# The Influence Mechanism of Knowledge Stock on Improvisational Behavior Under Time Pressure

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## Abstract

Improvisational behavior represents a behavioral pattern characterized by both immediacy and creativity. However, research that elaborates on the generation mechanism of improvisational behavior by incorporating its essential nature remains insufficient. To address this gap, the present study integrates knowledge association theory and activation theory—which respectively align with the creative and immediate characteristics of improvisational behavior—to investigate the influence mechanism of knowledge stock on individual improvisational behavior under time pressure. Study 1 (N=163) and Study 2 (N=163), employing college students and organizational employees as participants respectively, revealed through experiments that knowledge stock promotes individual improvisational behavior by enhancing knowledge transformation; this relationship was particularly stronger under moderate time pressure conditions. Study 3 (N=201) conducted a multi-time-point paired questionnaire survey, further confirming that time pressure exerts an inverted U-shaped moderating effect on the process through which knowledge stock influences knowledge transformation, which subsequently affects improvisational behavior. Across three studies, we conclude that under moderate time pressure, knowledge stock more effectively stimulates individual improvisational behavior through its impact on knowledge transformation, whereas this effect is weaker under high or low time pressure. These findings comprehensively elucidate the generation process mechanism through which knowledge stock enables improvisational behavior under time pressure, providing a novel perspective for effective theoretical integration based on its characteristics and holding positive significance for understanding the dynamic nature and complexity of improvisational behavior.

## Full Text

# Influence of Knowledge Stock on Improvisation Under Time Pressure

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### Abstract

Improvisation is a behavioral pattern characterized by both spontaneity and creativity. However, research that integrates these essential features to elaborate on the generative mechanisms of improvisation remains insufficient. To address this gap, the present study integrates knowledge linking theory and activation theory—corresponding respectively to the creative and spontaneous features of improvisation—to examine the influence mechanisms of knowledge stock on individual improvisation under time pressure. Study 1 (N = 163) and Study 2 (N = 163), employing student and organizational employee samples respectively, experimentally demonstrated that knowledge stock promotes individual improvisation through enhanced knowledge transformation, with this relationship being particularly pronounced under medium time pressure. Study 3 (N = 201) utilized a multi-time-point paired questionnaire survey to further confirm that time pressure exerts an inverted U-shaped moderating effect on the relationship between knowledge stock and knowledge transformation, which in turn influences improvisation. Across three studies, we conclude that under medium time pressure, knowledge stock more effectively stimulates individual improvisation through knowledge transformation, whereas this effect is weaker under high or low time pressure. These findings comprehensively reveal the generative process mechanisms through which knowledge stock empowers improvisation under time pressure, providing a novel perspective for theoretically integrating improvisation based on its characteristic features and offering meaningful insights into understanding the dynamic and complex nature of improvisation.

**Keywords:** improvisation, knowledge stock, knowledge transformation, time pressure

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## Introduction

In today's increasingly complex and uncertain environment, rigid predetermined arrangements and fixed plans may become shackles for organizational development. This compels organizational members to seize opportunities for change by taking immediate action flexibly under the dual pressures of time constraints and unexpected situations (Hu et al., 2018). Consequently, improvisation has become a critical source for organizations to rapidly respond to challenges, enhance effectiveness, and gain competitive advantages (Mannucci et al., 2021).

Evidently, individual improvisation is rooted in daily work practices and can drive organizations to achieve leapfrog development, with its importance becoming increasingly prominent (Cunha et al., 1999; Mamédio et al., 2022).

Individual improvisation refers to the spontaneous use of novel and creative methods to solve problems by drawing upon resources such as knowledge and experience (Magni et al., 2009; Vera & Crossan, 2005). Spontaneity and creativity constitute its primary characteristics: **Spontaneity** emphasizes the immediate response within time constraints (Wang et al., 2016; Leybourne & Smith, 2006), typically associated with time pressure for completing improvisational tasks (Li & Li, 2019; Crossan et al., 2005); **Creativity** refers to the characteristic of using resources to solve problems creatively (Vera & Crossan, 2005). Therefore, improvisation is also defined as "creativity under time pressure" (Crossan et al., 2005; Hodge & Ratten, 2015).

Existing research has fully affirmed the importance of improvisation (Abrantes et al., 2018; Arias & Cepeda, 2022; Chen et al., 2021; Liu et al., 2023; Parida et al., 2013; Xiang et al., 2020). However, although improvisation can occur at individual, team, and organizational levels, research at the individual level is extremely scarce compared to the team and organizational levels (Ciuchta et al., 2021). As the foundation of team and organizational improvisation (Cunha et al., 1999), individual improvisation is not only the driving force for improving team and organizational effectiveness but also a key behavior increasingly relied upon by modern successful organizations (Mannucci et al., 2021; Rego et al., 2022). The micro-foundations approach emphasizes that understanding collective phenomena fundamentally requires first clarifying the operational mechanisms at the individual level (Abell et al., 2008). However, existing reviews of improvisation research indicate that studies on antecedents of individual-level improvisation are significantly inadequate (Ciuchta et al., 2021). Therefore, in-depth exploration of the antecedents of individual improvisation is not only a necessary path to reveal its generative mechanisms but also a critical step to understand its micro-processes and advance relevant theoretical and practical development.

By reviewing existing literature, we find that the limited individual improvisation research primarily examines antecedents from internal factors (e.g., self-efficacy, Nisula, 2015; personality traits, Wu & Ma, 2019) and external factors (e.g., leadership styles, Ren et al., 2022; organizational culture, Hadida et al., 2015), with a focus on its creative characteristics (Nisula, 2015). However, this research perspective that focuses on either-or distinctions and one-sidedly emphasizes a single characteristic makes it difficult to comprehensively and accurately reveal the core essence of improvisation. In fact, Weick (2001) pointed out that improvisation is a "just-in-time strategy," emphasizing that inseparable "immediacy" and "creativity" are its defining characteristics (Vera & Crossan, 2004, 2005). These features collectively define the essence of improvisation as "improvisation on the spot," clearly distinguishing it from concepts such as innovative behavior and creativity (Crossan & Hurst, 2006; Nisula & Kianto, 2016).

Therefore, it is precisely the essential characteristics of improvisation that presuppose the necessary enabling elements for its generative mechanism. Only by introducing an integrated theoretical perspective corresponding to its features can we more comprehensively explore the driving mechanisms of improvisation and provide theoretical support for constructing a comprehensive and unified framework for improvisation generation, thereby laying a solid theoretical foundation for subsequent research.

Based on the essential connotation of improvisation, it is "creativity under time pressure"(Hodge & Ratten, 2015). Knowledge linking theory posits that individual responses in innovative situations do not rely solely on existing knowledge but rather on continuously linking existing knowledge with new knowledge to generate new ideas and perspectives, thereby shaping innovative problem solutions (Nonaka & Toyama, 2003). Consequently, knowledge linking theory emphasizes the important role of knowledge stock in the creative process (Caillies et al., 2002; Nonaka, 1994) and can effectively explain whether and how knowledge stock promotes improvisation. Knowledge stock, as the sum of various types of knowledge and experience that individuals have mastered (Luo et al., 2011), forms the basis for knowledge circulation, penetration, and transition (Zhang & Liang, 2019). In situations requiring immediate action, individuals rapidly integrate old and new knowledge based on their prior stock of knowledge (Zahra & George, 2002), continuously processing and constructing to stimulate knowledge transformation (Al-Tit, 2016; Sung & Choi, 2018). Knowledge transformation, as the linking of old and new knowledge, can initiate broader thinking processes and elicit multidimensional perspectives, thereby greatly promoting the emergence of new ideas (Wu & Dai, 2016) and effectively stimulating individual improvisation.

Furthermore, improvisation typically occurs in situations with time urgency that require rapid action (Shan et al., 2023), with time pressure serving as a necessary boundary condition for its generation (Cunha et al., 1999; Magni et al., 2010). Given that this situational condition exceeds the scope of knowledge linking theory itself, this study further introduces activation theory to address this question. Activation theory posits that increased time pressure elevates individuals' physiological activation levels, thereby affecting their cognitive and behavioral responses. However, beyond a certain critical point (CLA, optimal activation level), this activation 反而会妨碍个体的行为效率 (Gardner, 1986). Therefore, varying degrees of time pressure will determine whether individuals can maximize their knowledge management mechanisms, consequently producing differential effects on subsequent improvisation. Integrating these two theories, this study focuses on the essential connotation of improvisation and comprehensively constructs a mediated moderation process model of knowledge stock empowering improvisation under time pressure (as shown in Figure 1

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Thus, this study deepens the understanding of the scientific question regarding "how, under the influence of time pressure as a situational cue, knowledge

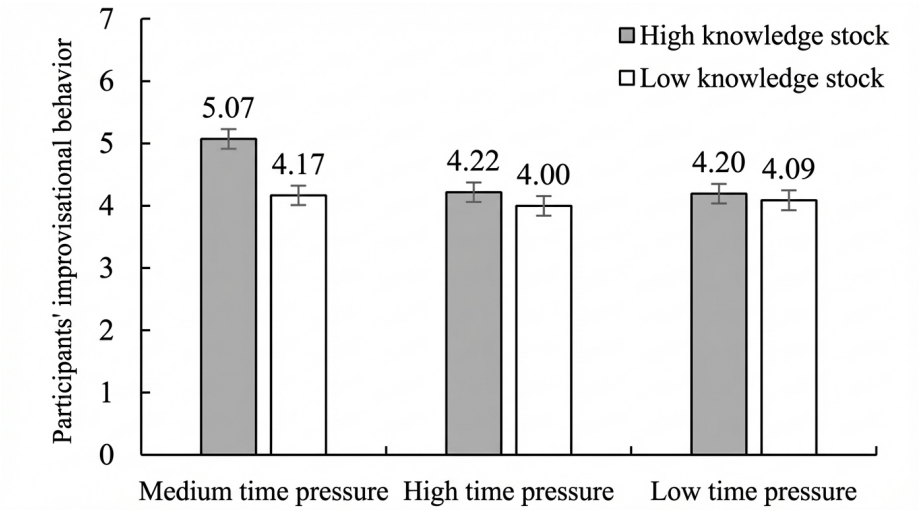


Figure 1: Figure 1

stock affects knowledge transformation to differentially stimulate individual improvisation," and attempts to construct a more rigorous explanatory framework to reveal the generative mechanisms of improvisation. Potential contributions include: First, this study directly focuses on the essential connotation of improvisation for theoretical integration, introducing knowledge linking theory and activation theory into the improvisation field, providing a systematic analytical framework for more comprehensively understanding improvisation generation mechanisms from an integrated perspective. Second, through empirical testing, this study clearly presents and verifies the boundary condition role of time pressure, providing a critical focal point for when knowledge management mechanisms can exert their maximum advantage and advancing the interpretation of deep-seated drivers of improvisation. Third, by elucidating the internal mechanisms through which knowledge stock influences improvisation, this study constructs a dynamic generation path for improvisation that organically integrates knowledge management and time pressure, offering a new perspective for exploring the antecedent mechanisms of improvisation.

