

In Their Shoes: A Structured Analysis of Job Demands, Resources, Work Experiences, and Platform Commitment of Crowdworkers in China

YIHONG WANG, Xi'an Jiaotong-Liverpool University, PRC

KONSTANTINOS PAPANGELIS, Rochester Institute of Technology, USA

IOANNA LYKOURENTZOU, Utrecht University, NL

HAI-NING LIANG, Xi'an Jiaotong-Liverpool University, PRC

IRWYN SADIEN, Xi'an Jiaotong-Liverpool University, PRC

EVANGELIA DEMEROUTI, Eindhoven University of Technology, NL

VASSILIS-JAVED KHAN, Eindhoven University of Technology, NL

Despite the growing interest in crowdsourcing, this new labor model has recently received severe criticism. The most important point of this criticism is that crowdworkers are often underpaid and overworked. This severely affects job satisfaction and productivity. Although there is a growing body of evidence exploring the work experiences of crowdworkers in various countries, there have been a very limited number of studies to the best of our knowledge exploring the work experiences of Chinese crowdworkers. In this paper we aim to address this gap. Based on a framework of well-established approaches, namely the Job Demands-Resources model, the Work Design Questionnaire, the Oldenburg Burnout Inventory, the Utrecht Work Engagement Scale, and the Organizational Commitment Questionnaire, we systematically study the work experiences of 289 crowdworkers who work for ZBJ.com - the most popular Chinese crowdsourcing platform. Our study examines these crowdworker experiences along four dimensions: (1) crowdsourcing job demands, (2) job resources available to the workers, (3) crowdwork experiences, and (4) platform commitment. Our results indicate significant differences across the four dimensions based on crowdworkers' gender, education, income, job nature, and health condition. Further, they illustrate that different crowdworkers have different needs and threshold of demands and resources and that this plays a significant role in terms of moderating the crowdwork experience and platform commitment. Overall, our study sheds light to the work experiences of the Chinese crowdworkers and at the same time contributes to furthering understandings related to the work experiences of crowdworkers.

CCS Concepts: • **Information systems** → **Crowdsourcing**.

Additional Key Words and Phrases: Keywords go here

ACM Reference Format:

Yihong Wang, Konstantinos Papangelis, Ioanna Lykourantzou, Hai-Ning Liang, Irwyn Sadien, Evangelia Demerouti, and Vassilis-Javed Khan. 2019. In Their Shoes: A Structured Analysis of Job Demands, Resources,

Authors' addresses: Yihong Wang, Xi'an Jiaotong-Liverpool University, PRC, Yihong.Wang18@student.xjtlu.edu.cn; Konstantinos Papangelis, Rochester Institute of Technology, USA, KPapangelis@me.com; Ioanna Lykourantzou, Utrecht University, NL, I.Lykourantzou@uu.nl; Hai-Ning Liang, Xi'an Jiaotong-Liverpool University, PRC, HaiNing.Liang@xjtlu.edu.cn; Irwyn Sadien, Xi'an Jiaotong-Liverpool University, PRC, Irwyn.Sadien@xjtlu.edu.cn; Evangelia Demerouti, Eindhoven University of Technology, NL, E.Demerouti@tue.nl; Vassilis-Javed Khan, Eindhoven University of Technology, NL, V.J.Khan@tue.nl.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

© 2019 Copyright held by the owner/author(s). Publication rights licensed to ACM.

2573-0142/2019/1-ART7 \$15.00

<https://doi.org/10.1145/3375187>

Work Experiences, and Platform Commitment of Crowdworkers in China. *Proc. ACM Hum.-Comput. Interact.* 4, GROUP, Article 7 (January 2019), 40 pages. <https://doi.org/10.1145/3375187>

1 INTRODUCTION

Crowdsourcing, i.e. the process of outsourcing tasks, by organizations or individuals, online in the form of an "open-call" [27, 42] has attracted commercial and academic interest in USA, Europe and India, primarily due to the success of Amazon Mechanical Turk (Mturk), one of the first platforms to support crowd work. In China, and over the last few years, crowdsourcing has garnered widespread interest. Articles in People's Daily and China Daily [97] describe crowdsourcing as a new value creation model, which invigorates IT industries using public intelligence. China, being one of the world's most populous countries and a rapidly growing digital economy today supplies a substantial workforce to crowdsourcing platforms. According to Huo, Zheng and Tu [83], by 2017 there were already 30 million Chinese crowdworkers serving more than 190,000 enterprises and individuals worldwide, generating a total business turnover of CNY 5 billion (approx. \$900M USD).

Following the growing interest in crowdsourcing, as well as the globalization of the crowd workforce [77], a number of studies in the CSCW and HCI fields have investigated the work experiences of crowdworkers in various countries. For example, an ethnographic study conducted in India [35] revealed that life circumstances, work and family commitments, as well as the access to and expertise with technologies and infrastructure, could have a significant impact on the the way Indian crowdworkers manage and accomplish crowd tasks. A survey of crowdworkers in the USA suggested that although high-income and low-income workers both use a variety of tools, such as browser extensions and scripts, to perform crowd tasks, high-income individuals tend to make a more frequent use of such tools, as well as batch completion strategies to earn higher wages [49]. In a study combining the answers of respondents living in both India and the United States, Gray et al. [34] found that crowdworkers interact with each other in a collaborative network to manage the administrative overhead and to find lucrative tasks and reputable employers. Very recently, Wood et al. [96] revealed that digital laborers in South-Asia and Sub-Saharan Africa have insufficient social protection and benefits, due to the laws and policies not recognizing the crowdsourcing labor model. They conclude that this legal gap not only leaves workers exposed to the unexpected changes of their working situation, but also limits their access to healthcare.

Although studies exploring the work experiences of crowdworkers in various countries are becoming increasingly prevalent in the CSCW and HCI literature, there have been no studies to the best of our knowledge exploring the work experiences of the Chinese crowdworkers.

In this paper, we address this gap and by utilizing a series of well-established approaches we explore the experiences of 289 crowdworkers working for ZBJ¹ - the largest crowdsourcing platform in China. Adapted for the crowdsourcing context, our framework structures crowdworker experiences across four axes: (1) crowdsourcing job demands, (2) job resources available to the crowdworkers, (3) crowdwork experiences, and (4) platform commitment. The methods we use to do so are: (1) Job Demands Resources model [21], (2) Work Design Questionnaire [64], (3) Oldenburg Burnout Inventory [21], (4) the Utrecht Work Engagement Scale [79], and (5) Organizational Commitment Questionnaire [66].

In light of the outcomes of our investigation, our contributions are primarily empirical in nature as the not only: (1) provide new insight into the relationships among job demands, job resources, crowdwork experiences, and platform commitment of Chinese crowdworkers and the influence of the demographic factors on these relationships, but (2) indicate that significant differences across these based on crowdworkers' gender, education, income, job nature, and health condition, which

¹<https://xianggang.zbj.com/>

illustrates that different crowdworkers have different needs and that these play a significant role in terms of moderating the crowdwork experience and platform commitment.

In the main, the contributions add to the growing body of HCI and CSCW research that seeks to understand the work experience of crowdworkers in different locales.

The rest of this paper is organised as follows. First we provide a review of the relevant literature. Next, we present our methodology, including a detailed description of the measuring instruments and their adaptation to the crowdsourcing context, worker population, study design and results analysis method. Then, we present our findings, elaborating on the detailed relationships among the four crowdworker experience axes, and the identified statistically significant demographic differences, based on crowdworker gender, age, marital status, education, income, job nature, and health condition. We conclude this work with a detailed discussion of these findings, limitations, and suggestions for future work.

2 LITERATURE REVIEW

2.1 Crowdwork Experience

2.1.1 *Burnout.*

Job burnout, as a negative aspect of work experience, was first put forward by Freudenberger [33]. It originally referred to the negative cognitive and emotional reactions (e.g. exhaustion and feeling of overload) of employees who worked under long-term stress in the context of human services, such as health care, social work, and teaching. In the 1980s, Maslach and Jackson [60] proposed a multi-dimensional concept of job burnout that includes three dimensions: exhaustion; depersonalization, and personal accomplishment. Exhaustion refers to the phenomenon that individuals feel when their effective physical and mental resources are overstretched. Depersonalization reflects the negative, indifferent or extremely avoidant attitude individuals may have towards their jobs and job recipients/patients while in a state of burnout. Personal accomplishment means that individuals in a job burnout situation can have a lower sense of competence, morale, and achievement.

Recent studies have shown that stressors leading to burnout in the traditional work setting² extend to other industries [21]. Researchers have also developed measurement instruments to help predict burnout in the workplace [21] based on the Oldenburg Burnout Inventory (OLBI), which defines burnout as a syndrome of negative work-related experiences, including feelings of exhaustion and disengagement from work. Building upon the definition put forth by Maslach and Jackson [60], exhaustion here refers to general feelings of emptiness, overtaxing from work, a strong need for rest, and a state of physical exhaustion, whereas disengagement refers to distancing oneself from the object and the content of one's work and moving towards negative, cynical attitudes and behaviours toward one's work in general [22]. In its role as a negative indicator of work experience, burnout has been found to predict long-term sickness absences (≥ 90 days) [71] and to be a better predictor of long-term health than depression and anxiety. Finally, at the organizational level, Vahey et al. [90] illustrated that individuals experiencing job burnout can exhibit increased absenteeism, and turnover, and are more prone to errors. This may lead to the impairment of the productivity and profitability of the organization for which the individuals work for.

2.1.2 *Crowdwork Engagement.*

In contrast to job burnout, work engagement is a positive aspect of work experience. One of the early viewpoints regarding this aspect emerged from role theory and was defined by Kahn [47], who stated that work engagement allows people to "employ and express themselves physically,

²Note: We use 'traditional work settings' and 'traditional industries' as a catch all term that includes all industries (both high- and low-tech) not associated with crowdsourcing (e.g. software development, social work, health care, engineering, and teaching.)

cognitively, emotionally and mentally during role performances". Soon after Kahn's definition, two schools of thought formed regarding work engagement and its relationship to work experience. On the one hand, holding the viewpoint that burnout and engagement are two poles of a continuum, Maslach and Leiter [61] characterized work engagement by reversing the three dimensions in their definition of burnout, whereby exhaustion turned into energy, depersonalization turned into involvement, and personal accomplishment turned into professional efficacy. Nevertheless, a recent study suggested that not all burnout dimensions were perfectly inversely related to the dimensions of work engagement. This study showed that the exhaustion dimension of burnout and the energy dimension of work engagement seem to represent two separate but highly related constructs [23].

From this, more recent, standpoint, work engagement is defined as a work-related, positive, fulfilling state of mind, which is characterized by three dimensions: vigor, dedication, and absorption. Vigor is related to the level of energy and mental resilience of employees. Dedication is explained as the sense of significance, enthusiasm, and pride that workers hold towards their jobs. Absorption is characterized by being completely concentrated and immersed in one's work. In its role as a positive indicator of work experience, work engagement has gained much popularity among HR managers as several researchers claim that it not only contributes to satisfaction and retention of employees at a personal level [17], but also plays an important role in the success of corporations at the organizational level [75].

Overall, according to the literature, burnout and work engagement represent the two sides of the same coin. Therefore, taking this analysis into account and in order to gain a more comprehensive understanding of the crowdworkers' perceptions of their jobs, in this paper we combine the dimensions of burnout and work engagement (both the negative and the positive aspects of work-related well-being) into a new crowdsourcing-specific dimension, hereby and for the rest of this study called crowdwork experience.

2.2 Platform Commitment

As indicated by the characteristics of burnout and engagement, both the negative and positive work experiences of the employees have significant effects on their organizations. It is therefore essential to introduce a concept measuring the worker-organisation dynamics. According to Van Dick [24], organizational commitment is defined as the psychological attachment of employees towards the organizations they belong to. Allen and Meyer [3] distinguished organizational commitment into three forms. The first form is the affective commitment related to the emotional attachment of employees to their organisation. Affective commitment consists of three aspects: the employees' strong acceptance and belief towards the aims of their organizations, their willingness to support the organization, and a feeling of membership and a desire to remain in the organization [65]. The second form of organisational commitment is normative commitment. It deals with the moral-ethical obligation of employees towards the organization as a whole, instead of other individuals [95]. Workers with such commitment are less likely to leave the company during difficult periods. The last form of commitment is continuance, which impels the employees to consider the cost of changing their employers [3]. Meyer et al. [63] stated that a high continuance commitment can reduce an employee's motivation for leaving their present employer as they may feel that there is a great cost attributed to wage loss and relocation after leaving.

Following in this vein, and despite employment relationships in the crowdsourcing industry being more flexible compared to traditional employment models [9], the attachments of crowdworkers towards their platforms can also be expected to play a key role in understanding their work experiences. Therefore, in this paper, we use the Organizational Commitment Questionnaire [66] to evaluate the organizational commitments of crowdworkers towards their platform, and report the results in a crowdsourcing-specific dimension called platform commitment.

2.3 Models to predict crowdwork experiences and platform commitment

Various models have been used to discover the factors that affect the work experiences of employees. The Job Demands-Control model was developed by Karasek [50] as an approach to model work-related stress, and indicates that effective job control and decision-making ability plays an important role in moderating the negative effects of stress in the work setting. The model suggests that 'skill', 'variety', 'task identity', 'task significance', 'autonomy', and 'feedback' affect the work-related outcomes of 'motivation', 'satisfaction', 'performance', 'absenteeism', and 'turnover' through the psychological situations of 'experienced meaningfulness', 'experienced responsibility' and 'knowledge of results' [36]. Moreover, according to the Vitamin model [93], environmental factors such as good working conditions, occupational prestige and social support could affect the mental health of employees. However, several problems regarding these models have been reported. The most recurrent among these problems is that the descriptive organizational approaches used in most studies simply describe the variables related to work experiences instead of explaining them [80].

After careful consideration of the applicability and practicality of these various models in a crowdsourcing context, we decided to use the Job Demands-Resources (JD-R) model of burnout established by Demerouti and Bakker [21], because regardless of occupation, two general categories of work characteristics can be derived from the JD-R model: job demands and job resources [5]. The JD-R model of job burnout links psychological processes to burnout. The 'job demands' bring about 'continuous fatigue', resulting in 'emotional exhaustion', and the 'lack of job resources' lead to 'retreat behavior', of which the long-term consequence is that workers distance themselves from their jobs.

According to Schaufeli and Bakker [81], job demands involve physical, social, and organizational aspects of the work that require continuous physical and psychological (i.e., cognitive and emotional) efforts. Cooper, Dewe and O'Driscoll [18] divided the job demands into quantitative and qualitative elements. The quantitative demands consist of the amount of work required and the amount of time provided to perform a task (e.g. work overload). The qualitative (emotional) job demands are related to the affective responses of staff to their work.

Job resources refer to the physical, psychological, social, or organizational elements that enable the working goals to be achieved, reduce job demands, reduce cost of physical and psychological impact, and motivate individuals to grow and develop [21, 81]. Richter and Hacker [76] further divided job resources into external and internal. External resources consist of economic returns, social support, management counseling, etc. Internal resources consist of autonomy, feedback, and the possibility of career development. When resources are limited, individuals are unable to cope with the negative effects of high demands and cannot achieve their goals [40].

The Job Demands-Resources model assumes that job demands and job resources involve two different processes, namely motivational and energetic processes [81]. On the one hand, motivational processes link job resources with organizational outcomes (e.g., turnover intentions) through work engagement. As indicated in the definition, job resources may play either intrinsic or extrinsic motivational roles as they not only foster personal growth and the development of employees but also promote the achievement of working goals. In the case of motivational processes, job resources fulfill the basic needs of employees such as competence [94] and relatedness [7], which, as a consequence, enhance well-being and intrinsic motivations of employees [78]. In the case of energetic processes, job resources may also play an extrinsic role because, according to Effort-Recovery model [62], employees may want to dedicate more effort and expand on their ability to better achieve their tasks in a work context with abundant resources. In either case, when the organization provides valuable job resources for workers to learn, grow, and develop [41], engagement is expected to occur and will mediate the relationship between job resources and

organizational outcomes [81]. On the other hand, the energetic process links job demands with health problems via burnout. This process can be explained using Hockey's [39] compensatory regulatory-control model which states that employees under pressure will either protect their primary performance goals with compensatory cost or accept a reduction in performance with no increase in cost. In order to deal with the increased demands, employees have to mobilize their compensatory effort with extra physiological and psychological costs, which leads to burnout and, in the long run, health problems [39]. Moreover, as ill health is significantly and positively related to turnover intentions [81] it is plausible to assume that employees with negative work experiences tend to have low organizational commitments.

Due to the fact that the Job Demands-Resources model has been shown to be applicable across various industries regardless of the occupations involved, it is reasonable to assume that the general work-related well-being mechanisms in crowdsourcing align with this model. Therefore, in light of previous JD-R studies [5], we develop two hypotheses to investigate the relationships among job demands, available job resources, crowdwork experiences and platform commitments based on Job Demands-Resources model and its two different processes (motivational and energetic) in a crowdsourcing context:

- **Hypothesis 1 (a):** Job demands negatively affect the platform commitments of Chinese crowdworkers by impairing crowdwork experiences.
- **Hypothesis 1 (b):** Job resources positively affect the platform commitments of Chinese crowdworkers by improving crowdwork experiences.

