently with other crowdworkers
- 4.34 Working on [name of platform] can feel lonely at times
- 4.35 The space I work in is hectic
- 4.36 I consider myself part of the [name of platform] community
- 4.37 When I communicate with other crowdworkers it is usually about requesters rather than specific tasks
- 4.38 When I communicate with other crowdworkers it is usually socially rather than about [name of platform] work or requesters
- 4.39 I feel comfortable contacting requesters with questions or problems
- 4.40 Do you have any particular strategies that help you to focus on your work
- 4.41 What advice would you give about effective task management to someone just starting on [name of platform]
- 4.42 is there anything else you'd like to say about your experience of working on [name of platform]

Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

Work-Life Indicator Scale

wli1.1. I take care of personal or family needs during work

wli1.2. I respond to personal communications eg emails texts and phone calls during work

wli1.3. I do not think about my family friends or personal interests while working so I can focus

wli1.4. when I work from home I handle personal or family responsibilities during work

wli1.5. I monitor personal related communications eg emails texts and phone calls when I am working

wli1.6. I regularly bring work home

wli1.7. I respond to work related communications eg emails texts and phone calls during my personal time away from work

wli1.8. I work during my vacations

wli1.9. I allow work to interrupt me when I spend time with my family or friends

wli1.10. I usually bring work materials with me when I attend personal or family activities

wli1.11. I control whether I am able to keep my work and personal life separate

wli1.12. I control whether I have clear boundaries between my work and personal life

wli1.13. I control whether I combine my work and personal life activities throughout the day

wli1.14. People see me as highly focused on my work

wli1.15. I invest a large part of myself in my work

wli1.16. People see me as highly focused on my family

wli1.17. I invest a large part of myself in my family life apart from [name of platform] do you have another job

Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

General Impressions

5.1 I completed this task like I would complete any other

5.2 I gave this task particular attention

5.3 This task was more interesting than most

5.4 I switched to other things while I was completing this task

5.5 I stayed focused on this task

5.6 I think the pay for this task was fair given the work required

5.7 I wanted to get through this task as quickly as possible

5.8 I felt like I could express my true opinions in this task

5.9 I took my time completing this task

5.10 I had more than enough time to complete the task

5.11 I found this task more boring than most

5.12 I had to rush through the task because there wasn't enough time

5.13 This task didn't let me express my true opinions

5.14 I think that this task expected too much work for the rate of pay

5.15 If you were advertising this task how much would you pay people

Scale: Strongly Agree, Agree, Disagree, Neither, Strongly Disagree

Appendix B: Materials for Studies 2 and 3

Participant Information Sheet

Title of Study: Help us understand how crowdworkers conduct their work

Department: UCL Interaction Centre

Name and Contact Details of the Researcher(s): Laura Lascau – llascau@cs.ucl.ac.uk

Name and Contact Details of the Principal Researcher: Prof Anna Cox – anna.cox@ucl.ac.uk

1. Invitation Paragraph

I am trying to understand how Workers on [name of platform] conduct their work as part of a PhD project at the UCL Interaction Centre. I am interested in looking at how you find work, use different tools, and organise your work.

If you accept to be part of this short study, I would like to ask you to record your screen for 90 minutes using Lookback. Lookback is a secure Chrome extension that allows you to easily record your screen in one go (you don't have to break your recording into small videos). I am asking for a 90-minute recording because I believe that this amount of time will give me a better idea of how you naturally find work, complete the work, and so on.

Everything that you record and will appear on your screen will be held under strict confidentiality. I will delete the recording shortly after I am done watching it as per University guidelines.

If you accept the task:

- Please conduct your work in a natural manner for 90 minutes.
- When you take breaks (and please do take breaks because you are not expected to work for 90 minutes continuously unless you wish to), please describe to me what it is that you are about to do or what you just did; for example, "I took a break from working to check a news website", or "I had

to take a break from working because someone in the house was speaking to me”.

- There is no need for you to describe what you’re doing in the 90 minutes.
- Lookback will ask you for your full name and email address, but there is no need to provide this information – simply input a random email address such as address@email.com.
- There is also no need for you to give Lookback access to your video camera.
- When you are have finished recording your screen, please paste the code you will be provided by Lookback into the box below.
- Follow this link to record your screen: [link to platform]

2. What is the project’s purpose?

The aim of the project is to understand how Workers on [name of platform] conduct their work. I am interested in looking at how Workers find work, use different tools, and organise their work.

3. Why have I been chosen?

We believe that your unique experience of being a Worker on [name of platform] can offer valuable insight into where crowdworkers conduct their work. We aim to engage with up to 20 crowdworkers in this study.

4. Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. You can withdraw at any time without giving a reason and without it affecting any benefits that you are entitled to. If you decide to withdraw you will be asked what you wish to happen to the data you have provided up that point.

5. What will happen to me if I take part?

Taking part in this study will involve recording your screen for 90 minutes using Lookback. Lookback is a secure Chrome extension that allows you to easily record your screen in one go (you don’t have to break your recording into small

videos). Everything that you record and will appear on your screen will be held under strict confidentiality. I will delete the recording shortly after I'm done watching it as per University guidelines.

6. Will I be recorded and how will the recorded media be used?

The video and audio recording made during this research will be used only for analysis and will be destroyed once it is analysed. No one outside the project will be allowed access to the original recordings.

7. What are the possible disadvantages and risks of taking part?

There are no foreseeable discomforts, disadvantages and risks for taking part. However, if you do feel uncomfortable, please feel free to withdraw from the study at any time.

8. What are the possible benefits of taking part?

You will be compensated for your time and will be paid via [name of platform] by entering a completion code in a job.

9. What if something goes wrong?

If you would like to raise a complaint about this research, please contact the Principal Researcher, Prof Anna Cox, at anna.cox@ucl.ac.uk If you feel like your complaint has not been handled to your satisfaction, you can contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk

10. Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.

11. Limits to confidentiality

Confidentiality will be respected subject to legal constraints and professional guidelines.

12. What will happen to the results of the research project?

Results will be disseminated in standard academic outlets. Results may also be disseminated via general interest magazines/newspapers/journals. You will not be identifiable in any report or publication. Video snippets of the recordings might be

used in presentation or at conferences, if written consent has been provided. Any confidential information will be blurred out, and you will not be identifiable in any of the presentations or conferences.

13. Data Protection Privacy Notice

The data controller for this project will be University College London (UCL). The UCL Data Protection Office provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk. UCL's Data Protection Officer can also be contacted at data-protection@ucl.ac.uk.

Further information on how UCL uses participant information can be found here: www.ucl.ac.uk/legal-services/privacy/participants-health-and-care-research-privacy-notice

Your personal data will be processed for the purposes outlined in this notice. The legal basis that would be used to process your personal data will be the provision of your consent. You can provide your consent for the use of your personal data in this project by completing the consent form that has been provided to you. Your personal data will be processed as long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this, and we will endeavour to minimise the processing of personal data wherever possible. If you are concerned about how your personal data is being processed, please contact UCL in the first instance at data-protection@ucl.ac.uk. If you remain unsatisfied, you may wish to contact the Information Commissioner's Office (ICO). Contact details, and details of data subject rights, are available on the ICO website at: <https://ico.org.uk/for-organisations/data-protection-reform/overview-of-the-gdpr/individuals-rights/>

14. Who is organising and funding the research?

This research is funded by the Engineering and Physical Sciences Research Council (EPSRC).

