Research article

Buffering or boosting? The dynamic curvilinear relationship between work-related use of information and communication technologies after-hours and wok procrastination

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A B S T R A C T

Work-related use of information and communication technologies after-hours (W_ICTs) blurs the boundaries between work and non-work domains, representing a typical boundary-crossing behavior that affects employees' lives and organizational development. Drawing on the Job Demands-Resources theory, this study develops a dynamic curvilinear model of the impact of W_ICTs on work procrastination, considering intrinsic motivation (self-efficacy and enjoyment) and regulatory focus (prevention focus). Empirical testing of the research hypotheses is conducted through a survey involving 817 employees with standard working hours (e.g. 9 a.m. to 5 p.m.). The results indicate that W_ICTs can be regarded as both inhibitors and promoters, with a U-shaped impact on work procrastination and an inverted U-shaped effect on self-efficacy and enjoyment. The mediating roles of self-efficacy and enjoyment are significant. Moreover, prevention focus moderates the relationship between W_ICTs and enjoyment, whereas the moderating effect between W_ICTs and self-efficacy is insignificant. This dynamic curvilinear relationship may explain the inconsistent results of prior studies regarding the relationship between W_ICTs and employees' negative behaviors. It contributes to expanding research on the outcomes of W_ICTs and the antecedents of work procrastination. Moreover, the proposed influence mechanism between W_ICTs and work procrastination has not been established from the perspective of intrinsic motivation and prevention focus. Hence, this study responds to scholars' calls and adds to the existing research on how W_ICTs affect work procrastination. These research findings enhance the current understanding of the effects of W_ICTs and offer valuable insights for organizations to effectively manage W_ICTs and address work procrastination behavior in practice.

1. Introduction

Advancements in the internet and electronic information technology have generated significant changes in how employees work, communicate, and manage their working hours [1]. In the modern workplaces, an increasing number of enterprises have adopted electronic technologies such as WeChat, DingTalk, Office Automatic (OA) systems, and online meeting applications (APPs) to facilitate

work-related communication [2]. These information technologies have enabled greater flexibility regarding when and where work can be performed and have reduced the costs associated with organizational communication. As data from QuestMobile indicate, in April 2023, DingTalk, with 199 million monthly active users and 700 million nailing users (https://www.questmobile.com.cn/), is a prominent example of how widely these office software and communication tools are used in China.

Although information and communication technologies have eliminated the boundaries of time and space, reduced organizational communication costs, and enhanced work flexibility, they have also directly contributed to employees' potential overtime work [3,4]. This phenomenon is known as the work-related use of information and communication technologies after-hours (W_ICTs), which refers to employees using mobile electronic devices to engage in work-related activities during non-working hours [5,6]. Research on the impact of W_ICTs has not yet reached a consensus. Some studies indicate that W_ICTs can intensify employee workloads during non-work hours, which may lead to several negative outcomes such as marital fatigue, work-family conflicts, time theft, deviant behavior, emotional exhaustion, and reduced job satisfaction [7–12]. Conversely, other scholars argue that W_ICTs can have positive effects on employees by improving workplace effectiveness, engagement, focus on opportunities, work-to-family enrichment, and interpersonal interaction [13–16]. However, the picture is not entirely clear, as some research suggests a complex, double-edged effect of W_ICTs on employee attitudes and behaviors. For example, Huo et al. [17] and Zhang et al. [18] proposed that moderate W_ICTs can positively influence employees' innovation behaviors and work engagement. However, W_ICTs may lead to declining innovation behaviors and work engagement at high frequency, suggesting an inverted U-shaped relationship. Therefore, to fully understand the impact of W_ICTs, it is necessary to take into account various factors such as cultural context, communication frequency, and individual differences [19]. At the same time, the current double-edged effect analysis of W_ICTs mainly focuses on employees' positive attitudes and behaviors and pays little attention to their negative results. Scholars and organizations need to delve into these complexities to foster a balanced perspective on W_ICTs that supports employees' well-being and productivity. Work procrastination is the behavior of employees' postponement of work tasks. It is considered one of the most challenging personal negative behaviors, profoundly affecting employees' lives and organizations' development [20–26]. At the individual level, procrastination implies failure in self-regulation, which results in considerable stress for employees [27]. It diminishes job satisfaction, generates negative emotions, and reduces employee well-being and task efficiency [28–30]. At the organizational level, employee procrastination significantly reduces organizational productivity [31]. A leader's procrastination induces a perception of work frustration among employees, leading to deviant behaviors and reduced organizational citizenship behaviors [32]. It is evident that scholars have primarily focused on the negative outcomes of work procrastination [21–23], with relatively few studies examining its antecedents and prevention strategies [24,25]. Therefore, it is worth investigating whether W_ICTs, as a flexible working pattern, can help employees manage their time better, effectively tackle work tasks and challenges, and ultimately alleviate their work procrastination.

Based on the Job Demands-Resources (JD-R) theory, previous studies show that W_ICTs may increase work pressure, as employees feel obligated to handle work-related tasks during their personal time [33]. This pressure can lead to resource depletion, which, in turn, may induce defensive resource behaviors and work procrastination [34]. In addition, a contrasting perspective views W_ICTs as a form of flexible work behavior [35]. From this perspective, W_ICTs can conduce to rational allocation of time, enabling employees to balance work and personal responsibilities, which may result in reduction of work procrastination. Therefore, these contrasting results raise the question of whether a double-edged effect exists between W_ICTs and work procrastination and what the underlying mechanisms are. This study resorts to the JD-R theory, which includes three assumptions, as shown in Fig. 1, to address the above questions [36,37].

● The "dual process" assumption suggests that any job has two different impact pathways on employees, namely, the "loss pathway" and the "gain pathway" [38]. When job demands are excessively high and are not adequately compensated by job resources, employees' psychological and physiological resources are continually depleted. This phenomenon results in employees experiencing burnout and then exhibiting work withdrawal behaviors or counterproductive behaviors. This process is named as "loss
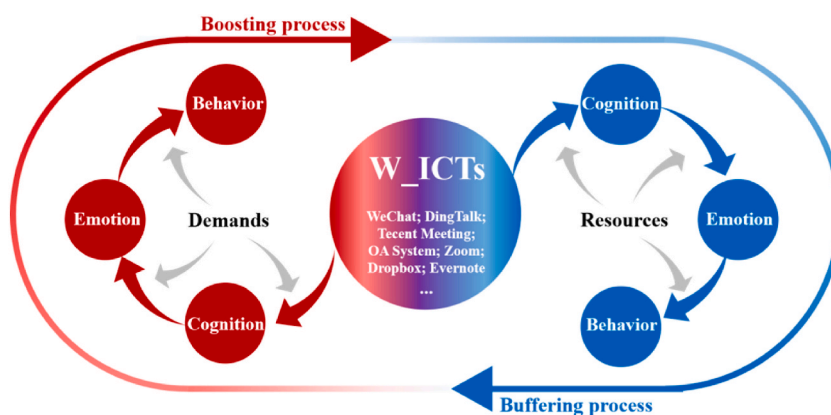

Fig. 1. The dynamic nature of W_ICTs from the perspective of JD-R theory.

pathway." On the contrary, sufficient job resources can increase employees' work motivation, resulting in positive outcomes such as high work engagement, job performance, and employee creativity. This process is named "gain pathway."

- The "buffering process" assumption suggests that job resources can alleviate the negative impact of high job demands on employees, such as employees' cognition, emotions, and behaviors [39,40].
- The "boosting process" assumption proposes that job resources, especially in the context of high job demands, can further enhance employees' work engagement and motivation levels. High job demands can motivate employees to utilize their job resources fully, improving work involvement and goal achievement [39,40].