2.4 Crowdsourcing and Crowdworkers

Since Howe [42] introduced the concept of crowdsourcing, the definition of what crowdsourcing is has evolved. Crowdsourcing is considered as a problem-solving tool [15], an online distributed problem-solving and production model [11, 19], an open collaborative learning paradigm [89], and a new resource for product development [72]. Estelles-Arolas and Gonzalez-Ladron-de-Guevara [27] extracted the basic features of crowdsourcing by summarizing more than 40 different kinds of crowdsourcing definitions and define crowdsourcing as a distributed problem-solving mechanism that convenes Internet users in public ways to accomplish tasks collaboratively or independently.

It stems from this online nature that the workforce involved in the crowdsourcing industry is varied in terms of different demographic backgrounds. The most recent research conducted by Difallah, Filatova and Ipeirotis [25] on Mturk found that there was a gender balance among crowdworkers (51% female, 49% male) and a large portion of them were younger and single individuals. According to Berg [9], crowdworkers are well-educated given the fact that more than half of the participants involved in their study have either college degrees (37.6%) or master degrees (16.9%). While the motivation of most crowdworkers is to meet their financial needs, crowdsourcing is considered a primary source of income for low-income crowdworkers whose annual household incomes were less than \$60,000. Huws, Spencer and Joyce [43] indicated that online short tasks and clickwork are the most popular category of crowdsourcing works while driving work is the least popular type of task for workers since most of them are infrequent crowdworkers who crowdwork part-time. Furthermore, it is reported by Zyskowski et al. [99] that some individuals with health issues are already participating in crowdwork, yet face challenges with regard to the accessibility of the tasks (e.g. getting past CAPTCHAs to create accounts for visually impaired workers).

Despite the substantial studies on the demographic characteristics of crowdworkers, the systematic investigation of the differences in work-related factors based on demographics - which has long been analyzed in other industries [91]- has hitherto been neglected in crowdsourcing context. Previous studies in other industries suggest that workers perceive their job-related factors

differently based on the following demographic variables: (1) gender (e.g. [85]), (2) age (e.g. [4]), (3) marital status (e.g. [58]), (4) education (e.g. [82]), (5) income level (e.g. [67]), (6) job nature (e.g. [52]) and (7) health condition (e.g. [8]). Therefore, based on the fact that crowdworkers are a heterogeneous group of people with different demographic characteristics and the fact that workers in different demographic groups perceive job-related factors differently, we put forward our second hypothesis to investigate the differences between various crowdworker demographic groups in terms of how they perceive their job demands, job resources, work experiences and platform commitments:

- **Hypothesis 2:** There are significant differences in the detailed aspects in job demands, job resources, crowdwork experience and platform commitment of crowdworkers in China based on (a) gender, (b) age, (c) marital status, (d) education, (e) income, (f) job nature and (g) health condition.

3 METHODOLOGY

3.1 Measuring Instruments and Adaptation

3.1.1 Job Demands and Job Resources.

Measuring instruments: Job Demands-Resources Scale and Work Design Questionnaire.

Two measuring instruments were used and adapted to evaluate the job demands and job resources of crowdworkers within a crowdsourcing context, namely the Job Demands-Resources Scale and Work Design Questionnaire. The Job Demands-Resources Scale (JDRS) was developed by Jackson and Rothmann (2005) to measure job demands and job resources. The 7 dimensions of JDRS were all proven to be reliable, given that 'Organizational support' ($\alpha = 0.88$), 'Growth opportunities' ($\alpha = 0.80$), 'Overload' ($\alpha = 0.75$), 'Job Insecurity' ($\alpha = 0.90$), 'Relationship with colleagues' ($\alpha = 0.76$), 'Control' ($\alpha = 0.71$) and 'Rewards' ($\alpha = 0.78$) were all above minimum threshold [46]. A four-point scale ranging from 1 (never) to 4 (always) was applied to evaluate all the items. JDRS is widely used in various industries (e.g. business, education and agriculture) to measure the variables of job demands and resources. This extensive use of the instrument has revealed that job demands usually require sustained physical or mental worker effort, while job resources are functional in reducing job demands and the associated physiological and psychological costs. The Work Design Questionnaire (WDQ) was developed by Morgeson and Humphrey [64] as a measure for assessing job design and the nature of work. WDQ has 77 items that are distributed into 21 dimensions measuring 4 theoretically distinct work characteristics, namely 'Task Characteristics', 'Knowledge Characteristics', 'Social Characteristics', and 'Work Context'. The items are rated on a five-point scale and the internal consistency of WDQ is excellent with an average reliability up to 0.87. According to Morgeson and Humphrey [64], the motivational work characteristics such as social support and autonomy demonstrate the benefit of improved affective outcomes, i.e., job satisfaction.

Instrument adaptation to the crowdsourcing context. In adapting JDRS and WDQ for the Job Demands section in our questionnaire, items from the 'Overload dimension' in JDRS (e.g., "Do you have to work at speed?" and "Does your work require your constant attention?"), as well as items from 'Work Context' category in WDQ (e.g., "The job has a low risk of accident" and "The workplace is free from excessive noise") were adapted to fit the context of our study. Notably, nine positively-worded items relating to working conditions (also in the Work Context category) were scored reversely to keep the consistency of the marking standard such that a higher score indicates higher job demands. The rephrased items are: "My crowdwork occurs in an environment with low risk of accident.", "My crowdwork occurs in an environment free from health hazards.", "My crowdwork occurs in a clean environment.", "My crowdwork occurs in an

environment with comfortable climate.", "My crowdwork occurs in an environment with comfortable lighting conditions.", "My crowdwork occurs in an environment free from radioactive facilities.", "I do my crowdwork in a comfortable body posture (e.g. eye height. Leg postural support).", "I access and use devices/instruments within easy reach when crowdworking (e.g. mouse, telephone, printer etc.).", "I use assistant devices when I am suffering from some health problems.(e.g. teletypewriter for hard-of-hearing crowdworkers)". See Section 2 of the supplementary document for more details. Moreover, the items related to the 'Problem Solving dimension' in the 'Knowledge Characteristics' category of WDQ were also included in our job demands section as we recognize that knowledge is one of the major contributions of crowdworkers towards crowdsourcing tasks [27]. In addition to this, to explore the interplay of information and job demands of crowdworkers we added six new questions: (1)"Crowdwork requires me to work long hours", (2) "Crowdwork requires me to put extra effort to keep my job secured", (3) "Crowdwork requirements are too detailed to improve working efficiently", (4) "Crowdwork requires me to have professional expertise and skills more than I practically have", (5) "My crowdwork occurs in an environment with radioactive facilities", and (6) "I use assistant devices when I am suffering some health problem". We also removed the following two items from WDQ because they are not applicable in a crowdworking context: (1) "The work place allows for all size differences between people in terms of clearance, reach, eye height, leg room, etc." and (2) "The job involves excessive reaching". After selecting the relevant items, two further modifications were made to better suit the sample environment. Firstly, we decided to use a unified five-point scale ranging from Never (1) to Always (5) to minimize confusion from using different scales in different sections. This also led to rephrasing certain items so that they could be better answered using the same scale (see section 2 of the supplementary document for more details). Secondly, to be in line with the etiquette, vernacular, and culture of our sample, the words "Work/Job", "Supervisor" and "Organization" were changed to "Crowdwork", "Requester" and "ZBJ Platform". Overall, the final job demands section consisted of 30 items rated on a five-point scale ranging from Never (1) to Always (5).

In adapting JDRS and WDQ for the Job Demands section in our questionnaire, items related to 'Growth opportunities', 'Relationship with colleagues' in JDRS (e.g., (1)"Does your work offer you opportunities to learn on the job?", (2)"Do you receive sufficient information on the results of your job?" and (3)"Do you get on well with your supervisor?"), as well as items in the 'Social Characteristics' category of WDQ (e.g., "I have the chance in my job to get to know people.") were extracted. Moreover, eight new items were added to gather more information concerning the job resources of crowdworkers. They were: (1) "I have opportunities to improve my crowdwork according to the relevant feedback", (2) "My crowdwork offers me opportunities to learn from other people", (3) "Requesters value the crowdwork I do for them", (4) "Requesters deliver on their promises", (5) "With crowdwork, I can improve my weak points", (6) "With crowdwork, I can develop a number of specialized skills and techniques", (7) "With crowdwork, I can develop new interests and hobbies", (8) "With crowdwork, I can strengthen my confidence and dignity". Similar to the further modifications in the Job Demands section, to unify the answering scales and better suit the crowdsourcing context, word replacements and some rephrasing was been done to the selected items. Consequently, the final job resource section consisted of the aforementioned 25 items rephrased and rated on a five-point scale ranging from Never (1) to Always (5).

3.1.2 Crowdwork Experience.

Measuring instrument: Oldenburg Burnout Inventory and Utrecht Work Engagement Scale. To assess the work experiences of crowdworkers, the Oldenburg Burnout Inventory (OBLI) and Utrecht Work Engagement Scale (UWES) are referred and adapted in this study. The OBLI is developed by Demerouti et al. [21] and contains 16 items measuring burnout in two sub-scales, namely,

exhaustion and disengagement. Identical answering categories ranging from totally disagree (1) to totally agree (4) are used and the Cronbach's alphas of the exhaustion and disengagement sub-scale are reported as 0.82 and 0.83 respectively [21]. The Utrecht Work Engagement Scale (UWES) is developed to assess work engagement, which consists of three dimensions, namely vigor, dedication, and absorption. All items are scored on a seven-point scale ranging from never (0) to everyday (6). It is reported by a plethora of studies that the internal consistency of UWES ranges between 0.8 and 0.9 [21, 81]. According to studies based on Job Demands-Resources model which used OBLI and UWES as their measures for the worker's experiences in various industries, it is commonly found across various industries (e.g. health care, manufacturing and) that burnout, as the negative aspect of work experiences, is caused by excessive job demands and lack of job resources while work engagement, as the positive aspect of work experience, is enhanced by increased job resources.

Instrument adaptation to the crowdsourcing context. In adapting OBLI and UWES for the Job Demands section in our questionnaire, all 16 items in OBLI were included except for "This is the only type of work that I can imagine myself doing" and "I feel more and more engaged in my work". We made this choice as the first item was highly unlikely to be applicable in our context due to the flexible and diverse nature of crowdsourcing [9]. The second item was excluded as it is too similar to the three items we adapted from the Dedication dimension in UWES (i.e., "I am enthusiastic about my work", "My job inspires me." and "I am proud of the work that I do."). In addition, six rephrased items relating to the Vigor and Absorption dimensions in UWES; (1)"I feel bursting with energy in crowdwork", (2) "I feel strong and vigorous in crowdwork", (3)"I feel like cold working when I get up in the morning", (4)"I feel happy when I am crowdworking intensively", (5) "I do completely immersed in my crowdwork", (6) "I get carried away when I am crowdworking") were also adapted and used. Typical questions in these dimensions were "In my job, I feel strong and vigorous" and "I am completely immersed in my work". Also, two items ("I can decide when to take a break during my crowdwork" and "I have a choice in deciding what I do at crowdwork") were added to obtain more information concerning the work experiences of crowdworkers. For the sake of consistency, the 16 aforementioned items adapted from the OBLI and UWES instruments were all reverse-scored such that a higher score in this section corresponds to a poorer crowdwork experience. These are: "I feel energized in my crowdwork.", "I feel bursting with energy in crowdwork.", "I feel strong and vigorous in crowdwork.", "I am enthusiastic about my crowdwork.", "I am inspired my crowdwork.", "I feel like crowdworking when I get up in the morning", "I feel happy when I am crowdworking intensively", "I am proud of the crowdwork.", "I do completely immersed in my crowdwork.", "I get carried away when I am crowdworking.", "I find new and interesting aspects in my crowdwork", "I am able to tolerate the pressure of my crowdwork very well.", "I find my crowdwork to be a positive challenge.", "I have enough energy for my leisure activities after crowdwork", "I manage the amount of my crowdwork well.", "I have a choice in deciding what I do at crowdwork.", "I can decide when to take a break during my crowdworking day.". See section 2 of the supplementary document for more details. All the selected items were, again, rephrased for the unified answering scale ranging from Never (1) to Always (5). Words such as "work" and "job" were also consistently replaced with the word "crowdwork" to emphasize to our participants that it is their experience of crowdwork rather than their other occupations that we measured in this section. The final 'Crowdwork Experiences' section consisted of 25 items rephrased and rated on a five-point scale ranging from Never (1) to Always (5).

3.1.3 Platform Commitment.

Measuring instrument: Organizational Commitment Questionnaire. For the purpose of measuring the crowdworker's commitment to their crowdsourcing platform, we refer and adapt the

instrument called Organizational Commitment Questionnaire [66]. There are 15 items included in OCQ, of which six items are negatively poled and therefore, these items were reversely scored. The construct of OCQ is still the object of heated discussion. Most studies present a one-factor construct when using the OCQ (e.g. [66]). However other studies suggests that two dimensions should be considered in OCQ, in which the positively and negatively poled items load on two different factors respectively [14]. Despite the different viewpoints about constructs and dimensions, the internal consistency of OCQ lies between 0.82 and 0.93 [65]. A seven-point scale with scale point anchors ranging from (1) Strongly Disagree to (7) Strongly Agree is used in OCQ. Studies based on OCQ suggested that organizational commitments are strengthened when workers experience greater job satisfaction through a positive work experience.

Instrument adaptation to the crowdsourcing context. In adapting OCQ for the Platform Commitment section in our questionnaire, most of the items in OCQ were included except "I find that my values and the organization's values are very similar", because it would result in ambiguity as the word "value" has various connotations in Chinese. Also, in this section we added three items with more straightforward meanings: (1) "I feel valued by ZBJ.com", (2) "I feel that ZBJ.com provides sufficient protection of rights and interests for me" (3) "I feel that ZBJ.com fails to reward extra effort" to improve clarity. Notably, besides the six original items that were negatively worded and reverse scored, one newly added question ("I feel that ZBJ.com fails to reward extra effort") was also reverse scored for the purpose of keeping internal consistency (See section 2 of the supplementary document for more details). Afterwards, we rephrased the selected items for fitting the unified answering scales as the original scale ranged from (1) Strongly Disagree to (7) Strongly Agree. Moreover, and similarly to above, the word 'organization' was replaced by the word "ZBJ platform" as it is the particular platform that our participants are working for. The final Platform Commitment section consisted of 17 items rephrased and rated on a five-point scale ranging from Never (1) to Always (5).

3.2 Final Questionnaire Summary

Overall, the adapted questionnaire consists of 97 items spread out over four sections, namely Job Demands, Job Resources, Crowdsourcing Experience and Platform Commitment.

3.2.1 Job Demands section.

Based on the results of our exploratory factor analysis, the Job Demands section consists of five dimensions:

- (1) Work Pressure - refers to the difficulties and challenges in the crowdsourcing process.
- (2) Cognitive Demand - measures the requirements in crowdsourcing from a cognitive perspective.
- (3) Physical Demand - refers to the physical effort of crowdworkers such as their muscular endurance.
- (4) Equipment use - evaluates the variety and complexity of the equipment and technologies used by crowdworkers.
- (5) Workplace Conditions - measures the working environment of crowdworkers.

3.2.2 Job Resources section.

The Job Resources section also contains 5 dimensions:

- (1) Self Development - measures the opportunities for crowdworkers to improve and fulfill themselves.
- (2) Social Communication - refers to the connections of crowdworkers with other workers.
- (3) Feedback - refers to the feedback obtained from the requesters.

- (4) Requester Support - measures the level of assistance obtained from the requesters.
- (5) Operation - refers to the interaction between crowdworkers and requesters in a typical crowdworking process, from the introduction of tasks to the final payment.

3.2.3 *Crowdwork Experience section.*

The Crowdwork Experience section consists of three dimensions:

- (1) Exhaustion - refers to crowdworkers' feelings of strain, need to rest, and state of physical fatigue.
- (2) Distancing - concerning the disengagement of oneself from the object and content of one's crowdwork and the negative attitude towards one's crowdwork.
- (3) Maladjustment - refers to the difficulties in accommodating one's work management and attitude to the specificities of crowdwork.

3.2.4 *Platform Commitment section.*

Finally, the Platform Commitment section consists of two dimensions:

- (1) Acknowledgement - refers to the sense of identity that crowdworkers receive from participating to the platform.
- (2) Loyalty - measures the willingness of the crowdworkers to keep working for the platform.

3.3 **The validity and reliability of the final questionnaire**

3.3.1 *The statistical analysis of validity and reliability.*

Exploratory factor analysis was conducted on the sections included in our adapted questionnaire to test the construct validity. First of all, simple principal components analysis was conducted. It was recommended by Kaiser [48] that the eigenvalue of the extracted factor be higher than 1.00. In addition, Cattell [13] suggested that the scree plot should be considered. Therefore, both eigenvalue and scree plots were generated to determine the number of extracted factors. Secondly, a principal component analysis with a varimax rotation was studied to analyze the possible solutions. According to Field and Tabachnick [87] and DeCoster [20], the following criteria were set to determine which factors should be retained: (1) Loading of item should be more than 0.35; (2) an item should not be permitted to load on two or more factors; (3) retained items and factors should make sense conceptually; (4) a factor in the model of principal component analysis should have at least 3 items.

