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Research on stimulating mechanism and restricting factors of employees' innovative behaviour under COVID-19

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Innovation is the foundation of an enterprise's survival and development. Employee innovation is the source of enterprise innovation. Under the COVID-19 epidemic, staff innovation is crucial to whether an enterprise can transform a crisis into an opportunity. However, the negative emotions caused by the epidemic will hinder staff innovation. The influence of the COVID-19 pandemic in China was investigated from May 2020 to October 2021 by using questionnaires. This study explores the motivating mechanism and restricting factors of employees' innovative behaviour under sudden public crisis events. The software SPSS 22.0 is used for the descriptive statistical and correlation analyses of the collected data. Enterprise managers need to study the influencing factors of employees' innovative behaviour under the COVID-19 epidemic to solve the problem of employees' negative emotions. Based on the statistical analysis of 639 valid questionnaires for employees of high-tech enterprises, this study explores the motivating mechanism and influencing factors of employees' innovative behaviour from the aspects of positive psychological quality and leaders' interpersonal emotion management. This study also uses work autonomy as a mediating variable to verify its mediating role in the process of employees' positive psychological quality and leaders' interpersonal emotion management on innovation behaviour. This study tested the moderating effect of employees' perceived corporate social responsibility on the relationship between employees' positive psychological quality, leaders' interpersonal emotion management and innovative behaviour. Through the statistical analysis of 639 valid questionnaires of employees in high-tech enterprises, the relevant model assumptions are verified. Therefore, under the COVID-19 pandemic, enterprises should take responsibility from the aspect of caring for employees to promote the positive effect of employees' psychological attitudes on work results. This study provides countermeasures to ensure the smooth progress of employee innovation activities.

KEYWORDS

COVID-19, employee innovation, stimulating mechanism, restricting factors, statistical analysis

Introduction

“Adhering to innovative development” must rely on high-quality innovative talents and all-around innovative thinking. Most Chinese enterprises are in the process of rapid technological development and innovation. Hence, to obtain and maintain advantages, they must continue to innovate, explore and develop (Huang et al., 2021). Among the many elements of innovation, “innovative employees” with innovation ability and innovation motivation have become one of the most basic and active factors in the organization. It has become increasingly important for Chinese enterprises to explore the development direction of innovation. Particularly in multinational operations with multi-cultural backgrounds, how to improve the innovation power of multinational enterprises, including the innovation behaviour of employees and the innovation performance of enterprises, has become an urgent problem for enterprises (Zhang, 2020). The role of employee innovation is also an important issue that has concerned the academia and industry. Research on the influencing factors of employees’ innovative behaviour is one of the hotspots at present. It plays a positive role in promoting employees to produce innovative ideas, implement innovative ideas and improve the organizational innovation ability.

Under the effects of the COVID-19 pandemic, enterprises generally face increased pressure on production and operation. Enterprise human resource management is becoming increasingly difficult, which has a huge negative effect on employee innovation in enterprises (especially small and medium-sized enterprises) (Zou et al., 2020). Hence, to cope with the rapidly changing market environment through digital transformation, enterprises adopt new technologies, new systems and new platforms, such as shared employees, cloud office and cloud shopping guides (Bao, 2020; Xiao, 2020) to enhance organizational toughness and enhance the anti-risk ability of enterprises. Employees are the main driving force of enterprise innovation. Employee innovation is the key for enterprises to maintain a competitive advantage in a highly competitive market environment. Therefore, how to encourage and motivate employees to improve innovation performance has become an important issue of common concern in academia and business (Chen et al., 2008). Knowledge innovation, technological innovation and talent cultivation in the knowledge economy era are facing great challenges under the background of the COVID-19 pandemic. People’s psychology and work style have been greatly affected. The negative feelings and fear caused by the pandemic also have an important effect on work behaviour. Thus, to stimulate employees’ learning interest and work motivation, many high-tech enterprises are committed to the transformation and innovation of business and work modes. The enterprise shall strengthen staff training and learning, business exchange and daily management to ensure the timely updating of knowledge and technology and the smooth resumption of work