## Theoretical Development

**Knowledge Stock and Improvisation** Based on the creative characteristic of improvisation, it fundamentally relies on the accumulation, integration, and reorganization of knowledge. As the core carrier of cognitive resources, knowledge forms the cornerstone for constructing higher-order thinking and creative solutions (Arias & Cepeda, 2022). Knowledge stock refers to the sum of various types of knowledge and experience accumulated by individuals in production and life practices (Luo et al., 2011). According to knowledge linking theory,

knowledge stock is regarded as an important resource base for innovation (Sung & Choi, 2018). Only with highly task-relevant knowledge can individuals deeply process, evaluate, and integrate task information to generate innovative ideas. Particularly in uncertain situations, individuals need to rapidly acquire and apply knowledge, which requires sufficient knowledge reserves (Arias & Cepeda, 2022), thereby triggering and adapting existing knowledge stock according to the situation, and spontaneously integrating relevant knowledge in real-time to provide new perspectives for improvisation (Weick, 1998). Therefore, individuals with high knowledge stock are more likely to rapidly integrate knowledge to achieve knowledge innovation and generate practices or thinking that deviate from traditional paradigms, thus stimulating improvisation.

Specifically, compared with low-stock individuals, high-stock individuals possess richer knowledge structures (Arias & Cepeda, 2022). They have stronger abilities to acquire and integrate knowledge, not only can they rapidly absorb necessary external knowledge and integrate it into their existing knowledge stock, stimulating cross-boundary fusion among various types of knowledge (Rui et al., 2017), thereby promoting cutting-edge thinking; but they can also identify and utilize high-value knowledge resources in specific domains (Mannucci & Yong, 2018), enabling them to quickly find key solutions when facing complex problems. This further enhances individuals' ability and proficiency in mastering knowledge, making them more adept at improvisation when it occurs (Mai et al., 2015). Therefore, high knowledge stock will facilitate individuals to explore various knowledge combinations to open up more innovative pathways, thereby promoting the generation of improvisation. Accordingly, we propose Hypothesis 1:

**H1:** Knowledge stock positively influences individual improvisation.

**The Mediating Role of Knowledge Transformation** Knowledge transformation refers to the ability to integrate existing knowledge stock with newly acquired knowledge to develop and refine new insights (Zahra & George, 2002). As an important pathway of knowledge management, knowledge transformation involves not only the capture, refinement, and integration of knowledge but also serves as the core channel for maximizing the effectiveness of knowledge resources (Wei & Zhang, 2007). According to knowledge linking theory, the linking of existing knowledge with new knowledge promotes efficient knowledge transformation (Nonaka & Toyama, 2003). Specifically, through the foundational role of knowledge stock, individuals engage in knowledge management activities. On one hand, knowledge stock, as the core knowledge competitiveness of individuals, forms the basis for knowledge circulation, penetration, and transition (Zhang & Liang, 2019). It can expand internal knowledge frameworks by developing various different yet interconnected knowledge nodes (Schilling et al., 2003). On the other hand, knowledge stock represents individuals' advanced agency in applying and acquiring knowledge (Sung & Choi, 2018), providing definite directions for exploring new knowledge (Lee & Huang, 2012).

Under external stimulation, it further creates new nodes by reorganizing and integrating existing stock knowledge (Sung & Choi, 2018), promoting accelerated capture of new knowledge, thereby developing synergistic potential between old and new knowledge and facilitating flexible transformation of knowledge structures. Thus, high knowledge stock provides favorable conditions for individuals to respond to external challenges, motivating them to continuously create and acquire new, necessary, and differentiated knowledge (Mabey & Zhao, 2017), and further driving individuals to classify and organize knowledge for deep processing and evaluation. On the basis of prior stock knowledge, individuals can effectively integrate old and new knowledge (Zahra & George, 2002). In situations requiring immediate action, knowledge stock reflects individuals' ability to understand and apply knowledge, activating and diffusing connected knowledge nodes to accelerate knowledge processing mechanisms, thereby promoting reconfiguration of old and new knowledge, increasing the likelihood of identifying creative breakthroughs (Griffith & Sawyer, 2010; Mahoney & Kor, 2015), and further stimulating individual knowledge transformation (Al-Tit, 2016; Sung & Choi, 2018).

Furthermore, when knowledge is transformed, individuals' existing creative thinking may be enriched or adjusted by old and new knowledge, enabling flexible exploration of cognitive pathways (Tang et al., 2015), at which point individuals tend to generate more innovation. Therefore, knowledge transformation may enhance individual improvisation. Specifically, during the knowledge transformation process, individuals add new knowledge, delete or transform old knowledge (Liyanage et al., 2009), and individual knowledge nodes are reactivated by the diffusion activation of relevant new nodes (Meyer & Schvaneveldt, 1971), thereby facilitating further integration of old and new knowledge to promote reconstruction of existing knowledge systems and strengthen their association with improvisational problems. This helps break rigid thinking to generate new ideas (Jiang & Chen, 2018) and shortens action response time to construct focused new problem-solving solutions with clearer objectives, enabling individuals to coordinate actions immediately (Vera et al., 2016), thereby effectively stimulating improvisation. Additionally, knowledge linking theory posits that by linking old and new knowledge, individuals can break through traditional thinking limitations and pioneer innovative pathways, forming unique viewpoints and ideas to promote creative behavior (Nonaka & Toyama, 2003). Based on this theory, knowledge stock influences individual improvisation through its effect on knowledge transformation. That is, knowledge stock motivates the acquisition of new knowledge (Wu & Shanley, 2009), and by establishing different yet richly connected nodes to diffusely activate relevant knowledge structures, it further decomposes, processes, and combines old and new knowledge to achieve knowledge transformation on the basis of successfully acquiring new knowledge, thereby breaking internal knowledge paradigms to initiate broader thinking processes and elicit multidimensional perspectives, closely linking them with problems, and catalyzing the emergence of novel ideas and solutions conducive to improvisation (Mamédio et al., 2022).

Therefore, we propose the following hypotheses:

**H2:** Knowledge stock positively influences knowledge transformation.
**H3:** Knowledge transformation mediates the relationship between knowledge stock and individual improvisation.

**The Moderating Role of Time Pressure** Based on the immediacy characteristic of improvisation, individuals must take action within limited time (Crossan et al., 2005; Leybourne & Smith, 2006). This immediate situational requirement is accompanied by time pressure (Vera & Crossan, 2004), making time pressure a key boundary condition for triggering improvisation. Time pressure refers to the sense of urgency generated by time limits or deadlines (Maruping et al., 2015). Existing research indicates that time pressure is typically viewed as a context requiring immediate response and can influence individuals' knowledge practice processes (Li et al., 2015). Activation theory posits that increased time pressure raises individuals' physiological activation levels, thereby affecting cognitive and behavioral responses. As time pressure gradually changes, activity levels in individuals' limbic system and other brain regions rise to CLA (optimal activation level) and then decline, meaning that either excessively high or low activation levels hinder individual behavioral efficiency, with only moderate time pressure enabling optimal performance (Gardner, 1986). Therefore, time pressure may nonlinearly moderate the relationship between knowledge stock and knowledge transformation, ultimately affecting subsequent improvisation.

Specifically, when time pressure is low, ample time facilitates the creation and acquisition of large amounts of new knowledge, yet may lead to disordered and redundant knowledge accumulation on the basis of original stock knowledge, manifesting as a non-task-focused state (Karau & Kelly, 1992). Under conditions of dispersed knowledge, obviously irrelevant knowledge is often difficult to filter (Edland & Svenson, 1993), thereby hindering the timely extraction of relevant new knowledge for integration with knowledge stock (Liu & Dang, 2013) and reducing the efficiency of core knowledge application and transformation. As time pressure increases, knowledge practice becomes more focused on clear target tasks, potentially activating non-redundant knowledge stock and promoting clever integration of old and new knowledge (Vera et al., 2016). That is, moderate time pressure provides individuals with sufficient time to develop and reorganize knowledge, establishing separation between time and knowledge space, thereby increasing flexibility in abstract extraction and processing classification of knowledge essence (Soderberg et al., 2015), which further enhances the effectiveness of knowledge stock. When extracting information and relevant knowledge from it, as long as one node is activated or becomes active, energy is transmitted to related nodes (Collins & Quillian, 1969; Meyer & Schvaneveldt, 1971), while also generating new nodes within the original stock range, consequently accelerating knowledge processing speed (Galotti, 2015). This makes the recombination of old and new knowledge possible (Sung & Choi, 2018), thereby achieving high-quality knowledge transformation. Therefore, moderate

time pressure becomes an opportunity for effective knowledge stock transformation, strengthening the promoting effect of knowledge stock on knowledge transformation.

However, when time pressure continues to increase beyond the optimal level, its positive utility cannot be sustained. Existing research indicates that when individuals experience relatively high time pressure, their activation level deviates from the specific level of stimulation, leading to decreased task engagement and behavioral efficiency (Baer & Oldham, 2006). This means that excessively high time pressure may limit the degree and scope of new knowledge creation, causing individuals to tend to rely solely on knowledge stock itself or easily accessible knowledge under conditions of insufficient new knowledge acquisition (Khedhaouria et al., 2017). That is, individuals invest less energy in considering new knowledge node combinations, being forced to rely on familiar routine algorithms (Staw et al., 1981), thus being limited within original knowledge frameworks and reducing the utilization of relevant new knowledge, which hinders individuals'thinking and knowledge processing abilities (Orasanu & Fischer, 1997) and is therefore detrimental to the combination, creation, and reuse of old and new knowledge, impeding knowledge transformation. In summary, we propose Hypothesis 4:

**H4:** Time pressure exerts a nonlinear moderating effect on the relationship between knowledge stock and knowledge transformation. Specifically, compared with high or low time pressure, the positive effect of knowledge stock on knowledge transformation is stronger under medium time pressure.

Based on the above hypotheses, we further propose a mediated moderation model. That is, under high or low time pressure, knowledge transformation triggered by knowledge stock will decrease accordingly, leading to insufficient reconstruction of internal knowledge systems and weakening the association with improvisational problems, thereby diminishing the positive effect on improvisation. Conversely, under medium time pressure, knowledge transformation triggered by knowledge stock will be more pronounced, likely enabling individuals to break away from initial frameworks and shift toward new and unusual ways of viewing problems, thus constructing the source of improvisational creativity and making the promoting effect on individual improvisation more prominent. Accordingly, we propose Hypothesis 5:

**H5:** Time pressure exerts a nonlinear moderating effect on the indirect effect of knowledge stock on improvisation through knowledge transformation. Specifically, this indirect effect is stronger under medium time pressure and weaker otherwise.