Additionally, to gain a better understanding of the influence mechanisms between W_ICTs and work procrastination, this study introduces intrinsic motivation as a new perspective, which uses "self-efficacy" and "enjoyment" to investigate the mediating effect [41–43]. Self-efficacy is the confidence individuals exhibit in their abilities when performing a specific task and their judgment of whether they can handle it [43,44]. Enjoyment refers to employees' positive emotions and cognitive evaluations of their work, which can promote individual development and contribute to long-term happiness [45]. Internal motivation is crucial when employees undertake uncertain work tasks [46–48], as it ignites their intrinsic drive and desires, leading to increased focus and engagement in their work. This phenomenon enables employees to experience joy and satisfaction in their tasks, driving them to continuously pursue self-improvement and growth. Additionally, internal motivation enhances employees' job performance and strengthens their loyalty to the organization, positively impacting the individual success and organizational development. According to JD-R theory, when W_ICTs is regarded as job demands, they induce stressors that result in physiological and psychological depletion. This imbalance in the allocation of resources between the work and family domains leads to conflict, reducing work pleasure and positive emotions [49]. This situation increases emotional exhaustion and fatigue [50]. When W_ICTs acts as job resources, they provide employees with material, psychological, social, or organizational resources, such as organizational support, performance feedback, and leader identification. This support will likely increase employees' self-efficacy and enjoyment [51]. Therefore, self-efficacy and enjoyment may mediate the relationship between W_ICTs and work procrastination.

Furthermore, scholars have found that personality can influence W_ICTs [52]. According to the Regulatory Focus Theory, employees with a prevention focus are more inclined to seek job security and stability [53]. They aim to fulfill essential job requirements, are sensitive to failure and loss, and try to avoid them as much as possible [54,55]. Prevention focus affects employees' preferences and goal achievement [56]. Therefore, employees with a prevention focus are more likely to adhere to conventions in their work and respond more negatively to W_ICTs. Hence, we argue that prevention focus may play a moderating role in the process through which W_ICTs influences work procrastination via intrinsic motivation.

In sum, this study makes the following three major contributions. First, it builds upon previous research by examining the dynamic curvilinear effect of W_ICTs on work procrastination through the lens of JD-R theory, thereby expanding the current understanding of the antecedents and outcomes associated with W_ICTs and work procrastination. This extension addresses a notable gap in the literature, in which prior studies have largely focused on linear relationships between variables without considering potential nonlinear effects. Second, by introducing self-efficacy and enjoyment as mediators, this study delves into the intricate relationship between W_ICTs and intrinsic motivation, revealing an "inverted U-shaped" pattern. This finding not only adds depth to the current understanding of the underlying mechanisms through which W_ICTs influences work procrastination but also underscores the importance of motivational factors in flexible work arrangements. Furthermore, this study goes beyond merely examining direct relationships and explores the moderating role of prevention focus in the association between W_ICTs and self-efficacy/enjoyment. This nuanced investigation sheds light on the boundary conditions of these relationships. It offers insights into how individual differences in cognitive orientation influence the effectiveness of W_ICTs in enhancing intrinsic motivation and mitigating work procrastination. Overall, this study builds upon the foundational work of scholars in the field while addressing the gaps in the existing literature. By exploring the complex relationships among W_ICTs, intrinsic motivation, work procrastination, and prevention focus, it provides valuable insights for organizations seeking to effectively manage flexible work arrangements and alleviate employees' procrastination tendencies, thus contributing to theoretical advancement and practical implications in organizational settings.

2. Theory and hypotheses

2.1. W_ICTs and work procrastination

W_ICTs refers to the behavior of employees who resort to applications such as WeChat, DingTalk, and Tencent Meeting during their after-hours to engage in work-related tasks [5,6,12]. This phenomenon includes communicating with colleagues or team members, conducting video conferences, and responding to emails, even during holidays or off-duty periods [16]. Research on the impact of W_ICTs on employee attitudes and behaviors has not yet reached a consensus. Some studies have revealed negative effects consequences such as work intensity, individual emotions, mental health, work control, and job satisfaction [7–10]. For example, Kim and Chon [57] propose that W_ICTs increases employees' emotional exhaustion, which further results in negative word-of-mouth. Lee et al.'s [58] study show that W_ICTs may decrease employees' affective commitment. The impact of emotional reactions and job stressors may force employees to engage in counterproductive work behaviors due to the activation of the psychological contract breach mechanism [59,60]. Conversely, other studies have highlighted positive effects, including improved workplace effectiveness, enhanced work engagement, greater focus on opportunities, work-to-family enrichment, and improved interpersonal interaction. However, the picture is not entirely clear, as some research has suggested a curvilinear relationship, indicating that moderate W_ICTs can foster innovation behaviors and work engagement, but excessive use may lead to a decline in these behaviors. The cultural context,

frequency of communication, and individual differences all play a role in shaping the impact of W_ICTs. Furthermore, the double-edged nature of W_ICTs is evident in studies that examine both positive and negative outcomes [18,61]. Huo et al. [17] use an experience sampling method to investigate the dual-influence pathway between W_ICTs and employee innovation behavior. They find that W_ICTs is associated with employee innovation behavior by increasing emotional exhaustion and perceived insider status.

Work procrastination is an extension of general procrastination within the organizational context, referring to employees' pro-active and irrational tendencies to delay tasks or behaviors that conflicts with organizational goals and development [21,26]. Therefore, scholars have investigated ways to prevent employees' work procrastination at the individual, task, and organizational levels [27,28,31,32]. At the individual level, research has found a significant negative correlation between employees characteristics and work procrastination. Factors such as conscientiousness, time management skills, self-control abilities and self-efficacy are negatively associated with work procrastination [62–64], while anxiety and stress show a significant positive correlation [65]. At the task-oriented level, task compliance and job autonomy influence work procrastination [66]. For instance, Metin et al. [21] find that lower job demands and fewer job resources make employees feel bored, leading to procrastination at work. At the organizational level, organizational commitment, leadership, and the "good fit" between the employment settings and employees seem to impact work procrastination [32,67–69].

As mentioned above, based on the JD-R theory, this study proposes a "double-edged" effect on the relationship between W_ICTs and work procrastination. In fact, at a low level of W_ICTs, this innovative communication approach breaks down temporal and spatial constraints, enabling individuals to handle work tasks more flexibly and enhancing their job autonomy. This is perceived as a valuable job resource, increasing work resilience and facilitating a more frequent exchange of resources across various domains [70,71]. Sufficient resources can stimulate intrinsic motivation among employees, which helps individuals fulfill their job responsibilities and reinforces their perceived time control, thereby enhancing individual work efficiency and vitality [72,73]. All these factors contribute to reducing work procrastination [74,75].

However, as the frequency of W_ICTs increases, employees are compelled to allocate a substantial amount of their time and energy to address work-related tasks that can arise at any moment. The unpredictability and frequent interruptions of information and electronic communication may force employees into an "always on call" state, impeding their ability to freely control their non-work activities. In this context, W_ICTs gradually becomes a job demand. Previous research has shown that higher job demands have negative impacts on employees' physiological, psychological, and social resources [76–78]. Specifically, the high frequency of W_ICTs continues to occupy employees' leisure time, increasing their work pressure and hindering psychological detachment and resource recovery processes. This phenomenon often leads to work-family conflict and emotional exhaustion [8,79], further increasing work procrastination [9]. Therefore, according to the JD-R theory, W_ICTs can be regarded both as a motivating job resource (buffering) and as a stress-inducing job demand (boosting), resulting in a "double-edged" effect on employees' work procrastination. Namely, a threshold exists for the impact of W_ICTs on work procrastination, which exhibits a U-shaped relationship. Thus, we propose the following hypothesis.