and production after the epidemic. Some scholars have also began to focus on employees’ psychology and work behaviour under the effects of the pandemic, such as building employees’ work resilience model to alleviate the psychological fear caused by the pandemic (Yang et al., 2020), improving innovation performance through the improvement of leaders’ interpersonal emotion management strategies, strengthening the role of corporate responsibility in boosting employees’ coping with difficulties, *etc.* (He et al., 2020). Knowledge workers use professional knowledge to create wealth through mental work with the aim of providing high value-added products (Horibe, 1999). The negative emotions bred in the epidemic environment inhibit the continuity and flexibility of thinking and are not conducive to the development of innovative work (Zhang and Chun, 2020). On the contrary, a positive mental state can improve the ideological and moral levels of employees and help them set the goal of completing work with high quality (Becker, 2008). For example, maintaining a positive work attitude and a sense of humour can bring about a considerable level of performance. Enterprise employees have tenacity, which can promote the development of innovative work, which can then bring considerable economic and social benefits. Xu, (2020) analyzed the significance of implementing the innovation driven development strategy, and discussed the role of the government and the feasible measures of enterprises under the innovation driven background. Chen et al. (2021) empirically analyzed the mechanism of management innovation affecting enterprise competitive advantage based on system theory and dynamic capability theory. Xie et al. (2022) investigated the impact of the COVID-19 on enterprise innovation bias and the regulatory effect of credit financing support on the relationship between the two. Shi and Cai (2022) concluded that under the impact of the COVID-19, the inherent drawbacks of Australia’s scientific research system have further emerged, and the development of scientific and technological innovation may be in a dilemma. In the face of the pandemic crisis, the working environment has changed greatly. However, the question is whether employees flexibly and independently plan, organize and complete their work and innovate in this situation. Some differences in the incentive mechanism can also be observed (Huang, 2020). We need to further clarify the constraints of the COVID-19 pandemic on innovative behaviour.

At present, China’s epidemic prevention and control have achieved phased victory. All walks of life have also gradually returned to work and production. The order of economic life has returned to the normal prevention and control stage. However, for small- and medium-sized enterprises, salary cuts, economic layoffs and development difficulties caused by the pandemic have still occurred. The psychological state of employees under the COVID-19 pandemic presents new characteristics. On the one hand, in addition to worrying about the threat of the pandemic to their health, employees also fear the occupational uncertainty brought by the changing epidemic situation and encounter

obstacles to innovation. On the other hand, the technological innovation under the epidemic crisis has raised new challenges and requirements for knowledge workers. With the rapid development of emerging information technologies, such as artificial intelligence, cloud computing and big data, employees can easily feel helpless under the pressure of survival of the fittest, which can lead to negative emotions, such as employee worry, panic and anxiety (Wang et al., 2020). Negative emotions will not only inhibit the fluency and flexibility of employees' thinking but also hinder the improvement of innovation performance. These are not conducive to the survival and development of enterprises. Because of this, how to effectively manage employees' emotions under COVID-19 and escort enterprises' innovative activities is particularly important. However, it is not easy for employees to manage negative emotions. As the helmsman of the enterprise, enterprise managers must take effective measures to eliminate the effects of employees' negative emotions on innovation performance. Enterprise managers need to clarify the negative factors that affect employees' innovative performance, thereby reducing the negative effects of COVID-19 on employees' innovative activities (Kaplan et al., 2014). In the field of enterprise innovation and transnational operation and development, scholars have conducted research from different levels, such as technology, resources, organization and management, national and corporate culture, and formed different academic views and research schools (Ai et al., 2017). Previous studies are based mostly on a daily stable working situation, and no detailed answers to the motivating mechanisms and restrictive factors of employees' innovative behaviour, such as COVID-19, have been explored. Thus, we construct a research model based on corporate autonomy as the mediator variable and employee perceived corporate social responsibility as the moderator variable and further explore the mechanism of positive psychological quality and leader interpersonal emotion management on employees' innovative behaviour. The purpose is to explore the influence mechanism of COVID-19 on the innovative behaviour and the factors that influence innovation. It provides some thinking for the rational use of various factors in the development of enterprises to manage and improve employees' innovative behaviour.