Cronbach's α was used to investigate the reliability of obtained factors. Although 0.70 is usually considered as an acceptable cut-off point [45], it is argued by Hair et al [37] that a Cronbach's α of more than 0.6 indicates a reasonable internal consistency. Therefore, the lowest standard of Cronbach's α in this study was set to be at least 0.6.

To test the factorial validity of the sections involved in our questionnaire, confirmatory factor analysis was conducted using the structural equation modelling (SEM) method with the help of the AMOS program. The following criteria were considered in this study: (1) $\chi^2/\text{degree of freedom}$ (CMIN/DF) should be less than 5; (2) The Root Mean Square Error of Approximation (RMSEA) should be less than 0.08; (3) The Goodness of Fit Index (GFI) and Comparative Fit Index (CFI) should be higher than 0.90.

3.3.2 *Validity and reliability of the Job Demands section.*

The descriptive statistics (see Table 1 in section 3 of the supplementary document) indicate that the pattern of the data contained in the Job Demand section is normally distributed, given the fact that no item had skewness exceeding 2.00 or kurtosis more than 4.00. Therefore, a principal component analysis was conducted on all the items to evaluate the number of factors that could be extracted. The initial analysis based on Eigenvalues suggested there were 7 factors which explained 58.884% of

the variances, yet the scree plot (see Figure 1 in section 3 of the supplementary document) indicated that the possible factor solution should include at least 5 factors because the curve tended to be flat after the fifth component. After conducting a principal component analysis with a varimax rotation on various possible solutions, we decided to retain 5 factors in Job Demand section. Based on the aforementioned criteria regarding items remaining, the following 5 items were removed because of low factor loading: (1) “Crowdwork requirements are too detailed to improve working efficiently”, (2) “Crowdwork requires me to have professional expertise and skills more than I practically have”, (3) “Crowdwork makes me experience a mental collapse”, (4) “Crowdwork requires me to work long hours”, (5) “I use assistant devices when I am suffering some health problems”. In addition, three items were removed because of multiple loading, which are: (1) “Crowdwork requires me to deal with problems that I have not met before”, (2) “My crowdwork occurs in an environment with low risk of accident”, (3) “Crowdwork makes me experience a physical collapse”. Furthermore, item 19 (“My crowdwork occurs in an environment with low risk of accident”) and item 24 (“My crowdwork occurs in an environment with radioactive facilities”) were also deleted because a factor should have at least three items which are conceptually related. The eliminated items are all excluded from further analysis.

The factor loading and commonalities as well as the extracted factors and their cumulative explanation of the variance are shown in Table 2 in section 3 of the supplementary document. It can be observed that five factors are represented in the final Job Demand section comprised of 20 items. The first factor included 7 items measuring how comfortable the working environments are for crowdworkers to do their tasks. However, as mentioned in the Methodology section, these items are reversed scored for the purpose of retaining the consistency in this section that higher scores indicate more job demands. Thus, the first factor was named ‘Work Condition’. The second factor was labeled as ‘Work Pressure’, which refers to the difficulties and challenges in crowdworking process. Factor 3 concerned the physical effort of crowdworkers, which was labeled as ‘Physical Demand’. Factor 4 was named as ‘Equipment Use’, because the items involved in this factor evaluated the variety and complexity of the equipment and technologies used by crowdworkers. The last factor was labeled as ‘Cognitive Demand’ measuring the requirements in crowdwork from a cognitive perspective. 5 factors explained 60.925% of the variance in total.

According to the aforementioned criteria regarding confirmatory factor analysis, the results demonstrated that the factorial validity of the Job Demand section was acceptable (see Figure 2 in section 3 of the supplementary document), given the fact that the Goodness of Fit Index (GFI) and the Comparative Fit Index (CFI) were all higher than 0.90. The Root Mean Square Error of Approximation (RMSEA) was less than 0.08 and the $\chi^2/\text{degree of freedom}$ ration (CMIN/DF) was less than 2. Furthermore, the results also shows that all factors obtained in Job Demand section were reliable, ranging between 0.705 and 0.852.

3.3.3 *Validity and reliability of the job resources section.*

The descriptive statistics of the job resources section (see Table 3 in section 3 of the supplementary document) revealed a normally distributed data pattern in the Job Resources section in with the skewness and kurtosis below cut-off points. Therefore, all items were involved in the principal component analysis to discover the possible factor solutions. The results of initial analysis indicated that 6 factors with Eigenvalues were larger than 1 explained 55.816% of the variance. However, the scree plot (see Figure 3 in section 3 of the supplementary document) suggested a possible 4-factor solution with moderate steepness past the fourth component. After evaluating different results generated by the principal component analysis with a varimax rotation, 5 factors were retained in the Job Resources section. Based on the aforementioned criteria in the statistical analysis section, item 3 (“I have opportunities to find out how well I do my crowdwork”) was removed because of

double loading. Due to low factor loading, item 5 (“My crowdwork offers me opportunities to get to know other people”) and item 20 (“With crowdwork, I can improve my weak points”) were also eliminated.

The factor loading and communalities as well as the extracted factors and their cumulative explanation of the variance are shown in Table 4 of section 3 of the supplementary document, which also demonstrates that five factors are represented in the Job Resources section, comprised of 22 items. The first factor in Job Resource section included 7 items measuring the opportunities for crowdworkers to improve and fulfill themselves, therefore, it was named as ‘Self Development’. The second factor was labeled as ‘Social Communication’ and refers to the connections with others. The third factor was labeled as ‘Feedback’ referring to the feedback obtained from the work requesters. For the same reason, the fourth factor was named ‘Requester Support’ as it concerned the assistance obtained from the requester. At last, there were 4 items measuring the interaction between crowdworkers and requesters in a typical crowdworking process, therefore, it was labeled as ‘Operation’. 54.538% of the variance was explained by the 5 factors cumulatively. Figure 4 in section 3 of the supplementary document displays the results of confirmatory factor analysis conducted on the Job Resources section, which indicated an acceptable fit of the model to the data. Furthermore, the Cronbach’s α shown in Figure 4 in section 3 of the supplementary document was acceptable considering that the lowest standard for internal consistency was set to 0.6 in the statistical analysis section.

3.3.4 *Validity and reliability of crowdwork experience section.*

The descriptive statistics of the crowdwork experience section (see Table 5 in section 3 of the supplementary document) shows that no item has skewness or kurtosis exceeding the cut-off points set in statistical analysis section. To avoid common method bias, a Harman’s single-factor test was conducted before further analysis. The test indicated an acceptable result, with more than one factor extracted and the first factor contributing less than 40% of the explanation for the variance (Podsakoff et al., 2003). Afterwards, a principal component analysis was conducted on all the items included in the Crowdwork Experience section. According to initial analysis of the Eigenvalue (larger than 1), 5 factors explaining 57.675% of the variance were expected to emerge. Nevertheless, the scree plot (see Figure 5 in section 3 of the supplementary document) indicated a 4-factor solution. After considering the criteria of exploratory factor analysis and conducting principal component analysis with a varimax rotation, 3 factors were retained for further analysis. Consequently, 3 items (1. “I find new and interesting aspects in my crowdwork”, 2. “I feel like cold working when I get up in the morning”, and 3. “I am able to tolerate the pressure of my crowdwork very well”) were removed due to low communalities. Four items (1. “I do completely immersed in my crowdwork”, 2. “I find new and interesting aspects in my crowdwork”, 3. “I need more time to relax after crowdwork than usual”, and 4. “I have enough energy for my leisure activities after crowdwork”) were removed because of double loading. In addition, item 10 (“I get carried away in my crowdworking”) was also removed, as it did not conceptually relate to the rest of the items in the corresponding factor.

The rotated component matrix of the crowdwork experience (see Table 6 in section 3 of the supplementary document) displays the factor loading and communalities as well as the extracted factors and their cumulative explanation of the variance. We concludes that there were three factors involved in the final Crowdwork Experience section, comprised of 17 items. The first factor was labeled as ‘Exhaustion’, which refers to the feelings of strain, need to rest, and state of physical fatigue. To maintain the internal consistency of this section as mentioned in the Methodology section, the 7 items included in factor 2 were reverse scored (See Section 1 of the supplementary document) so that they referred to the disengagement of oneself from the object

and content of one's crowdwork and the negative attitude towards one's crowdwork, which can be summarized as 'Distancing'. The third factor was called 'Maladjustment' referring to the difficulties in accommodating one's work management and attitude to the specificities of crowdwork. 56.081% of the variance was explained by the 3 factors in total.

The result of CFA and Cronbach's α of Crowdwork Experience section (see Figure 6 in section 3 of the supplementary document) demonstrate an acceptable fit of the model to the data, given the fact that all the indices meet the criteria set in the statistical analysis section. Moreover, Figure 6 in section 3 of the supplementary document also reveals the acceptable reliability of the Crowdwork Experience section by showing the Cronbach's α ranging between 0.696 and 0.868.

3.3.5 Validity and Reliability of Platform Commitment section.

According to the results of descriptive statistics which were used to explore the data on the initial 17 items in the Platform Commitment section, Table 7 of the supplementary document indicated that no items deviated from the normal distribution. Therefore, a principal component analysis was conducted on all the items in this section. Three factors were suggested to be extracted by the initial Eigenvalue analysis and the scree plot also revealed a 3-factor solution. However, we decided to retain 2 factors after inspecting and comparing the results of varimax rotation to the results of previous studies (Shadur Rodwell, 2000; Yousef, 2003). Item 8 ("I feel like working for a different crowdsourcing platform as long as the type of work is similar.") and item 13 ("I pay attention to the fate of ZBJ.com platform.") were removed because of low communalities. In addition, the following 3 items were also deleted due to double loading, which are: (1) "I feel valued by ZBJ.com", (2) "I feel very little loyalty to ZBJ.com", (3) "I regard this ZBJ.com as a great organization and discuss with my friends". The two factors included in Platform Commitment explained 50.026% of the variance cumulatively.

The statistics presented in Table 8 of the supplementary document illustrate the factor loading and communalities as well as the extracted factors and their cumulative explanation of the variance. Two factors are represented in the final Platform Commitment section, comprised of 12 items. The first factor is labeled as 'Acknowledgement', referring to sense of identity of crowdworkers to their platform. As aforementioned in the Methodology section, the 6 items included in the second factor were reverse scored (See Section 1 of the supplementary document), and the second factor is therefore named 'Loyalty', which refers to the willingness of the crowdworker to keep working for the platform. Two factors explained 50.03% of the variance in total.

The indices in Figure 8 of the supplementary document illustrate an acceptable fit of the model to the data through the Goodness of Fit Index (GFI) and the Comparative Fit Index (CFI) being higher than 0.90, the Root Mean Square Error of Approximation (RMSEA) being less than 0.08, and the χ^2 / degree of freedom ration (CMIN/DF) being less than 2. The internal consistency of the Platform Commitment section also proved to be reliable with the Cronbach's α of the two dimensions being 0.829 and 0.725.

3.4 Research procedure

The research procedure consisted of four phases: (1) Adaptation and construction of questionnaire, (2) Pilot test, (3) Deployment, and (4) Data collection.

Four experts were consulted in order to appropriately adapt the relevant instruments and construct a questionnaire to achieve the goals set forth in this study. Firstly, an expert in the job demand-resources field gave us advice about the general framework of our questionnaires and directed us towards the relevant instruments regarding the structure of JD-R model. Secondly, three experts in the field of human computer interaction were consulted to rephrase the items in the instruments and to compile additional, crowdworking-related items so that our questionnaire

would be more applicable to the crowdsourcing context. Thirdly, to translate the questionnaire into colloquial and everyday Chinese the services of a linguist were employed.

After the adaptation and construction of the questionnaire, a small pilot study was conducted involving 14 Chinese crowdworkers. The goal of this pilot study was to examine the intelligibility of our items and to estimate the approximate time to complete the questionnaire. Following the results of the pilot test, we rephrased three items that caused confusion and instituted a 5-minute constraint to enforce that participants take at least five minutes to complete the questionnaire.

3.5 Participants

We conducted our survey in April 2018. We recruited crowdworkers on the ZBJ platform. The ZBJ platform is the biggest Chinese crowdsourcing platform with 19 million registered crowdworkers and approximately 4 million daily active workers. The operation of ZBJ is similarly to Upwork³ and Mturk⁴ - that is crowdworkers undertake a variety of tasks ranging from click work to creative design tasks that are posted by requesters in the form of an open call. Due to budget constraints, we were unable to obtain data from all active workers. Therefore, in order to make our sample as representative as possible, we decided to set up the questionnaire open to all crowdworkers on Zbj.com and investigate around 300 of them. The participation was voluntary. After investigating the crowdworker compensation of other studies that did similar length online surveys - usually 3-10 CNY (approx. \$0.45 USD to \$1.50 USD) on ZBJ platform - an above-average price of 15 CNY (approx. \$2.1 USD) per worker per survey was set as a reward to motivate crowdworkers to participate in the survey. To deploy our questionnaire, we used the WJX survey platform, which is popular in China for its usability and functionality. However, instead of posting the questionnaire directly on the ZBJ crowdsourcing platform, we decided to deploy a request with a website link and a QR code that forwarded the crowdworkers to our questionnaire in the WJX survey. We did so because the ZBJ platform does not support questionnaire-based surveys. Introduction and participation requirements were detailed in both the request page on ZBJ and the questionnaire front page on WJX. The introduction covered the purpose of the study, information on the researchers, and their email addresses in case participants had any problems with the research. The requirements reminded participants that they (1) must be above 18 years old, (2) must take at least 5 minutes to complete the questionnaire, (3) must not repeat participation, and (4) must post evidence of completion on ZBJ to get the reward. With the help of the screening function built in WJX platform, any submissions that failed to meet the above requirements were rejected. When crowdworkers completed the questionnaire successfully, a verification code generated by WJX was displayed so that they could either copy the code or take a screenshot and post it onto the ZBJ platform as evidence of completion. A total of 326 replies were collected, however, 37 of them were either rejected as they either didn't meet the abovementioned criteria or not properly completed. The reward was paid to crowdworkers that provided valid responses once their ID and verification code were collected. Therefore, at the end we only considered 289 valid responses and used them for the further analysis.

The demographic information of our participants is provided in Table 1. According to the statistics, our sample, had slightly more males: 174 participants were male (60.21%) and 115 female (39.79%). Approximately half of our participants were young and married: 54.33% between the age of 26 and 35 and 52.6% married. Most of them were educated: 70.25% had undergraduate (64.36%) or graduate degrees (5.54% masters and 0.35% PhD) and the rest of the participants were high school graduates (26.3%) or lower (3.46%). With regard to the annual income, 26.64% of the participants

³<https://www.upwork.com/>

⁴<https://www.mturk.com/>

have an annual income of less than CNY 40K (approx. \$6k USD), 38.41% of the participants earn between 40K to 60K (approx. \$9K USD) and roughly one-third (34.95%) more than 60K. Earning money (40.93%), learning new knowledge/skills (26.33%) and seeking interesting tasks (17.97%) are the top three motivations for crowdworkers to join the ZBJ platform. In addition, a vast majority of our participants (86.51%) claim to work part-time on ZBJ while the rest of them (13.49%) take crowdwork as their full-time job. At last, most of our participants (81.66%) stayed healthy in the past 12 months prior to the present study while a small number of them (18.34%) suffered from poor health conditions caused by physical and/or mental issues (more details are provided in supplementary document).

| Characteristics | Category | Number (N=289) | Percentage(%) |
|-------------------------|--------------------------|----------------|---------------|
| Gender | Male | 174 | 60.21 |
| | Female | 115 | 39.79 |
| Age | 18-25 | 103 | 35.64 |
| | 26-35 | 157 | 54.33 |
| | 36-45 | 27 | 9.34 |
| | >45 | 2 | 0.69 |
| Marriage Status | Single | 152 | 52.6 |
| | Married | 129 | 44.46 |
| | Other status | 8 | 2.76 |
| Education | High school or below | 86 | 29.76 |
| | College/University | 186 | 64.36 |
| | Master | 16 | 5.54 |
| | PhD | 1 | 0.35 |
| Annual Income | <20k | 25 | 8.65 |
| | [20k-39.99k) | 52 | 17.99 |
| | [40k-59.99k) | 111 | 38.41 |
| | ≥60k | 101 | 34.95 |
| Motivatiion | Interesting tasks | 101 | 17.97 |
| | Knowledge/Skills | 148 | 26.33 |
| | Feedback/Acknowledgement | 82 | 14.59 |
| | Money | 230 | 40.93 |
| | Others | 1 | 0.001 |
| Job Nature | Full-time | 39 | 13.49 |
| | Part-time | 250 | 86.51 |
| Health Condition | Healthy | 236 | 81.66 |
| | Unhealthy | 53 | 18.34 |