## Study 1: Experimental Study with Student Sample

### Experimental Purpose

Through measuring the average preparation time and standard deviation required for the experimental task, this study aimed to determine the time limits for different time pressure conditions in the formal experiment and to verify H1.

### Experimental Participants

Among university students, 161 valid questionnaires were distributed and collected (52 males; M = 21.77 years, SD = 2.25) using the knowledge stock scale to measure participants' knowledge stock levels. The scale scores were arranged in ascending order from low to high. Based on Kelley (1939), participants scoring in the top 27% were selected as the low knowledge stock group (43 participants, 11 males), and those in the bottom 27% as the high knowledge stock group (43 participants, 18 males). A total of 86 participants were recruited (29 males; M = 21.48 years, SD = 2.23). All participants volunteered for the pre-experiment, had not participated in similar experiments before, and received ten yuan as compensation after the experiment.

Independent samples t-tests revealed significant differences between the high knowledge stock group (M = 5.14, SD = 0.47) and low knowledge stock group (M = 3.33, SD = 0.53), $t(84) = 16.65$, $p < 0.001$. Meanwhile, no significant age difference existed between high and low knowledge stock groups (M_high = 21.93, SD = 2.39; M_low = 21.02, SD = 1.97, $t(84) = 1.92$, $p = 0.058$). Chi-square tests showed no significant gender difference between the two groups ( $^2 = 2.55$, $p = 0.110$).

### Experimental Task and Materials

Following existing improvisation research (Hill et al., 2017; Lewis et al., 2015; Perrmann-Graham et al., 2022), we employed a thematic speech task. Referencing Zhang et al. (2016), we used a "cafeteria design" speech task theme. After participants searched for relevant materials and completed preparation, the experimenter initiated questions about cafeteria design, and participants delivered impromptu speeches.

Regarding the determination of question materials, this study referenced Chen (2009). First, 30 current graduate students were interviewed to identify key points they valued in cafeteria design processes. These key points were then compiled into a questionnaire. Second, 320 questionnaires were distributed within a university, asking participants to select (multiple choices allowed) important aspects of cafeteria design, ultimately yielding 315 valid responses. The results are presented in Table 1 .

**Table 1** Cafeteria Design Key Points (N = 315)

| Key Point | Percentage |
|---|---|
| Multi-functional tables and chairs/Table and chair design | 53.02% |
| Appearance and interior layout | 49.84% |
| Meal selection/Ordering/Food items | 47.94% |
| Dishware recycling | 47.62% |
| Pricing | 45.71% |
| Service quality | 45.71% |
| Environmental hygiene | 35.56% |

The experimenter asked participants questions based on these cafeteria design key points, such as: "What design ideas do you have for cafeteria dishware recycling?" This design maximally ensures that random questioning fully stimulates participants' improvisational behavior (Hill et al., 2017).

### Experimental Design and Procedure

Participants were invited to the experimental site, where the experimenter explained instructions one-on-one and completed the experiment. The specific procedure was as follows:

1. **Demographics and pre-test**: Participants completed demographic information and a pre-test knowledge stock questionnaire.
2. **Phase 1**: Participants were instructed to carefully read task instructions (Task: Please use search devices to find any materials you need, combine them with your cognition and ideas, and design your ideal school cafeteria (or propose improvements for current cafeteria issues). Record your ideas and viewpoints, as the experimenter will later ask you to deliver an impromptu design statement speech. Please ensure your design is practical and feasible). After understanding the task requirements, participants completed a 7-point scale assessing task theme familiarity. Participants could then use computers to search for materials, using any search system they preferred, and were required to input or copy/paste useful task information into a notebook file or write on A4 paper to form a written speech for later impromptu delivery. When participants felt they had searched sufficient materials and were prepared, they informed the experimenter.
3. **Manipulation check and variable measurement**: After Phase 1, participants completed a manipulation check questionnaire and recorded preparation time (in minutes) based on their current feelings.
4. **Phase 2**: The experimenter randomly asked participants questions about the task theme, and participants delivered impromptu speeches based on these questions. With participants' consent, speeches were recorded for subsequent scoring. After Phase 2, participants completed a knowledge transformation measurement questionnaire based on their true feelings and actual behaviors during the impromptu speech task.

5. **Debriefing**: Participants were informed that the formal experiment was completed and received compensation.

### Measurement Instruments

**Knowledge Stock**: Participants self-reported knowledge stock before the experiment. Based on Rui et al. (2017), the scale contained 6 items (e.g., "I possess knowledge and resources accumulated from multiple disciplines or work experiences" ) using a 7-point Likert scale from "1 = strongly disagree" to "7 = strongly agree." The average score was calculated as the final score, with higher scores indicating higher knowledge stock. Cronbach' s = 0.85.

**Knowledge Transformation**: Participants self-reported knowledge transformation after the experiment (post-Phase 2). Based on Flatten et al. (2011), the scale contained 4 items (e.g., "I have the ability to organize and use collected knowledge" ) using a 7-point Likert scale. Cronbach' s = 0.84.

**Improvisation**: This study employed the Consensual Assessment Technique (Amabile, 1983) to evaluate individual improvisation, a method effectively applied in creativity and improvisation research (Bilsen, 2010; Evans, 2016; Lewis et al., 2015). Specifically, two experts (a professor and an associate professor) from an organizational behavior research team independently rated participants' speeches based on four dimensions of improvisation (following Lewis et al., 2015: fluency, originality, elaboration, flexibility) using a 7-point Likert scale from "1 = low-scoring impromptu speech" to "7 = high-scoring impromptu speech." High scores included excellent oral fluency, more original ideas, detailed elaboration beyond creative ideas, and flexibility. As the two raters showed high consistency (Cronbach' s = 0.77, ICC = 0.77, $p < 0.001$), their average scores were used as the final improvisation scores.

**Control Variables**: Gender, age, education level, major, and task theme familiarity were included as control variables (Nisula & Kianto, 2016). Task theme familiarity was measured with a single item using a 7-point Likert scale: "To what extent are you familiar with this task theme?" from "1 = very unfamiliar" to "7 = very familiar" (Liu et al., 2019).

### Experimental Results

No significant difference existed in average time used between high and low knowledge stock groups (M_low = 10.40 min, SD = 2.47; M_high = 10.16 min, SD = 1.85, t(84) = 0.49, p = 0.623). The average preparation time was 10.28 minutes (SD = 2.17). After rounding, following Weenig and Maarleveld (2002), we compressed time by using 50% of the average preparation time distribution under no time limit as the time limit for the high time pressure condition (i.e., 5 minutes). Following Benson and Svenson (1993), we calculated the time limit for the medium time pressure condition by subtracting the standard deviation from the mean (i.e., 8 minutes).

To preliminarily verify H1, an independent samples t-test with knowledge stock group as the independent variable and improvisation as the dependent variable revealed that the high knowledge stock group (M = 4.27, SD = 0.99) showed significantly higher improvisation than the low knowledge stock group (M = 3.74, SD = 0.94), t(84) = 2.51, p = 0.014, Cohen' s d = 0.54. Another independent samples t-test with knowledge stock group as the independent variable and knowledge transformation as the dependent variable showed that the high knowledge stock group (M = 5.50, SD = 0.84) demonstrated significantly higher knowledge transformation than the low knowledge stock group (M = 4.91, SD = 0.77), t(84) = 3.41, p = 0.001, Cohen' s d = 0.74. Additionally, the difference in perceived task theme familiarity between high (M = 5.42, SD = 1.31) and low (M = 4.95, SD = 1.15) knowledge stock groups was not significant, t(84) = 1.75, p = 0.085. In summary, knowledge stock positively predicted improvisation, providing preliminary evidence for H1.

### Research Discussion

The pre-experiment determined time limits for different time pressure conditions by calculating preparation time under unlimited time conditions, ensuring the reasonableness of time settings in the study. Additionally, results suggested a positive correlation between knowledge stock and improvisation, initially supporting H1. However, the internal mechanism through which knowledge stock influences improvisation has not been thoroughly explored. Therefore, Study 1 continued to employ experimental methods, combined with time limits set under different time pressure conditions, to further investigate the mechanistic relationship between knowledge stock and improvisation, examining the mediating role of knowledge transformation and the moderating role of time pressure in this process, thereby revealing the generative mechanisms of individual improvisation.

## Study 1: Main Experiment with Student Sample

### Experimental Purpose

To test H1–H5, exploring whether and how knowledge stock influences individual improvisation and its underlying mechanisms, and examining whether time pressure moderates these effects.

### Experimental Participants

Using G*Power 3.1 (Faul et al., 2007) to determine sample size, Study 1 required 158 participants to achieve 80% statistical power (1- ) with effect size f = 0.25 and significance level = 0.05. Among university students in East China, 301 knowledge stock questionnaires were distributed (99 males, 202 females; average age 22.04 ± 2.12 years). Scale scores were arranged in ascending order. Following Kelley (1939), participants scoring in the top 27% were selected as the low knowledge stock group (81 participants, 17 males), and those in the

bottom 27% as the high knowledge stock group (82 participants, 21 males). A total of 163 participants were recruited (38 males; M = 22.28 years, SD = 2.01). All participants volunteered, had not participated in similar experiments before, and received ten yuan as compensation after the experiment.

Independent samples t-tests revealed significant differences between high (M = 4.67, SD = 0.45) and low (M = 3.39, SD = 0.55) knowledge stock groups, $t(161) = 16.17$, $p < 0.001$. No significant age difference existed between groups (M_high = 22.33, SD = 2.01; M_low = 22.23, SD = 2.03, $t(161) = 0.30$, $p = 0.765$). Chi-square tests showed no significant gender difference ( $^2 = 0.49$, $p = 0.485$).

### Experimental Task

Same as pre-experiment.

### Experimental Design and Procedure

A 2 (knowledge stock: high/low) × 3 (time pressure: high/medium/low) between-subjects design was employed. The sample included: high knowledge stock–medium time pressure group (n = 27), high knowledge stock–high time pressure group (n = 27), high knowledge stock–low time pressure group (n = 28); low knowledge stock–medium time pressure group (n = 27), low knowledge stock–high time pressure group (n = 27), and low knowledge stock–low time pressure group (n = 27). Participants were randomly assigned to groups, with the experimenter explaining instructions one-on-one.