The existing research has not yet involved in the systematic research on employees' innovative behavior under the COVID-19. In case of a public crisis, enterprises should shoulder their responsibilities to employees to promote high-quality work output. The outbreak of the COVID-19 has caused a global public health crisis that has had considerable influence and caused significant change in people's work and life. In this context, positive psychological quality and leaders' interpersonal emotion management are studied as the influencing factors of innovative behaviour, which highlights the importance of multiple factors to maintain and improve work efficiency in the face of the pandemic. This study also

provides a new perspective for academia to explore the influencing factors of employees' innovative behaviour in special situations. Therefore, this paper explores the influence of multiple factors on innovation behaviour under COVID-19 and explores the mediating and moderating roles of corporate autonomy and employee perceived corporate social responsibility in the impact mechanism. Finally, the incentive mechanism of COVID-19 employees' innovative behaviour is constructed. The research conclusion can broaden and extend the research field of positive psychological quality to a certain extent and enrich the research on the effects of multiple factors, including psychological factors, on innovation behaviour. It also provides reference and thinking for China's high-tech enterprises to cope with the effects of COVID-19, cultivate and inspire innovative talents from a psychological perspective, and achieve full recovery.

Literature review and research hypothesis

Positive psychological quality and innovative behaviours of employees

The concept of positive psychological quality comes from positive psychology and is its core concept. Positive psychology is a science that focuses on people's development potential, virtues and other positive qualities. It explores the occurrence and development of human positive psychology, including positive emotional experience, positive individual personality and positive organizational system (Seligman, 2000). Positive psychology explores human potential, virtues and strength from a new perspective. Positive psychological quality puts forward two concepts: positive personality characteristics and positive quality. Positive quality describes the individual's positive psychological characteristics and causes, which are the embodiment of excellent personality traits (Zhou and Wang, 2019). When combined with a specific virtue, positive psychology can be divided into six dimensions and 24 quality advantages (Peterson and Seligman, 2004). The six dimensions include wisdom and knowledge, courage, benevolence, justice, moderation and transcendence. These positive psychological qualities give people dynamic support and direction guidance in life and work, cherish gratitude in good times and dare to face adversity. People feel anxious when the COVID-19 pandemic became so severe and difficult to overcome. Negative emotions are manifested in doubts about reality, active abandonment of efforts and failure to ignite work motivation. Negative emotions ultimately have a serious effect on individual innovation behaviour and even team innovation performance. However, if enterprise employees can exert unremitting efforts in adversity and constantly improve themselves, it can promote the formation

of resilience to achieve goals but also brings a steady stream of creativity. Innovation behaviour can be defined as a systematic and complete process composed of three stages: creation, concept promotion and implementation of creativity. Each stage of innovation behaviour has its special value (Scott and Bruce, 1994). The generation stage of innovation presents innovative ideas in the field of work. In the promotion stage of innovation, we should explain and demonstrate our new ideas to our working partners and superiors for support. The implementation stage of innovation involves putting the innovation model into practice, which is the link to verifying the new idea. Trait activation theory holds that the external situation is related closely to the formation of individual traits and can predict their corresponding behaviours in the future. The COVID-19 pandemic can be interpreted as a negative attitude to the creativity of employees. Studies have shown that job anxiety causes employees to lack the courage to deal with risks, leading to complacency at work. A negative mentality affects the formation and promotion of innovative thinking and inhibits the exertion of creativity. When the organization attaches importance to the development and utilization of employees' positive psychological quality, it can stimulate employees' innovative behaviour. In addition, individuals who show strong goal learning orientation and creative personality at work and individuals who show the characteristics of justice and sense of humour in interpersonal values have been proven to show more innovative behaviour.