Hypothesis 1. There is a U-shaped relationship between W_ICTs and work procrastination. Namely, when W_ICTs is low, it can reduce work procrastination as a job resource (Hypothesis 1a); when W_ICTs is high, it can increase work procrastination as a job demand (Hypothesis 1b).

2.2. Mediating effect of intrinsic motivation

Intrinsic motivation refers to the desire to work that arises from interest in or curiosity about in the job itself [80,81]. It generally originates from individuals' positive reactions towards work tasks, such as curiosity, involvement, interest, satisfaction, and so on [82]. Scholars often use self-efficacy and enjoyment to reflect employees' internal motivation [83,84]. Bandura introduced self-efficacy in the 1970s based on research in social psychology. He proposed that self-efficacy involves individuals' confidence in their ability to perform tasks and their expectations and judgments regarding their competence in these tasks [44]. Studies have shown that individuals with high self-efficacy have high levels of creativity and performance [47,85]. Enjoyment refers to satisfaction and rewards from activities or outcomes that contribute to individual development and long-term happiness [45]. A substantial body of literature has demonstrated the positive impact of enjoyment, suggesting that employees with a higher level of enjoyment tend to exhibit more prosocial behaviors, participate in a greater number of innovative activities, and employ flexible strategies to cope with stress [42,86].

According to JD-R theory, W_ICTs can be viewed as both job resources and job demands. This duality can lead to conflicts in employees' intrinsic motivation. Therefore, this study proposes that self-efficacy and enjoyment play an inverted U-shaped mediating role in the relationship between W_ICTs and work procrastination. On the one hand, when the level of W_ICTs is low, frequent contact with colleagues and leaders can enhance interpersonal relationships and further strengthen employees' sense of control over work tasks [87,88]. Therefore, employees are more likely to perceive W_ICTs as job resources that provides them with greater job autonomy, representing their ability for self-discipline and self-determination [89], and further enhancing their intrinsic motivation [90,91]. Moreover, employees with higher levels of intrinsic motivation tend to exhibit a stronger willingness to work, a greater sense of meaningfulness in their work, and experience greater psychological satisfaction, thereby enhancing their self-efficacy and enjoyment. Previous research indicates that the self-efficacy and enjoyment can increase employees' work engagement [92,93], which further reducing the work procrastination. On the other hand, when the level of W_ICTs is high, employees perceive it as a job demand, reducing their self-efficacy and enjoyment. Specifically, the asynchronous nature of electronic information communication sometimes requires employees to invest a significant amount of personal time to cope with interruptions and delays in maintaining ongoing work communication and task handling. Over time, this not only fails to alleviate employees' daily task pressures but also adds to their

workload as an additional source of stress, resulting in a decrease in intrinsic motivation [94,95]. Moreover, a high frequency of W_ICTs occupies a significant portion of employees' personal time, inducing intra-role negative emotions, such as tension and anxiety. Studies have shown that negative emotions can undermine individual self-efficacy and enjoyment, causing employees to experience more frustration and avoidance of work [84,96]. Employees may engage in compensatory behaviors to alleviate these negative effects, namely, work procrastination.

During the dynamic process of W_ICTs from low to high, both the gain pathway, which is perceived as a job resource, and the loss pathway, perceived as a job demand, undergo a dynamic evaluation. As the level of W_ICTs increases, it gradually contributes to employees' job satisfaction and self-efficacy as a job resource. Employees with higher levels of intrinsic motivation experience greater job autonomy and flexibility [91,97], leading to greater work engagement and reduced procrastination. Meanwhile, the negative effects of W_ICTs as a job demand on employees' self-efficacy and enjoyment gradually increase. When these negative effects align with the positive effects, employees' intrinsic motivation peaks, and the level of W_ICTs reaches a threshold. However, as the level of W_ICTs exceeds the threshold and continues to rise, the negative effects outweigh the positive ones, leading to a decline in the impact of W_ICTs on work procrastination. Thus, moving from low to high levels of W_ICTs, its impact on self-efficacy and enjoyment shifts from positive to negative after reaching a peak, following an inverted U-shaped curve relationship. Subsequently, it affects work procrastination. Hence, we propose the following hypotheses.

Hypothesis 2.   There is an inverted U-shaped relationship between W_ICTs and self-efficacy. Namely, when W_ICTs is low, it can increase self-efficacy as a job resource (Hypothesis 2a); when W_ICTs is high, it can reduce self-efficacy as a job demand (Hypothesis 2b).

Hypothesis 3.   There is an inverted U-shaped relationship between W_ICTs and enjoyment. Namely, when W_ICTs is low, it can increase enjoyment as a job resource (Hypothesis 3a); when W_ICTs is high, it can reduce enjoyment as a job demand (Hypothesis 3b).

Hypothesis 4.   Self-efficacy mediates the U-shaped relationship between W_ICTs and work procrastination.

Hypothesis 5.   Enjoyment mediates the U-shaped relationship between W_ICTs and work procrastination.

2.3. Moderating effect of prevention focus

In Regulatory Focus Theory, the prevention focus is a core self-regulation tendency [53,54]. Individuals with prevention focus tend to prioritize responsibility and safety. Their primary focus is to avoid negative outcomes, which leads them to be cautious and inclined toward steer clear of risk-related activities. This mindset reflects a preference for maintaining the status quo and adhering to a safety-conscious and conservative approach [55,98]. Previous studies proposed that personality can influence W_ICTs. Employees with high levels of prevention focus tend to display characteristics such as introversion and relatively low level of enthusiasm for interpersonal interactions and organizational commitment [99]. Consequently, their work behavior tends to be less proactive as they tend to avoid situations or initiatives that carry perceived risks. This tendency can significantly affect their willingness take on new challenges or change their work environment [100]. Therefore, given this propensity toward caution and compliance, individuals with prevention focus are more likely to view W_ICTs with a critical eye, potentially perceiving them as disruptive or risky to the existing equilibrium.

Drawing on the concept of prevention focus, this study aims to investigate whether it moderates the inverted U-shaped relationship between W_ICTs and intrinsic motivation. As W_ICTs increases from low to moderate, employees allocate their personal time to work-related tasks, blurring the boundaries between work and personal life. Particularly, W_ICTs may cause employees to remain on call beyond their regular working hours, resulting in negative emotions. Employees with a high prevention focus are more susceptible to experiencing these negative emotions during such times [53,101]. Moreover, when employees engage in W_ICTs, such as answering calls or working from home, they may not receive the corresponding rewards for their extra effort. This scenario can lead to conflicts between employees and the organization owing to frequent overtime and extended working hours. Thus, they may have a negative attitude and sense of rejection towards work tasks to avoid such conflicts or losses, further reducing their intrinsic motivation. In additional, these employees prefer maintaining existing work patterns to prevent job insecurity stemming from potential organizational changes [102]. Therefore, they do not perceive W_ICTs as a job resource that enhances work efficiency. This dynamic may affect their willingness to engage in work-related in their after-hours, reducing their intrinsic motivation.

In contrast, employees with a low prevention focus are more likely to perceive W_ICTs as a job resource. Sufficient job resources can provide employees with psychological and organizational resources such as organizational support, performance feedback, and a stronger sense of identification with their leaders. These factors are likely to enhance employees' self-efficacy and enjoyment. However, as the frequency and intensity of W_ICTs further increase from moderate to high, employees' self-efficacy and enjoyment decrease. At this point, W_ICTs, viewed as a job demand, initiates a resource-depletion process. Excessive workload and prolonged working online make highly prevention focus employees more likely to experience negative emotions and lower self-efficacy. Therefore, this study suggests that the resource depletion is more pronounced among high prevention focus employees, which results in a stronger negative impact of high-intensity W_ICTs on self-efficacy and enjoyment. Thus, we propose the following hypotheses.

Hypothesis 6.   Prevention focus moderates the inverted U-shaped relationship between W_ICTs and self-efficacy. That is, the inverted U-shaped relationship is stronger with low prevention focus than those with high prevention focus.