15. Contact for further information

Prof Anna Cox UCLIC, University College London, London WC1E 6BT, United Kingdom +44 (0)20 3108 7074 anna.cox@ucl.ac.uk

Participant Consent Form

Please complete this form after you have read the Information Sheet about the research.

Title of Study: Help us understand how crowdworkers conduct their work

Department: UCL Interaction Centre

Name and Contact Details of the Researcher(s): Laura Lascau – llascau@cs.ucl.ac.uk

Name and Contact Details of the Principal Researcher: Prof Anna Cox – anna.cox@ucl.ac.uk

Name and Contact Details of the UCL Data Protection Officer: Lee Shailer data-protection@ucl.ac.uk

This study has been approved by the UCL Research Ethics Committee:
Project ID number: Z6364106/2018/08/02 social research

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by ticking/initialling each box below I am consenting to this element of the study.

I understand that it will be assumed that unselected boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

1. I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction.

2. I consent to take part in a study that will ask me to record my screen for 90

minutes while working on [name of platform].

3. I understand that personal information will be used for the purposes explained to me I understand that such information will be handled in accordance with all applicable data protection legislation.

4. I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified.

5. I understand that my data gathered in this study will be stored anonymously and securely. It will not be possible to identify me in any publications.

6. I understand that my information may be subject to review by responsible individuals from the University to include the Engineering and Physical Sciences Research Council (EPSRC) for monitoring and audit purposes.

7. I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.

8. I understand the direct/indirect benefits of participating.

9. I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.

10. I understand that I will not benefit financially from this study or from any possible outcome it may result in in the future.

11. I understand that I will be compensated for the portion of time spent in the study or fully compensated if I choose to withdraw.

12. I agree that my anonymised research data may be used by others for future research. [No one will be able to identify you when this data is shared.]

13. I understand that the information I have submitted will be published as a report and I wish to receive a copy of it. Yes/No

14. I consent to screen recording my workflow while completing tasks on [name of platform] and understand that the recordings will be destroyed immediately following transcription.

15. I consent to having anonymised stills of my screen recording presented at conferences or to be used in the PhD thesis, journals, general interest magazines or

newspapers.

16. I hereby confirm that I understand the inclusion criteria as detailed in the Information Sheet and explained to me by the researcher.

17. I hereby confirm that:

(a) I understand the exclusion criteria as detailed in the Information Sheet and explained to me by the researcher; and

(b) I do not fall under the exclusion criteria.

18. I have informed the researcher of any other research in which I am currently involved or have been involved in during the past 12 months.

19. I am aware of who I should contact if I wish to lodge a complaint.

20. Use of information for this project and beyond:

(a) I would be happy for the data I provide to be archived at the UCL Interaction Centre.

(b) I understand that other authenticated researchers will have access to my anonymised data.

If you would like your contact details to be retained so that you can be contacted in the future by UCL researchers who would like to invite you to participate in follow up studies to this project, or in future studies of a similar nature, please tick the appropriate box below.

(a) Yes, I would be happy to be contacted in this way

(b) No, I would not like to be contacted

Appendix C: Materials for Study 4

Part 1: Qualitative Survey

Participant Information Sheet

Instructions: Taking part in this study requires that you write a description of 400 words or more about the ways in which you plan your time.

We specifically wish to know about:

- How you plan your time for [name of platform] work and non-work activities (such as family time, hobbies, etc).
- Any challenges you face planning your work and non-work time as a worker on [name of platform].

Writing the 400-word description should take no more than 25 minutes. We will also ask you four demographic questions at the end. We are going to pay you fairly for your time. In return we ask that you use the time to give genuine consideration to the questions. We will pay an extra \$2 bonus for responses that show a degree of thought and consideration.

1. Invitation Paragraph

You are being invited to take part in a research project. Before you decide whether or not to take part, it is important that you understand why the research is being conducted and what your participation would involve. Please take the time to read the following information carefully, and discuss it with others if you wish. If there is anything you are unsure about, feel free to send us an email for more information (llascau@cs.ucl.ac.uk).

2. Why have I been chosen?

You have been chosen to participate in this study as you are registered as a worker on [name of platform].

3. Do I have to take part?

It is entirely up to you to decide whether or not to take part. If you do decide to take part, you will be asked to consent to participating in the research. You can

withdraw from the study at any time during the study without giving a reason, at which point no data will be saved. However, because the study is anonymous, after you have completed the study you will not be able to withdraw any data you have entered.

4. What will happen to me if I take part?

The study consists of a survey within which you will be asked to write about the ways in which you plan your time working on [name of platform] and non-work time (e.g., time with family, hobbies, volunteering, etc.). Depending on what type of information you provide in this study, you may be invited to a follow-up survey study in the next few days.

5. What are the possible disadvantages and risks of taking part?

No risks have been identified.

6. What are the possible benefits of taking part?

Apart from payment for your time (via [name of platform]), no direct benefits have been identified. However, your involvement in this study may help in the development of future tools for crowdworkers.

7. What if something goes wrong?

If something happens that you are unhappy with while participating in this study, and you would like to discuss it or raise a complaint, please get in contact with the principal researcher Prof. Anna Cox (anna.cox@ucl.ac.uk). If you feel that your complaint has not been handled to your satisfaction by the principle researcher, you can contact the Chair of the UCL Research Ethics Committee (ethics@ucl.ac.uk).

8. Will my taking part in this project be kept confidential?

All the information that we collect about you during this research will be kept strictly confidential subject to legal constraints and professional guidelines. You will not be identifiable in any ensuing reports or publications.

9. What will happen to the results of the research project?

The data collected as part of this study will be used in published journal article(s) or conference paper(s) which will also be made available on the following website: <https://uclic.ucl.ac.uk/people/anna-cox>. Alternatively, you may contact the

principal researcher (anna.cox@ucl.ac.uk) to request a copy of any published documents using data collected as part of this study.

10. Funding and Contact Information

This research is funded by the Engineering and Physical Sciences Research Council (EPSRC).

Should you wish to contact the research team, please find below the necessary contact details:

Laura Lascau, Ph.D. Research Student - llascau@cs.ucl.ac.uk

Prof Anna Cox, Principal Investigator - anna.cox@ucl.ac.uk

Participant Consent Form

In selecting each box below I am consenting to this element of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

Select each box below to agree:

1. I confirm that I have read and understood the study information on the previous page. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction and would like to take part in the online survey.

2. I consent to participate in the study.

3. I understand that my information may be subject to review by responsible individuals from the University for monitoring and audit purposes.

4. I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.

5. I understand the direct/indirect benefits of participating.

6. I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.

7. I understand that, apart from the [name of platform] payment, I will not benefit financially from this study or from any possible outcome it may result in in the future.

8. I agree that my anonymised research data in the survey study may be used by others for future research. (No one will be able to identify you when this data is shared)

9. I understand that the information I have submitted will be published as a report.

10. I hereby confirm that I understand the inclusion criteria as detailed in the Information Sheet.

11. I am aware of who I should contact if I wish to lodge a complaint.

12. Use of information for this project and beyond. I would be happy for the data I provide to be archived at the UCL Interaction Centre. I understand that other authenticated researchers will have access to my anonymised data.

Survey Questions We are going to pay you fairly for your time. In return we ask that you use the time to give genuine consideration to the questions. We will pay an extra \$2 bonus for responses that show a degree of thought and consideration.

Please tell us about how you schedule your work and non-work time.

1. Please think about the last day during which you worked on [name of platform]. Please write your (minimum) 400-word answer in the textbox below.