The experimental procedure was consistent with the pre-experiment:

1. **Demographics and pre-test**: Participants completed demographic information and a current emotional state questionnaire (having previously completed the knowledge stock questionnaire). Considering that individuals' emotional states might affect time-pressured tasks, measurements of participants' emotions before and after task completion were included to exclude possible interference from emotional changes (Zhong et al., 2018).
2. **Phase 1**: Participants carefully read task instructions and completed a 7-point scale assessing task theme familiarity. They were informed to prepare for the impromptu speech task within the limited time (5/8/10 min), with a countdown timer on the table as a manipulation (Liu et al., 2019). When time expired, participants were instructed to immediately stop searching and indicate readiness.
3. **Manipulation check and variable measurement**: After Phase 1, participants completed a perceived time pressure manipulation check questionnaire based on their current feelings.
4. **Phase 2**: The experimenter randomly asked participants questions about the task theme, and participants delivered impromptu speeches. With consent, speeches were recorded for scoring. After Phase 2, participants completed knowledge transformation and post-task emotion questionnaires

based on their true feelings and actual behaviors.

5. **Debriefing**: Participants were informed the experiment was complete and received compensation.

### Experimental Manipulation and Measurement Instruments

**Time Pressure Manipulation**: After the experimental manipulation (post-Phase 1), participants completed the perceived time pressure scale from Bai and Yao (2018), measured with a single item: "How much time pressure do you currently feel?" using a 7-point Likert scale from "1 = no pressure" to "7 = extreme pressure."

**Emotion**: Participants rated their emotions before and after the task (pre-Phase 1 and post-Phase 2) using a single item from Wen et al. (2022): "How is your current emotional state?" on a 7-point Likert scale from "1 = very low mood" to "7 = very high mood."

**Knowledge Stock**: Participants self-reported knowledge stock before the experiment using the same scale as the pre-study. Cronbach' s = 0.81.

**Knowledge Transformation**: Participants self-reported knowledge transformation after the experiment (post-Phase 2) using the same scale as the pre-study. Cronbach' s = 0.86.

**Improvisation**: Using the Consensual Assessment Technique, consistent with the pre-study. The two raters showed high consistency (Cronbach' s = 0.78, ICC = 0.78, $p < 0.001$), so their average scores were used as final improvisation scores.

**Control Variables**: Gender, age, education level, major, and task theme familiarity were included as control variables (Nisula & Kianto, 2016; Liu et al., 2019).

### Manipulation Check

A one-way ANOVA on time pressure scale scores across three groups showed significant differences: $F(2, 160) = 34.02$, $p < 0.001$. High time pressure group ($M = 4.94$, $SD = 1.51$) perceived significantly higher time pressure than medium time pressure group ($M = 3.43$, $SD = 1.33$), $p < 0.001$; medium time pressure group ($M = 3.43$, $SD = 1.33$) perceived significantly higher time pressure than low time pressure group ($M = 2.69$, $SD = 1.51$), $p = 0.009$. These results indicate successful time pressure manipulation. Additionally, paired samples t-tests showed no significant emotional differences between pre- and post-task time points ($t(162) = -1.74$, $p = 0.083$).

### Hypothesis Testing

Independent samples t-tests with knowledge stock group as the independent variable revealed that the high stock group ($M = 4.49$, $SD = 0.83$) showed sig-

nificantly higher improvisation than the low stock group (M = 4.09, SD = 0.89), t(161) = 3.04, p = 0.003, Cohen' s d = 0.48. The high stock group (M = 5.00, SD = 0.71) also demonstrated significantly higher knowledge transformation than the low stock group (M = 4.71, SD = 0.82), t(161) = 2.39, p = 0.018, Cohen' s d = 0.37. The difference in perceived task theme familiarity between high (M = 5.49, SD = 0.89) and low (M = 5.28, SD = 0.85) stock groups was not significant, t(161) = 1.49, p = 0.138.

Analysis of covariance with knowledge stock as the independent variable and age, gender, major, education level, and task theme familiarity as covariates showed significant main effects of knowledge stock on improvisation, F(1, 156) = 8.24, p = 0.005, $p^2$ = 0.05, and on knowledge transformation, F(1, 156) = 5.36, p = 0.022, $p^2$ = 0.03. Regression analyses indicated that knowledge stock had a significant positive effect on knowledge transformation (B = 0.28, SE = 0.12, p = 0.018), and knowledge transformation positively influenced improvisation (B = 0.55, SE = 0.08, p < 0.001). Monte Carlo method (Selig & Preacher, 2008) revealed that the indirect effect of knowledge stock on improvisation through knowledge transformation was 0.16, 95% CI [0.03, 0.30]. In summary, H1–H3 were supported.

To further test the moderating effect of time pressure, ANOVA with improvisation as the dependent variable and knowledge stock, time pressure, and their interaction as independent variables (controlling for age, gender, major, education level, and task theme familiarity) showed significant main effects of knowledge stock, F(1, 152) = 9.32, p = 0.003, $p^2$ = 0.06, and time pressure, F(2, 152) = 5.95, p = 0.003, $p^2$ = 0.07. Participants under medium pressure (M = 4.62, SD = 0.84) showed significantly higher improvisation than those under high pressure (M = 4.11, SD = 0.99, p = 0.015) and low pressure (M = 4.15, SD = 0.70, p = 0.005). No significant difference existed between high and low pressure groups, p = 0.996.

The interaction between knowledge stock and time pressure was significant, F(2, 152) = 4.39, p = 0.014, $p^2$ = 0.06 (see Figure 2

). Simple effects analysis revealed that under medium time pressure, improvisation levels differed significantly between knowledge stock groups, F(1, 152) = 17.48, p < 0.001, $p^2$ = 0.10, with the high stock group (M = 5.07, SD = 0.63) showing significantly higher improvisation than the low stock group (M = 4.17, SD = 0.77), p < 0.001. Under high time pressure, no significant difference existed between knowledge stock groups, F(1, 152) = 0.63, p = 0.428. Under low time pressure, no significant difference existed between knowledge stock groups, F(1, 152) = 0.10, p = 0.747. Thus, medium time pressure best facilitates the positive effect of knowledge stock on individual improvisation, while high or low time pressure renders the effect of knowledge stock on improvisation insignificant.

**Figure 2** The Effect of Knowledge Stock and Time Pressure on Improvisation

With knowledge transformation as the dependent variable, ANOVA revealed

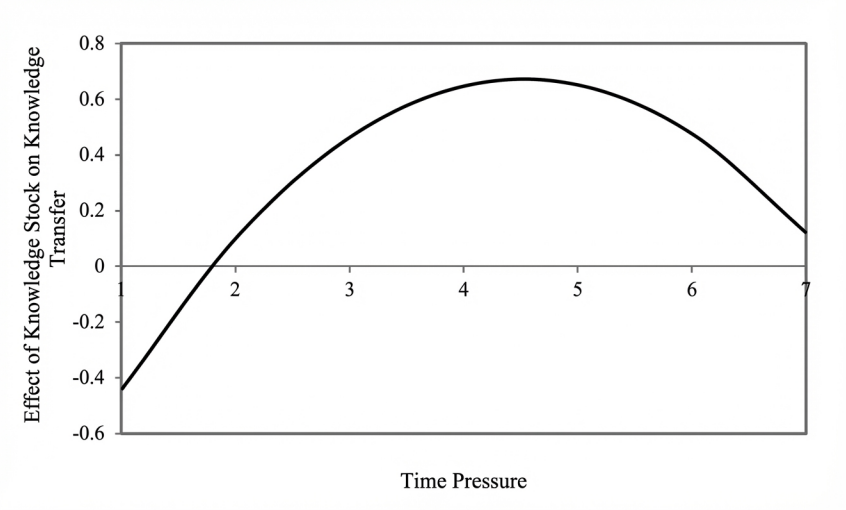


Figure 2: Figure 2

significant main effects of knowledge stock, $F(1, 152) = 5.36$, $p = 0.022$, $p^2 = 0.03$, but not of time pressure, $F(2, 152) = 2.55$, $p = 0.082$. The interaction between knowledge stock and time pressure significantly affected knowledge transformation, $F(2, 152) = 3.50$, $p = 0.033$, $p^2 = 0.04$ (see Figure 3

). Simple effects analysis showed that under medium time pressure, knowledge transformation levels differed significantly between knowledge stock groups, $F(1, 152) = 12.07$, $p = 0.001$, $p^2 = 0.07$, with the high stock group ($M = 5.37$, $SD = 0.60$) showing significantly higher knowledge transformation than the low stock group ($M = 4.64$, $SD = 0.90$), $p = 0.001$. Under high time pressure, no significant difference existed between knowledge stock groups, $F(1, 152) = 0.38$, $p = 0.538$. Under low time pressure, no significant difference existed between knowledge stock groups, $F(1, 152) = 0.01$, $p = 0.943$. Thus, medium time pressure facilitates the positive effect of knowledge stock on knowledge transformation, while high or low time pressure renders the effect of knowledge stock on knowledge transformation insignificant. Regression analyses (Table 2 ) showed that the effect of knowledge stock on knowledge transformation differed significantly between high vs. medium pressure groups ($B = -0.59$, 95% CI [-1.15, -0.04], $SE = 0.28$, $p = 0.037$) and between low vs. medium pressure groups ($B = -0.73$, 95% CI [-1.29, -0.18], $SE = 0.28$, $p = 0.010$), indicating a significant moderating effect of time pressure. Simple slope analysis revealed that under medium pressure, knowledge stock significantly and positively predicted knowledge transformation (simple slope = 0.72, 95% CI [0.33, 1.11], $SE = 0.20$, $p < 0.001$), but this positive effect was not significant under high or low pressure ($B\_high = 0.13$, 95% CI [-0.27, 0.52], $SE = 0.20$, $p = 0.523$; $B\_low = -0.02$, 95% CI [-0.41, 0.38], $SE = 0.20$, $p = 0.941$). H4 was supported.