Therefore, this paper proposes the following hypothesis:

H1: positive psychological quality can positively affect employees' innovation behaviour.

Work autonomy and employee innovation behaviour

The research on work autonomy began in the 1960s, and its definition focuses mostly on the individual's ability and degree of control over work. Early studies took work autonomy as a single element in the work trait model and believed that work autonomy refers to the extent to which employees can independently determine the progress of work tasks, which helps to stimulate employees' work motivation and sense of responsibility. Some concepts posit that work autonomy is the degree to which employees can control and decide on work processes, work methods and work standards. Work autonomy is closely related to individual psychological needs. The satisfaction of this independent psychological demand is affected by the external environment and controlled by personality traits such as personality and cognition. The COVID-19 pandemic has caused employees to feel the threat of the external environment to their health and work. A lot of work is done online, and the processes and methods are no longer as clear and controllable as before. The destruction of the sense of stability causes greater pressure,

resulting in mental tension and burnout, which reduces their motivation and willingness to work. Previous studies have verified the correlation between work autonomy and extroverted personality. The study found that employees with extroverted personalities are very confident in interpersonal communication. Employees with extroverted personalities can be very involved in personal work and interaction with team members, reflecting strong work autonomy and innovative output (Gursoy et al., 2011). Some studies also believe employees' conscientious personalities can drive the development of innovative work (Simmering et al., 2003). Some scholars have also explored the role of work autonomy in promoting employees' innovation, encouraging them to participate in decision-making to ensure their work autonomy, which can promote employees' innovative behaviour and efficiency to a great extent.

Therefore, this paper puts forward the following hypothesis:

H2: employees' work autonomy can positively affect employees' innovation behaviour.

Intermediary role of work autonomy

Job autonomy is not only affected by many individual characteristics but is also a key variable affecting employees' work behaviour and progress. When employees think they have control and autonomy over their work, they will bring a high level of innovation output (Amabile et al., 1996). The study found that when employees cannot decide what ways and methods to work by themselves, it will be detrimental to the cultivation of their creativity. Other studies have found that when the organization gives employees work autonomy, employees will have more new ideas and innovative performance. Some studies believe that giving employees the freedom to choose their working methods can stimulate their work enthusiasm and help them transform new ideas into practice. Giving employees the right to arrange their work independently has also been found to be an incentive for employees to effectively develop their creativity. In addition, the influence of work autonomy on innovation behaviour is also regulated by psychological ownership and psychological availability. Because individual traits and working conditions determine job performance, many studies have taken work autonomy, work characteristics and personality traits as antecedent variables to verify its effects on outcome variables. Existing research results show that managers not only improve employees' environmental adaptability but also their work autonomy by integrating resources and cause employees to invest time and energy in innovation activities. In an error-tolerant management atmosphere, employees can easily form the advantageous characteristics of active learning, establish higher work goals and produce innovative behaviour through high autonomy work. These results have great enlightenment for exploring the positive psychology of employees to deal with

the effects of the epidemic and the role of work autonomy on innovation behaviour. Facing the test of public health emergencies, employees can maintain a positive working attitude and good workplace interpersonal relationships. If employees work in special situations and still have freedom and controllability, it will help to promote work progress and new ideas.

Therefore, this paper puts forward the following hypothesis:

H3: work autonomy mediates the positive impact of positive psychological quality on innovation behaviour.