Hypothesis 7.   Prevention focus moderates the inverted U-shaped relationship between W_ICTs and enjoyment. That is, the inverted

U-shaped relationship is stronger with low prevention focus than those with high prevention focus.

The theoretical model is shown in Fig. 2.

3. Methods

3.1. Sample and collection

This study employed various methods, including web pages, APPs, telephones, and emails, for the collection of questionnaires. The entire data collection process spanned approximately 8 months, from December 2022 to July 2023. The sample was drawn from 13 state-owned enterprises (SOEs) located in Beijing, Hebei, Guangdong, Shanxi, and Anhui provinces in China. The widespread use of electronic communication devices within SOEs allowed us to disseminate the survey efficiently, thus ensuring a broader and more representative sample. To ensure accuracy, data from the period encompassing December 2022 (due to China's Covid-19-related policies) and January 2023 (due to the Chinese New Year) were excluded from the analysis. This multi-channel approach and selection was designed to maximize the randomness in sample selection, thereby reducing the potential for selection bias. This method enhances the representative of our sample and contributes to the overall validity and reliability of our research findings.

A total of 1031 questionnaires were collected. To further ensure the representativeness of the sample, we rigorously eliminated invalid questionnaires with missing data rates exceeding 5 % and unclear work hour boundaries (e.g., from 9 a.m. to 5 p.m.). Finally, we obtained 817 valid questionnaires, resulting in a response rate of 79.2 %. This large and diverse sample is reflective of the target population, allowing for reliable extrapolation of the findings to a broader context. In this survey, males accounted for 55.2 % of the total, whereas females accounted for 44.8 %. Approximately 26.0 % of employees were 18–25 years old, 47.9 % were 26–35 years old, 15.4 % were 36–45 years old, 10.7 % were 46–55 years old, and 0.12 % were 56 years old and above. Regarding the educational level, participants with a college degree or below accounted for 31.3 %, those having a bachelor's degree were 59.4 %, and 9.3 % had a postgraduate degree or above. Regarding marital status, 49.9 % were unmarried, 47.9 % were married, and 2.2 % were others. Regarding working years, those with less than one year accounted for 16.3 %, those having worked for 1–5 years were 45.4 %, those having worked for 6–10 years were 21.1 %, 5.9 % worked for 11–15 years, 6.0 % for 16–20 years, and 5.3 % worked for over 20 years.

3.2. Measures

All measures of the variables in this study were obtained from internationally recognized and publicly available scales that have been widely validated for their suitability in measuring the intended constructs. A translation and back-translation procedure were implemented to ensure the consistency and equivalence of the questionnaires. Furthermore, to ensure the cultural relevance and validity of the Chinese versions of these scales, we invited experts in the field of management and doctoral students to conduct a thorough examination of our Chinese questionnaires. Their expertise and insights helped to confirm that our indicators are aligned, thereby enhancing the internal and external validity of our measurements. Except for W_ICTs and demographic information, all other variables were measured using a Likert 5-point scale, with "1 = strongly disagree" and "5 = strongly agree."

W_ICTs. The scale, originally developed by Boswell and Olson-Buchanan [103], has been adapted by Ma et al. [59] to better align with the Chinese context, gaining widespread acceptance among researchers. This version of the scale has consistently shown good reliability and validity across numerous studies. It comprises three items measured on a Likert 7-point scale with responses ranging from "1 = strongly disagree" to "7 = strongly agree". Examples include "How often do I communicate with others for work matters
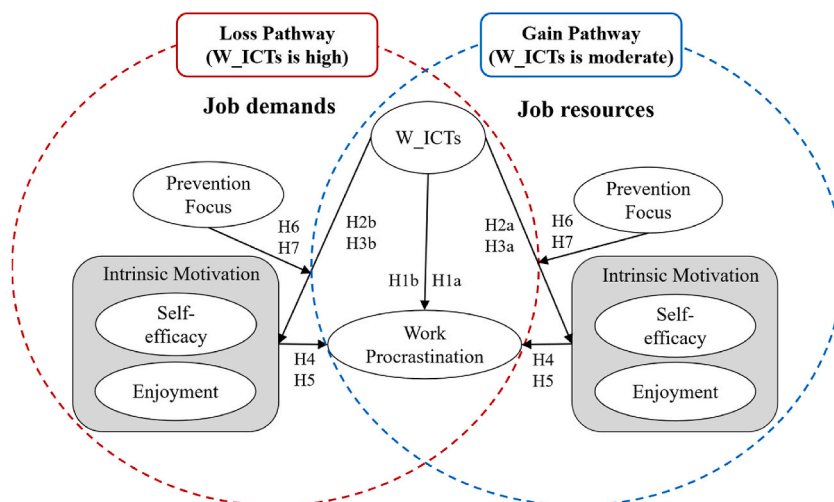

Fig. 2. Theoretical model.

through the APPs (e.g., WeChat, Tencent Meeting) after-hours?". The Cronbach's α for this scale was 0.883, indicating a high level reliability.

Work procrastination. The general procrastination scale by Lay et al. [65] was used to measure work procrastination, which consists of 20 items. Examples include "Even for very simple and easy tasks, I rarely complete them within a few days" and "I won't start writing until it's close to the deadline for submitting reports." In this study, the Cronbach's α for this scale was 0.948, demonstrating high reliability.

Self-efficacy. The general self-efficacy scale developed by Luszczynska et al. [104] was employed to measure self-efficacy. This scale comprises 10 items and is used to assess an individual's general confidence in dealing with various environmental challenges or facing new situations. For example, "In my work, if I put in the necessary effort, I am certain I can solve most problems." The reliability of this scale was confirmed by a Cronbach's α value of 0.954.

Enjoyment. The scale from Kanai et al. [105], which is part of the workaholism scale, was used in this study. It consists of 7 items, such as "My job is enjoyable, often does not feel like work." The Cronbach's α for this scale was 0.858, indicating a high level reliability.

Prevention focus. The regulatory focus scale developed by Lockwood et al. [106] was used to measure prevention focus. It consists of 9 items, such as "I often worry that I will not achieve my work goals" and "I am more inclined to avoid losses than to achieve gains." In this study, the Cronbach's α was 0.830 and showed good reliability.

Control variables. Employees' gender, age, educational level, working years, and marital status were selected as control variables to avoid potential impacts on the results.

4. Results analysis

4.1. Descriptive analysis

This study used descriptive analysis (means, standard deviations, and correlations) using SPSS 26.0 to explore the relationships among the variables. As shown in Table 1, W_ICTs was significantly related to self-efficacy, enjoyment, prevention focus, and work procrastination ($r_1 = 0.412$, $r_2 = 0.231$, $r_3 = 0.093$, $r_4 = 0.335$, respectively; $p < 0.01$). Self-efficacy and enjoyment were significantly and negatively correlated with work procrastination ($r_5 = -0.312$, $r_6 = -0.636$; $p < 0.01$). These correlation results provide preliminary evidence for subsequent hypothesis testing.

4.2. Normality test

The Q-Q plot method, a graphical tool for testing the normality of samples, was employed to assess the correspondence between the actual and theoretical distributions of the variables. As shown in Fig. 3, the horizontal axis represents the observed values of the variables, and the vertical axis denotes the expected values in a normally distributed set. Among the assessed variables, W_ICTs, work procrastination, self-efficacy, enjoyment, and prevention focus all displayed normal distributions within the participant sample.