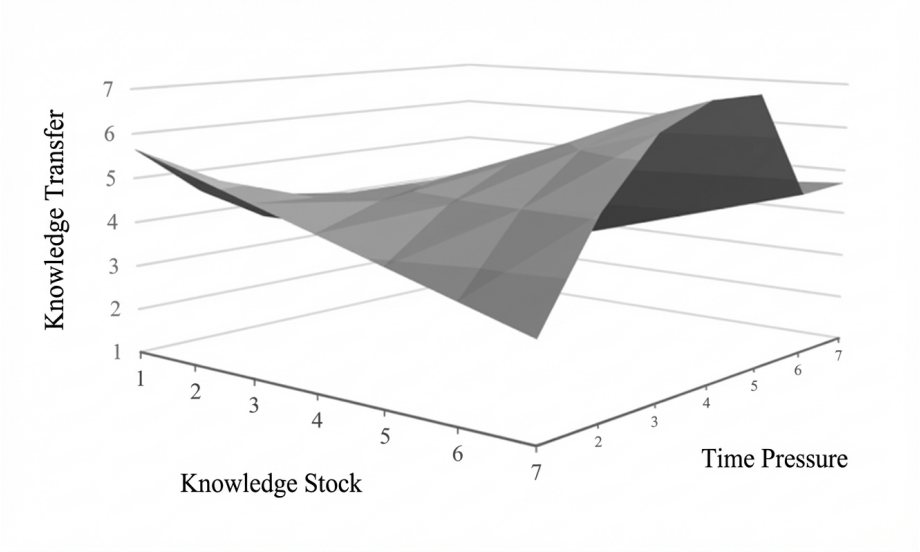


Figure 3: Figure 3

**Table 2** Regression Analysis Results

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Gender | -0.27 (0.16) | -0.06 (0.04) | 0.18 (0.14) |
| Age | 0.21 (0.14) | 0.17 (0.13) | -0.04 (0.13) |
| Education | -0.05 (0.08) | -0.04 (0.07) | 0.10 (0.07) |
| Major | 0.40 (0.13)** | -0.31 (0.14)* | 0.28 (0.12)* |
| Theme familiarity | -0.49 (0.16)** | -0.07 (0.03)+ | -0.33 (0.15)* |
| Knowledge stock | 0.93 (0.21)*** | 0.57 (0.20)** | 0.72 (0.20)*** |
| Knowledge stock × W1 | -0.75 (0.30)* | -0.86 (0.31)** | -0.59 (0.28)* |
| Knowledge stock × W2 | -0.09 (0.19) | -0.16 (0.20) | -0.73 (0.28)* |

Note: W1 and W2 are dummy variables representing experimental conditions. W1: medium time pressure = 0, high time pressure = 1, low time pressure = 0; W2: medium time pressure = 0, high time pressure = 0, low time pressure = 1. ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

Finally, Monte Carlo method (Selig & Preacher, 2008) was used to calculate the confidence interval for the mediated moderation effect. As shown in Table 3 , the indirect effect was significant under medium time pressure (B = 0.35, 95% CI [0.15, 0.59]) but not under high (B = 0.06, 95% CI [-0.13, 0.27]) or low (B = -0.01, 95% CI [-0.20, 0.19]) time pressure. The differences in indirect effects

were significant (high vs. medium: -0.29, 95% CI [-0.60, -0.01]; low vs. medium: -0.36, 95% CI [-0.69, -0.08]), both excluding 0, indicating significant differences. Thus, H5 was supported.

**Table 3** Mediated Moderation Effect Analysis Results

| Time Pressure Level | Indirect Effect | 95% CI |
|---|---|---|
| High time pressure | 0.06 | [-0.13, 0.27] |
| Medium time pressure | 0.35 | [0.15, 0.59] |
| Low time pressure | -0.01 | [-0.20, 0.19] |
| Difference (high vs. medium) | -0.29 | [-0.60, -0.01] |
| Difference (low vs. medium) | -0.36 | [-0.69, -0.08] |
| Difference (high vs. low) | 0.07 | [-0.21, 0.36] |

### Research Discussion

Study 1 supported all hypotheses. Results showed a positive correlation between knowledge stock and improvisation; under medium time pressure, high-stock individuals exhibited higher knowledge transformation and improvisation than low-stock individuals. Additionally, time pressure moderated the relationship between knowledge stock and knowledge transformation, with medium time pressure significantly strengthening the positive effect, while high or low pressure weakened it. Further analysis indicated that the indirect effect of knowledge stock on improvisation through knowledge transformation was also moderated by time pressure. Given that Study 1 used a student sample, to enhance ecological validity and further understand the relationship between knowledge stock and improvisation, Study 2 collected new sample data from real organizational settings to strengthen external validity.

## Study 2: Organizational Employee Sample

### Experimental Purpose

Study 2 selected a corporate-related task scenario and used organizational employees as participants to replicate hypothesis testing.

### Experimental Participants

Using G*Power 3.1 (Faul et al., 2007) to determine sample size, Study 2 required 158 participants to achieve 80% statistical power (1- ) with effect size f = 0.25 and significance level = 0.05. Consequently, 163 full-time employees (92 males; M = 36.05 years, SD = 7.47) were recruited from 5 manufacturing companies in East China. All participants volunteered and received ten yuan as compensation after the experiment.

### Experimental Task

Consistent with the pre-experiment, given that all visited companies had corporate cafeterias and considering the appropriateness of the task theme, the theme was changed from school cafeteria design to company cafeteria design.

### Experimental Design and Procedure

A between-subjects design was employed, with participants randomly assigned to groups: "medium time pressure" group (n = 55), "high time pressure" group (n = 54), and "low time pressure" group (n = 54). The experimenter explained instructions one-on-one. No significant age differences existed among the three groups (M_high = 34.57, SD = 7.21; M_medium = 36.87, SD = 7.65; M_low = 36.69, SD = 7.45, F(2, 160) = 1.59, p = 0.206). Chi-square tests showed no significant gender differences ( $^2(2) = 3.48$, p = 0.176). Study 2 also included measurements of participants' emotions before and after task completion and perceived time pressure manipulation checks. The experimental procedure was consistent with Study 1.

### Experimental Manipulation and Measurement Instruments

**Time Pressure Manipulation**: Participants completed the manipulation check after the experimental manipulation (post-Phase 1) using the same instrument as Study 1.

**Emotion**: Participants rated their emotions before and after the task (pre-Phase 1 and post-Phase 2) using the same instrument as Study 1.

**Knowledge Stock**: Participants self-reported knowledge stock using the same scale as the pre-study. Cronbach' s = 0.82.

**Knowledge Transformation**: Participants self-reported knowledge transformation after the experiment (post-Phase 2) using the same scale as the pre-study. Cronbach' s = 0.93.

**Improvisation**: Using the Consensual Assessment Technique, consistent with the pre-study. The two raters showed high consistency (Cronbach' s = 0.85, ICC = 0.84, p < 0.001), so their average scores were used as final improvisation scores.

**Control Variables**: Gender, work tenure, age, education level, and task theme familiarity were included as control variables (Nisula & Kianto, 2016; Liu et al., 2019).

### Manipulation Check

A one-way ANOVA on time pressure scale scores showed significant differences: F(2, 160) = 131.57, p < 0.001. The high pressure group (M = 5.41, SD = 1.38) perceived significantly higher time pressure than the medium pressure group

(M = 3.64, SD = 0.70), p < 0.001; the medium pressure group (M = 3.64, SD = 0.70) perceived significantly higher time pressure than the low pressure group (M = 1.81, SD = 1.26), p < 0.001. These results indicate successful time pressure manipulation. Paired samples t-tests showed no significant emotional differences between pre- and post-task time points (t(162) = -0.97, p = 0.336).

### Descriptive Statistics and Correlation Analysis

Descriptive statistics are presented in Table 4 . Results showed significant positive correlations between knowledge stock and improvisation (r = 0.28, p < 0.001), between knowledge transformation and improvisation (r = 0.52, p < 0.001), and between knowledge stock and knowledge transformation (r = 0.27, p < 0.001).

**Table 4** Descriptive Statistics of Study Variables (N = 163)

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Gender | - | | | | | | | | |
| 2. Age | -0.07 | - | | | | | | | |
| 3. Education | -0.02 | 0.85*** | - | | | | | | |
| 4. Work tenure | -0.05 | 0.44*** | 0.15+ | - | | | | | |
| 5. Position | -0.14+ | 0.27*** | 0.28*** | 0.52*** | - | | | | |
| 6. Theme familiarity | -0.11 | 0.24** | 0.18* | 0.21** | -0.21** | - | | | |
| 7. Knowledge stock | -0.24** | 0.22** | 0.21** | -0.03 | -0.04 | -0.12 | - | | |
| 8. Knowledge transformation | -0.12 | 0.15+ | 0.27*** | -0.02 | 0.18* | -0.15+ | 0.53*** | - | |
| 9. Improvisation | -0.14+ | 0.28*** | 0.28*** | -0.02 | 0.13+ | -0.01 | 0.58*** | -0.04 | - |

Note: Gender: 1 = male, 2 = female; Position: 1 = frontline manager, 2 = middle manager, 3 = senior manager, 4 = regular employee; Education: 1 = high school or below, 2 = college, 3 = undergraduate, 4 = graduate or above. ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

### Hypothesis Testing

Regression analyses showed significant main effects of knowledge stock on improvisation (B = 0.35, SE = 0.12, p = 0.004) and knowledge transformation (B

= 0.23, SE = 0.09, p = 0.012). After controlling for knowledge stock, knowledge transformation positively affected improvisation (B = 0.63, SE = 0.09, p < 0.001). Monte Carlo method (Selig & Preacher, 2008) revealed that the indirect effect of knowledge stock on improvisation through knowledge transformation was 0.14, 95% CI [0.03, 0.27]. Thus, H1–H3 were supported.

After controlling for gender, work tenure, age, position, education level, and task theme familiarity, the interaction between time pressure and knowledge stock significantly predicted knowledge transformation (F(2, 151) = 3.51, p = 0.032), indicating a moderating effect. Further analysis (Table 5 ) showed that the effect of knowledge stock on knowledge transformation differed significantly between high vs. medium pressure groups (B = -0.52, 95% CI [-0.93, -0.11], SE = 0.21, p = 0.014) and between low vs. medium pressure groups (B = -0.49, 95% CI [-0.87, -0.12], SE = 0.19, p = 0.010), confirming the moderating effect of time pressure. Simple slope analysis revealed that under medium pressure, knowledge stock significantly and positively predicted knowledge transformation (simple slope = 0.57, 95% CI [0.24, 0.90], SE = 0.17, p = 0.001), but this effect was not significant under high or low pressure (B_high = 0.05, 95% CI [-0.21, 0.31], SE = 0.13, p = 0.703; B_low = 0.08, 95% CI [-0.11, 0.27], SE = 0.10, p = 0.424). H4 was supported.