- How did you plan your time for [name of platform] work?
- How did you plan your time for non-[name of platform] activities, such as family time, hobbies, etc?
- Do you plan particular times to work and not to work?
- What challenges do you find on a daily basis to planning your time for work and non-work?

2. Is there anything about scheduling your work and non-work activities that you would like to tell us about?

Demographics

1. What gender do you identify as? Options: Woman, Man, Non-binary, Prefer not to disclose, Prefer to self-describe

2. How old are you? Options: Under 24 years old, 24 - 34 years old, 35 - 44 years old, 45 - 54 years old, 55 - 64 years old, 65 years or over, Prefer to not say

3. What is your highest obtained education level? Options: Some high school, Some college/technical training, University undergraduate programme (e.g., Bachelor's), University post-graduate programme (e.g., Master's), Doctoral degree (e.g., PhD), Prefer not to answer

4. Please indicate on the slider the proportion of your personal income you get from working on [name of platform] and/or other crowdworking websites. Options: 0% to 100%

5. Would you like to take part in the next weeks in a diary study in which you will be paid \$20 to document a day in your life? The study looks at everyday life to find out what activities most contribute to people's wellbeing. Options: Yes, No

Part 2: Time-Use Diaries

Participant Information Sheet:

You are invited to take part in a diary study.

What's involved? We would like to ask you to fill out a simple diary, outlining your daily activities. The information we collect is used to understand how you spend your time (whether it's working on [name of platform], relaxation or helping and caring for others), and how that's different for different types of people. It's an interesting chance to reflect on your daily life.

As a thank you, we will give everyone who takes part \$20.

We might also conduct a short interview with you at the end of the study (compensation for taking part in the interview will be separate).

If you decide to take part in the diary study you will be asked to:

- Fill in the two diaries in the document you will be asked to fill in:
 - the 'Paid Work Time' diary on Sunday, in the evening, and
 - the 'Everyday Life' diary on Monday, throughout the day.

- On the Sunday, you will be asked to fill in the ‘Paid Work Time’ diary with the hours of work on [name of platform] you have scheduled for the week.
- On the Monday, you will be asked to fill in the ‘Everyday Life’ diary with your main and secondary activity (if any) for each 10-minute period throughout the day.
- It’s up to you how you decide to fill in the surveys throughout the day: on your computer, or on the go on your phone, or combined. You can also print the files and send them back to us at the end of the study.

What will happen to the information I give? We will treat the information you give in the strictest confidence. The results collected are used for research purposes only and no one looking at the findings will be able to identify you.

Who is carrying out the study? A PhD Researcher from the UCL Interaction Centre is carrying out the study. If you decide that you would like to take part in the diary study, please click on the link below to be taken to the online document you will need to fill in. In the document, you will also find instructions about how to fill in the two diaries: [link to document]

Time-Use Diaries: Firstly, on pages 289 and 290, Figures 6.4 and 6.5 present screenshots of the Excel File that we shared with the participants. Specifically, these two screenshots present instructions for filling in the diaries.

Secondly, on pages 291, 292, and 293, Figures 6.6, 6.7, and 6.8 present screenshots of the Excel File that we shared with the participants. Specifically, these three screenshots present the Paid Work Time Diary, which was the first diary participants were asked to complete.

Finally, on pages 294 - 302, the nine figures present screenshots of the Excel File that we shared with the participants. Specifically, these nine screenshots present the Everyday Life Diary, which was the second diary participants were asked to complete.

Figure 6.4: Instructions Diary Study Part I

You are invited to take part in a diary study

What's involved?
 We would like to ask you to fill out a simple diary, outlining your daily activities. The information we collect is used to understand how you spend your time (whether it's working on [name of platform], relaxation or helping and caring for others), and how that's different for different types of people. It's an interesting chance to reflect on your daily life.

As a thank you, we will give everyone who takes part \$20.

We might also conduct a short interview with you at the end of the study (compensation for taking part in the interview will be separate).

If you decide to take part in the diary study you will be asked to:

- Fill in the two diaries in this document:
 - the 'Paid Work Time' diary on Sunday, November 10, in the evening, and
 - the 'Everyday Life' diary on Monday, November 11, throughout the day.
- On the Sunday, you will be asked to fill in the 'Paid Work Time' diary with the hours of work you have scheduled for the week.
- On the Monday, you will be asked to fill in the 'Everyday Life' diary with your main and secondary activity (if any) for each 10-minute period throughout the day.
- The diaries are in the tabs at the bottom of this file.
- It's up to you how you decide to fill in the surveys throughout the day; on your computer, or on the go on your phone, or combined. You can also print the files and send them back to us at the end of the study.

Examples of the diaries are provided below.

What will happen to the information I give?
 We will treat the information you give in the strictest confidence. The results collected are used for research purposes only and no one looking at the findings will be able to identify you in any way.

Who is carrying out the study?
 A PhD Researcher from the UCL Interaction Centre is carrying out the study.

Please scroll below to see examples of the two diaries.

A. Example of a filled in Paid Work Time diary:

Example 1: on Monday, 4 November, you plan on working from 7.15am to 6.00pm with a lunch break between 1.15pm and 2.15pm.

Day	Month	Day of the week	Did not work	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
0	4	1 1 Monday	<input type="checkbox"/>				X	X	X	X	X	X	X	X	X	X	X	X	X	X

B. Example of a filled in Everyday Life diary:

Were you alone or with somebody you know?

Figure 6.5: Instructions Diary Study Part II

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Day	Month	Day of the week	Did not work	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	
0	4	1 1	Monday				X	X	X	X	X	X	X	X	X	X	X	X	X	X	

B. Example of a filled in Everyday Life diary:

Please record your activity below

Time	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Were you alone or with somebody you know? Mark all relevant boxes					
					People who live with you					
Early Morning					Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people
7am-7:10	Woke up the children			At home				X		
7:10-7:20	Had breakfast	Checked emails	X	" "		X		X		
7:20-7:30	" "	Talked with my family		" "		X		X		
7:30-7:40	Cleared the table	Listened to the radio	X	" "		X				
7:40-7:50	" "	" "	X	" "	X					
7:50-8am	Helped the children dressing	Talked with my children		" "				X		
8am-8:10	" "	" "		" "				X		
8:10-8:20	Went to the day care center	" "		On foot				X		

Use quote marks to record that an activity lasted longer than 10 minutes.

To make a selection on your computer, click on the box and type the letter "X" using your keyboard.

Thank you for deciding to take part in our study.

Remember to start filling in your diaries on Sunday evening!