4.3. Confirmatory factor analysis

The survey in this study was all reported by employees, which may raise the potential for common method bias due to the single-source sample. To address this concern, this study followed the approach suggested by Podsakoff et al. [107], conducting a confirmatory factor analysis using AMOS 26.0 to verify the construct validity of our scales and measurement model. As shown in Table 2, the fit indices for our proposed model (Five-factor model: W_ICTs, work procrastination, self-efficacy, enjoyment, and prevention focus) were significantly better than those of alternative models ($\chi^2 = 2517.01$, $df = 1101$, $\chi^2/df = 2.29$, CFI = 0.96, TLI = 0.95, RMSEA = 0.05). These findings suggest no evidence of common method bias in the data.

Table 1
The results of descriptive analysis.

Variables	1	2	3	4	5	6	7	8	9
1. Ages	–								
2. Edu level	−0.024	–							
3. Marital status	0.583**	−0.023	–						
4. Working years	0.756**	−0.087*	0.474**	–					
5. W_ICTs	0.237**	0.262**	0.173**	0.092**	–				
6. Self-efficacy	0.192*	0.287**	0.148**	0.062	0.412**	–			
7. Enjoyment	0.135**	0.056	0.113**	0.049	0.231**	0.440**	–		
8. WP	0.003**	−0.040	0.003	0.047	0.093**	−0.312**	−0.636**	–	
9. PF	0.162**	0.125*	0.101**	0.057	0.335**	0.304**	0.335**	−0.222**	–
Mean	2.11	1.78	1.53	2.56	3.44	3.24	3.28	3.11	2.46
SD	0.916	0.599	0.573	1.303	1.093	0.961	0.875	0.841	0.842

Note: **$p < 0.01$, WP= Work procrastination, SD= Standard deviations, Edu level = Educational level, PF = prevention focus.
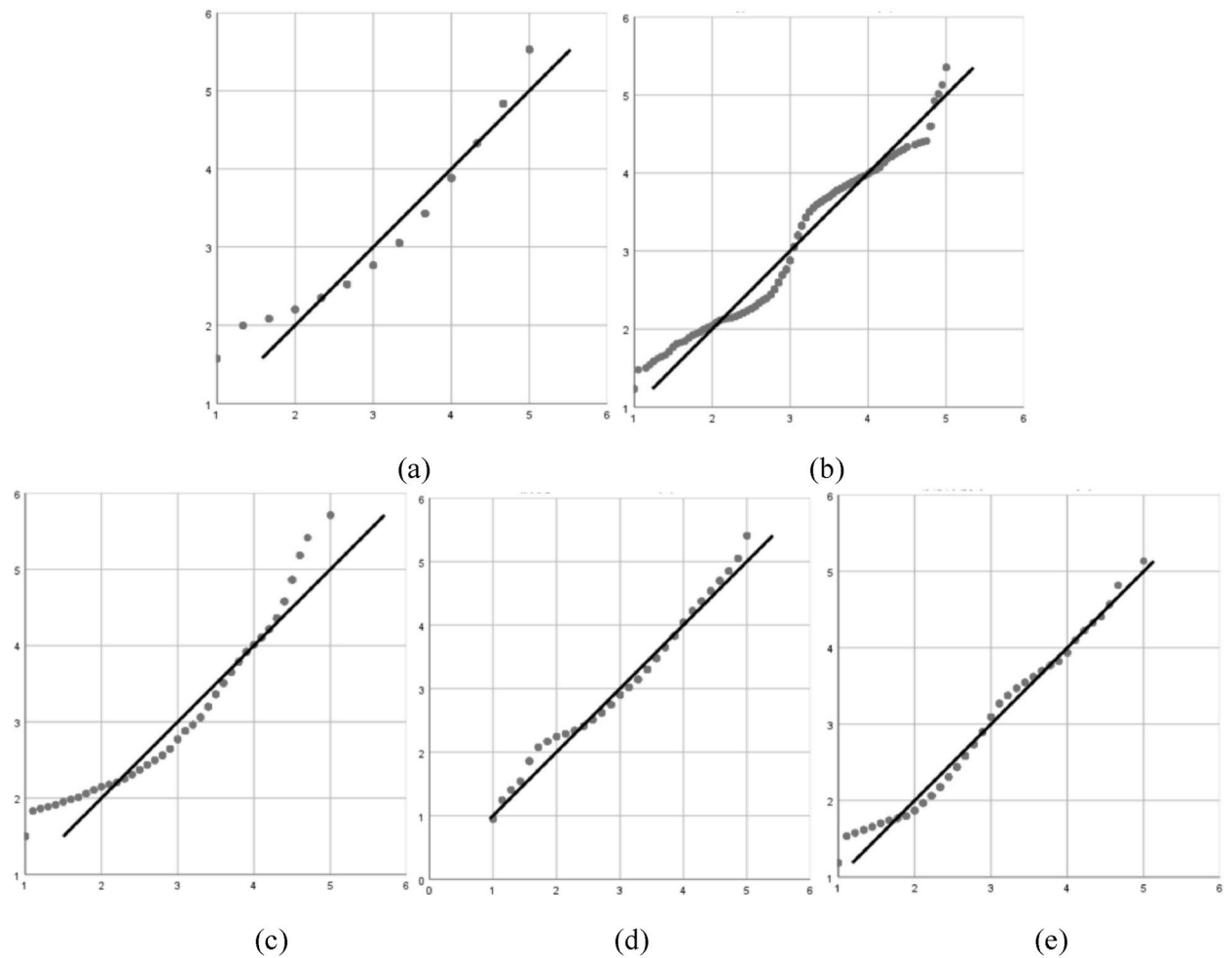
Fig. 3. (a) Normality test of W_ICTs; (b) normality test of work procrastination; (c) normality test of self-efficacy; (d) normality test of enjoyment; (e) normality test of prevention focus.

Table 2
The results of confirmatory factor analysis.

Models	Factors	χ^2	df	χ^2/df	CFI	TLI	RMSEA
One-factor model	W_ICTs + Self-efficacy + Enjoyment + PF + WP	17447.66	1124	15.52	0.48	0.45	0.18
Two-factor model	W_ICTs + Self-efficacy + Enjoyment + PF, WP	13930.58	1122	12.42	0.59	0.57	0.16
Three-factor model	W_ICTs, Self-efficacy + Enjoyment + PF, WP	8417.89	1108	7.60	0.77	0.75	0.10
Four-factor model	W_ICTs, Self-efficacy + Enjoyment, PF, WP	5197.71	1105	4.70	0.87	0.86	0.10
Five-factor model	W_ICTs, Self-efficacy, Enjoyment, PF, WP	2517.01	1101	2.29	0.96	0.95	0.05

Note: PF = prevention focus, WP = work procrastination.

4.4. Multicollinearity test

The correlation analysis in Table 1 showed that the coefficients among all the measured variables were below 0.7, providing initial evidence of no multicollinearity. Subsequently, a more comprehensive evaluation of the multicollinearity among the variables was conducted by considering the variance inflation factor (VIF). Note that VIF values exceeding 10 typically indicate multicollinearity. The results revealed that the VIF values for W_ICTs, work procrastination, self-efficacy, enjoyment, and prevention focus were lower than 2. Since the VIF values were considerably below the threshold, no evidence of multicollinearity is observed among the variables.

4.5. Tests of hypotheses

This study used the "U-shaped relationship test" method proposed by Haans et al. [108] to test our hypotheses. The analysis was

conducted by SPSS 26.0; the results were showed in Table 3. Model 1 represents the regression model of control variables on work procrastination. In Model 2, after controlling employee's gender, age, educational level, marital status and working years, W_ICTs (β_1 = 0.347, p < 0.001) and its square term (β_2 = 0.413, p < 0.001) have significant positive effects on work procrastination ($\triangle R^2$ = 0.126, F = 17.775, p < 0.001). According to Model 2, the range of normalized W_ICTs is [−2.44, 1.56]. Therefore, when W_ICTs takes the minimum value (x_{min} = -2.44), the curve slope $k = \beta_1 + 2\beta_2 < 0$; when W_ICTs takes the maximum value (x_{max} = 1.56), the curve slope $k = \beta_1 + 2\beta_2 > 0$, and the inflection point of the curve falls within the interval [−2.44, 1.56]. These results reveal the presence of a U-shaped relationship between W_ICTs and work procrastination. Specifically, a lower level of W_ICTs is associated with decreased work procrastination. However, as the frequency of W_ICTs increases, work procrastination also increases. Thus, Hypothesis 1 was supported. The impact of W_ICTs on work procrastination is illustrated in Fig. 4.