Table 1. Demographic information of Chinese Crowdworkers

Aside from the demographic information, we also observed the crowdwork characteristics of our participants (see Table 2). To be specific, the Chinese crowdworkers in this study were relatively experienced as most of them (82.01%) have been crowdworkers for more than 1 year and over two thirds of them (68.17%) worked for two or more crowdsourcing platforms. That being said that only a small part of our participants had less than 1 year of crowdwork experiences and less than one thirds of them (31.83%) merely worked for one platform. In addition, it was common for our participants to do two or more tasks at the same time (73.36%) while 26.64% of the workers would focus on 1 task at a time. Although they generally undertook multiple tasks simultaneously, the Chinese crowdworkers in our sample seemed to be able to finish crowdtasks in short time as a large portion of the participants (85.12%) reported that they spent less than 30 hours on tasks every week, among which 57.79% of them would crowdwork less than 20 hours. Interestingly, all of our participants undertook tasks in their personal time: nearly two thirds of them (62.63%) would "ocassionally" or "sometimes" do tasks when they are free and the rest 37.37% of the participants

admitted the crowdtasks would "often" or "always" occupy their spare time. As there is a variety of tasks on ZBJ platform, instead of listing all the possible tasks we asked participants to select their favorite tasks according to following features: structured or unstructured, individual or collaborative, low commitment or high commitment. In our sample, the most popular choice among Chinese crowdworkers (54.33%) is unstructured tasks that require collaboration and are of low commitment. One typical task of this type on ZBJ platform would be real-time idea jams. Besides, nearly half of our participants (47.75%) would also do structured tasks that one can do individually and require no to low commitment (e.g. survey). However, tasks such as translation and data science would not be popular among Chinese crowdworkers as only 16.96% of them undertake structured tasks that one can do individually, require high commitment.

| Characteristics | Category | Number (N=289) | Percentage (%) |
|--|-----------------|----------------|----------------|
| Years of Crowdworking | <1 year | 52 | 17.99 |
| | 1-2 years | 93 | 32.18 |
| | >2 years | 144 | 49.83 |
| Ever worked for | Only 1 platform | 92 | 31.83 |
| | 2 platforms | 103 | 35.64 |
| | ≥3 platforms | 94 | 32.53 |
| Tasks at hand (Simultaneously) | 1 task | 77 | 26.64 |
| | 2 tasks | 76 | 26.30 |
| | ≥3 tasks | 136 | 47.06 |
| Crowdworking hours (Weekly) | <20 hours | 167 | 57.79 |
| | 20-30 hours | 79 | 27.33 |
| | >30 hours | 43 | 14.88 |
| Work in personal time | Never | 0 | 0 |
| | Occasionally | 87 | 30.10 |
| | Sometimes | 94 | 32.53 |
| | Often | 76 | 26.30 |
| | Always | 32 | 11.07 |
| Type of tasks (Multiple choice) | U, I, L | 92 | 31.83 |
| | U, I, H | 102 | 35.29 |
| | U, C, L | 157 | 54.33 |
| | U, C, H | 83 | 28.72 |
| | S, I, L | 138 | 47.75 |
| | S, I, H | 49 | 16.96 |
| | S, C, L | 61 | 21.11 |

Note: U = Unstructured, I = Individual, C = Collaborative, L = Low commitment, H = High commitment, S = Structured

Table 2. Crowdwork characteristics of Chinese Crowdworkers

3.6 Statistical Analysis

The statistical analysis was carried out with the help of ‘Statistical Package for the Social Scientist’ [16]. According to Tabachnick and Fidell [87], it is necessary to examine the skewness and kurtosis before analysis to ensure that an abnormal distribution of variables does not degrade the solutions from the analysis. Therefore, we calculated the distribution pattern of the data by evaluating the means, standard deviations, skewness, and kurtosis. The cut-off points to ensure a normal distribution are 2.00 for skewness [32] and 4.00 for kurtosis [31].

According to Stevens [86], multivariate analysis of variance (MANOVA) tests whether changes in independent variables have significant effects on dependent variables. Therefore, we used MANOVA to measure the significance of differences between demographic groups with regard to the detailed aspects in job demands, job resources, crowdwork experiences, and platform commitment dimensions. When a significant effect was found as a result of MANOVA, a one-way analysis of

variance (ANOVA) was then performed to further investigate the relationships between dependent variables and independent variables. For cases where there were only two groups in a demographic variable, a t-test was conducted to complete the further analysis.

Pearson correlation coefficients were calculated to describe the relationships of the detailed sub-dimensions among job demands, job resources, crowdwork experience, and platform commitment. With respect to statistical significance, a 95% confidence interval was set in this study.

According to Kline [56], path analysis is by definition restricted to observed variables. We therefore add up the scores of the detailed job demands, job resources, crowdwork experiences, and platform commitments respectively to calculate the mean score of each dimension (total score of each dimension / number of elements included) and then use the results as observed variables to further investigate the causal relationships between job demands, job resources, crowdwork experience, and platform commitment.

The analysis of our data is structured as follows. First, we do descriptive statistics and perform a series of Pearson's correlation tests, to examine the relationships among the sub-dimensions contained in Job Demand, Job Resource, Crowdwork Experience and Platform Commitment sections. After that, we conduct a path analysis to examine the causal relationship among these four dimensions and understand better the working mechanism in crowdsourcing context. Together, the correlation results and the path analysis enable us to examine Hypotheses 1 (a) and 1(b), i.e. that job demands lower crowdworker platform commitment, while job resources increase it, by impairing and improving crowdwork experiences respectively. Next, to examine Hypothesis 2, we conduct a Multivariate analysis of variance (MANOVA), investigating the demographic differences regarding the job demands, job resources, crowdwork experiences and platform commitments based on gender, age, marital status, educational level, annual income, job nature and health conditions of crowdworkers. Once the significant differences were found, we further conduct univariate and post-hoc analyses to explore which demographic groups differ significantly to the rest.

4 RESULTS

4.1 Examining Hypothesis 1

4.1.1 Correlation Results.

The correlation results indicate that the most significant correlations were found between the sub-dimensions of the Job Demand and Crowdwork Experiences dimensions, and that these relationships were in the expected direction (Table 1). More specifically, we found that: 1) Work pressure, as a job demand, is positively related to Exhaustion ($r = +.166$, $n=289$, $p < 0.01$); 2) Physical Demand, as a job demand, is positively related to Exhaustion ($r = +.335$, $n=289$, $p < 0.001$), distancing ($r = +.140$, $n=289$, $p < 0.05$) and Maladjustment ($r = +.198$, $n=289$, $p < 0.01$); 3) Work condition, as a job demand, is positively related to and Exhaustion ($r = +.280$, $n= 289$, $p < 0.001$), Distancing ($r = +.251$, $n=289$, $p < 0.001$) and Maladjustment ($r = +.548$, $n=289$, $p < 0.001$); 4) Equipment use, as a job demand, is positively related to Exhaustion ($r = +.215$, $n=289$, $p < 0.001$).

In addition, most of the significant correlations between variables in the Job Resource and Crowdwork Experiences dimensions were also as anticipated. More specifically: 1) self development, as a job resource, is negatively related to Exhaustion ($r = -.188$, $n=289$, $p < 0.01$), Distancing ($r = -.640$, $n=289$, $p < 0.001$) and Maladjustment ($r = -.533$, $n=289$, $p < 0.001$); 2) Social communication, as a job resource, is negatively related to Distancing ($r = -.471$, $n=289$, $p < 0.001$) and Maladjustment ($r = -.167$, $n=289$, $p < 0.01$); 3) Feedback, as a job resource, is negatively related to Exhaustion ($r = -.151$, $n=289$, $p < 0.05$), Distancing ($r = -.422$, $n=289$, $p < 0.001$) and Maladjustment ($r = -.473$, $n=289$, $p < 0.001$); 4) Requester support, as a job resource, is negatively related to Distancing ($r = -.457$, $n=289$, $p < 0.001$) and Maladjustment ($r = -.285$, $n=289$, $p < 0.001$); 5) Operation, as a job resource, is negatively related to

Exhaustion ($r = -.218, n=289, p < 0.001$), Distancing ($r = -.466, n=289, p < 0.001$) and Maladjustment ($r = -.584, n=289, p < 0.001$). Furthermore, with regard to the significant relationships between variables in Crowdwork Experiences and Platform Commitment, it is found that all the significant correlations are as expected, given the fact that: 1) Exhaustion, as a crowdwork experience, is negatively related to Acknowledgement ($r = -.146, n=289, p < 0.05$) and Loyalty ($r = -.600, n=289, p < 0.001$); 2) Distancing, as a crowdwork experience, is negatively related to Organizational Acknowledgement ($r = -.435, n=289, p < 0.001$) and Loyalty ($r = -.229, n=289, p < 0.001$); 3) Maladjustment, as a crowdwork experience, is negatively related to Acknowledgement ($r = -.503, n=289, p < 0.001$) and Loyalty ($r = -.382, n=289, p < 0.001$). Nevertheless, there were 6 unexpected correlations in contrast with the previous studies based on JD-R theory in other industries. These are: 1) Social communication, as a job resources, is positively related to Exhaustion ($r = +.137, n=289, p < 0.05$); 2) Work pressure, as a job demand, is negatively related to Distancing ($r = -.377, n=289, p < 0.001$); 3) Cognitive demand, as a job demand, is negatively related to Exhaustion ($r = -.195, n=289, p < 0.01$); 4) Cognitive demand, as a job demand, is negatively related to Distancing ($r = -.298, n=289, p < 0.001$); 5) Cognitive demand, as a job demand, is negatively related to Maladjustment ($r = -.375, n=289, p < 0.001$); 6) Equipment use, as a job demand, is negatively related to Distancing ($r = -.134, n=289, p < 0.05$).

| Factor | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------------------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|----|
| Work Pressure | 3.2747 | .60709 | 1 | | | | | | | | | | | | | | |
| Cognitive Demand | 3.4152 | .73639 | .279** | 1 | | | | | | | | | | | | | |
| Physical Demand | 2.1499 | .92620 | .048 | -.057 | 1 | | | | | | | | | | | | |
| Work Condition | 2.2953 | .67206 | -.047 | -.302** | .392** | 1 | | | | | | | | | | | |
| Equipment Use | 2.6563 | .81997 | .259** | .155** | .437** | .127* | 1 | | | | | | | | | | |
| Self Development | 3.4493 | .63643 | .347** | .511** | .008 | -.303** | .265** | 1 | | | | | | | | | |
| Social Communication | 3.0069 | .79734 | .309** | .083 | .176** | .075 | .344** | .365** | 1 | | | | | | | | |
| Feedback | 3.2318 | .63490 | .182** | .479** | .033 | -.375** | .205** | .529** | .215** | 1 | | | | | | | |
| Requester Support | 3.1081 | .60254 | .324** | .168** | .098 | -.152** | .304** | .412** | .509** | .366** | 1 | | | | | | |
| Operation | 3.5640 | .56270 | .170** | .313** | -.162** | -.495** | .092 | .459** | .220** | .436** | .369** | 1 | | | | | |
| Exhaustion | 2.1740 | .69494 | .166** | -.195** | .335** | .280** | .215** | -.188** | .137* | -.151* | .005 | -.218** | 1 | | | | |
| Distancing | 2.5823 | .61654 | -.377** | -.298** | .140* | .251** | -.134* | -.640** | -.471** | -.422** | -.457** | -.466** | .191** | 1 | | | |
| Maladjustment | 2.6736 | .74842 | -.097 | -.375** | .198** | .548** | -.105 | -.533** | -.167** | -.473** | -.285** | -.584** | .314** | .467** | 1 | | |
| Acknowledgement | 3.0638 | .68302 | .031 | .422** | .153** | -.282** | .273** | .521** | .278** | .499** | .347** | .423** | -.146* | -.435** | -.503** | 1 | |
| Loyalty | 3.4567 | .68483 | -.100 | .219** | -.247** | -.369** | -.163** | .252** | -.066 | .178** | .028 | .368** | -.600** | -.229** | -.382** | .412** | 1 |

Table 3. Descriptive Statistics and Pearson's correlations of the factors.

4.1.2 Path Analysis.

We used SPSS AMOS to conduct a path analysis to further investigate the causal relationships between Job Demand, Job Resource, Crowdwork Experiences, and Platform Commitment. According to the aforementioned criteria in the Methodology section that path analysis is by definition restricted to observed variables, the four dimensions contained in our model were defined as measurable variables with their mean values (total score of each dimension / number of sub-dimensions included). The results illustrate an acceptable fit of the model to the data through the Goodness of Fit Index (GFI) and the Comparative Fit Index (CFI) being 0.989 and 0.990 respectively, the Root Mean Square Error of Approximation (RMSEA) being 0.082 and the χ^2 / degree of freedom (CMIN/DF) being 2.959. See Figure 1.

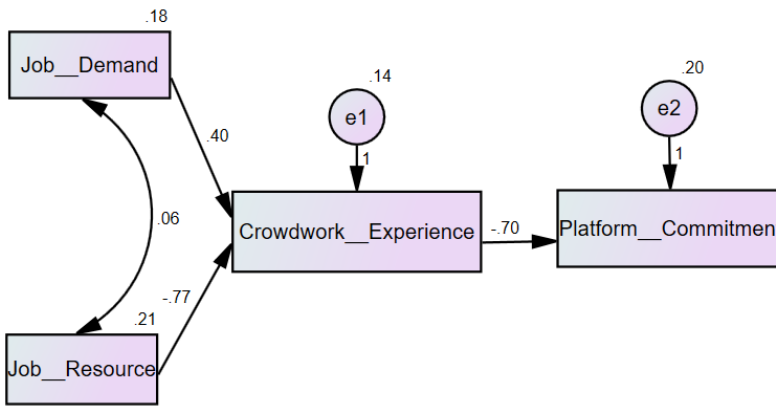


Fig. 1. The results of path analysis.

| χ^2 | df | χ^2/df | RMSEA | GFI | CFI |
|----------|----|-------------|-------|-------|-------|
| 5.918 | 2 | 2.959 | 0.082 | 0.990 | 0.989 |

Table 4. Fit indices of path analysis.

Also, through the decomposition of the entire model and the bootstrap analysis for the significance of the indirect effects (see table 2 and table 3), it is found that:

- (1) Job Demand has a significantly positive direct effect on Crowdwork Experiences with a standardized path coefficient equal to 0.334 ($p < 0.001$), which means that greater job demands increase the feelings of fatigue, disengagement, and maladjustment among crowdworkers.
- (2) Job Resource has a significantly negative direct effect on Crowdwork Experiences with the standardized path coefficient equal to -0.697 ($p < 0.001$), which suggests that more job resources would help crowdworkers remit negative crowdwork experiences such as exhaustion, distancing, and maladjustment.
- (3) Crowdwork Experiences has a significantly negative direct effect on Platform Commitment with the standardized path coefficient equal to -0.618 ($p < 0.001$), which indicates that unpleasant crowdwork experiences damage the acknowledgement and loyalty of crowdworkers towards the platform.

- (4) Job Demand has a significantly negative indirect effect on Platform Commitment through Crowdwork Experiences (indirect effect = -0.207 ; LLCI = -0.372 ; ULCI = -0.185). That is to say, the increase of job demands leads to more negative crowdwork experiences which result in the decrease of acknowledgement and loyalty of crowdworkers toward their platforms.
- (5) Job Resource, on the other hand, has a positively indirect effect on Platform Commitment through Crowdwork Experiences (indirect effect = 0.431 ; LLCI = 0.420 ; ULCI = 0.650), which suggests that more job resources would improve the sense of acceptance and faith of crowdworkers towards organizations through alleviating the negative crowdwork experiences of crowdworkers.

Hypothesis 1 confirmed. Based on the the specific correlations of the sub-dimensions and the general causal relationships between Job Demand, Job Resource, Crowdwork Experiences, and Platform Commitment, we confirm Hypothesis 1(a) that job demands negatively affect the platform commitments of crowdworkers by impairing their crowdwork experiences, as well as Hypothesis 1(b) that job resources positively affect the platform commitments of crowdworkers by improving their crowdwork experiences.

| Effect Type | Paths | Coefficient | Total Effect |
|------------------|--|-------------|--------------|
| Direct Effects | Job Demands -> Crowdwork Experiences | 0.334 | |
| | Job Resources -> Crowdwork Experiences | -0.697 | |
| | Crowdwork Experiences -> Platform Commitments | -0.618 | -0.757 |
| Indirect Effects | Job Demands -> Crowdwork Experiences -> Platform Commitments | -0.207 | |
| | Job Resources -> Crowdwork Experiences -> Platform Commitments | 0.431 | |

Table 5. Path Decompositions.

| Paths | Coefficient | 95% confidence Intervals | |
|--|-------------|--------------------------|--------------|
| | | Lower Bounds | Upper Bounds |
| Job Demands -> Crowdwork Experiences -> Platform Commitments | -0.207 | -0.372 | -0.185 |
| Job Resources -> Crowdwork Experiences -> Platform Commitments | 0.431 | 0.420 | 0.650 |

Table 6. Bootstrap analysis for the significance of the indirect effects.

4.2 Examining Hypothesis 2

To test Hypothesis 2, T-test, MANOVA, and post-hoc analysis were used to determine the differences between demographic crowdworker groups with regard to the detailed aspects in Job Demands, Job Resources, Crowdwork Experiences, and Platform Commitment respectively. The demographic groups included gender, age, marital status, education, income, job nature, and health condition (in reference to their general health condition over the past 12 months). A visual summary of the results is shown in figure 2 below.