To read-Instructions | To fill in-Paid Work Time Diary | To fill in-Everyday Life Diary | +

Figure 6.7: Paid Work Time Diary Part II

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BD
32																																																																												
33	<input type="checkbox"/> Unusual work week for other reasons																																																																											
34																																																																												
35	<input type="checkbox"/> None of the above																																																																											
36																																																																												
37																																																																												
38	Please fill in here your diary of work time:																																																																											
39	<ul style="list-style-type: none"> Mark with an 'X' each 15-minute interval when you plan to work in the next 7 days. It is not a problem if you do not manage to stick to the plan. 																																																																											
40	<ul style="list-style-type: none"> If you are not planning on working on any particular day, tick the 'No work' box. 																																																																											
41																																																																												
42	Day	Month	Day of the week	No work																																																																								
43	1st day				4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																																									
44	0 8	1 1	Monday	<input type="checkbox"/>																																																																								
45																																																																												
46	Day	Month	Day of the week	No work																																																																								
47	2nd day				4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																																									
48	0 9	1 1	Tuesday	<input type="checkbox"/>																																																																								
49																																																																												
50	Day	Month	Day of the week	No work																																																																								
51	3rd day				4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																																									
52	1 0	1 1	Wednesday	<input type="checkbox"/>																																																																								
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54	Day	Month	Day of the week	No work																																																																								
55	4th day				4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																																									
56	1 1	1 1	Thursday	<input type="checkbox"/>																																																																								
57																																																																												
58	Day	Month	Day of the week	No work																																																																								
59	5th day				4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																																									
60	1 2	1 1	Friday	<input type="checkbox"/>																																																																								
61																																																																												
62	Day	Month	Day of the week																																																																									
				To read-Instructions To fill in-Paid Work Time Diary To fill in-Everyday Life Diary +																																																																								

Figure 6.8: Paid Work Time Diary Part III

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX
51	1st day																	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																																												
52	1	0	1	1	Wednesday																																																																							
53	Day																	Month																			Day of the week																																							
54	4th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
55	1	1	1	1	Thursday																																																																							
56	Day																	Month																			Day of the week																																							
57	5th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
58	1	2	1	1	Friday																																																																							
59	Day																	Month																			Day of the week																																							
60	6th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
61	1	3	1	1	Saturday																																																																							
62	Day																	Month																			Day of the week																																							
63	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
64	1	4	1	1	Sunday																																																																							
65	Day																	Month																			Day of the week																																							
66	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
67	1	4	1	1	Sunday																																																																							
68	Day																	Month																			Day of the week																																							
69	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
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71	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
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81	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
82	Day																	Month																			Day of the week																																							
83	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
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85	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
86	Day																	Month																			Day of the week																																							
87	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
88	Day																	Month																			Day of the week																																							
89	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
90	Day																	Month																			Day of the week																																							
91	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
92	Day																	Month																			Day of the week																																							
93	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
94	Day																	Month																			Day of the week																																							
95	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
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98	Day																	Month																			Day of the week																																							
99	7th day																	No work																			4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm																									
100	Day																	Month																			Day of the week																																							

Remember to fill in the Everyday Life Diary tomorrow.

◀ ▶ To read-Instructions **To fill in-Paid Work Time Diary** To fill in-Everyday Life Diary +

Figure 6.9: Paid Work Time Diary Part I

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	2. Everyday Life Diary Instructions																		
2																			
3																			
4	Please read the instructions below to help you fill in your diary. There is also an example of a filled in diary at the end of the Instructions sheet .																		
5																			
6	When should I fill in the diary?																		
7	<ul style="list-style-type: none"> • We would like you to complete the diary on Monday, November 11. 																		
8	<ul style="list-style-type: none"> • The diary study starts at 4pm and covers 24 hours, with three hours on each page. 																		
9	<ul style="list-style-type: none"> • Please take the diary with you during the day and fill it in every now and then when you have a spare moment (for example, on the bus or train, at lunchtime or while you wait for someone). 																		
10	<ul style="list-style-type: none"> • It's up to you how you decide to fill in the surveys throughout the day: on your computer, or on the go on your phone, or combined. You can also print the files and send them back to us at the end of the study. 																		
11	<ul style="list-style-type: none"> • If you want to fill in the diary on your phone you will firstly have to log into Microsoft Excel Online on your phone (enter http://portal.office.com in your phone's web browser). To log in, you will have to enter an email address and password, or create a new account. 																		
12																			
13	<ul style="list-style-type: none"> • If you want to fill in the diary in pen and paper, please email us at llascau@cs.ucl.ac.uk and we will send you a printer-friendly copy of the diary. 																		
14																			
15	Completing the Everyday Life diary																		
16	What where you doing?																		
17	<ul style="list-style-type: none"> • In this column, record what you consider to be your main activity for each 10 minute period. 																		
18	<ul style="list-style-type: none"> • If you were doing more than one activity at the same time, only record the main activity in this column. 																		
19	<ul style="list-style-type: none"> • If you did one thing after another during the 10 minutes, record the activity that took the most time. 																		
20	<ul style="list-style-type: none"> • If you were doing something you feel is too private to record, please write "personal". 																		
21																			
22	Work																		
23	<ul style="list-style-type: none"> • If you have more than one job, please record which one you were working at. 																		
24	<ul style="list-style-type: none"> • Please record when you took any breaks. Also please record what you did during breaks. For example, "Lunch break, had lunch" or "Lunch break, went for a walk". 																		
25																			
26	School/college																		
27	<ul style="list-style-type: none"> • Please record whether you study at home or attend classes/lectures. 																		
28	<ul style="list-style-type: none"> • Include the type of study, such as college, etc. 																		
29	<ul style="list-style-type: none"> • If the studies are part of paid work, please note this in the diary. 																		
30																			
31	Housework and childcare																		
32	<ul style="list-style-type: none"> • Please record what you were really doing. For example, "Cooked dinner", "Washed the dishes", "Put my child to bed", "Mowed the lawn", "Cleaned the house", "Washed the car". 																		
33																			
34	Sleeping																		
35	<ul style="list-style-type: none"> • Please record any occasions during the night when you weren't sleeping. For example, if you have woken up and are doing nothing, reading or caring for children, doing any work, etc. 																		
36																			
37	Reading																		
38	<ul style="list-style-type: none"> • If you were reading, please record what you read. For example, "Read a newspaper", "Read a magazine", "Read a book". 																		
39	<ul style="list-style-type: none"> • If you were reading on a tablet or e-reader such as a Kindle, please remember to fill in the 'Did you use a smartphone, tablet or computer?' column. 																		
40																			
<p>Navigation: To read-Instructions To fill in-Paid Work Time Diary To fill in-Everyday Life Diary +</p>																			

Figure 6.10: Paid Work Time Diary Part II

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
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Figure 6.11: Paid Work Time Diary Part III

If you have any questions about how to complete the diary, please click here to email us at llascau@cs.ucl.ac.uk

Please begin filling in your first diary here:

Instructions

- Record your main activity for each 10-minute period. Please note only one main activity on each line!
- Use quote marks to record that an activity lasted longer than 10 minutes.

Please record your activity below

Time	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Were you alone or with somebody you know? Mark all relevant boxes							
					Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know	
<i>example</i>	<i>image labelling task</i>	<i>watching movie with toddler</i>	<i>X</i>	<i>at home</i>		<i>X</i>		<i>X</i>				
<i>example</i>	<i>took a break from working to make a cup of coffee</i>	<i>" "</i>	<i>X</i>	<i>at home</i>				<i>X</i>				
4am-4.10												
4.10-4.20												
4.20-4.30												
4.30-4.40												
4.40-4.50												
4.50-5am												
5am-5.10												
5.10-5.20												
5.20-5.30												
5.30-5.40												
5.40-5.50												
5.50-6am												
6am-6.10												
6.10-6.20												

To read—Instructions
 To fill in—Paid Work Time Diary
 To fill in—Everyday Life Diary
 +

Figure 6.12: Paid Work Time Diary Part IV

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
103			6am-6.10																		
104			6.10-6.20																		
105			6.20-6.30																		
106			6.30-6.40																		
107			6.40-6.50																		
108			6.50-7am																		
109																					
110			Time Morning	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know							
111			7am-7.10																		
112			7.10-7.20																		
113			7.20-7.30																		
114			7.30-7.40																		
115			7.40-7.50																		
116			7.50-8am																		
117			8am-8.10																		
118			8.10-8.20																		
119			8.20-8.30																		
120			8.30-8.40																		
121			8.40-8.50																		
122			8.50-9am																		
123			9am-9.10																		
124			9.10-9.20																		
125			9.20-9.30																		
126			9.30-9.40																		
127			9.40-9.50																		
128			9.50-10am																		
129																					
130			Time Morning and Early Afternoon	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know							
131			10am-10.10																		
132			10.10-10.20																		
133			10.20-10.30																		
134			10.30-10.40																		
135			10.40-10.50																		

Reminders:

- If you were doing something you feel is too private to record, please write "personal".
- Please record any main or secondary task you do, no matter how small.
- Please record when you took any breaks.
- Please record any occasions during the night when you weren't sleeping.