This study further examines the mediating effects of intrinsic motivation, namely self-efficacy and enjoyment. As indicated by the regression results in Model 3, the squared term of W_ICTs is negatively correlated with self-efficacy (β_3 = -0.416, $\triangle R^2$ = 0.321, F = 56.093, p < 0.001). When W_ICTs is minimum (x_{min} = -2.44), the slope k >0; and when W_ICTs is maximum (x_{max} = 1.56), k <0, indicating an inverted U-shaped relationship between W_ICTs and self-efficacy (as shown in Fig. 5 (left)). Thus, Hypothesis 2 was supported. Similarly, in Model 4, the squared term of W_ICTs is negatively correlated with enjoyment (β_4 = -0.399, $\triangle R^2$ = 0.152, F = 21.842, p < 0.001), indicating an inverted U-shaped relationship between these two variables (as shown in Fig. 5 (right)). Thus, Hypothesis 3 was supported. In Model 5, both self-efficacy (β_5 = -0.621, p < 0.001) and enjoyment (β_6 = -0.116, p < 0.001) are negatively correlated with work procrastination ($\triangle R^2$ = 0.494, F = 89.620, p < 0.001). Moreover, the relationship between the squared term of W_ICTs and work procrastination is significantly reduced (β_7 = 0.117, p < 0.001). According to the three-step mediation analysis proposed by Baron and Kenny [109], self-efficacy and enjoyment partially mediate the relationship between W_ICTs and work procrastination. Hence, Hypothesis 4 and Hypothesis 5 were supported.

However, Hayes et al. [110] proposed that Baron and Kenny's three-step method for testing mediation effects may be biased in cases of U-shaped relationships between variables and may not clearly explain the role of the mediators. Therefore, this study further introduced the Bootstrap method (bootstrapping = 5000 times) recommended by Preacher et al. [111] to test the mediating effect of intrinsic motivation on the relationship between W_ICTs and work procrastination. As shown in Table 4, the 95 % confidence interval for the mediating effect of self-efficacy ranges from [−0.077, −0.026], which does not include 0; and the mediating effect is statistically significant (β_8 = -0.050, p < 0.001). Similarly, the 95 % confidence interval for the mediating effect of enjoyment ranges from [−0.158, −0.066], which does not include 0; and the mediating effect is statistically significant (β_9 = -0.113, p < 0.001). According to the Bootstrap mediation test, self-efficacy and enjoyment play significant mediating roles in the relationship between W_ICTs and work procrastination. Therefore, Hypothesis 4 and Hypothesis 5 were further supported.

This study used the method proposed by Haans et al. [108] to test the moderating effect in a U-shaped relationship. The approach was developed as follows:

$m_i = \beta_{10} + \beta_{11}x + \beta_{12}x^2 + \beta_{13}xw + \beta_{14}x^2w + \beta_{15}w, i = 1, 2$. Where:

- m_i represents the mediator variable, which includes self-efficacy and enjoyment;
- x represents W_ICTs;
- w represents the moderating variable, which is prevention focus.

According to Haans et al.'s research, for a U-shaped relationship.

- If β_{14} is positive and significant, the curve's inflection point shifts to the right as the level of the moderating variable increases.
- If $\beta_{11}\beta_{14} - \beta_{12}\beta_{13} > 0$ and significant, the U-shaped curve is steeper at higher levels of the moderating variable.

In Model 7 (in Table 5), since the coefficient of the interaction term between the square of W_ICTs and prevention focus is not

Table 3
The results of hierarchical regression analysis.

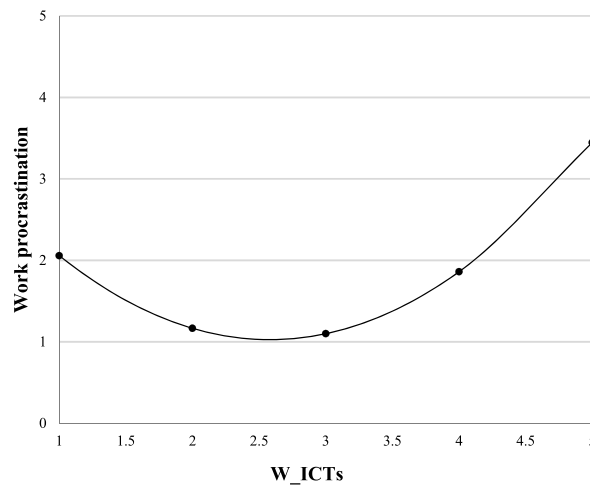| Variables	Work procrastination		Self-efficacy	Enjoyment	Work procrastination
	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	−0.128***	−0.095***	0.039	0.028	−0.073***
Age	−0.075	−0.002	0.055	0.016	0.015
Educational level	−0.016	−0.023	0.163***	−0.033	−0.024
Marital status	0.001	0.008	0.028	0.029	0.029
Working years	0.112*	0.072	−0.045	−0.033	0.046
W_ICTs		0.347***	0.100***	−0.011	0.352***
W_ICTs^2		0.413***	−0.416***	−0.399***	0.117***
Self-efficacy					−0.621***
Enjoyment					−0.116***
R^2	0.022	0.133	0.327	0.159	0.500
$\triangle$R^2	0.016	0.126	0.321	0.152	0.494
F	3.608***	17.775***	56.093***	21.842***	89.620***

Note: *p < 0.05, **p < 0.01, ***p < 0.001.

Fig. 4. The U-shaped relationship between W_ICTs and work procrastination.
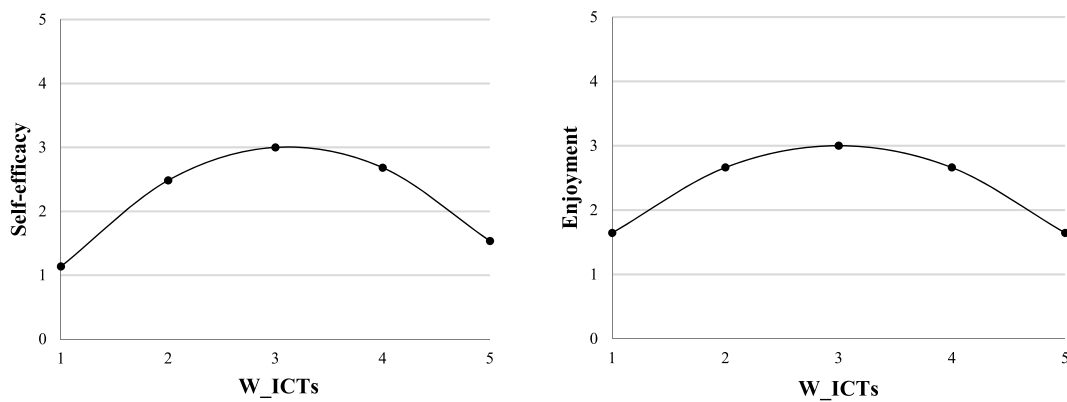

Fig. 5. The inverted U-shaped relationship between W_ICTs and intrinsic motivation.

Table 4
Bootstrap results for the mediating variables.