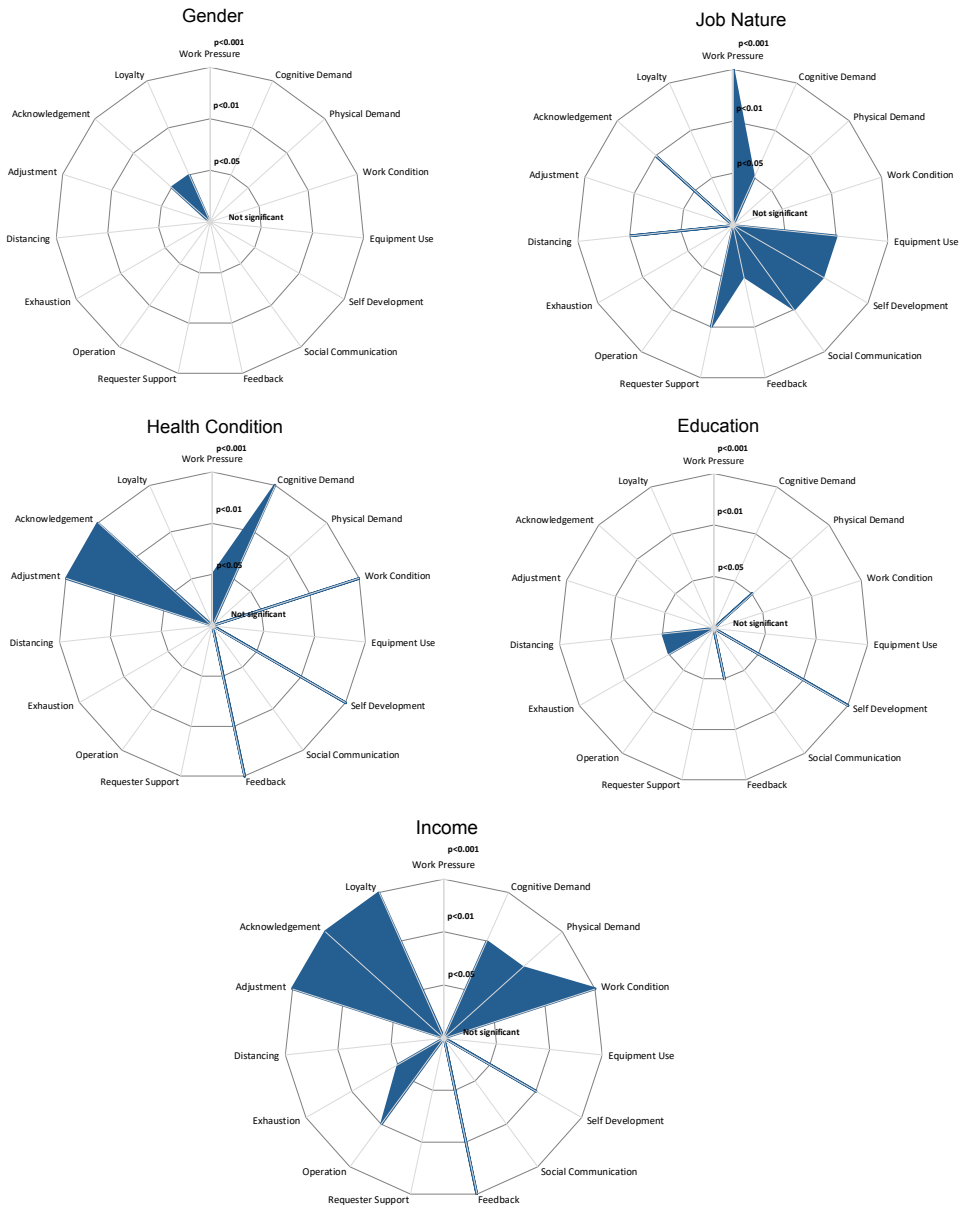


Fig. 2. The results of the demographic differences of gender, education, income, job nature and health condition with regard to the detailed aspects in Job Demands, Job Resources, Crowdwork Experiences, and Platform Commitment respectively.

4.2.1 Hypothesis 2(a) accepted.

While the differences are statistically insignificant in the dimensions of Job Demands, Job Resources, and Crowdwork Experiences based on gender, the T-test results (see supplementary document section 6.1) suggest that there are significant differences in the two sub-dimensions of Platform Commitment, those are:

- (1) Acknowledgment: Male workers scored significantly lower than the female workers (mean difference = $-.18501$, $t(287)=-2.270$, $p<0.05$, Cohen's $d = .27107$) in this aspect, which suggested that female crowdworkers tend to have a higher sense of identity towards ZBJ platform.
- (2) Loyalty: We found that male workers were less faithful to ZBJ platform because they also scored significantly lower than the female workers regarding Loyalty (mean difference = $-.18305$, $t(287)=-2.240$, $p<0.05$, Cohen's $d = .26740$).

4.2.2 Hypothesis 2(b) rejected.

The multivariate analysis of variance (MANOVA) was conducted to assess age differences on job demands, job resources, crowdwork experience and platform commitment. However, given the result of the multivariate test that $F(30,544)= 1.228$, $p = .190$; Wilk's $\lambda = .877$, partial $\eta^2 = .063$, there is no significant difference among the crowdworker groups based on age. Therefore, our Hypothesis 2(b) that there are significant differences in the detailed aspects in job demands, job resources, crowdwork experience and platform commitment of crowdworkers in China based on age could be confirmed.

4.2.3 Hypothesis 2(c) rejected.

The result of the multivariate test in another MANOVA also indicated that there is no significant difference among the crowdworker groups based on marital status, $F(30,544)= 1.264$, $p = .160$; Wilk's $\lambda = .874$, partial $\eta^2 = .065$. Therefore, our Hypothesis 2(c) that there are significant differences in the detailed aspects in job demands, job resources, crowdwork experience and platform commitment of crowdworkers in China based on marital status could also not be confirmed.

4.2.4 Hypothesis 2(d) accepted.

According to the result of the multivariate test, there was a statistically significant difference among the crowdworker groups based on education level, $F(30,544)= 1.931$, $p<0.01$; Wilk's $\lambda = .817$, partial $\eta^2 = 0.096$. Therefore, Hypothesis 2(d) was confirmed since there are significant differences in the detailed aspects in job demands, job resources, crowdwork experience and platform commitment of crowdworkers in China based on education. Given the significance of the overall test, the univariate main effects were examined. Significant univariate main effects for education were obtained for Physical Demand, $F(2,286)=4.627$, $p<0.05$, partial $\eta^2 = .031$; Self Development, $F(2,286)=8.696$, $p<0.001$, partial $\eta^2 = .057$; Feedback, $F(2,286)=4.291$, $p<0.05$, partial $\eta^2 = 0.029$; Exhaustion, $F(2,286)=3.450$, $p<0.05$, partial $\eta^2 = .024$; Distancing, $F(2,286)=3.825$, $p<0.05$, partial $\eta^2 = .026$. After that, the post-hoc analysis using Bonferroni method was conducted to determine which groups differ from the rest with regard to the dependent variables. Notably, the result of the post-hoc analysis indicated that there was no significant difference regarding Exhaustion in the between-group comparisons. In order to confirm this finding, we also tested with other pairwise post-hoc analysis methods (e.g. Hochberg method) and found the same result. Therefore, we specify our findings as follows:

- (1) Physical Demand: We find that crowdworkers with advanced educational levels such as Master's and PhD degrees (Mean = 2.8039 , SD = $.92089$) are more likely to experience higher physical demands based on muscle endurance and strength in comparison to undergraduates (Mean = 2.1147 , SD = $.87542$) and those who finished high school or lower (Mean = 2.0969 , SD = $.99392$).
- (2) Self development: Lower educational levels turn out to be a greater advantage for crowdworkers to further develop themselves, since both undergraduate crowdworkers (Mean = 3.5200 , SD = $.62886$) and crowdworkers with lower degrees (Mean = 3.4103 , SD = $.59279$) scored higher than postgraduate-level crowdworkers, who may have already acquired sufficient knowledge and expertise in their Master's and PhD education.

- (3) Feedback: The feedback obtained by undergraduate crowdworkers (Mean = 3.2984, SD = .62413) is significantly better than that received by Master's or PhD degree holders (Mean = 2.8824, SD = .41569).
- (4) Distancing: We find that, compared to those crowdworkers who never attended college or university (Mean = 2.4618, SD = .62661), crowdworkers with Master or PhD degrees (Mean = 2.8739, SD = .64064) tend to feel more disengagement and negative experiences regarding their crowdwork.

4.2.5 Hypothesis 2(e) accepted.

The results of the multivariate test indicated that there was a statistically significant difference among the crowdworker groups based on annual income, $F(30,544)= 2.713$, $p<0.001$; Wilk's $\lambda = .757$, partial $\eta^2 = 0.130$. Therefore, Hypothesis 2(e) was confirmed that there are significant differences in the detailed aspects in job demands, job resources, crowdwork experience and platform commitment of crowdworkers in China based on income. Given the significance of the overall test, the univariate main effects were examined. Significant univariate main effects for annual income were obtained for Cognitive Demand, $F(2,286)=4.798$, $p<0.01$, partial $\eta^2 = .032$; Physical Demand, $F(2,286)=6.783$, $p<0.01$, partial $\eta^2 = .045$; Work Condition, $F(2,286)=3.777$, $p<0.001$, partial $\eta^2 = .058$; Self Development, $F(2,286)=5.450$, $p<0.01$, partial $\eta^2 = .037$; Feedback, $F(2,286)=9.010$, $p<0.001$, partial $\eta^2 = .059$; Operation, $F(2,286)=7.077$, $p<0.01$, partial $\eta^2 = .047$; Exhaustion, $F(2,286)=3.078$, $p<0.05$, partial $\eta^2 = .021$; Maladjustment, $F(2,286)=9.458$, $p<0.001$, partial $\eta^2 = .062$; Acknowledgement, $F(2,286)=11.481$, $p<0.001$, partial $\eta^2 = .074$; Loyalty, $F(2,286)=8.329$, $p<0.001$, partial $\eta^2 = .055$. After that, the post-hoc analysis using Bonferroni criterion was conducted to determine which groups differ from the rest with regard to the dependent variables. Notably, the result of the post-hoc analysis indicated that there was no significant difference regarding Exhaustion in the between-group comparisons, given the significance of Exhaustion was very weak at p equal to 0.048. In addition, post-hoc analyses using other pairwise post-hoc analysis methods (e.g. Hochberg method) also indicated the same result. Therefore, Exhaustion is excluded and the rest of findings are listed as follows:

- (1) Cognitive Demand: Concerning cognitive demands, in contrast to those with average annual incomes between CNY 40k - 60K (Mean = 3.3123, SD = .65177) or those with high annual incomes above CNY 60K (Mean = 3.3630, SD = .71040), crowdworkers who earned less than CNY 40K a year (Mean = 3.6320, SD = .84221) are more likely to report higher mental effort and experience more mental strain in doing crowdwork.
- (2) Physical Demand: On the contrary, crowdworkers with higher income tend to feel higher physical effort, which is supported by the statistics that crowdworkers who earn more than CNY 60K a year (Mean = 2.4125, SD = .89461) score higher than those in the middle-income (Mean = 2.0511, SD = .95367) and low-income groups (Mean = 1.9481, SD = .85680).
- (3) Work Condition: As the items in Work Condition dimension are reverse-scored, the lower mean score of low-income crowdworkers (Mean = 2.0563, SD = .70380) indicate that they usually work in better environments compared to those who earn CNY 40-60K (Mean = 2.3003, SD = .59705) or more than CNY 60K a year (Mean = 2.4719, SD = .67580).
- (4) Self Development: Regarding the abilities developed in crowdwork, such as professional expertise and skills, the Post-Hoc analysis suggests that crowdworkers in the high-income group (Mean = 3.6271, SD = .76516) perceive that they self-develop less in comparison of those who are in the low-income group and earn less than CNY 40K year (Mean = 2.33140, SD = .64016). That being said, the difference between the higher-income and middle-income groups is not statistically significant.

- (5) Feedback: When taking Feedback into consideration, it can be seen that crowdworkers with low annual income (Mean = 3.1238, SD = .54843) obtain more feedback from requesters as this group scored the best in contrast to middle-income (Mean = 2.3.1532, SD = .62901) and high-income groups (Mean = 3.6271, SD = .76516).
- (6) Operation: In addition, another finding is that crowdworkers with high annual income feel less involved in their interactions with requesters as the statistic shown in the post-hoc analysis suggests that both low-income (Mean = 3.6721, SD = .60325) and middle-income groups (Mean = 3.6369, SD = .48697) score better than high-income group (Mean = 3.3985, SD = .57574) with regard to the Operation dimension.
- (7) Maladjustment: As higher scores indicated worse work-related adjustment, findings in this dimension revealed that crowdworkers in the low-income group (Mean = 2.4026, SD = .75769) have better feelings and abilities in accommodating themselves to their crowdwork given the scores reported by both middle-income (Mean = 2.6727, SD = .54306) and high-income groups (Mean = 2.8812, SD = .86742) are significantly higher.
- (8) Acknowledgement: Crowdworkers with low annual income (Mean = 3.3711, SD = .77600) tend to have a stronger sense of identity regarding their crowdsourcing platforms compared to those who earn CNY 40k-60k (Mean = 2.9344, SD = .60541) or above CNY 60K annually (Mean = 2.9717, SD = .61876).
- (9) Loyalty: The last finding of the differences based on annual income is that compared to the middle-income (Mean = 3.4432, SD = .65026) and high-income groups (Mean = 3.2871, SD = .54583), crowdworkers with low annual incomes (Mean = 3.6987, SD = .82182) are more likely to keep working for their current crowdsourcing platforms as their scores are the highest among all the groups in the Loyalty dimension.

4.2.6 Hypothesis 2(f) accepted.

Nine significant differences regarding the detailed dimensions in Job Demand, Job Resource, Crowdwork Experiences and Platform Commitment based on job nature are suggested by the T-test (see supplementary document section 6.6). Those are:

- (1) Work Pressure: In contrast to part-time crowdworkers, full-time crowdworkers reported significantly higher work pressure elements, such as time constraints and the pressure to come up with novel ideas (mean difference = .55977, $t(287)=5.634$, $p<0.001$, Cohen's $d = 0.98198$).
- (2) Cognitive Demand: Full-time crowdworkers reported significantly higher cognitive demands compared to part-time crowdworkers (mean difference = .25115, $t(287)=1.991$, $p<0.05$, Cohen's $d = 0.34052$).
- (3) Equipment Use: With respect to time consumption and complexity, the use of equipment in crowdwork is more challenging for full-time crowdworkers when compared to part-time workers (mean difference = .40721, $t(56.997)=3.364$, $p<0.01$, Cohen's $d = 0.53721$).
- (4) Self development: It is reported that full-time crowdworkers may develop their skills, knowledge, and specialties more in comparison to part-time crowdworkers (mean difference = .36980, $t(287)=3.438$, $p<0.01$, Cohen's $d = 0.57592$).
- (5) Social Communication: Full-time crowdworkers tend to have more opportunities to build connections with others and learn from coworkers as they scored higher in the Social Communication dimension in contrast to part-time crowdworkers (mean difference = .41685, $t(287)=3.081$, $p<0.01$, Cohen's $d = 0.54227$).
- (6) Feedback: Full-time crowdworkers perform better in obtaining feedback, which means they usually get more sufficient and timely responses from requesters in comparison to part-time crowdworkers (mean difference = .25813, $t(287)=2.381$, $p<0.05$, Cohen's $d = 0.39724$).

- (7) Requester Support: Full-time crowdworkers are more likely to be supported and assisted by requesters compared to part-time workers (mean difference = .28256, $t(287)=2.755$, $p<0.01$, Cohen's $d = 0.48216$).
- (8) Distancing: Part-time crowdworkers, however, are found to engage in their crowd tasks better than the full-time crowdworkers, as they score significantly lower than the latter (mean difference = -.33015, $t(287)=3.158$, $p<0.01$, Cohen's $d = 0.56212$) regarding their level of work disengagement.
- (9) Acknowledgment: Full-time crowdworkers tend to have a stronger sense of identity with the crowdsourcing platforms they are currently working for compared to part-time crowdworkers (mean difference = .31162, $t(287)=2.678$, $p<0.01$, Cohen's $d = 0.43266$) who may take crowdsourcing work occasionally from different platforms.

4.2.7 Hypothesis 2(g) accepted.

Seven findings were suggested by the results of the t-test (see section 6.7 of the supplementary document) which was conducted to examine the significant differences in the specific dimensions in Job Demand, Job Resource, Crowdwork Experiences and Platform Commitment based on the general condition of health of the crowdworkers in that past 12 months. These are:

- (1) Work Pressure: Compared to the those who were healthy in the 12 months prior to the study, crowdworkers who suffered from health problems were more likely to experience pressures in their crowdwork (mean difference = .27816, $t(61.195)=2.282$, $p<0.05$, Cohen's $d = 0.39295$).
- (2) Cognitive Demands: Cognitive demands were also regarded as one of the major concerns among unhealthy crowdworkers as they scored nearly 4 on average, which is significantly higher than that of healthy crowdworkers (mean difference = .70070, $t(287)=6.723$, $p<0.001$, Cohen's $d = 1.0602$).
- (3) Work Condition: Since the higher scores in Work Condition indicate worse working environments, it was found that crowdworkers in poor health conditions tend to work in a better environment as they scored significantly lower than healthy crowdworkers. (mean difference = -38084, $t(287)=-3.815$, $p<0.001$, Cohen's $d = 0.57171$).
- (4) Self development: Surprisingly, the statistics suggested that, in comparison to the healthy group, unhealthy crowdworkers found that they can better develop themselves with the knowledge and expertise at work (mean difference = .45648, $t(64.737)=4.008$, $p<0.001$, Cohen's $d = 0.66688$).
- (5) Feedback: Crowdworkers in poor health conditions are likely to obtain more sufficient and timely feedback from requesters in contrast to healthy crowdworkers (mean difference = .60565, $t(287)=6.743$, $p<0.001$, Cohen's $d = 1.04609$), though a good health condition may help them interact more with others in their crowdwork.
- (6) Maladjustment: Unhealthy crowdworkers report better crowdwork-related adjustment as they scored significantly lower than healthy crowdworkers (mean difference = -.46288, $t(287)=-4.184$, $p<0.001$, Cohen's $d = 0.61718$).
- (7) Acknowledgment: Unhealthy crowdworkers scored significantly higher than healthy crowdworkers (mean difference = .44573, $t(61.737)=3.365$, $p<0.01$, Cohen's $d = 0.57638$). in the Acknowledgement dimension, which indicates that crowdworkers in poorer health conditions tend to have a stronger sense of identity and belonging to the crowdsourcing platforms they currently work for.