◀ ▶ To read—Instructions To fill in—Paid Work Time Diary **To fill in—Everyday Life Diary** +

Figure 6.13: Paid Work Time Diary Part V

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
134			10.30-10.40																	
135			10.40-10.50																	
136			10.50-11am																	
137			11am-11.10																	
138			11.10-11.20																	
139			11.20-11.30																	
140			11.30-11.40																	
141			11.40-11.50																	
142			11.50-12pm																	
143			12pm-12.10																	
144			12.10-12.20																	
145			12.20-12.30																	
146			12.30-12.40																	
147			12.40-12.50																	
148			12.50-1pm																	
149																				
150			Time Afternoon	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know						
151			1pm-1.10																	
152			1.10-1.20																	
153			1.20-1.30																	
154			1.30-1.40																	
155			1.40-1.50																	
156			1.50-2pm																	
157			2pm-2.10																	
158			2.10-2.20																	
159			2.20-2.30																	
160			2.30-2.40																	
161			2.40-2.50																	
162			2.50-3pm																	
163			3pm-3.10																	
164			3.10-3.20																	
165			3.20-3.30																	
166			3.30-3.40																	
167			3.40-3.50																	
168			3.50-4pm																	
169																				

• Please record when you took any breaks.
 • Please record any occasions during the night when you weren't sleeping.

To read—Instructions To fill in—Paid Work Time Diary **To fill in—Everyday Life Diary** +

Figure 6.14: Paid Work Time Diary Part VI

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
169																					
			Time Afternoon and Early Evenings	Late	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/ partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know						
170			4pm-4.10																		
171			4.10-4.20																		
172			4.20-4.30																		
173			4.30-4.40																		
174			4.40-4.50																		
175			4.50-5pm																		
176			5pm-5.10																		
177			5.10-5.20																		
178			5.20-5.30																		
179			5.30-5.40																		
180			5.40-5.50																		
181			5.50-6pm																		
182			6pm-6.10																		
183			6.10-6.20																		
184			6.20-6.30																		
185			6.30-6.40																		
186			6.40-6.50																		
187			6.50-7pm																		
188																					
189																					
			Time Evening		What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/ partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know						
190			7pm-7.10																		
191			7.10-7.20																		
192			7.20-7.30																		
193			7.30-7.40																		
194			7.40-7.50																		
195			7.50-8pm																		
196			8pm-8.10																		
197			8.10-8.20																		
198			8.20-8.30																		
199			8.30-8.40																		
200			8.40-8.50																		
201			8.50-9pm																		
202																					

Reminders:

- If you were doing something you feel is too private to record, please write "personal".
- Please record any main or secondary task you do, no matter how small.
- Please record when you took any breaks.
- Please record any occasions during the night when you weren't sleeping.

◀ ▶ To read-Instructions To fill in-Paid Work Time Diary **To fill in-Everyday Life Diary** +

Figure 6.15: Paid Work Time Diary Part VI

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
203			9pm-9.10																		
204			9.10-9.20																		
205			9.20-9.30																		
206			9.30-9.40																		
207			9.40-9.50																		
208			9.50-10pm																		
209																					
			Time	What were you doing?	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know							
210			Overnight	Please write down one main activity.																	
211			10pm-10.10																		
212			10.10-10.20																		
213			10.20-10.30																		
214			10.30-10.40																		
215			10.40-10.50																		
216			10.50-11pm																		
217			11pm-11.10																		
218			11.10-11.20																		
219			11.20-11.30																		
220			11.30-11.40																		
221			11.40-11.50																		
222			11.50-12pm																		
223			12pm-12.10																		
224			12.10-12.20																		
225			12.20-12.30																		
226			12.30-12.40																		
227			12.40-12.50																		
228			12.50-1am																		
229																					
			Time	What were you doing?	If you did something else at the same time, what else did you do?	Did you use a smartphone, laptop, tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Parent	Child aged 0-7	Child over 7	Other people	Others you know							
230			Late overnight	Please write down one main activity.																	
231			1am-1.10																		
232			1.10-1.20																		
233			1.20-1.30																		
234			1.30-1.40																		
235			1.40-1.50																		

Reminders:

- If you were doing something you feel is too private to record, please write "personal".
- Please record any main or secondary task you do, no matter how small.
- Please record when you took any breaks.
- Please record any occasions during the night when you weren't sleeping.

◀ ▶
To read-Instructions
To fill in-Paid Work Time Diary
To fill in-Everyday Life Diary
+

Figure 6.16: Paid Work Time Diary Part VIII

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
234			1.30-1.40																	
235			1.40-1.50																	
236			1.50-2am																	
237			2am-2.10																	
238			2.10-2.20																	
239			2.20-2.30																	
240			2.30-2.40																	
241			2.40-2.50																	
242			2.50-3am																	
243			3am-3.10																	
244			3.10-3.20																	
245			3.20-3.30																	
246			3.30-3.40																	
247			3.40-3.50																	
248			3.50-4am																	
249																				
250																				
251																				
252	Please fill in the following checklist:																			
253	Please fill in the following checklist:																			
254	Please fill in the following checklist:																			
255	Please fill in the following checklist:																			
256	Please fill in the following checklist:																			
257	Please fill in the following checklist:																			
258	Please fill in the following checklist:																			
259	Please fill in the following checklist:																			
260	Please fill in the following checklist:																			
261	Please fill in the following checklist:																			
262	Please fill in the following checklist:																			
263	Please fill in the following checklist:																			
264	Please fill in the following checklist:																			
265	Please fill in the following checklist:																			
266	Please fill in the following checklist:																			
267	Please fill in the following checklist:																			
268	Please fill in the following checklist:																			
269	Please fill in the following checklist:																			
270	Please fill in the following checklist:																			
271	Please fill in the following checklist:																			
272	Please fill in the following checklist:																			

1. When did you fill in the diary? Select option(s) by typing the letter "X" on your keyboard.

Now and then during the diary day

At the end of the diary day

The day after the diary day

2. Did you feel rushed this day?

Yes

No

3. Was this an ordinary or an unusual day?

An ordinary day

◀ ▶ To read—Instructions To fill in—Paid Work Time Diary **To fill in—Everyday Life Diary** +