	Bootstrap result		Two-Tailed P-Value	95 % confidence interval	
	Effects	SE		Lower	Upper
Total effect	0.071	0.027	<0.01	0.019	0.124
Direct effect	0.234	0.022	<0.001	0.192	0.276
Mediating effect of self-efficacy	−0.050	0.013	<0.001	−0.077	−0.026
Mediating effect of enjoyment	−0.113	0.023	<0.001	−0.158	−0.066
Total indirect effect	−0.163	0.307	<0.001	−0.223	−0.101

statistically significant ($\beta = 0.038$, p > 0.05), it suggests that prevention focus does not moderate the relationship between W_ICTs and employees' self-efficacy. Therefore, Hypothesis 6 was not supported. In Model 9, the coefficient of the interaction between the square of W_ICTs and prevention focus is positive and significant ($\beta_{14} = 0.168 > 0$, $\triangle R^2 = 0.260$, F = 29.603, p < 0.001), indicating that a high level of prevention focus makes the inverted U-shaped curve smoother. Additionally, $\beta_{11}\beta_{14} - \beta_{12}\beta_{13} < 0$ suggests that the curve's inflection point is lower for a high level of prevention focus. Thus, Hypothesis 7 was supported.

Following Aiken and West's [112] simple slope test, this study analyzed the relationship between W_ICTs and enjoyment under low (M − 1SD) and high (M + 1SD) levels of prevention focus. As shown in Fig. 6, when the level of W_ICTs is low, employees with a low prevention focus show a stronger positive impact of W_ICTs on enjoyment than those with a high prevention focus. However, when employees exhibit a high level of W_ICTs, those with low prevention focus show a stronger negative impact on enjoyment.

Table 5
The results of moderating effect test.

Variables	Self-efficacy		Enjoyment	
	Model 6	Model 7	Model 8	Model 9
Gender	0.083	0.073	0.065	0.029
Age	0.046	0.045	−0.007	−0.011
Educational level	0.256***	0.252***	−0.060	−0.073
Marital status	0.048	0.047	0.047	0.046
Working years	−0.029	−0.025	−0.014	−0.001
W_ICTs	0.069**	0.102	0.044	−0.119
W_ICTs^2	−0.222***	−0.290***	−0.180***	−0.513***
Prevention focus	0.130	0.075	−0.246***	−0.013
W_ICTs × Prevention focus		−0.190		0.012
W_ICTs^2 × Prevention focus		0.038		0.168***
R^2	0.338	0.342	0.207	0.269
$\triangle R^2$	0.331	0.334	0.119	0.260
F	51.518***	41.871***	26.304***	29.603***

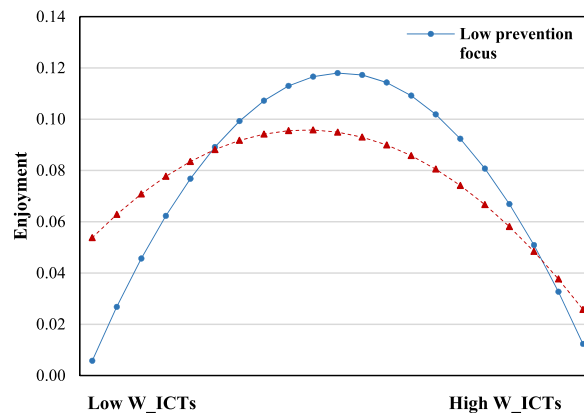Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Fig. 6. The moderating effect of prevention focus between W_ICTs and enjoyment.

5. Discussions

This study uses JD-R theory to examine the dynamic curvilinear relationship between W_ICTs and work procrastination. The mediating role of intrinsic motivation (self-efficacy and enjoyment) and the moderating role of prevention focus are also investigated. Empirical testing of the research hypotheses was conducted and the following findings are obtained.

First, while existing literature has extensively investigated the relationship between W_ICTs and employees' behavior [3–5,19], research on the influence of this topic still presents limitations. This study builds on previous research [13–18] by examining the impact of W_ICTs on work procrastination. Based on the JD-R theory, our study provides empirical evidence supporting the hypothesis that W_ICTs exhibit both buffering and boosting effects on work procrastination. Specifically, the buffering effect of W_ICTs stems from their ability to provide resources and support, thereby enhancing task completion and productivity. W_ICTs can offer access to relevant information, communication tools, and task management platforms, which enable employees to organize their work efficiently and stay on track with deadlines. Additionally, W_ICTs foster flexible communication and collaboration, facilitating quick decision-making and problem-solving among team members [17]. Consequently, effective utilization of W_ICTs equips employees to manage their workload, thereby reducing the likelihood of procrastination. However, as W_ICTs usage intensifies from moderate to high levels, procrastination behavior increases. The boosting effect of W_ICTs on work procrastination occurs when new stressors and distractions impede task completion. This finding is consistent with previous research [34,113,114], which indicates the negative impact of W_ICTs on employee initiative behavior, highlighting that excessive W_ICTs may lead to decreased work efficiency and negative work attitudes among employees. Constant notifications, emails, and messages through W_ICTs can disrupt employees' focus and concentration, leading to task-switching behavior and procrastination. Moreover, the boundary between work and family has become blurred with the pervasive use of W_ICTs, which makes it challenging for employees to disengage from work-related responsibilities during non-working hours [16,57]. As a result, the excessive use of W_ICTs can contribute to heightened stress levels, cognitive overload, and procrastination tendencies as employees struggle to manage the influx of work-related demands.

Then, this study further explores the mediating roles of self-efficacy and enjoyment in the U-shaped relationship between W_ICTs and work procrastination. On one hand, employees experiencing moderate levels of W_ICTs often perceive greater job autonomy and

flexibility, fostering heightened intrinsic motivation [91,97]. Consequently, these individuals exhibit increased engagement in work tasks, which alleviates procrastination. These results align with previous studies that have shown how moderate W_ICTs can decrease negative behavior [6,12,114]. By fostering a balanced approach to W_ICTs usage, individuals are better equipped to navigate work-related tasks with greater ease and effectiveness. On the other hand, when W_ICTs exceeds a certain threshold, they diminish employees' intrinsic motivation, thereby leading to work procrastination. One potential rationale could be attributed to the substantial allotment of employees' personal time consumed by the frequent use of W_ICTs, eliciting intra-role negative emotions like tension and anxiety. These emotions have the potential to diminish individual self-efficacy and enjoyment, thereby fostering heightened feelings of frustration and work avoidance. These findings are consistent with previous studies [76,88]. Accordingly, employees may engage in compensatory behaviors, such as work procrastination, to alleviate these negative effects.

Finally, this study indicates that prevention focus significantly moderate the inverted U-shaped relationship between W_ICTs and enjoyment, whereas no significant moderating effect is found between W_ICTs and self-efficacy. This finding aligns with previous studies that emphasize the significance of prevention focus in enhancing the influence of job characteristics on employees' intrinsic motivation [115–118]. Previous studies have elucidated how individuals with a strong prevention focus tend to prioritize avoiding negative outcomes and maintaining stability in their work environment. Our results show that the inverted U-shaped effect is weaker when the employees have a higher prevention focus. Individuals with a stronger prevention focus experience heightened resource depletion when exposed to high-intensity W_ICTs, which results in a more pronounced negative effect. In particular, this group may develop a negative attitude toward work tasks to avoid W_ICTs, thereby diminishing their enjoyment. However, no moderating effect is observed in the relationship between W_ICTs and self-efficacy. One possible explanation is that prevention focus may interact with the emotional tone of W_ICTs, such as the tone of voice, facial expressions, and use of emoji [8,119], affecting employees' self-efficacy. Previous research has shown that prevention focus can interact with negative emotions, such as anxiety and sadness [120,121], which can impact individuals' attitudes and behaviors. At the same time, these negative emotions also influence self-efficacy. However, in this study, W_ICTs is measured in terms of frequency, and the emotional tone of W_ICTs is not assessed. Consequently, the moderating effect of prevention focus on the relationship between W_ICTs and self-efficacy is not confirmed.