Hypothesis 2 partially accepted. The findings above suggest that most of the aforementioned demographic characteristics would have impact on at least one aspect of job demands, job resources, crowdwork experiences and platform commitments of crowdworkers, we can therefore partially

accept Hypothesis 2. In specific we could confirm significant differences of the job demands, job resources, crowdwork experience or platform commitment of crowdworkers based on (a) gender, (d) education, (e) income, (f) job nature and (g) health condition we could not confirm significant differences for (b) age, (c) marital status.

5 DISCUSSION OF RESULTS

In this study, we aim to (a) investigate the relationships among Job Demands, Job Resources, Crowdwork Experiences, and Platform Commitment in a crowdsourcing context in China, and (b) assess the differences between the different crowdworker demographic groups, with respect to the above four dimensions and their sub-dimensions.

With regard to our first objective of this study, we first conducted a pairwise correlation test to investigate the relationships between (1) job demands and crowdwork experiences, (2) job resources and crowdwork experience and (3) crowdwork experience and platform commitment. The results of the correlation test illustrated that, on the one hand, the increase in four types of task-related demands, namely work pressure, physical demands, work conditions and equipment use, would generally exacerbate the exhaustion, distancing and maladjustment at crowdwork. On the other hand, job resources in a crowdsourcing context (i.e. self development, feedback, requester support, social communications and operation), would help Chinese crowdworkers remit such negative crowdwork experiences. Three out of four job demands, namely work pressure, physical demands and work condition, echo previous crowdsourcing studies which have revealed that the work experiences of crowdworkers both in China and elsewhere (e.g. US, India) were affected by stressful deadlines and complex requirements in tasks [55, 84], dehumanizing crowdwork conditions[34], physical challenges[88]. Our findings in relation to job resources are also in line with the findings from prior crowdsourcing studies which have shown the positive impacts of self development, feedback, requesters support and social communications on crowdwork experiences [29, 35, 70]. That being said, our study has for the first time shown that using complex equipment in crowdtasks (equipment use dimension) and having a robust workflow process from the introduction of tasks to the final payment (operation dimension) would be factors that affects work experiences in a crowdsourcing context. According to the statistics in correlation table (see table 3), equipment use as a job demand would lead to exhaustion, while having a clear operative workflow as a job resource would help crowdworkers remit the feeling of exhaustion, distancing and maladjustment. In addition, we have uncovered reveal that the inferior experiences (ie. exhaustion, distancing and maladjustment) in general negatively related to the loyalty and acknowledgement of Chinese crowdworkers towards the ZBJ platform. This finding not only comes in with prior crowdsourcing study [12] which suggested low crowdwork satisfaction would increase the turnover of Mturkers specific to certain requesters, but also extends this understanding through revealing that the impacts of negative work experience are not limited only to the requesters but to the platform as well.

Further, in spite of investigating the connections between job demands, job resources, crowdwork experiences, and platform commitments pairwise, we also used path analysis to collectively explore the causal relationships between the four aspects. Our results illustrated that, in crowdsourcing context in China, crowdworkers would have inferior crowdwork experiences and consequently lower platform commitment if they suffered from excessive crowdwork demands, while sufficient resources in crowdwork would help them remit the negative experiences and therefore increase their loyalty and acknowledgement towards crowdsourcing platform. Although this is the first study that applied the JD-R theory to the crowdsourcing context (a context that is different from traditional work settings - see [6] for more detail), our findings, for the most part, are in line with previous findings from other industries. For example, the study of Hakanen et al. [38] in the human services industry revealed that positive work experience, in the form of work engagement,

mediated the relationship between job resources and organizational commitment. The same study also revealed that - similarly to our results - negative work experience, i.e. burnout, mediated the relationship between job demands and personal health conditions, and was positively related to the turnover intentions of employees [81]. The consistency of our results with previous Job Demands-Resources studies illustrates that the utilization of traditional organizational science (OS) approaches, such as Job Demands-Resources theory, would be beneficial to further investigate the crowdwork experiences in crowdsourcing context.

However, it should be noted that not all of our findings workers were fully aligned with the findings of studies that use the Job Demands-Resources model in a traditional work setting [38]. This indicates that, although traditional organizational science approaches can be useful in investigating the work experiences, they still need to remain flexible in how we conceptualize and study the objects specifically in crowdsourcing context. The unexpected findings are that: (1) social communications (elements in Job Resources) is found to be positively related to exhaustion (elements in Job Demands), (2) cognitive demand (element in Job Demands) is found to be negatively related to exhaustion, distancing, and maladjustment (elements in Crowdwork Experiences), (3) physical demand and equipment use (elements in Job Demands) are found to be negatively related to distancing (element in Crowdwork Experiences). This is attributed to the job characteristics of crowdwork may differ from those of traditional work [69] and some of the predictors in traditional industrial-organizational (I-O) psychology may not perfectly apply to a crowdsourcing context [12]. Take the relationship between social communication and exhaustion as an example, our results may be surprising if seen from the perspective of more traditional industries, given that the findings from previous studies using the Job Demands-Resources model (e.g. [21]) show that communication-related job resources (e.g. relationship with colleagues and supervisors) normally help in reducing feelings of exhaustion. But in a crowdsourcing context our results make sense as previous crowdsourcing studies revealed that (1) that crowdsourcing platforms do not provide support to informal communication between crowdworkers so that they have to use other methods to communicate with each other either to share task information or to collaborate while performing tasks [34], and (2) that crowdworkers need to communicate, collaborate and coordinate constantly with each others in collaborative projects [70]. As such, since communication between crowdworkers is inconvenient and mainly work related, it leads to stress and exhaustion.

Further, the present study investigated the differences between demographic groups with regard to the detailed sub-dimensions of the Job Demand, Job Resource, Crowdwork Experience, and Platform Commitment dimensions. Our results indicate significant differences across the four dimensions based on crowdworkers' gender, education, income, job nature, and health condition. This illustrates that different crowdworkers have different needs and threshold of demands and resources and that this plays a significant role in terms of moderating the crowdwork experience and platform commitment.

Specifically, with regard to the significant differences based on gender, we find that, in comparison to male Chinese crowdworkers, female Chinese crowdworkers tend to have higher sense of acknowledgement and loyalty to the ZBJ platform. Although previous research on traditional industries has already illustrated that women tend to be more satisfied with their jobs than men and this oftentimes results in more appreciation and acceptance towards the organizations [85], this is the first time that the differences in platform commitment between genders is observed in crowdsourcing context. From the perspective of crowdsourcing, this is because the work flexibility that crowdsourcing provides is more likely to benefit female crowdworkers than males as Bolotnyy and Emanuel [10] stated that women tend to have greater demand of time and workplace flexibility

than men. In addition, given 22% of the female workers in China experienced severe gender discrimination when seeking employment [98], the more and fairer working opportunities provided by crowdsourcing platforms would also increase their platform commitments.

With respect to the significant differences based on educational levels, we found that, in comparison to crowdworkers that hold bachelor degrees and those who have high-school diploma or lower, highly educated Chinese crowdworkers such as Master's and PhD degree holders tend to experience higher physical demand and obtain less feedback and self-development. Consequently, this makes them feel more exhausted and disengaged from crowdwork. This finding is not surprising if seen from the perspective of traditional industries as a previous Job Demands-Resources study among teachers demonstrated that workers with higher education tend to have higher levels of burnout, with physical demands being the main reasons why [82]. From the perspective of crowdsourcing, although there are no studies to the best of our knowledge focused on the differences in crowdwork experience between crowdworkers with different educational levels, Retelny et al. [74] found that crowdworkers with high expertise would usually accomplish well-paid yet complex tasks (e.g. engineering and design) with minimal communication due to the skill and knowledge differences with other workers. Based on this, well-educated Chinese crowdworkers may have inferior crowdwork experiences because they (1) have already acquired ample specialism on the specific field so that there are only limited opportunities to develop themselves through crowdtasks, (2) undertake more complex tasks on ZBJ platform such as software development and industrial design [57], which tend to be demanding have high requirements, and (3) may not communicate so much with the requesters as, due to their specialized domain knowledge, may understand the project better than the requesters. Therefore, according to the Job Demands-Resources theory, the increase in job demand (ie. physical demands) and the lack of job resources (ie. self-development and feedback) eventually lead to the exhaustion and disengagement of well-educated Chinese crowdworker.

Although studies on the topic of the income of crowdworkers in a Chinese context has illustrated Chinese crowdworkers were in general (63.64%) belong to low-income population who earned less than 3,000 CNY (approx. \$430 USD) every month [29], our results extend the understanding of low-income Chinese crowdworkers through revealing their crowdwork-related demands and resources as well as how these factors affect the work experiences and commitments towards crowdsourcing platforms. In detail, we first found that Chinese crowdworkers with lower annual incomes (less than CNY 40k - approx. \$5714 USD) tend to have relatively less crowdwork demands. That being said, although they experienced the most cognitive demands among all the income groups, low-income crowdworkers would work in less challenging workplaces (e.g. environment with low risk of accident) with less physical demands in comparison to the crowdworkers who earn more than 40K every year. The reason why this group of workers have higher cognitive demands can be that low-income Chinese crowdworkers are more likely to regard crowdsourcing as their primary source of income so that they have higher imperative to work harder and put more effort on tasks in order to increase the likelihood of task acceptance and therefore payment. This understanding echoes previous studies of the crowdworkers from Amazon Mechanical Turk and CrowdFlower (now Figure Eight), which have found that (1) low-income crowdworkers are more likely to use crowdsourcing as their primary source of income [9, 44] and that (2) more than 40% of crowdworkers in developing countries earn relatively lower income and tend to spend their crowdsourcing incomes on basic expenses (e.g. food) [73]. On the other hand, based on Berg's study which suggested that 57% of the crowdworkers who regard crowdsourcing as their main job were unemployed prior to crowdworking on Mturk or Crowdflower (now Figure Eight) and over 40% of them crowdwork from home [9], our finding that low-income Chinese crowdworkers have less crowdwork demands

regarding their work environment and physical efforts may also be attributed to the unemployment status of crowdworkers in crowdsourcing context in China.

In addition to the relatively less crowdwork demands, we further found that low-income Chinese crowdworkers, compared to high income groups (annual income > 40K CNY), would obtain more work-related resources in the aspects of self-development, feedback and operation. This is in line with Indian MTurker-based crowdsourcing studies which demonstrated (1) that low-income workers could develop their skills considerably through operating not only simple tasks (e.g. drawing bounding boxes) but also high-level tasks such as copyediting [54], and (2) that crowdworkers need to interact with requesters effectively to increase their earnings from crowdsourcing [35]. The possible reasons behind low income Chinese crowdwork getting more crowdwork resources are that, on the one hand, they have stronger motivation to develop their skills by doing different types of tasks so that they can increase their income by doing a wide variety of tasks. On the other hand, the income from crowdsourcing is more important to low-income crowdworkers and based on this they are more likely to communicate more frequently with requesters, as it plays an essential role in the acceptance of submitted tasks [26] and, therefore, payments.

Based on the mechanisms of the Job Demands-Resources theory [23, 38] and the above-discussed findings that low-income Chinese crowdworkers have relatively less job demands (ie. less challenging work environment and physical fatigue though more cognitive demands) and more job resources (ie. knowledge/skills development, effective communication), it is unsurprising to find that they have better crowdwork experiences (ie. better work-related adjustment) and higher commitments regarding their acknowledgement and loyalty towards ZBJ platform. This indicates that in a Chinese crowdsourcing context, the monetary reward from tasks is of more influence on the low-income crowdworkers who are likely to work from home, possibly due to the prior unemployment. The importance of the income from crowdsourcing motivates them to work more focused and seek for more crowdwork resources to increase their incomes. As a result, the earning and resources gained from crowdsourcing improve their crowdwork experiences which consequently increase their commitments towards the crowdsourcing platforms.

With respect to the significant differences based on job nature, it is not surprising to find that full-time Chinese crowdworkers face more job demands in terms of work pressures and equipment use. Supported by one of the most recent crowdsourcing studies which revealed that the full-time Chinese crowdworkers usually work for specialized companies (e.g. design, software) in which crowdwork are regarded as part of their formal businesses [92], this is because that full-time Chinese crowdworkers are more likely to use professional equipment to undertake obligatory tasks with tight deadlines and specialized requirements. For example, interior design tasks requiring VR technology. This consequently leads to the increase in the perceived pressures from tasks and the efforts on operating equipments and instruments. Moreover, the finding that full-time employees have more job demands is also common in other industries. For example, based on the study of workers from information technology, pharmaceutical and consulting sectors, Keliher and Anderson [52] suggested that part-time workers usually spend less time than full-time workers and that reduced working hours are positively related to lower levels of work-related challenges and stresses.

Furthermore, full-time Chinese crowdworkers also reported that they are likely to gain more job resources regarding the 'Self development', 'Social communications', 'Feedback', and 'Requester support' dimensions. One of the possible explanations is that they are trying to build their competitive edge in order to maintain job security and income through crowdsourcing. This is supported by previous studies which show that 'power-workers' who spend long hours on crowdwork are more motivated to develop skills, interact with requesters, build a network of collaborators, and strive for positive reputation than occasional workers [34, 51],

Next, the finding that part-time Chinese crowdworkers tend to have better engagement is also as anticipated, and comes in line with the study of Fagan et al. [28] who demonstrated that part-timers are less likely to experience high levels of work intensity, which, according to the Job Demands-Resources theory, is negatively related to work engagement. This may also be the case in crowdsourcing as part-time crowdworkers may have more opportunities to do different tasks based on their own interests as they do not obligatorily work on stressful, high-paying tasks like full-time crowdworkers usually do. This understanding is supported by previous studies that have shown that task diversity is regarded as a positive predictor of crowdwork engagement and that part-time crowdworkers tend to do a wide variety of tasks [51, 68].

Interestingly, we also found that full-time Chinese crowdworkers experience higher disengagement and tend to have higher commitment to the ZBJ platform, given that they were found to have more crowdwork resources as above-discussed. This is in contrast with the mechanism of Job Demands-Resources [21, 38], but it is consistent with studies on the influence of job nature on organizational commitments, which demonstrate that full-time workers are more committed in comparison to part-time workers [59]. From a crowdsourcing point of view this may be because full-time crowdworkers, compared to part-time crowdworkers, rely more on ZBJ platform to make their living, which helps them develop more of a sense of identity and acceptance towards this platform.

As for the significant differences based on health conditions in the past 12 months, we found that unhealthy Chinese crowdworkers experience more crowdwork demands regarding work pressures and cognitive demands though they tend to work in less challenging workplaces in comparison to healthy crowdworkers. Their excessive demands (ie. work pressure and cognitive demands) are attributed to the health issue as Alavinia and Burdorf [2] illustrated that health problems have negative effects on the work ability of employees. This is also consistent with prior crowdsourcing studies which showed that workers with a poor health condition experience more work-related challenges [99]. However, as a result of the work-related difficulties caused by health issues, unhealthy crowdworkers are more likely to do crowdtasks in comfortable workplaces where were found to be salutary to their symptoms [9, 99]. Therefore, it is unsurprising that they perceived lower demands from workplace conditions, such as working in an environment that may cause health hazards. Our next finding with regard to job resources is that Chinese crowdworkers in poor health conditions obtain more self development and feedback in their crowdwork. This finding is partially in agreement with Zyskowski et al. [99] who claimed that, for specific disability sub-populations, socialization in crowdsourcing community is critical for personal development, though this is not the case for crowdworkers with social anxieties. On the basis of Dispositional Theory, which asserts that it is in human nature to find more sources to produce satisfactory results [53], one possible explanation is that crowdworkers in poor health conditions may tend to seek more job resources. This for example can include the development of personal skills and knowledge that is helpful in performing crowdsourcing tasks, as well as seeking feedback from requesters to offset the influence of the increased job demands possibly caused by their health problems. Following in this vein and supported by studies of the Job Demands-Resources model that show that job resources alleviate the negative impact of job demands on work experiences [81], the finding that unhealthy Chinese workers have better work adjustment may be because the job resources (i.e. self development and feedback) they obtain help them approach their crowdwork and associated challenges with a positive attitude and more flexible work arrangements.

Finally, our study finds that unhealthy Chinese crowdworkers have better commitment to the ZBJ platform. This may be because unhealthy crowdworkers feel more grateful that the ZBJ platform provides them opportunities to work to earn a living regardless of their health condition, which would enhance their acknowledgement towards the ZBJ platform. This is in line with Zyskowski

et al. [99] and their assertion that crowdworkers with health problems share a general feeling of satisfaction in finding real work online with quick and efficient payments.