Figure 6.17: Paid Work Time Diary Part IX

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
263																				
264			2. Did you feel rushed this day?																	
265			<input type="checkbox"/> Yes																	
266																				
267			<input type="checkbox"/> No																	
268																				
269																				
270			3. Was this an ordinary or an unusual day?																	
271			<input type="checkbox"/> An ordinary day																	
272																				
273			<input type="checkbox"/> An unusual day																	
274																				
275																				
276			Finally, please go through the diary once again and check the following:																	
277																				
278			• Please check that you have noted only one main activity at each line and that there are no empty time periods.																	
279																				
280			• Have you recorded all travel and modes of transport?																	
281																				
282			• Have you made the duration of secondary activities, if any?																	
283																				
284			• Please check that you have always completed the "Were you alone or with somebody you know?" column.																	
285																				
286																				
287																				
288			<p>Please make sure that you filled the two diaries correctly.</p> <p>If all looks right, you can click on thix box to email us and let us know that you completed the diary. Alternatively, send us a message at llascau@cs.ucl.ac.uk</p> <p>Thank you!</p>																	
289																				
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302																				

← ▶
To read—Instructions
To fill in—Paid Work Time Diary
To fill in—Everyday Life Diary
+

Part 3: Interview Study

Participant Information Sheet:

Title of Study: Time scheduling for crowdworkers

Department: UCL Interaction Centre

Name and Contact Details of the Researcher(s): Laura Lascau – llascau@cs.ucl.ac

Name and Contact Details of the Principal Researcher: Prof Anna Cox – anna.cox@ucl.ac.uk

1. Invitation Paragraph

You are being invited to interview with a PhD researcher as part of a project at the UCL Interaction Centre. The purpose of the interview is to get an understanding of how you schedule your time working on [name of platform]. Participation is voluntary, but before you decide it is important for you to understand why the research is being done and what participation will involve. Please take time to read the following information carefully and to decide whether or not you wish to take part. Ask us if there is anything that is not clear or if you would like more information.

2. What is the project's purpose?

The aim of the project is to how workers on [name of platform] schedule their work. We are interested in seeing how much control you have over scheduling your working hours. We are hoping that the findings of this study will help inform the development of future tools or interventions to crowdworkers.

3. Why have I been chosen?

You have been chosen to participate in this study as you are registered as a worker on [name of platform] and took part in our previous survey and diary study. We aim to talk with up to 15 crowdworkers in this interview study.

4. Do I have to take part?

It is entirely up to you to decide whether or not to take part. If you do decide to take part, you will be asked to consent to participating in the research. You can withdraw from the study at any time during the study without giving a reason, at which point no data will be saved. However, because the study is anonymous, after

you have completed the study you will not be able to withdraw any data you have entered.

5. What will happen to me if I take part?

Taking part in this study will involve being interviewed once by one researcher. You might also be contacted to participate again in future research. These interviews will be done online and will last for approximately 30-45 minutes and you will be asked to describe the ways in which you plan your time working on [name of platform] and non-work time (e.g., time with family, hobbies, volunteering, etc.).

6. Will I be recorded and how will the recorded media be used?

The audio recording made during this research will be used only for analysis, and will be destroyed once it is transcribed. No one outside the project will be allowed access to the original recordings.

7. What are the possible disadvantages and risks of taking part?

There are no foreseeable discomforts, disadvantages and risks for taking part. However, if you do feel uncomfortable, please feel free to withdraw from the study at any time.

8. What are the possible benefits of taking part?

You will be compensated for your time as consideration for providing information during the interview. You will be paid via [name of platform] by entering an interview completion code in a job.

9. What if something goes wrong?

If you would like to raise a complaint about this research, please contact the Principal Researcher, Prof Anna Cox, at anna.cox@ucl.ac.uk If you feel like your complain has not been handled to your satisfaction, you can contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk

10. Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.

11. Limits to confidentiality

Confidentiality will be respected subject to legal constraints and professional guidelines.

12. What will happen to the results of the research project?

Results will be disseminated in standard academic outlets. Results may also be disseminated via general interest magazines/newspapers/journals. You will not be identifiable in any report or publication.

13. Data Protection Privacy Notice

The data controller for this project will be University College London (UCL). The UCL Data Protection Office provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk. UCL's Data Protection Officer can also be contacted at data-protection@ucl.ac.uk.

Further information on how UCL uses participant information can be found here: www.ucl.ac.uk/legal-services/privacy/participants-health-and-care-research-privacy-notice

Your personal data will be processed for the purposes outlined in this notice. The legal basis that would be used to process your personal data will be the provision of your consent. You can provide your consent for the use of your personal data in this project by completing the consent form that has been provided to you. Your personal data will be processed as long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this, and will endeavour to minimise the processing of personal data wherever possible. If you are concerned about how your personal data is being processed, please contact UCL in the first instance at data-protection@ucl.ac.uk. If you remain unsatisfied, you may wish to contact the Information Commissioner's Office (ICO). Contact details, and details of data subject rights, are available on the ICO website at: <https://ico.org.uk/for-organisations/data-protection-reform/overview-of-the-gdpr/individuals-rights/>

14. Who is organising and funding the research?

This research is funded by the Engineering and Physical Sciences Research Council (EPSRC).

15. Contact for further information

Prof Anna Cox UCLIC, University College London, London WC1E 6BT,
United Kingdom +44 (0)20 3108 7074 anna.cox@ucl.ac.uk

Thank you for reading this information sheet and for considering to take part in this research study.

Interview Guide:

First of all, thank you very much for agreeing to participate in this study. I guess I could start by telling you a little bit about what the study is about and about myself. In short, this study is looking at how crowdworkers schedule their work. I am interested in learning about when and how do crowdworkers schedule their work and non-work, how much control you have over your schedules, and also what working time preferences you have.

I am PhD Student and in general I want to understand the working conditions of people who work on [name of platform]. For example, the spaces in which you work, the tools that you use, the type of work that you do, etc. I am doing this research as I want to be able to feed into the designs of future crowdworking platforms. So far, I ran two studies with crowdworkers in which I learnt about the time pressures of working on [name of platform] (such as having a small amount of time to accept work before other workers, or working with tasks which have short allotted completion times, etc).

In this interview I would like to focus on the ways in which you manage your own time as a worker on [name of platform]. I will first ask you a few general questions about your experience with [name of platform], then I will ask you a few questions based on the answer you provided in the survey last week, and then finally I will ask a few questions about your diary.

There are no right/wrong answers. I am interested in your views. I am expecting this interview to take around 30 minutes but if we go over the time I will send you a bonus on [name of platform] calculated at the base rate of \$10/hour

General questions about the survey:

- How did you find it?

General questions about time scheduling:

- For how long have you been working on [name of platform]?
- Do you work on any other crowdworking platforms?

Questions about time scheduling:

- How many hours do you schedule for [name of platform] work a day?
 - How many would you say you work in reality on average?
- When are you planning on working tomorrow?
- Do you generally plan when you are going to work?
- How many days do you schedule for [name of platform] work per week?
 - How many hours did you end up working last week?
- Do you find yourself working during the evenings or at the weekend?
- Do you use scripts? If so, do you have to accept new tasks or are they added to your queue automatically?
- Do you schedule taking breaks?
- Can well do you feel you can stick to your schedules (work, breaks, etc).

Questions about the diary entries:

- When did you work yesterday?
 - How did you decide on these times?
 - What was the time determined by?
- Did anything unexpected come up for you in your schedule?

Questions about everyday scheduling:

- Are you satisfied with your existing working schedule?
- When would you say are your most productive hours on [name of platform]?
- Please describe any deviations from the typical pattern: variation, how often?
- Overtime work? By choice or is it required?
- What does your ideal working schedule look like?
- How many hours a week would you rather work?
- Do you feel like you have a sort of routine?
- What barriers do you face when scheduling your working hours on [name of platform] or other crowdsourcing websites?
- Do you feel that you have working-time autonomy? That is, complete autonomy over your working hours and schedules, the ability to work when you want, etc.