Moderating role of employees' perceived corporate social responsibility

Employees' perceived corporate social responsibility refers to employees' subjective perception of the results of corporate social responsibility activities. Employees will be affected by the organization's social responsibility activities and make different responses at work. At the same time, it will also reduce work anxiety and establish a positive working attitude because of the material support and psychological assistance provided by the organization. Enterprises strictly implement pandemic prevention and control measures to ensure the safety of employees and use a variety of platform measures to care for employees. At the same time, employees stick to their posts under effective prevention and control measures to ensure production, which enhances employees' confidence in actively facing work. Similar to the social exchange theory, when employees feel that the organization is working hard for their benefit, their gratitude and reward psychology is more likely to stimulate efforts and enterprising behaviour. This constructive behaviour plays an important role in the sustainable development of the organization. As an emotional exchange between employees and organizations, employees' enthusiastic work can produce more innovative behaviours that are beneficial to the organization. When an enterprise performs its social responsibility in a crisis and is perceived by employees, it can become a source of strong support for employees to face difficulties and challenges, form a sense of fairness and produce positive work behaviour.

Therefore, this paper puts forward the following hypothesis:

H4: employees' perceived corporate social responsibility positively regulates the positive relationship between positive psychological quality and innovation behaviour.

Leaders' interpersonal emotion management and employees' innovative behaviour

During the COVID-19 pandemic, employees, as the main practitioners of enterprise innovation, play an important role in

improving the overall performance of enterprise innovation. Previous studies have shown that emotion affects employees' innovation performance. Based on the expansion and construction theory of positive emotions, positive emotions can promote the development of employees' innovative thinking and improve innovation performance (Lin et al., 2014). On the contrary, employees with high negative emotional experiences are more likely to reduce their motivation to actively obtain innovation resources, are unwilling to face the risks and challenges brought by innovation and reduce the implementation of innovation activities (Chen and Plucker, 2014; Yao et al., 2018). Therefore, in an organization, leaders adopt appropriate interpersonal emotion management strategies to regulate employees' negative emotions, which can promote employees to carry out innovation activities more actively and improve innovation performance. Leaders' interpersonal emotion management refers to leaders' intention to manage employees' negative emotions (Lottle and Williams, 2016). When managing the negative emotions of subordinates, leaders use four strategies: situation correction, cognitive change, attention distribution and response adjustment (Grawitch and Kramer, 2003). Situational modification means leaders improve employees' negative emotions by changing or removing situational factors that cause employees' negative emotions. The pandemic has resulted in business difficulties. Leaders have informed employees that enterprises can alleviate the enterprise crisis through online marketing. Cognitive change means leaders stand in the perspective of employees to inspire them look at problems with a more positive attitude. The epidemic has reduced business orders and increased idle time. Leaders are encouraged to regard this time as a valuable opportunity to learn charging. Attention distribution means leaders reduce or eliminate the effects of negative emotions on employees by distracting employees' attention. When employees feel depressed, leaders distract employees by sharing exciting stories. Response adjustment refers to leaders encouraging or requiring employees to suppress their negative emotional expressions. When employees feel anxious because of the difficulties of enterprise capital turnover, leaders still require employees to remain happy. Given the important role of employee innovation performance in achieving sustainable development, this study also focuses on the effects of leader interpersonal emotion management on employee innovation performance. Leaders' rational use of interpersonal emotion management strategies can promote employees to implement out-of-role behaviour (Wang et al., 2020).

In the context of COVID-19, enterprises require continuous innovation to seek survival and development (Wang and Gao, 2021). Leaders adopt two interpersonal emotion management strategies: situation correction and cognitive change, which can stimulate employees' positive reciprocity. Employees tend to improve their innovation performance and help leaders solve