A summary of the above-discussed key contributions and novelty pertinent to the present study are presented in Table 7 below.

| Dimensions examined | Studied previously by | Novel contributions of the current study |
|---|---------------------------------|---|
| Job Demands affect work experiences | [84]*, [55]** [34]**, [88]** | Even though studies in China (e.g. [84]) and elsewhere (e.g. [55], [34] and [88]) have suggested (1) work pressures, (2) work conditions and (3) physical challenges negatively affect the crowdworkers' experiences, our study also explored the work experiences of Chinese crowdworkers from wider perspectives. As a result of this, our study has shown that equipment use (i.e. the use of complex and advanced instruments/tools in crowdtasks) is positively related to the exhaustion of workers in a crowdsourcing context. |
| Job resources affect experiences | [29]*, [30]* [35]** | Prior crowdsourcing studies have examined that job resources such as feedback, requester support, social communication and self development are considered to positively affect the work experience of crowdworkers both in China (e.g. [29, 30]) and in other crowdsourcing context (e.g. India [35]). However, the present study further determined that, aside from these aspects, the operative workflow (ie. operation dimension) is positively related to their exhaustion, distancing and maladjustment. This finding supplements one novel factor affecting work experiences in crowdsourcing context. |
| Work experience affect platform commitment | [12]** | In a US-based MTurker-based study, Brawley and Pury [12] have found that the low crowdwork satisfaction would increase the turnover of crowdworkers specific to certain requesters. Similar to this study, our work also revealed the positive relationship between inferior crowdwork experiences and commitment of crowdworkers in crowdsourcing context in China. However, as we did not focus on the impact of work experience to interpersonal level, our study illustrated that that the work experience of Chinese crowdworkers significantly moderates their acknowledgement and loyalty towards crowdsourcing. |

Table 7 continued from previous page

| Dimensions examined | Studied previously by | Novel contributions of the current study |
|--|--|--|
| Relationships among job demands, job resources, work experiences and platform commitments | [5] ^{***} , [36] ^{***} [22] ^{***} , [80] ^{***} | Although the Job Demands-Resources theory has been utilized in various industries (e.g. [5, 22, 36, 80]), the present study for the first applied it in crowdsourcing context by adapting a questionnaire involving items that are specifically related to crowdworks and crowdworkers. With the help of this, our results initially revealed that job demands are negatively related to platform commitments by impairing crowdwork experience of Chinese crowdworkers, while job resources are positively related to platform commitments by improving their crowdwork experience. This finding reinforces the notion that the utilization of traditional organizational science (OS) approaches, such as Job Demands-Resources theory, can be applied to investigate the work experiences of crowdworkers |
| Influence of demographics | Gender: [85] ^{***} , [98] [*] Education: [78] ^{***} , [69] ^{**} Income: [51] ^{**} , [44] ^{**} [9] ^{**} , [73] ^{**} , Job nature: [92] [*] , [52] ^{***} , [59] ^{***} Health condition: [2] ^{***} , [99] ^{**} , [53] ^{***} | Even though the impact of demographic factors on work experiences have been examined assiduously by scholars (e.g. [52, 85]), there are no studies to the best of our knowledge considered the characteristics of crowdworkers when measuring the work experience in a crowdsourcing context in China. By discussing our findings in a specific Chinese context (e.g. [92, 98]) and comparing them to the related outcomes in other crowdsourcing context (e.g. US and Europe [9, 73]), the present study indicate that there are significant differences across the job demands, job resources, crowdwork experiences and platform commitments based on crowdworkers' gender, education, income, job nature, and health condition. This illustrates that different crowdworkers have different needs and threshold of demands and resources and that this plays a significant role in terms of moderating the crowdwork experience and platform commitment. |

Table 7. Results compared with prior studies⁴.

6 CONCLUSION

Based on a framework of well-established approaches, namely the (1) Job Demands Resources model [21]; (2) Work Design Questionnaire [64]; (3) Oldenburg Burnout Inventory [21]; (4) Utrecht Work Engagement Scale [79] and (5) Organizational Commitment Questionnaire [66], we systematically study the work experiences of 289 Chinese crowdworkers employed through the ZBJ platform - the most popular Chinese crowdsourcing platform to date.

⁴Note: * Chinese crowdsourcing literature, ** Non-Chinese crowdsourcing literature, *** traditional work setting

Our study examines these crowdworkers' experiences along four dimensions: (1) crowdsourcing job demands, (2) job resources available to the workers, (3) crowdwork experiences, and (4) platform commitment. Our result indicated that in a crowdsourcing context in China, job demands negatively affect the platform commitments of Chinese crowdworkers by impairing crowdwork experiences while Job resources positively affect the platform commitments of Chinese crowdworkers by improving crowdwork experience. In addition, the outcome in the present paper revealed that there are significant differences across the four dimensions based on crowdworkers' gender, education, income, job nature, and health condition. This illustrates that different crowdworkers have different needs and threshold of demands and resources and that this plays a significant role in terms of moderating the crowdwork experience and platform commitment. Overall, our study does numerous new contributions to the growing body of HCI and CSCW research that seeks to understand the work experiences of crowdworkers.

Leveraging upon the findings of our study we offer the following recommendations for Chinese crowdsourcing platforms, and policy makers. Please note that even though these were written with the Chinese context in mind we believe that are applicable in other contexts as well.

Recommendations for crowdsourcing platforms. As illuminated in the discussion section above many of the results of this study echo findings related to the more traditional industries. Due to this we suggest that Chinese crowdsourcing platforms build on these parallels and employ incentive measures that are usually applied in traditional work settings. This can include, for example, online training that aim to help develop the skills of crowdworkers. Such initiatives not only have the potential to improve the skills of crowdworkers but also can potentially increase the crowdworkers' work experience and commitments to the platform. Moreover, Chinese crowdsourcing platforms could also utilize the results of our study regarding the work experience of crowdworkers and develop platform specific tools to support the crowdwork of them [1]. For example, in order to improve communication between requesters and crowdworkers, crowdsourcing platforms could link their communication system to popular social networking software (e.g. Wechat⁵).

Recommendations for policy makers. With regard to the practical implications for policy makers and regulators in crowdsourcing industry, we recommend that they should recognize crowdsourcing as freelance digital employment and incorporate it in the current minimum wage policies. This will improve the job satisfaction of crowdworkers and provide them a higher salary, pension, and insurance. We propose this not only because for a significant percentage of respondents in our study (40.93%) crowdsourcing was the primary employment and sole income stream but also because it aligns with the government's push towards "mass entrepreneurship and mass innovation" (*dazhong chuanye wanzhong chuangxin*; 大众创业万众创新)⁶. Furthermore, based on the outcomes of this study we recommend that policy makers and regulators should develop specific policies based on the individual circumstances of crowdworkers to help those with life difficulties. For example, as it was found that crowdworkers with health problems perceived higher work pressures in contrast with healthy crowdworkers a subsidy policy similar to workers in more traditional industries can be set in place to support them when in ill health. Chiefly, the outcomes of our study add to the growing body of HCI and CSCW research that seeks to understand the work experience of crowdworkers in different locales. Our contributions are primarily empirical in nature and provide new insights into: (1) the relationships among job demands, job resources, crowdwork experiences, and platform commitment of Chinese crowdworkers, (2) and the influence of the demographic factors on these relationships.

⁵<https://weixin.qq.com/>

⁶<http://www.gov.cn/zhengce/zhuti/shuangchuang/index.htm>

The major limitation of this study is that the results were only obtained from self-report questionnaires, which result in the present study investigating crowdwork experiences merely based on the statistical results. Another limitation is the representativeness of the sample as only crowdworkers from the ZBJ platform were involved in this study. Therefore, future work on the topic is suggested to: (1) vary the method of data collection - e.g. conduct interviews and focus groups to elicit the lived experiences of Chinese crowdworkers, (2) involve more crowdworkers from other crowdsourcing platforms, for example EPWK.com, to increase the representativeness of the sample, and (3) further investigate whether methods that are commonly used in a traditional work context can be applied to crowdsourcing, (4) examine, compare, and contrast crowdwork against the traditional work settings in China, (5) conduct moderated mediation analysis for the purpose of generating a more comprehensive picture of the different mechanisms of job demands and job resources in a crowdworking context.

ACKNOWLEDGMENTS

Parts of this project were funded by Xi'an Jiaotong-Liverpool University grant PGRS1819-1-010 and RDF15-02-17.

REFERENCES

- [1] Simon à Campo, Vassilis-Javed Khan, Konstantinos Papangelis, and Panos Markopoulos. 2019. Community heuristics for user interface evaluation of crowdsourcing platforms. *Future Generation Computer Systems* 95 (June 2019), 775–789. <https://doi.org/10.1016/j.future.2018.02.028>
- [2] Seyed Mohammad Alavinia and Alex Burdorf. 2008. Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. *International Archives of Occupational and Environmental Health* 82, 1 (Oct. 2008), 39–45. <https://doi.org/10.1007/s00420-008-0304-6>
- [3] Natalie J. Allen and John P. Meyer. 1990. The measurement and antecedents of affective, continuance and normative commitment to the organization. *Journal of Occupational Psychology* 63, 1 (March 1990), 1–18. <https://doi.org/10.1111/j.2044-8325.1990.tb00506.x>
- [4] A. S. Antoniou, F. Polychroni, and A. N. Vlachakis. 2006. Gender and age differences in occupational stress and professional burnout between primary and high-school teachers in Greece. *Journal of Managerial Psychology* 21, 7 (2006), 682–690. <https://doi.org/10.1108/02683940610690213>
- [5] Arnold B. Bakker, Evangelia Demerouti, Toon W. Taris, Wilmar B. Schaufeli, and Paul J. G. Schreurs. 2003. A multigroup analysis of the job demands-resources model in four home care organizations. *International Journal of Stress Management* 10, 1 (2003), 16–38. <https://doi.org/10.1037/1072-5245.10.1.16>
- [6] Sally-Anne Barnes, Anne Green, and Maria de Hoyos. 2015. Crowdsourcing and work: individual factors and circumstances influencing employability: Crowdsourcing and work. *New Technology, Work and Employment* 30, 1 (March 2015), 16–31. <https://doi.org/10.1111/ntwe.12043>
- [7] Roy F. Baumeister and Mark R. Leary. 1995. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117, 3 (1995), 497–529. <https://doi.org/10.1037/0033-2909.117.3.497>
- [8] Salai Vanni Bawi. [n.d.]. DISABILITY IN MYANMAR. ([n. d.]), 37.
- [9] Janine Berg. 2016. *Income security in the on-demand economy : findings and policy lessons from a survey of crowdworkers*. Technical Report 994906483402676. International Labour Organization. <https://ideas.repec.org/p/ilo/ilowps/994906483402676.html>
- [10] Valentin Bolotnyy and Natalia Emanuel. [n.d.]. Why Do Women Earn Less Than Men? Evidence from Bus and Train Operators (Job Market Paper). ([n. d.]). <https://www.americanvoiceforfreedom.org/wp-content/uploads/2019/01/Why-Do-Women-Earn-Less-Than-Men.pdf>
- [11] Daren C. Brabham. 2009. Crowdsourcing the Public Participation Process for Planning Projects. *Planning Theory* 8, 3 (Aug. 2009), 242–262. <https://doi.org/10.1177/1473095209104824>
- [12] Alice M. Brawley and Cynthia L.S. Pury. 2016. Work experiences on MTurk: Job satisfaction, turnover, and information sharing. *Computers in Human Behavior* 54 (Jan. 2016), 531–546. <https://doi.org/10.1016/j.chb.2015.08.031>
- [13] Raymond B. Cattell. 1966. The Scree Test For The Number Of Factors. *Multivariate Behavioral Research* 1, 2 (April 1966), 245–276. https://doi.org/10.1207/s15327906mbr0102_10
- [14] Kellie Caught, Mark A. Shadur, and John J. Rodwell. 2000. The Measurement Artifact in the Organizational Commitment Questionnaire. *Psychological Reports* 87, 3 (Dec. 2000), 777–788. <https://doi.org/10.2466/pr0.2000.87.3.777>

- [15] Chao-Min Chiu, Ting-Peng Liang, and Efraim Turban. 2014. What can crowdsourcing do for decision support? *Decision Support Systems* 65 (2014), 40–49. <https://doi.org/10.1016/j.dss.2014.05.010>
- [16] Sheridan J. Coakes and Clara Ong. 2011. *SPSS Version 18.0 for Windows: Analysis Without Anguish* (1 ed.). Wiley, Milton, Qld.
- [17] Curt Coffman, Gabriel Gonzalez-Molina, and Ashok Gopal. 2002. *Follow This Path: How the World's Greatest Organizations Drive Growth by Unleashing Human Potential*. Grand Central Publishing. Google-Books-ID: yP3leRwetIgc.
- [18] Cary L. Cooper, Philip J. Dewe, and Michael P. O'Driscoll. 2001. *Organizational stress: A review and critique of theory, research, and applications*. Sage Publications, Inc, Thousand Oaks, CA, US.
- [19] David Corsar, Peter Edwards, John Nelson, Chris Baillie, Konstantinos Papangelis, and Nagendra Velaga. 2017. Linking open data and the crowd for real-time passenger information. *Journal of Web Semantics* 43 (March 2017), 18–24. <https://doi.org/10.1016/j.websem.2017.02.002>
- [20] Jamie DeCoster. 1998. Overview of Factor Analysis. (Aug. 1998), 10.
- [21] E. Demerouti, A. B. Bakker, F. Nachreiner, and W. B. Schaufeli. 2001. The job demands-resources model of burnout. *The Journal of Applied Psychology* 86, 3 (June 2001), 499–512.
- [22] Evangelia Demerouti, Evangelia Demerouti, Arnold B. Bakker, Ioanna Vardakou, and Aristotelis Kantas. 2003. The Convergent Validity of Two Burnout Instruments. *European Journal of Psychological Assessment* 19, 1 (March 2003), 12–23. <https://doi.org/10.1027/1015-5759.19.1.12>
- [23] Evangelia Demerouti, Karina Mostert, and Arnold B. Bakker. 2010. Burnout and work engagement: A thorough investigation of the independency of both constructs. *Journal of Occupational Health Psychology* 15, 3 (2010), 209–222. <https://doi.org/10.1037/a0019408>
- [24] Rolf van Dick. 2004. *Commitment und Identifikation mit Organisationen*. Hogrefe. Google-Books-ID: KfeWPAACAAJ.
- [25] Djellel Difallah, Elena Filatova, and Panos Ipeirotis. 2018. Demographics and Dynamics of Mechanical Turk Workers. In *Proceedings of the Eleventh ACM International Conference on Web Search and Data Mining (WSDM '18)*. ACM, New York, NY, USA, 135–143. <https://doi.org/10.1145/3159652.3159661> event-place: Marina Del Rey, CA, USA.
- [26] Steven Dow, Anand Kulkarni, Scott Klemmer, and Björn Hartmann. 2012. Shepherding the Crowd Yields Better Work. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work (CSCW '12)*. ACM, New York, NY, USA, 1013–1022. <https://doi.org/10.1145/2145204.2145355> event-place: Seattle, Washington, USA.
- [27] Enrique Estellés-Arolas and Fernando González-Ladrón-de Guevara. 2012. Towards an integrated crowdsourcing definition. *Journal of Information Science* 38, 2 (April 2012), 189–200. <https://doi.org/10.1177/0165551512437638>
- [28] Colette Fagan, Helen Norman, Mark Smith, and María C. Gonzalez Menendez. 2014. *In search of good quality part-time employment*. Technical Report 994839683402676. International Labour Organization. <https://ideas.repec.org/p/ilo/ilowps/994839683402676.html>
- [29] Youli Fei. [n.d.]. Research on the Influential Factor and Their Mechanism of Online Innovation Contest Performance. <http://kreader.cnki.net/Kreader/CatalogViewPage.aspx?dbCode=cmdm&filename=1016736048>.
- [30] Xiaoliang Feng and Minxue Huang. [n.d.]. Research on the Solvers' Participating Motivation of Crowdsourcing. 4 ([n. d.]), 25–35. <https://doi.org/10.14134/j.cnki.cn33-1336/f.2013.04.009>
- [31] Andy Field. 2009. *Discovering Statistics Using SPSS*. SAGE Publications. Google-Books-ID: a6FLF1YOqtsC.
- [32] John F. Finch and Stephen G. West. 1997. The Investigation of Personality Structure: Statistical Models. *Journal of Research in Personality* 31, 4 (Dec. 1997), 439–485. <https://doi.org/10.1006/jrpe.1997.2194>
- [33] Herbert J. Freudenberger. 1974. Staff Burn-Out. *Journal of Social Issues* 30, 1 (Jan. 1974), 159–165. <https://doi.org/10.1111/j.1540-4560.1974.tb00706.x>
- [34] Mary L Gray, Siddharth Suri, Syed Shoaib Ali, and Deepti Kulkarni. 2016. The Crowd is a Collaborative Network. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing - CSCW '16*. ACM Press, San Francisco, California, USA, 134–147. <https://doi.org/10.1145/2818048.2819942>
- [35] Neha Gupta, David Martin, Benjamin V. Hanrahan, and Jacki O'Neill. 2014. Turk-Life in India. In *Proceedings of the 18th International Conference on Supporting Group Work - GROUP '14*. ACM Press, Sanibel Island, Florida, USA, 1–11. <https://doi.org/10.1145/2660398.2660403>
- [36] J. Richard Hackman and Greg R Oldham. 1980. *Work redesign*. Addison-Wesley, Reading, Mass. OCLC: 5674287.
- [37] Joseph F. Hair, Ronald L. Tatham, Rolph E. Anderson, and William Black. 1998. *Multivariate Data Analysis* (5th ed.). Prentice Hall, Upper Saddle River, N.J.
- [38] Jari J. Hakanen, Arnold B. Bakker, and Wilmar B. Schaufeli. 2006. Burnout and work engagement among teachers. *Journal of School Psychology* 43, 6 (Jan. 2006), 495–513. <https://doi.org/10.1016/j.jsp.2005.11.001>
- [39] G. R. Hockey. 1997. Compensatory control in the regulation of human performance under stress and high workload; a cognitive-energetical framework. *Biological Psychology* 45, 1-3 (March 1997), 73–93.
- [40] G. Robert J. Hockey. 1993. Cognitive-energetical control mechanisms in the management of work demands and psychological health. In *Attention: Selection, awareness, and control: A tribute to Donald Broadbent*. Clarendon Press/Oxford University Press, New York, NY, US, 328–345.