Appendix D: Materials for Study 6

Participant Information Sheet

Title of Study: Influence the design of future of crowdworking platforms

Department: UCL Interaction Centre

Name and Contact Details of the Researcher(s): Laura Lascau – llascau@cs.ucl.ac.uk

Name and Contact Details of the Principal Researcher: Prof Anna Cox – anna.cox@ucl.ac.uk

1. Invitation Paragraph You are being invited to take part in a research project. Before you decide whether to take part or not, it is important for you to understand why the research is being done and what participation will involve. Please take time to read the following information and let us know (llascau@cs.ucl.ac.uk) if you have any further questions.

Do you work on crowdworking platforms because you need flexible working hours? Influence the design of future crowdworking platforms by taking part in an online co-design session and receive \$100.

How? Online co-design session lasting just under two hours, with a researcher and other participants.

When? You can choose from a list of dates and times that suit you and the other participants.

Where? In short, online via Microsoft Teams and Miro. To participate in this study, you will need to be in a quiet place for two hours, be able to focus, and have Microsoft Teams and Miro installed on your computer.

2. What is the project's purpose?

Crowdworking platforms promise flexibility in terms of when you can work and for how long. However, that promise does not always hold true. Nevertheless,

since it's important for people to have flexible time schedules, we want to understand what crowdworking platforms could look like in 20 years from now.

3. Why have I been chosen?

We aim to engage with up to 20 people who work on crowdworking platforms in this study. We are recruiting people over 18 years ago who work on crowdworking platforms because they need flexible working hours. We are using opportunity sampling, so anyone who fits these criteria is invited to participate. There are, however, a few instances in which you will not be able to participate in the study. You will not be able to participate if any of the following apply to you:

- You are under the age of eighteen;
- You do not work on crowdworking platforms because you need flexible working hours; and
- You have ever been (or are currently) involved in the design or evaluation of any crowdworking platforms (e.g., you have been asked by someone working for a crowdworking platform to give your opinions about a new feature of the platform).
- You want to retain control over how the information you share on Miro will be treated or used. The Miro board used during the co-design session will be shared with the other participants in the co-design sessions. Miro, the company, has access to the Miro boards, therefore we cannot control the use of the information posted on the boards. However, we take maintaining your privacy very seriously; we describe what steps we will take to maintain your privacy in the following sections.

4. Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to 'sign' a digital consent form. You can withdraw at any time without giving a reason, without incurring a penalty or loss, and without it affecting any benefits that you are

entitled to. If you decide to withdraw you will be asked what you wish to happen to the data you have provided up that point.

5. What will happen to me if I take part?

Participation involves taking part in an online co-design session with a researcher and other participants. Co-design is an approach of directly and intentionally including people in the design and development process of technology.

The co-design sessions will last just under two hours and to be held over Microsoft Teams and Miro. During the online co-design session, you will be joined by three other people who also work on crowdworking platforms because they need flexible working hours. Together, you will be asked to think long-term about your future selves in 20 years using the platform, as well as your children becoming your age and using the platform. There will be a few design exercises to support this activity, such as writing a story about what a crowdworking platform that would give people flexibility in their schedules might look like. We will also ask you for your honest feedback on a few design ideas of our own.

Importantly, during the co-design sessions, you will be asked to think about the future of crowdworking platforms in general terms, rather than about the future of a specific crowdworking platform. In this sense, we will ask you to avoid naming any specific crowdworking platform during the co-design sessions, and to also avoid sharing information that might reveal the contents of the crowdworking platform, such as screenshots of any pages or features. Finally, if you decide to take part in the co-design sessions, you will be asked to read and adhere to our Code of Conduct, which you can find at the following link: [TBD]

6. Will I be recorded and how will the recorded media be used?

Audio and video will be recorded throughout the co-design sessions. The audio and video recordings will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. Recordings will only be labelled with an anonymous numerical ID. Recordings will be deleted at the conclusion of the study.

7. What are the possible disadvantages and risks of taking part?

There are no foreseeable discomforts, disadvantages and risks for taking part. However, if you do feel uncomfortable, please feel free to withdraw from the study at any time.

8. What are the possible benefits of taking part?

You will be compensated \$100 for your time. You will also contribute to research investigating the future of online work.

9. What if something goes wrong?

If you would like to raise a complaint about this research, please contact the Principal Researcher, Prof Anna Cox, at anna.cox@ucl.ac.uk If you feel like your complaint has not been handled to your satisfaction, you can contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk

10. Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.

11. Limits to confidentiality

Confidentiality will be respected subject to legal constraints and professional guidelines. Furthermore, confidentiality will be respected unless there are compelling and legitimate reasons for this to be breached. If this was the case we would inform you of any decisions that might limit your confidentiality. Finally, please note that confidentiality may not be guaranteed in co-design sessions, workshops or focus groups as participants will know information about each other.

12. What will happen to the results of the research project?

Results will be disseminated in standard academic outlets. Results may also be disseminated via general interest magazines/newspapers/journals. You will not be identified directly in any report and the researchers will seek to anonymize names, institutions etc mentioned in transcripts. Quotes may appear in published work though, and these could be identifiable to certain individuals based on a contextual understanding, although the researchers will endeavour not to use quotations where this might happen. Should you be interested in the results, we will provide them

with the findings we publish.

The results of the design activities may also be disseminated in ensuing reports or publications. Where this is the case, you will be recognised anonymously in the reports or publications.

13. Local Data Protection Privacy Notice

The data controller for this project will be University College London (UCL). The UCL Data Protection Office provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk.

This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information can be found in our 'general' privacy notice: For participants in research studies, [click here](#)

The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices.

The lawful basis that would be used to process your personal data will be [performance of a task in the public interest.]

The lawful basis used to process special category personal data will be for scientific and historical research or statistical purposes.

Your personal data will be processed so long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this, and will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk.

If you remain unsatisfied, you may wish to contact the Information Commissioner's Office (ICO). Contact details, and details of data subject rights, are available on the ICO website.

14. Who is organising and funding the research?

This research is funded by the Engineering and Physical Sciences Research

Council (EPSRC).

15. Contact for further information

Prof Anna Cox UCLIC, University College London, London WC1E 6BT,
United Kingdom +44 (0)20 3108 7074 anna.cox@ucl.ac.uk

If you agree to participate in the project, you will be given a copy of the information sheet and a signed consent form to keep for your records. Thank you for reading this information sheet and for considering to take part in this research study.

Code of Conduct

The co-design sessions will follow a discussion-based format. Please keep comments concise and be aware of the space you take up. As we have limited time, we want to make sure many voices are heard.

Feel free to leave the talk, move around in your own physical setting, or take a moment to yourself whenever needed.

We encourage respectful debate and constructive critiques. Be hard on systems and soft on people; avoid personal attacks and allow us to all collectively find ways to address systemic issues.

In the event of harassment or discrimination by another attendee, directly message the researcher. They are equipped to take appropriate action.

Do not use, post, or discuss potentially harmful content without first providing a warning to participants. This includes (but is not limited to) flashing lights, discriminatory content (racist, sexist, genderist, classist, ableist, transphobic etc), sexually violent topics, or other offensive and stressful content.

Technical issues, anxiety, and glitches are expected. Be patient. Show sensitivity to anyone speaking, be kind and be supportive. People's lived experiences are not for debate; their ideas, policies, and suggestions are. The lines between these two are not always clear so give one another the benefit of the doubt. Grace, sensitivity, and validation go a long way toward creating community.