**Table 5** Regression Analysis Results

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Gender | -0.16 (0.17) | 0.01 (0.02) | -0.13 (0.24) |
| Age | 0.01 (0.02) | -0.01 (0.02) | -0.04 (0.16) |
| Work tenure | -0.22 (0.08)** | -0.23 (0.07)** | -0.41 (0.23)+ |
| Education | 0.23 (0.11)* | 0.17 (0.10) | -4.37 (1.49)** |
| Position | 0.04 (0.07) | -0.04 (0.06) | -0.04 (0.06) |
| Theme familiarity | 0.17 (0.10)+ | 0.11 (0.08) | 0.50 (0.10)*** |
| Knowledge stock | 0.45 (0.07)*** | 0.34 (0.07)*** | 0.57 (0.17)** |
| Knowledge stock × W1 | -0.26 (0.14)* | 0.13 (0.05)** | -0.52 (0.21)* |
| Knowledge stock × W2 | -0.02 (0.13) | 0.01 (0.04) | -0.49 (0.19)* |

Note: W1 and W2 are dummy variables representing experimental conditions. W1: medium time pressure = 0, high time pressure = 1, low time pressure = 0; W2: medium time pressure = 0, high time pressure = 0, low time pressure = 1. ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

Monte Carlo method (Selig & Preacher, 2008) was used to calculate the confidence interval for the mediated moderation effect. As shown in Table 6 , the indirect effect was significant under medium time pressure (B = 0.28, 95% CI [0.10, 0.51]) but not under high (B = 0.02, 95% CI [-0.11, 0.16]) or low (B = 0.04, 95% CI [-0.06, 0.15]) time pressure. The differences in indirect effects were significant (high vs. medium: -0.26, 95% CI [-0.52, -0.05]; low vs. medium:

-0.24, 95% CI [-0.49, -0.05]), both excluding 0, indicating significant differences. Thus, H5 was supported.

**Table 6** Mediated Moderation Effect Analysis Results

| Time Pressure Level | Indirect Effect | 95% CI |
|---|---|---|
| High time pressure | 0.02 | [-0.11, 0.16] |
| Medium time pressure | 0.28 | [0.10, 0.51] |
| Low time pressure | 0.04 | [-0.06, 0.15] |
| Difference (high vs. medium) | -0.26 | [-0.52, -0.05] |
| Difference (low vs. medium) | -0.24 | [-0.49, -0.05] |
| Difference (high vs. low) | -0.02 | [-0.18, 0.15] |

### Research Discussion

Study 2, conducted in an organizational setting, supported all hypotheses. Results showed that time pressure significantly moderated the relationship between knowledge stock and knowledge transformation: under medium time pressure, the positive effect of knowledge stock on knowledge transformation was stronger, while weaker under high or low pressure. Additionally, the indirect effect of knowledge stock on improvisation through knowledge transformation was also moderated by time pressure: under medium time pressure, knowledge stock significantly promoted improvisation through knowledge transformation, with a significant indirect effect that weakened otherwise. Activation theory posits that different intensities of stressors trigger different activation levels, leading to differential outcomes (Gardner, 1986). When time pressure rises to a moderate level, information processing and behavioral response efficiency peak (Li et al., 2015), strengthening the positive effect of knowledge stock on knowledge transformation. However, when time pressure exceeds this optimal value, excessive time pressure reduces work motivation, weakening the positive relationship. We therefore speculate that time pressure may exhibit a nonlinear inverted U-shaped moderating effect. Study 3 will employ a full-model questionnaire study to transform this inverted U-shaped moderating trend into more intuitive graphical representation and re-verify the hypotheses.

## Study 3: Multi-Time-Point Field Survey

### Research Purpose

Based on the results of the first two experiments, Study 3 further verified H4-H5, examining the inverted U-shaped moderating effect of time pressure.

### Research Sample

The sample comprised leaders and employees from 13 manufacturing companies in East and Central China. With assistance from company HR departments,

we invited 387 employees and their 52 supervisors to participate. To reduce common method bias, we used a multi-time-point, multi-source data collection approach. At Time 1 (T1), employees reported their knowledge stock levels and perceived time pressure. At Time 2 (T2, two weeks after T1), employees reported knowledge transformation levels, while supervisors reported employees' improvisation behavior.

After eliminating questionnaires with incorrect, missing, or unmatched information, we obtained 201 valid employee questionnaires (response rate: 51.94%) and 37 valid supervisor questionnaires (response rate: 71.15%). In the final sample, 64.86% of teams had 50% or more subordinates completing the survey, with an average of 5.43 subordinates per supervisor. Among the 201 employees, 52.70% were male, with an average age of 35.82 years (SD = 5.55) and average tenure working with their supervisor of 6.50 years (SD = 3.89). Additionally, 84.60% of employees had college degrees or higher.

### Measurement Instruments

All scales used 7-point Likert scoring (1 = "strongly disagree," 7 = "strongly agree" ).

**Knowledge Stock (T1)**: Same scale as pre-study. Cronbach' s = 0.91.

**Time Pressure (T1)**: Based on Maruping et al. (2015), 4 items (e.g., "To complete tasks on time, I often face great pressure" ). Cronbach' s = 0.93.

**Knowledge Transformation (T2)**: Same scale as pre-study. Cronbach' s = 0.89.

**Improvisation (T2)**: Based on Vera and Crossan (2005), 7 items (e.g., "This employee can handle unexpected events on the spot" ) rated by supervisors. Cronbach' s = 0.94.

**Control Variables (T1)**: Gender, work tenure, age, team size, education level, and tenure with supervisor were included as controls (Magni et al., 2009).

### Data Analysis Strategy

As the sample involved one supervisor rating multiple subordinates, we examined between-group differences in improvisation. Results showed an ICC1 value of only 0.07, $F(36, 164) = 1.42$, $p = 0.073$, indicating that variance explained by supervisor factors was small and data had strong independence (ICC1 $< 0.10$, Bliese, 2000). Therefore, individual-level statistical analysis was more appropriate (Bliese & Hanges, 2004).

### Confirmatory Factor Analysis and Common Method Bias Test

To examine discriminant validity among the four constructs (improvisation, knowledge stock, knowledge transformation, and time pressure), confirmatory

factor analysis was conducted using Mplus. The four-factor model ( $^2$ = 197.83, df = 183, $^2$/df = 1.08, RMSEA = 0.02, CFI = 0.99, TLI = 0.99, SRMR = 0.04) showed better fit indices than alternative models, indicating good discriminant validity.

Harman' s single-factor test was used to examine common method bias. The first unrotated factor explained 35.74% of variance, below the 40% threshold. Additionally, the unmeasured latent method construct (ULMC) approach was used. After incorporating the method factor, model fit indices were: $^2$ = 174.46, df = 163, $^2$/df = 1.07, CFI = 0.99, TLI = 0.99, RMSEA = 0.02, SRMR = 0.03. Compared to the original model, CFI, TLI, and RMSEA improvements were all less than 0.02, and the $\Delta^2$ test comparing the four-factor model was non-significant ($\Delta^2/\Delta$df = 23.37/20, p = 0.271), indicating no significant improvement in model fit. Overall, no serious common method bias existed.

### Descriptive Statistics and Correlation Analysis

Descriptive statistics are presented in Table 7 . Knowledge stock was significantly positively correlated with knowledge transformation (r = 0.53, p < 0.001) and improvisation (r = 0.58, p < 0.001). Time pressure was significantly negatively correlated with improvisation (r = -0.15, p = 0.029) but not with knowledge transformation (r = -0.04, p = 0.559).

**Table 7** Descriptive Statistics of Study Variables (N = 201)

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Gender | - | | | | | | | | | |
| 2. Age | 0.13+ | - | | | | | | | | |
| 3. Education | 0.17* | 0.89*** | - | | | | | | | |
| 4. Work tenure | 0.13+ | 0.24** | 0.66*** | - | | | | | | |
| 5. Team size | -0.08 | -0.01 | -0.02 | 0.13+ | - | | | | | |
| 6. Tenure with supervisor | -0.01 | -0.02 | 0.15* | 0.65*** | 0.06 | - | | | | |
| 7. Knowledge stock | -0.02 | 0.19** | 0.17* | -0.02 | 0.13+ | -0.01 | - | | | |
| 8. Time pressure | -0.12 | 0.27*** | 0.18* | -0.12 | 0.53*** | 0.08 | 0.58*** | - | | |
| 9. Knowledge transformation | -0.01 | -0.02 | -0.01 | -0.02 | -0.04 | 0.01 | 0.56*** | 0.04 | - | |

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10. Improvisation | -0.15* | 0.53*** | 0.24** | -0.03 | 0.18* | -0.01 | 0.58*** | 0.15* | 0.34*** | |

Note: Gender: 1 = male, 2 = female; Team size: 1 = 3 people or fewer, 2 = 4-6 people, 3 = 7-12 people, 4 = 13-15 people, 5 = more than 15 people; Education: 1 = high school or below, 2 = college, 3 = undergraduate, 4 = graduate or above. ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

### Hypothesis Testing

Regression results are reported in Table 8 . Model 2 showed that knowledge stock had a significant positive effect on improvisation (B = 0.64, SE = 0.06, p < 0.001). Model 6 showed that knowledge stock had a significant positive effect on knowledge transformation (B = 0.56, SE = 0.06, p < 0.001). Model 4 showed that knowledge stock (B = 0.45, SE = 0.07, p < 0.001) and knowledge transformation (B = 0.34, SE = 0.07, p < 0.001) both had significant positive effects on improvisation. Monte Carlo method (Selig & Preacher, 2008) revealed that the indirect effect of knowledge stock on improvisation through knowledge transformation was 0.19, 95% CI [0.11, 0.28]. Thus, H1–H3 were supported.

**Table 8** Regression Analysis Results (Main Effects and Mediation)

| Variable | Model 1 (Improvisation) | Model 2 (Improvisation) | Model 3 (Knowledge transformation) | Model 4 (Improvisation) | Model 5 (Knowledge transformation) | Model 6 (Knowledge transformation) |
|---|---|---|---|---|---|---|
| Gender | -0.11 (0.17) | -0.03 (0.04) | 0.01 (0.04) | -0.09 (0.13) | 0.14 (0.12) | 0.08 (0.03)** |
| Age | -0.10 (0.14) | -0.02 (0.03) | -0.02 (0.03) | -0.10 (0.10) | 0.12 (0.09) | 0.07 (0.02)** |
| Work tenure | 0.08 (0.03)** | 0.04 (0.02)+ | 0.01 (0.02) | 0.02 (0.03) | -0.01 (0.03) | 0.01 (0.02) |
| Education | 0.64 (0.06)*** | 0.04 (0.14) | -0.01 (0.03) | -0.01 (0.03) | -0.09 (0.11) | 0.17 (0.10)+ |
| Tenure with supervisor | 0.02 (0.13) | -0.01 (0.03) | -0.01 (0.03) | -0.09 (0.10) | 0.14 (0.09) | 0.04 (0.02)+ |
| Knowledge stock | 0.58 (0.06)*** | 0.45 (0.07)*** | 0.34 (0.07)*** | 0.56 (0.06)*** | - | - |

| Variable | Model 1 (Improvisation) | Model 2 (Improvisation) | Model 3 (Knowledge transformation) | Model 4 (Improvisation) | Model 5 (Knowledge transformation) | Model 6 (Knowledge transformation) |
|---|---|---|---|---|---|---|
| Knowledge transformation | - | - | - | 0.34 (0.07)*** | - | |

Note: N = 201; ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

After controlling for gender, work tenure, age, team size, education, and tenure with supervisor, we tested the interaction between time pressure and knowledge stock on knowledge transformation. Following Hayes and Preacher (2010), we examined the inverted U-shaped moderating effect of time pressure. Table 9 shows that in Model 11, the interaction between time pressure and knowledge stock significantly affected knowledge transformation (B = 0.81, SE = 0.23, p < 0.001), as did the interaction between the quadratic term of time pressure and knowledge stock (B = -0.09, SE = 0.03, p = 0.001). The positive and negative significant coefficients indicate an inverted U-shaped moderation of time pressure on the relationship between knowledge stock and knowledge transformation, supporting H4.