- [41] Inge Houkes, Peter P. M. Janssen, Jan de Jonge, and Frans J. N. Nijhuis. 2001. Specific relationships between work characteristics and intrinsic work motivation, burnout and turnover intention: A multi-sample analysis. *European Journal of Work and Organizational Psychology* 10, 1 (2001), 1–23. <https://doi.org/10.1080/13594320042000007>
- [42] Jeff Howe. 2006. The Rise of Crowdsourcing. *Wired* (June 2006). <https://www.wired.com/2006/06/crowds/>
- [43] Ursula Huws, Neil Spencer, and Simon Joyce. 2016. *Crowd Work in Europe: Preliminary results from a survey in the UK, Sweden, Germany, Austria and the Netherlands*. Foundation for European Progressive Studies.
- [44] Panagiotis G. Ipeirotis. 2010. *Demographics of Mechanical Turk*. SSRN Scholarly Paper ID 1585030. Social Science Research Network, Rochester, NY. <https://papers.ssrn.com/abstract=1585030>
- [45] Jum C. Nunnally Ira H. Bernstein. 2019. *Psychometric Theory (Third Edition)* by Ira H. Bernstein, Jum C. Nunnally: McGraw-Hill Education 9780071070881 Softcover, 3rd edition. - BookVistas. <https://www.abebooks.com/9780071070881/Psychometric-Theory-Third-Edition-Ira-0071070885/plp>
- [46] Leon Jackson and Sebastiaan Rothmann. 2005. Work-Related Well-Being of Educators in a District of the North-West Province. *Perspectives in Education* 23, 3 (Sept. 2005), 107–122.
- [47] William A. Kahn. 1992. To Be Fully There: Psychological Presence at Work. *Human Relations* 45, 4 (April 1992), 321–349. <https://doi.org/10.1177/001872679204500402>
- [48] Henry F. Kaiser. 1960. The Application of Electronic Computers to Factor Analysis. *Educational and Psychological Measurement* 20, 1 (April 1960), 141–151. <https://doi.org/10.1177/001316446002000116>
- [49] Toni Kaplan, Susumu Saito, Kotaro Hara, and Jeffrey P Bigham. [n.d.]. Striving to Earn More: A Survey of Work Strategies and Tool Use Among Crowd Workers. ([n. d.]), 9.
- [50] Robert A. Karasek. 1979. Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. *Administrative Science Quarterly* 24, 2 (1979), 285–308. <https://doi.org/10.2307/2392498>
- [51] N Kaufmann, Thimo Schulze, and Daniel Veit. 2011. More than fun and money. Worker Motivation in Crowdsourcing—A Study on Mechanical Turk. *Proceedings of the Seventeenth Americas Conference on Information Systems*.
- [52] Clare Kelliher and Deirdre Anderson. 2010. Doing more with less? Flexible working practices and the intensification of work. *Human Relations* 63, 1 (Jan. 2010), 83–106. <https://doi.org/10.1177/0018726709349199>
- [53] Kanwal Khalid. 2011. Muhammad Ali Jinnah University Islamabad Pakistan. 3, 5 (2011), 29.
- [54] Shashank Khanna, Aishwarya Ratan, James Davis, and William Thies. 2010. Evaluating and Improving the Usability of Mechanical Turk for Low-income Workers in India. In *Proceedings of the First ACM Symposium on Computing for Development (ACM DEV '10)*. ACM, New York, NY, USA, 12:1–12:10. <https://doi.org/10.1145/1926180.1926195> event-place: London, United Kingdom.
- [55] Aniket Kittur, Jeffrey V. Nickerson, Michael Bernstein, Elizabeth Gerber, Aaron Shaw, John Zimmerman, Matt Lease, and John Horton. 2013. The Future of Crowd Work. In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work (CSCW '13)*. ACM, New York, NY, USA, 1301–1318. <https://doi.org/10.1145/2441776.2441923> event-place: San Antonio, Texas, USA.
- [56] Rex B. Kline. 2011. *Principles and practice of structural equation modeling, 3rd ed.* Guilford Press, New York, NY, US.
- [57] Ioanna Lykourantzou, Vassillis-Javed Khan, Konstantinos Papangelis, and Panos Markopoulos. 2019. Macrotask Crowdsourcing: An Integrated Definition. In *Macrotask Crowdsourcing*, Vassillis-Javed Khan, Konstantinos Papangelis, Ioanna Lykourantzou, and Panos Markopoulos (Eds.). Springer International Publishing, Cham, 1–13. https://doi.org/10.1007/978-3-030-12334-5_1
- [58] Alessandro Marinaccio, Pierpaolo Ferrante, Marisa Corfiati, Cristina Di Tecco, Bruna M. Rondinone, Michela Bonafede, Matteo Ronchetti, Benedetta Persechino, and Sergio Iavicoli. 2013. The relevance of socio-demographic and occupational variables for the assessment of work-related stress risk. *BMC Public Health* 13, 1 (Dec. 2013), 1157. <https://doi.org/10.1186/1471-2458-13-1157>
- [59] Thomas N. Martin and John C. Hafer. 1995. The multiplicative interaction effects of job involvement and organizational commitment on the turnover intentions of full- and part-time employees. *Journal of Vocational Behavior* 46, 3 (1995), 310–331. <https://doi.org/10.1006/jvbe.1995.1023>
- [60] Christina Maslach and Susan E. Jackson. 1981. The measurement of experienced burnout. *Journal of Organizational Behavior* 2, 2 (April 1981), 99–113. <https://doi.org/10.1002/job.4030020205>
- [61] Christina Maslach and Michael P. Leiter. 1997. *The truth about burnout: How organizations cause personal stress and what to do about it*. Jossey-Bass, San Francisco, CA, US.
- [62] Theo F. Meijman and Gijsbertus Mulder. 1998. Psychological aspects of workload. In *Handbook of work and organizational: Work psychology, Vol. 2, 2nd ed.* Psychology Press/Erlbaum (UK) Taylor & Francis, Hove, England, 5–33.
- [63] John P. Meyer, David J. Stanley, Lynne Herscovitch, and Laryssa Topolnytsky. 2002. Affective, Continuance, and Normative Commitment to the Organization: A Meta-analysis of Antecedents, Correlates, and Consequences. *Journal of Vocational Behavior* 61, 1 (Aug. 2002), 20–52. <https://doi.org/10.1006/jvbe.2001.1842>
- [64] Frederick P. Morgeson and Stephen E. Humphrey. 2006. The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology* 91,

- 6 (2006), 1321–1339. <https://doi.org/10.1037/0021-9010.91.6.1321>
- [65] Richard T. Mowday, Lyman W. Porter, and Richard M. Steers. 1982. *Employee-organization linkages: the psychology of commitment, absenteeism, and turnover*. Academic Press. Google-Books-ID: HNO7AAAAIAAJ.
- [66] Richard T Mowday, Richard M Steers, and Lyman W Porter. 1979. The measurement of organizational commitment. *Journal of Vocational Behavior* 14, 2 (April 1979), 224–247. [https://doi.org/10.1016/0001-8791\(79\)90072-1](https://doi.org/10.1016/0001-8791(79)90072-1)
- [67] Ahmad Nafis and AKHTER MD MAHMUD. 2011. Study the Impact of Fatigue and Optimizing Productivity of an Assembly Line of Garment Industry. 2, 11 (2011), 8.
- [68] Cuong D Nguyen, Nargess Tahmasbi, Triparna De Vreede, Gert-Jan De Vreede, Onook Oh, and Roni Reiter-Palmon. 2015. Participant Engagement in Community Crowdsourcing. In *ECIS*.
- [69] Thomas O'Neill, Laura A. Hambley, Nathan S. Greidanus, Rhiannon MacDonnell, and Theresa J. B. Kline. 2009. *Predicting Teleworker Success: An Exploration of Personality, Motivational, Situational, and Job Characteristics*. SSRN Scholarly Paper ID 1487798. Social Science Research Network, Rochester, NY. <https://papers.ssrn.com/abstract=1487798>
- [70] Xin Peng, Muhammad Ali Babar, and Christof Ebert. [n.d.]. Collaborative Software Development Platforms for Crowdsourcing. 31, 2 ([n.d.]), 30–36. <https://doi.org/10.1109/MS.2014.31>
- [71] Ulla Peterson, Gunnar Bergström, Evangelia Demerouti, Petter Gustavsson, Marie Asberg, and Ake Nygren. 2011. Burnout levels and self-rated health prospectively predict future long-term sickness absence: a study among female health professionals. *Journal of Occupational and Environmental Medicine* 53, 7 (July 2011), 788–793. <https://doi.org/10.1097/JOM.0b013e318222b1dc>
- [72] Marion K. Poetz and Martin Schreier. 2012. The Value of Crowdsourcing: Can Users Really Compete with Professionals in Generating New Product Ideas? *Journal of Product Innovation Management* 29, 2 (2012), 245–256. <https://doi.org/10.1111/j.1540-5885.2011.00893.x>
- [73] Lisa Posch, Arnim Bleier, Fabian Flöck, and Markus Strohmaier. 2018. Characterizing the Global Crowd Workforce: A Cross-Country Comparison of Crowdworker Demographics. *arXiv preprint arXiv:1812.05948* (2018).
- [74] Daniela Retelny, Sébastien Robaszkiewicz, Alexandra To, Walter S. Lasecki, Jay Patel, Negar Rahmati, Tulsee Doshi, Melissa Valentine, and Michael S. Bernstein. 2014. Expert Crowdsourcing with Flash Teams. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology (UIST '14)*. ACM, New York, NY, USA, 75–85. <https://doi.org/10.1145/2642918.2647409>
- [75] Amy Richman. [n.d.]. Everyone Wants an Engaged Workforce how can you create it? ([n.d.]), 4.
- [76] Peter Richter and Winfried Hacker. 1998. *Belastung und Beanspruchung: Stress, Ermüdung und Burnout im Arbeitsleben*. Asanger. Google-Books-ID: FJSZAAAACAAJ.
- [77] Joel Ross, Lilly Irani, M. Six Silberman, Andrew Zaldivar, and Bill Tomlinson. 2010. Who are the crowdworkers?: shifting demographics in mechanical turk. In *Proceedings of the 28th of the international conference extended abstracts on Human factors in computing systems - CHI EA '10*. ACM Press, Atlanta, Georgia, USA, 2863. <https://doi.org/10.1145/1753846.1753873>
- [78] R. M. Ryan and C. Frederick. 1997. On energy, personality, and health: subjective vitality as a dynamic reflection of well-being. *Journal of Personality* 65, 3 (Sept. 1997), 529–565.
- [79] WB Schaufeli and D Van Dierendonck. 2000. Utrecht burnout scale: manual (UBOS 2000).
- [80] W. B. Schaufeli. 2003. Past performance and future perspectives of burnout research. *SA Journal of Industrial Psychology* 29, 4 (Jan. 2003), 1–15. <https://journals.co.za/content/psyc/29/4/EJC88982>
- [81] Wilmar B. Schaufeli and Arnold B. Bakker. 2004. Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. *Journal of Organizational Behavior* 25, 3 (2004), 293–315. <https://doi.org/10.1002/job.248>
- [82] Fahri Sezer. 2012. Examining of Teacher Burnout Level in Terms of Some Variables. *International Online Journal of Educational Sciences* 3, 4 (2012), 617–631.
- [83] Shengping Huo, Zheng Chijian, and Hailang Tu. 2017. On the Research of Intelligent Coupling and Coordination between Employers and Witkey on the Crowd Innovation Network Platform. *Journal of Xiangtan University* 41, 1 (Jan. 2017), 94–101. <https://doi.org/0.13715/j.cnki.jxupss.2017.01.017>
- [84] Lei Shi. [n.d.]. Factors Affecting Solvers to Participate in Crowdsourcing: An Empirical Study from China. http://kreader.cnki.net/Kreader/CatalogViewPage.aspx?dbCode=cndm&filename=1012048232.nh&tablename=CMFD201301&compose=&first=1&uid=WEEvREcwSljHSldTTEYzU3EyDRNc3BEREVnRzCcUdPeFpjODZ4QUw1UT0=\protect\T1\textdollar9A4hf_YAuvQ5obgVAqNKPCYcEjKensW4IQMovwHtwkf4VYPoHbKxJw!!
- [85] Peter J. Sloane and Hector Williams. 1996. Are “Overpaid” Workers Really Unhappy? A Test of the Theory of Cognitive Dissonance. *LABOUR* 10, 1 (1996), 3–16. <https://doi.org/10.1111/j.1467-9914.1996.tb00077.x>
- [86] James P. Stevens. 2002. *Applied multivariate statistics for the social sciences, 4th ed.* Lawrence Erlbaum Associates Publishers, Mahwah, NJ, US.
- [87] Barbara G. Tabachnick and Linda S. Fidell. 2012. *Using Multivariate Statistics* (6 ed.). Pearson, Boston, Mass.

- [88] Rannie Teodoro, Pinar Ozturk, Mor Naaman, Winter Mason, and Janne Lindqvist. [n.d.]. The motivations and experiences of the on-demand mobile workforce. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing - CSCW '14* (2014). ACM Press, 236–247. <https://doi.org/10.1145/2531602.2531680>
- [89] UNSW Australia Business School, Daniel Schlagwein, Niels Bjorn-Andersen, and Copenhagen Business School. 2014. Organizational Learning with Crowdsourcing: The Revelatory Case of LEGO. *Journal of the Association for Information Systems* 15, 11 (Nov. 2014), 754–778. <https://doi.org/10.17705/1jais.00380>
- [90] Doris C. Vahey, Linda H. Aiken, Douglas M. Sloane, Sean P. Clarke, and Delfino Vargas. 2004. Nurse Burnout and Patient Satisfaction. *Medical Care* 42, Suppl (Feb. 2004), II–57–II–66. <https://doi.org/10.1097/01.mlr.0000109126.50398.5a>
- [91] Nina Pološki Vokić and Ana Bogdanić. 2007. *Individual differences and occupational stress perceived: a Croatian survey*. Technical Report 0705. Faculty of Economics and Business, University of Zagreb. <https://ideas.repec.org/p/zag/wpaper/0705.html>
- [92] Yihong Wang, Konstantinos Papangelis, Ioanna Lykourantzou, and Vassilis-Javed Khan. 2019. The Changing Landscape of Crowdsourcing in China. In *Conference Companion Publication of the 2019 on Computer Supported Cooperative Work and Social Computing - CSCW '19*. ACM Press. <https://doi.org/10.1145/3311957.3359469>
- [93] Peter Warr. 1987. *Work, unemployment, and mental health*. Oxford University Press, New York, NY, US.
- [94] Robert W. White. 1959. Motivation reconsidered: The concept of competence. *Psychological Review* 66, 5 (1959), 297–333. <https://doi.org/10.1037/h0040934>
- [95] Yoash Wiener. 1982. Commitment in Organizations: A Normative View. *The Academy of Management Review* 7, 3 (1982), 418–428. <https://doi.org/10.2307/257334>
- [96] Alex J Wood, Mark Graham, Vili Lehdonvirta, and Isis Hjorth. 2019. Networked but Commodified: The (Dis)Embeddedness of Digital Labour in the Gig Economy. *Sociology* (Feb. 2019), 0038038519828906. <https://doi.org/10.1177/0038038519828906>
- [97] Xinhua. 2015. China to explore new models to boost innovation, entrepreneurship - Business - Chinadaily.com.cn. http://www.chinadaily.com.cn/business/2015-09/26/content_21989332.htm
- [98] Li Yuan. [n.d.]. China Tech Workers Wanted: Women Need Not Apply. ([n. d.]). <https://www.wsj.com/articles/china-tech-workers-wanted-women-need-not-apply-1502972944>
- [99] Kathryn Zyskowski, Meredith Ringel Morris, Jeffrey P. Bigham, Mary L. Gray, and Shaun K. Kane. 2015. Accessible Crowdwork?: Understanding the Value in and Challenge of Microtask Employment for People with Disabilities. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15)*. ACM, New York, NY, USA, 1682–1693. <https://doi.org/10.1145/2675133.2675158> event-place: Vancouver, BC, Canada.