Acknowledgements: This Code of Conduct borrows heavily and is modified from CHIWORK's Code of Conduct.

Participant Consent Form

Please complete this form after you have read the Information Sheet about the research.

Title of Study: Influence the design of future crowdworking platforms

Department: UCL Interaction Centre

Name and Contact Details of the Researcher(s): Laura Lascau – llascau@cs.ucl.ac.uk

Name and Contact Details of the Principal Researcher: Prof Anna Cox – anna.cox@ucl.ac.uk

Name and Contact Details of the UCL Data Protection Officer: Alexandra Potts data-protection@ucl.ac.uk

This study has been approved by the UCL Research Ethics Committee: Project ID number Z6364106/2022/06/19 social research

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Select each box below to agree:

1. I confirm that I understand that by selecting each box below I am consenting to this element of the study. I understand that it will be assumed that unselected boxes mean that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study

2. I confirm that I have read and understood the Information Sheet for the above study and understand what the study involves.

3. I had the opportunity to ask questions and discuss the study and received satisfactory answers to all my questions or have been advised of an individual to contact for answers to any future questions or concerns.

4. I confirm that I have not ever been (or are currently) involved in the design or

evaluation of any crowdworking platforms (e.g., you have been asked by someone working for a crowdworking platform to give your opinions about a new feature of the platform).

5. I understand that during the co-design sessions I will be asked to avoid naming any specific crowdworking platform.

6. I understand that during the co-design sessions I will be asked to avoid sharing information that might reveal the contents of crowdworking platforms, such as screenshots of any pages or features.

7. I confirm that I have read the Code of Conduct provided in the information sheet and will adhere to it during the co-design sessions

8. I understand that this research requires me to be audio and video recorded.

9. I understand that all data gathered in this study (i.e., audio and video recordings) will be pseudomysed and stored securely using password-protected software and used only for analysis purposes by researchers. Data will be deleted upon study completion.

10. I understand that my personal information will be used for the purposes explained to me I understand that such information will be handled in accordance with all applicable data protection legislation.

11. I understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately without giving a reason.

12. I understand that data from this study will be presented in academic journals and at conferences and that I and my data will not be identifiable.

13. I understand that my pseudomysed data may be subject to review by responsible individuals from the University monitoring and audit purposes.

14. I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.

15. I hereby confirm that I meet all of the inclusion criteria and do not meet any of the exclusion criteria detailed in the Information Sheet.

16. I am aware of who I should contact if I wish to lodge a complaint.

17. I consent to participate in the study and I understand that according to data protection legislation, 'public task' will be the lawful basis for processing my personal data.

Design Materials

Firstly, on page 318, Figure 6.18 presents a screenshot of the Miro board that we shared with the participants. Specifically, this screenshot provides an overview of the information provided to the participants at the start of the co-design sessions.

Next, on pages 319 - 321, Figures 6.19, 6.20, and 6.21 present screenshots of the Miro board that we shared with the participants. Specifically, these three screenshots present the exercises we asked participants to complete during the co-design sessions.

Figure 6.18: Co-Design Study: Introduction

Introductions (5 minutes)

Why am I here?

I'm currently finishing a PhD in Human-Computer Interaction, which has been exploring the working conditions of crowdworking platforms.

In particular, I've been exploring a concept known as *temporal flexibility*: having flexibility in terms of *when* and *for how long* someone can work on crowdworking platforms.

Who are you?

Reminder: Please don't share any personal information about yourselves :)

Why are you here?

- To help brainstorm the future of crowdworking platforms!

Can we foresee a future crowdworking platform in which we would want our children to participate?

- In other words, to help brainstorm the design of future crowdworking platforms, which would offer you flexibility in your time schedules.

What to expect from today?

- 10-minute reflection exercise
- 10-minute affinity mapping exercise
- 15-minute creative writing exercise
- 10-minute break
- 25-minute card sorting exercise
- 25-minute design exercise



This agenda is flexible. You are welcome to change the exercises we do today.

Any questions?

Figure 6.19: Co-Design Study: Exercises 1 and 2

<p>1/5 Reflection exercise (10 minutes)</p> <p>Please reflect and take notes of your experiences.</p> <p>Ask: Individually, think about the last day when you worked on a crowdworking platform.</p> <ul style="list-style-type: none">• How did you plan your work time?• How did you plan your non-work time? For example, time with family, friends, or hobbies?• Did you encounter any difficulties in managing your time? If so, what where those? <p>Please use the space to the right to take any notes.</p> <p><i>Individually:</i> 5 minutes to reflect on your experiences.</p> <p><i>Individually:</i> 5 minutes to vote on your top three reflections using the stars. Which reflections are the most important to you at this point in time?</p>	<p>Participant 1</p> <p><small>Please use this space to map your reflections</small></p>  <p>☆☆☆</p>	<p>Participant 2</p> <p><small>Please use this space to map your reflections</small></p> 
<p>2/5 Affinity mapping exercise (15 minutes)</p> <p>Ask: As a group, we will map together your top three reflections and see what patterns we can spot.</p> <p>We will use the space to the right to group the post-its.</p> <p><i>Collaboratively:</i> 15 minutes to work together as a group.</p>	<p>All participants</p> <p><small>Please use this space to map your reflections</small></p>	

Figure 6.20: Co-Design Study: Exercise 3

<p>3/5 Creative writing exercise (15 minutes)</p> <p>Some people work on crowdsourcing platforms because they need flexibility in their time schedules.</p> <p>Ask: Individually, please write a story about what an ideal day would like for you one year from now if the creators of crowdworking platforms addressed the issues we have discussed in the previous exercise.</p> <p><i>There are no right answers. The story can be as long or short as you like. It can be about a real situation or about a fictional situation.</i></p> <p>You can write your answers in a text editor at first, and then copy and paste your text onto the board.</p> <p><i>Individually:</i> 5 minutes to write a story.</p> <p><i>Collaboratively:</i> 10 minutes (~2 minutes each) to share your reflections with the group.</p>	<p>Participant 1</p> <p><small>Please read - use this space to say any questions you have</small></p> 	<p>Participant 2</p> <p><small>Please read - use this space to say any questions you have</small></p> 
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Break (10 minutes)

Figure 6.21: Co-Design Study: Exercises 4 and 5

4/5 Card sorting exercise (25 minutes)

To the right, each one of you has a collection of 19 cards. The cards describe features of crowdworking platforms that could give you more flexibility or control over your time.

Ask: Individually, I'd like you to sort these cards into three categories: high, medium, and low priority.

Which of these features would you like to see adopted in the next five years by crowdworking platforms?

Individually: 10 minutes to sort the cards into the three categories.

Collaboratively: 15 minutes (~3 minutes each) to share your reflections with the group.

Participant 1

Suggestions



High priority jobs Medium priority jobs Low priority jobs

5/5 Design exercise (25 minutes)

Finally, let's think longer-term about the future of crowdworking platforms.

Ask: As a group, envision your future selves in 20 years from now using crowdworking platforms, as well as your children becoming your age and using crowdworking platforms.

What should crowdworking platforms that offer flexibility look like?

- Doesn't have to be about interfaces; it can be about more general aspects.
- The technology (if any) doesn't have to exist yet; anything is possible.

Collaboratively: 25 minutes to work together as a group.

All participants

Proposed: *use this space to log and present your ideas*

High priority jobs Medium priority jobs Low priority jobs

Thank you! 🙌👏

Any final thoughts or comments?