**Table 9** Regression Analysis Results (Moderating Effect of Time Pressure)

| Variable | Model 9 | Model 10 | Model 11 |
|---|---|---|---|
| Gender | -0.09 (0.14) | -0.01 (0.03) | -0.02 (0.03) |
| Age | -0.01 (0.03) | -0.04 (0.03) | -0.01 (0.03) |
| Work tenure | -0.03 (0.03) | -0.04 (0.03) | -0.04 (0.03) |
| Education | 0.01 (0.04) | 0.01 (0.03) | 0.01 (0.03) |
| Team size | -0.10 (0.10) | -0.09 (0.10) | -0.08 (0.10) |
| Tenure with supervisor | 0.09 (0.09) | 0.07 (0.09) | 0.11 (0.09) |
| Knowledge stock | 0.74 (0.21)** | 0.85 (0.50)+ | 1.27 (0.48)** |
| Time pressure | - | 0.92 (1.15) | 1.82 (1.10)+ |
| Time pressure$^2$ | - | -0.11 (0.13) | -0.21 (0.13)+ |
| Knowledge stock × Time pressure | - | - | 0.27 (0.12)* |
| Knowledge stock × Time pressure$^2$ | - | - | 0.81 (0.23)*** |
| $R^2$ | 0.31 | 0.32 | 0.36 |

Note: N = 201; ***p < 0.001,*** *p < 0.01,* p < 0.05, +p < 0.10.

To facilitate observation of the moderating effect, we plotted the interaction in Figure 4 [FIGURE:4]. The figure shows that time pressure has a threshold. On

the left side of the threshold, increasing time pressure promotes the relationship between knowledge stock and knowledge transformation. However, on the right side, excessively high time pressure weakens the promoting effect of knowledge stock on knowledge transformation.

Substituting the regression results from Model 11 into the equation $Y = B + B X + B W + B W^2 + B XW + B XW^2$ (where X = knowledge stock, W = time pressure, Y = knowledge transformation), we plotted the three-dimensional interaction graph in Figure 5 [FIGURE:5]. Initially, the slope of the relationship between knowledge stock and knowledge transformation continuously increased, indicating that increasing time pressure strengthened the positive effect of knowledge stock on knowledge transformation. However, when time pressure exceeded a certain threshold, the slope began to decline, eventually showing a negative effect, indicating that time pressure weakened the positive effect of knowledge stock on knowledge transformation.

**Figure 4** Inverted U-Shaped Moderating Effect of Time Pressure

**Figure 5** Effect of Knowledge Stock and Time Pressure on Knowledge Transformation Under Inverted U-Shaped Moderation

Finally, Monte Carlo method (Selig & Preacher, 2008) was used to calculate the confidence interval for the mediated moderation effect. As shown in Table 10 , in the effect of time pressure moderating the influence of knowledge stock on improvisation through knowledge transformation, the indirect effect was strongest and significant at moderate time pressure (M, B = 0.24, 95% CI [0.13, 0.36]). At high time pressure, the effect decreased from strong (M + 1SD, B = 0.19, 95% CI [0.11, 0.29]) to weak (M + 2SD, B = 0.03, 95% CI [-0.11, 0.17]). At low time pressure, the effect also decreased from strong (M - 1SD, B = 0.17, 95% CI [0.08, 0.27]) to weak (M - 2SD, B = -0.03, 95% CI [-0.17, 0.10]). Further analysis showed that as time pressure increased from very low (M - 2SD) to low (M - 1SD), the effect increased significantly (B = -0.19, 95% CI [-0.34, -0.07]). From low (M - 1SD) to medium (M), the effect increased but with diminishing significance (B = -0.07, 95% CI [-0.14, -0.02]). From medium (M) to high (M + 1SD), the effect decreased but not significantly (B = 0.05, 95% CI [-0.01, 0.11]). From high (M + 1SD) to very high (M + 2SD), the effect decreased further with significant difference (B = 0.16, 95% CI [0.05, 0.32]). Overall, the effect size changed from negative to positive rapidly, then gradually weakened, and finally decreased rapidly, presenting an inverted U-shaped trend that matches Figures 4 and 5. In summary, H5 was supported.

**Table 10** Mediated Moderation Effect Analysis Results

| Time Pressure Level | Indirect Effect | 95% CI | Between-Level Differences |
|---|---|---|---|
| Very low (M - 2SD) | -0.03 | [-0.17, 0.10] | - |

| Time Pressure Level | Indirect Effect | 95% CI | Between-Level Differences |
|---|---|---|---|
| Low (M - 1SD) | 0.17 | [0.08, 0.27] | a-b: -0.19*** |
| Medium (M) | 0.24 | [0.13, 0.36] | b-c: -0.07* |
| High (M + 1SD) | 0.19 | [0.11, 0.29] | c-d: 0.05 |
| Very high (M + 2SD) | 0.03 | [-0.11, 0.17] | d-e: 0.16* |

Note: a = very low, b = low, c = medium, d = high, e = very high. ***p < 0.001,*** *p < 0.01,* p < 0.05.

### Research Discussion

Study 3, using a questionnaire method, again supported all hypotheses and focused on testing the inverted U-shaped moderating effect of time pressure, transforming it into more intuitive graphical representation. In organizational settings, after controlling for a series of variables, results remained robust. Moreover, compared to the first two studies, Study 3 more strongly supported the moderating effect of time pressure. Specifically, as time pressure increased from low to medium levels, the promoting effect of knowledge stock on knowledge transformation gradually strengthened, while as time pressure increased from medium to high levels, this promoting effect gradually weakened. Additionally, Study 3 further explored the specific mechanism of the mediated moderation effect, with its indirect effect size also showing an inverted U-shaped trend, matching the nonlinear moderating effect of time pressure on the relationship between knowledge stock and knowledge transformation. That is, medium pressure can maximize the promoting effect of knowledge stock on knowledge transformation, and its inverted U-shaped moderating effect acts on individual improvisation through the mediation of knowledge transformation.

## General Discussion

### Research Findings

This study focuses on the essential connotation of improvisation, integrating knowledge linking theory and activation theory to correspond to its creative and spontaneous characteristics, respectively. It explores the influence of knowledge stock on individual improvisation, examines the mediating role of knowledge transformation, and investigates the moderating role of time pressure, thereby comprehensively constructing a process model of knowledge stock empowering improvisation under time pressure. Through two experimental studies (with students and organizational employees) and one questionnaire survey, we found:

(1) positive correlations between knowledge stock and improvisation, and between knowledge stock and knowledge transformation; (2) knowledge transformation mediates the relationship between knowledge stock and improvisation, with knowledge stock positively influencing improvisation through knowledge transformation; (3) time pressure exerts an inverted U-shaped moderating effect on the relationship between knowledge stock and knowledge transformation, with the promoting effect strengthening as time pressure increases from low to medium levels and weakening as time pressure increases from medium to high levels. Furthermore, time pressure also inverted U-shaped moderates the indirect effect of knowledge stock on improvisation through knowledge transformation, with the effect size first increasing rapidly then gradually weakening. Specifically, under medium time pressure, the indirect effect of knowledge stock on improvisation through knowledge transformation is strongest; conversely, it is weaker under high or low time pressure. Overall, this study reveals the process mechanisms through which knowledge stock empowers improvisation under time pressure, fundamentally reflecting and expanding our understanding of the essence of improvisation and providing new directions for future improvisation research.

### Theoretical Implications

**First**, this study conducts theoretical integration based on the essential connotation of improvisation, aiming to deeply explore the generation mechanism of individual improvisation that combines immediacy and creativity from concepts and characteristics, thereby expanding the theoretical system of improvisation research. Previous studies have primarily examined antecedents from external factors or general organizational behavior theories, with certain limitations in 刻画 ing the fundamental internal operating mechanisms and applicable boundaries of improvisation. Moreover, their theoretical perspectives have remained centered on creativity (Liu et al., 2023; Nisula, 2015). While this can provide insights into improvisation generation mechanisms from a partial perspective, it is insufficient to form a systematically integrated explanatory framework based on the essential characteristics of improvisation, nor does it constitute a comprehensive understanding of its formation mechanisms. Such emphasis has led to relative neglect of the immediacy characteristic (Wang et al., 2016; Leybourne & Smith, 2006). However, simply increasing attention to immediacy cannot fully develop or balance improvisation research, nor can it construct a comprehensive and unified improvisation theoretical framework. Therefore, this study deeply analyzes the generation process of improvisation based on its essential characteristics: the creative characteristic requires knowledge resources for cognitive reconstruction (knowledge stock), while the immediacy characteristic demands a time-constrained context (time pressure). This profoundly reveals the cognitive sources and realistic contexts of improvisation generation and comprehensively analyzes the entire process of "why," "when," and "how" of improvisation. Meanwhile, this study fully utilizes the unique advantages of knowledge linking theory and activation theory, 梳理 s their logical consistency, and proposes an integrated

theoretical model to identify the generation mechanism of improvisation: time situational cues stimulate different immediate responses from individuals, and their contingency stems from different transformation modes when individuals process knowledge under time pressure, resulting in improvisational behavior. This comprehensively constructs a process model of knowledge stock empowering improvisation under time pressure and further promotes the integration of theories related to its characteristics to extend the foundational theoretical perspective of improvisation. This approach of constructing theoretical research from research concepts and basic characteristics helps more accurately describe and simulate complex real-world phenomena, avoids possible conceptual ambiguity during research, promotes deeper understanding of its generation process to improve theoretical frameworks, and makes theoretical construction more operational, thereby providing useful references for subsequent research.