5.1. Theoretical implications

The key theoretical implications can be summarized as follows. First, by adopting the JD-R theory as a foundational framework, this study uncovers a novel U-shaped relationship between W_ICTs and work procrastination. While previous research has primarily examined the linear effect of W_ICTs [7–10], this study reveals that W_ICTs exhibits a dual effect: it serves as an inhibitor of work procrastination at moderate levels; however, when it exceeds a certain threshold, it becomes a promoter of work procrastination. This study also supplements previous research by focusing on double-edged effects [18,61]. Varying degrees of W_ICTs have both buffering and boosting effects on work procrastination. Therefore, this significant finding not only offers a possible explanation for the inconsistent results observed in prior studies regarding the relationship between W_ICTs and employees' negative behaviors but also contributes to the expansion of research on the outcomes of W_ICTs and the antecedents of work procrastination. Moreover, it responds to scholars' calls for further exploration of the impact of buffering or boosting effects on employee behavior [39,40].

Second, this study focuses on self-efficacy and enjoyment as the two core variables of intrinsic motivation and investigates the mechanism through which W_ICTs impacts work procrastination from the perspective of intrinsic motivation. This study reveals an inverted U-shaped relationship between W_ICTs, self-efficacy, and enjoyment, further impacting work procrastination. In contrast to prior research, which has often focused on variables such as emotional responses, work engagement, and psychological detachment [6,8,122], this study introduces a fresh perspective by considering intrinsic motivation as a mediator in the W_ICTs—individual behavior relationship [41,42]. Additionally, previous research on the double-edged effects of W_ICTs has predominantly focused on assessing its impact by selecting negative and positive variables. However, this research not only shows that W_ICTs simultaneously influences employees' positive and negative states, but also considers its impact on internal motivation as a dynamic transformation process. These findings enhance the current understanding of the mediation mechanisms that link W_ICTs to procrastination. It also sheds light on the specific pathways, intrinsic motivation, through which W_ICTs influences procrastination, offering valuable insights into the dynamics of this relationship.

Third, this study examines the moderating effect of prevention focus on the relationship between W_ICTs and intrinsic motivation. The results indicate that prevention focus moderates the relationship between W_ICTs and enjoyment, deepening the current understanding of how W_ICTs affect enjoyment. However, the moderating effect of prevention focus on the relationship between W_ICTs and self-efficacy is not confirmed. Therefore, by exploring the moderating role of prevention focus in W_ICTs, this study not only offers a new theoretical perspective on the boundary conditions for the inverted U-shaped effect of W_ICTs on enjoyment, but also enriches the theoretical application of Regulatory Focus Theory.

5.2. Practical implications

First, managers can establish balanced policies for W_ICTs by recognizing the positive impact of moderate W_ICTs on reducing work procrastination. This may involve limiting the frequency of work-related messages sent during non-work hours, particularly late at night or on weekends, to ensure that employees have sufficient time to rest and relax. Second, given the mediating role of intrinsic motivation in the relationship between W_ICTs and work procrastination, managers should focus on enhancing employees' self-efficacy and enjoyment. Self-efficacy can be achieved through training, providing the necessary resources, and offering support to help employees feel more confident and competent in managing their work tasks, thereby reducing procrastination. Moreover,

enjoyment plays a critical role in reducing work procrastination. Managers can create positive and enjoyable work environments that encourage employees to experience fun and satisfaction at work. It can be accomplished by offering interesting tasks, reward systems, and employee mental well-being support. Third, considering that different employees may have diverse needs and responses regarding W_ICTs, managers should adopt personalized management strategies, taking into account the prevention or promotion focuses, to reduce work procrastination.

5.3. Limitations and future directions

Although the dynamic mechanism of the impact of W_ICTs on employees' procrastination is confirmed, this study still has the following limitations. First, this study adopts a cross-sectional research design in which all variables are measured simultaneously. However, it is possible that there is a time lag between W_ICTs and employees' work procrastination. Since cross-sectional data may not fully and accurately reflect causal relationships between variables, longitudinal surveys should be considered in the future. Second, this study mainly focuses on the frequency of W_ICTs. Nevertheless, it is crucial to acknowledge that the content-related factors and emotional tone of W_ICTs, including linguistic elements like formal or informal greetings and non-linguistic features such as emoji usage, are equally significant. Future research could explore the impact of emotion-based W_ICTs on employee attitudes and behaviors more deeply. Third, this study focuses on the prevention focus of the Regulatory Focus Theory. Future research might extend this investigation to explore the moderating effect of the promotion focus, providing a more comprehensive perspective on the influence of regulatory focus in this context. Last but not least, this study exclusively investigated employees in SOEs within the context of Chinese culture. Different cultural backgrounds, industry settings, and organizational structures may lead to varying influences on work attitudes, values, and behaviors. Future research could explore the usage of W_ICTs in different cultural backgrounds, industry types, and organizational structures to gain a more comprehensive understanding of changes in employee work attitudes and behaviors.

6. Conclusions

This study contributes to understanding of the complex relationship between W_ICTs and work procrastination. Drawing upon JD-R theory, we developed a dynamic curvilinear model that considers self-efficacy, enjoyment, and prevention focus as key factors influencing this relationship. Empirical testing conducted through a survey of 817 employees yielded several key findings.

First, W_ICTs can act as an inhibitor and promoter of work procrastination, displaying a U-shaped impact on the phenomenon. This result suggests that the moderate use of W_ICTs during off-hours can enhance employees' productivity and reduce procrastination, whereas excessive use may lead to increased procrastination. Second, intrinsic motivation, namely self-efficacy and enjoyment, plays a significant mediating role in the relationship between W_ICTs and work procrastination. This finding implies that when employees have high levels of self-efficacy and enjoyment, W_ICTs are more likely to have a positive impact on their work performance and reduce procrastination. Third, prevention focus moderates the relationship between W_ICTs and enjoyment, indicating that the effect of W_ICTs on enjoyment is stronger when employees have a prevention focus. However, the moderating effect of prevention focus on the relationship between W_ICTs and self-efficacy is insignificant.

These findings contribute to our understanding of the complex relationship between W_ICTs and work procrastination and provide valuable insights for organizations seeking to manage W_ICTs and address work procrastination behavior. By considering the mediating role of intrinsic motivation and the moderating effect of prevention focus, organizations can develop effective strategies to optimize the use of W_ICTs and promote employees' well-being and productivity.

In conclusion, this study highlights the importance of considering intrinsic motivation and prevention focus when examining the impact of W_ICTs on work procrastination. The findings underscore the need for organizations to foster a supportive environment that promotes employees' self-efficacy and enjoyment, while also encouraging a balanced approach to W_ICTs. By doing so, organizations can harness the potential benefits of W_ICTs and mitigate the risks associated with work procrastination.

Data availability statement

The data presented in this study are available on request from the first author.

Informed consent

Based on the features of our digital data collection channels, which include web pages, apps, telephone, and email, we opted for orally informed consent to enhance practicality and convenience in securing real-time consent through conversational interactions. It is important to note that confirmation of recorded verbal consent is employed in our study methodology. All respondents provided oral informed consent, and their confirmation has been recorded, allowing them to participate in this study and to have their data published in a journal article.

Ethics declarations

This study was reviewed and approved by Ethics Committee of School of Economics and Management, Beijing Information Science and Technology University, with the approval number EA202301017. All participants provided informed consent to participate in the study.

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CRediT authorship contribution statement

Ganli Liao: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Conceptualization. **Li Feng:** Visualization, Supervision, Resources, Conceptualization. **Xinyi Zheng:** Writing – review & editing, Funding acquisition. **Jiao Zhou:** Resources, Methodology, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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