**Second**, this study provides a detailed explanation of the inverted U-shaped moderating effect of time pressure in the improvisation generation mechanism, injecting fresh vitality into improvisation research. Hamzeh et al. (2019) pointed out that time pressure is a key factor triggering improvisation, and it is this immediate situational condition that makes improvisation fundamentally different from innovation, creativity, and other behaviors (Cunha et al., 1999; Miner et al., 2001). That is, time pressure is not only an important boundary condition shaping improvisation but also provides a unique research dimension (Crossan & Hurst, 2006; Magni et al., 2010; Vera & Crossan, 2004, 2005). However, current literature lacks deeper explanation and verification of how time pressure as a boundary condition drives improvisation, limiting profound understanding of the improvisation concept. Therefore, this study explores how knowledge stock affects knowledge transformation to differentially stimulate individual improvisation under the influence of time pressure as a situational cue, compensating for the limitation of one-sidedly focusing on creative characteristics to understand improvisation generation mechanisms. The unique contribution of this study lies in identifying and verifying the nonlinear moderating effect of time pressure on knowledge management processes and their indirect relationships, promoting comprehensive understanding of deep-seated drivers of improvisation. Specifically, this study uses activation theory to focus on the aftermath of time pressure' s influence on individual behavior, identifying and testing the activation strengthening mechanisms of different time pressure levels. Results show that moderate time pressure strengthens the relationship between knowledge stock and knowledge transformation, maximizing the stimulation of knowledge management practices, promoting positive knowledge acquisition actions, and indirectly and significantly influencing improvisation through knowledge processing methods. Therefore, by clearly presenting and verifying the important boundary mechanism of time pressure, this study provides a critical focal point for when knowledge management mechanisms can exert their maximum advantage, thereby revealing differential effects on individual improvisation. This exploration is not simply based on the current nonlinear effects of time pressure on creative behavior but further deepens the conclusion' s connotation based on

the essential characteristics of improvisation. This provides empirical evidence and analytical foundation for revealing the inverted U-shaped moderating effect of time pressure in the improvisation process, promotes the transformation of improvisation research from static to dynamic perspectives, and beneficially supplements existing research while providing directions for future research.

**Third**, this study concretizes the knowledge management process in the improvisation generation mechanism, providing more detailed explanatory mechanisms for the essential connotation of improvisation, thereby elucidating the internal mechanisms through which knowledge stock influences improvisation. Although previous studies have pointed out the important role of knowledge management practices (knowledge sharing, knowledge creation, etc.) in improvisation (Nisula & Kianto, 2016; Vera et al., 2016), their focus has been on superficial processes of knowledge flow, neglecting the foundational efficacy of knowledge stock in improvisation generation, resulting in a disconnection in the causal logic chain of improvisation generation mechanisms and making it like "water without a source" or "a tree without roots." Moreover, their logic still relies on ideas from creativity literature (Nisula, 2015), tending to simply reduce improvisation to other creative behaviors, which may fall into the trap of replicating the generation mechanisms of these creative behaviors (e.g., creativity). Therefore, this study shows that we must fully combine the essential connotation of improvisation to identify its driving mechanisms: knowledge stock, as the core carrier of cognitive resources, forms the necessary foundation for the creativity of improvisation; time pressure, as a situational driving factor, provides the necessary contextual condition for the immediacy of improvisation, thereby clarifying its specific embedded path in the causal logic chain. To this end, this study starts from knowledge linking theory, pointing out that knowledge stock is the transformer for improvisation to exert its effectiveness, can guide knowledge search cognitive paths, and under the stimulation of a certain degree of time pressure, promotes collaborative knowledge acquisition and application, thus endowing individuals with better adaptability and creativity, ultimately transforming into improvisation mechanisms. Through a comprehensive framework integrating knowledge stock, knowledge transformation, and time pressure, this study constructs a dynamic generation process of improvisation, analyzing how individuals are activated and further integrate newly acquired knowledge with existing stock to create knowledge transformation results that positively influence improvisation occurrence, further enriching the antecedent variable system of individual improvisation. This conclusion not only meets the needs of the knowledge economy era but also highlights the incomparable value of knowledge stock in the improvisation process. Based on this, this study clarifies the improvisation generation process by exploring the mechanism through which knowledge stock promotes improvisation, both contributing to improvisation theory and expanding new perspectives for future improvisation research.

### Practical Implications

**First**, considering the relationship effects between knowledge management and individual improvisation, organizations and managers can encourage employees to learn autonomously and improve their knowledge reserves through customized learning and training programs and advanced knowledge base infrastructure (Crossan et al., 2005). Simultaneously, organizations need to motivate individuals to strategically build necessary knowledge bases, such as constructing dynamic knowledge management platforms including suggestion systems, quality circles, and intranet information systems (Sung & Choi, 2018). Moreover, to maximize individuals' enthusiasm for knowledge accumulation, sharing, and transformation, managers should 致力于培养个体间的社会资本，如强大的社会关系、共享的知识、信任以及群体认同等 (Cabrera & Cabrera, 2005), helping employees quickly access required knowledge and resources when facing unexpected events to promote novel improvisation exploration. On the other hand, external knowledge is an important resource for individuals to learn new technologies, solve problems, and create core competitiveness. Therefore, to transform knowledge into substantive action and achieve excellent improvisation effects, organizations need to encourage individuals to participate in cross-departmental projects and regularly hold knowledge sharing meetings, accumulate extensive experience, and expand external knowledge acquisition channels. For example, expanding industrial chains in various fields and markets, holding external R&D discussions and exchange activities to collect more external knowledge, and broadening knowledge horizons can greatly promote knowledge transformation and application, enabling individuals to improvise more flexibly when facing uncertain environments.

**Second**, considering the inverted U-shaped moderating effect of time pressure, organizations and managers should recognize the significance of time pressure. Although knowledge management practices play a "leveraging" role, the premise is that managers must recognize time pressure as a key element stimulating knowledge management practices and acting on improvisation (Hamzeh et al., 2019; Vera & Crossan, 2004), thereby further establishing appropriate response times to meet improvisation challenges. Therefore, managers should maintain time pressure at moderate levels according to task nature and job requirements to most effectively stimulate employee improvisation. Managers can maintain close communication with employees, affirm their important role in improvisation tasks, create a supportive work atmosphere, and provide corresponding immediate training to avoid inhibiting employee improvisation through excessive pressure. Simultaneously, managers should provide some incentive measures to help employees cope with time pressure and encourage setting stretch goals to mitigate negative effects of excessively high or low time pressure. Additionally, besides acquiring task-specific knowledge, employees can benefit from actual improvisation behavior training (Vera & Crossan, 2005). That is, organizations can regularly conduct drills for handling sudden challenges and continuous learning models to cultivate employees' improvisation capabilities (Miner et

al., 2001), such as solving complex problems under time constraints, emergency response simulations of real workplace crisis management events, etc., thereby significantly enhancing employees' immediate response capabilities and work enthusiasm.

### Limitations and Future Directions

**First**, research methods need improvement. Although combining experiments and questionnaires enhances result reliability, limitations remain. First, while the quasi-experimental approach has advantages in revealing variable relationships, its ecological validity needs further verification. Future research could combine diary methods, case studies, laboratory experiments, and field studies (Urbach & Weigelt, 2019) to deeply analyze the internal process of improvisation, comprehensively understand improvisation in complex situations, and examine the universality and generalizability of research conclusions. Second, this study used relatively simplified experimental designs to exclude task heterogeneity interference and enhance reliability and replicability, but this may mean that some findings are products of simplified experimental designs. Future research could enrich task types and their connotations, design diverse and realistic improvisation task scenarios to increase richness and authenticity of experimental materials, making research results more practically applicable while fully testing material validity.

**Second**, variable manipulation needs improvement. First, self-report scales were used to measure high and low knowledge stock levels, which, while reflecting individual associations with knowledge stock, are not results of random manipulation, making causal relationships less definitive. Future research could combine subjective and objective assessment methods, such as test questions, intelligence tests, knowledge quizzes, or real-time knowledge learning tasks to manipulate knowledge stock, providing more reliable evidence. Additionally, the breadth and depth of knowledge stock constitute its structure and content, and future research could deeply explore how its dual dimensions produce differential enhancement or inhibition effects on improvisation at different stages, and further analyze how domain-specific knowledge stock affects the internal mechanisms of task-specific improvisation. Second, experiments stimulated knowledge transformation through individuals' self-feedback on knowledge application and processing during task completion, which has certain feasibility. Future research could combine physiological indicators such as EEG and eye-tracking to accurately capture and analyze cognitive processes, further revealing why and how knowledge stock transforms and the underlying mechanisms and decision-making thought processes. Finally, this study referenced the classic manipulation paradigm of objective time pressure (Svenson & Edland, 1987), effectively stimulating improvisation through time limits. However, time pressure may trigger individual emotional changes (Meurs et al., 2010), subsequently affecting improvisation. Future research could examine emotions under time pressure as evidence of successful manipulation or further explore their moderating role

in knowledge management and improvisation generation processes to discover novel findings.

**Third**, research content needs further expansion. Although this study deeply explored the generation mechanism of individual improvisation from the perspective of its concept and characteristics, and analysis indicates that explaining collective phenomena requires consideration of lower-level entities, the study focused mainly on individual-level variables without generalizing results to team or organizational levels, which may limit broad application of conclusions. Past research shows that group effects can be explained by individual-level cognitive changes (Staw et al., 1981); however, team- or organizational-level effects may differ from individual-level results and performance characteristics. Therefore, future research could further explore the operating mechanisms and influence effects of high-level constructs at team or organizational levels (e.g., team knowledge stock, knowledge transformation) in the improvisation process, opening new exploration directions for improvisation research at various organizational management levels. Additionally, according to improvisation characteristics, current definitions do not limit improvisation to only effective coping behaviors (Magni & Maruping, 2013). Therefore, future research could further explore the dual effects of improvisation in rapidly changing situations—bringing positive reputation on one hand while potentially being ineffective or even destructive—and examine their differential impacts on individuals, teams, and organizations.

### Research Conclusion

This study explored the generation mechanism of improvisation based on its essential connotation. Results show: (1) positive correlations between knowledge stock and improvisation, and between knowledge stock and knowledge transformation; (2) knowledge transformation mediates the relationship between knowledge stock and improvisation, with knowledge stock positively influencing improvisation through knowledge transformation; (3) time pressure exerts an inverted U-shaped moderating effect on the relationship between knowledge stock and knowledge transformation, further influencing improvisation through knowledge transformation. Specifically, under medium time pressure, the indirect effect of knowledge stock on improvisation through knowledge transformation is strongest; conversely, it is weaker under high or low time pressure. In summary, this study reveals the process mechanisms through which knowledge stock empowers improvisation under time pressure, fundamentally reflecting and expanding our understanding of improvisation' s essence and providing new directions for future improvisation research.

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