problems in enterprise production and operation. Leaders use two interpersonal emotion management strategies: attention distribution and response adjustment, which is easy to stimulate employees' negative reciprocity and reduce employees' innovation performance. Therefore, when leaders use a situation correction strategy to manage employees' negative emotions, they can help employees solve the problems of negative emotions from the root. To repay the care and understanding of leaders, employees will be more active in innovation activities, respond to the challenges in the innovation process and improve their innovation performance. When leaders use cognitive change strategies to manage employees' negative emotions, they will stand in the perspective of employees, help them look at problems from a more positive perspective, and reduce or eliminate negative emotions. At this time, employees perceive the care and help from leaders, which will stimulate their positive mutual motivation and strive to improve their innovation performance. Different from situation correction and cognitive change strategies, when leaders use attention distribution strategy to manage employees' negative emotions, they just try to divert employees' attention to help employees get rid of the troubles of negative emotions temporarily. This makes employees think that leaders are unwilling to invest relevant resources, that is, they do not benefit employees. To achieve psychological balance, employees are more inclined to maintain their work status and reduce the risks and uncertainties caused by innovation activities, to achieve self-protection. In addition, when leaders adopt response adjustment strategies to manage employees' negative emotions, they not only ignore employees' emotional needs but also require employees to inhibit the expression of their own negative emotions. Employees who are negatively treated by leaders will have negative psychology of reciprocity, reduce their willingness to innovate and reduce their innovation behaviour.

Therefore, this paper puts forward the following hypothesis:

H5: Leaders' interpersonal emotion management has a positive effect on innovation behaviour.

Research methods

Sample and data collection

The influence of the COVID-19 pandemic in China was investigated from May 2020 to October 2021 by using questionnaires. Electronic questionnaires were used in line with the requirements for pandemic prevention and control. The survey samples were from Shanghai, Nanjing, Hangzhou and other Yangtze River Delta regions. A total of 800 questionnaires were distributed and 639 valid questionnaires were recovered, with an effective recovery rate of 79.88%. The basic information of the sample is as

follows: in terms of age, men accounted for 58.6% while women accounted for 41.4%. An independent sample *t*-test confirmed the absence of a significant difference between the collected data on men and women in the main research variables, and thus, it does not interfere with the effectiveness of the research conclusion. In terms of age, 31.2% had ages 30 years and below, 49.6% had ages 31–40 years, 13.6% had ages 41–50 years and only 5.6% had ages 51 and above years, reflecting the younger characteristics of knowledge workers in the sample. In terms of working years, 5.2% have been working for 3 years, 41.7% had 4–8 years of work experience, 35.3% had 9–15 years of work experience and 17.8% had 16 years and above. Most employees have rich working experience. In terms of educational background, respondents with senior high school and below accounted for 2.5%, junior college accounted for 7.8%, undergraduate level accounted for 29.6% and graduate level and above accounted for 60.1%. Hence, the education level of the surveyed employees is generally high. On the whole, the samples selected in the study can represent the basic situation of high-quality employees in high-tech industries and meet the research requirements.

Variable measurement

Most of the main variables in this paper were revised following the original ideas of foreign scholars, combined with the pandemic situation and the characteristics of local high-tech enterprises. The five-level Likert scale was formed following Wang et al. (2020) and Zou et al. (2020). The surveyed employees scored consistently between the content of each item statement and the actual situation in their work. They selected between 1 and 5, and the degree of compliance increased from 1 to 5.

Positive psychological quality

The measurement of this variable draws from the results of Meng and Guan, (2009), wherein the respondents were asked to select 14 items from the positive psychological quality evaluation scale for young people. The scale was revised in combination with the work and psychological characteristics of knowledge workers. The scale has two dimensions: work-oriented positive psychological quality and interpersonal values-oriented positive psychological quality. The former includes "I am preserving," "I am curious about new things," "I can feel the support of my partners," "I have careful thinking" and so on. The latter includes "I treat people sincerely and warmly," "I am always grateful to my working partners," "I adhere to the principle of fairness and justice," "I am a humorous person" and so on. The Cronbach coefficient of positive psychological quality scale is 0.895, and the

Cronbach coefficients of work-oriented and value-oriented positive psychological qualities are 0.914 and 0.887, respectively.

Leaders' interpersonal emotion management

The measurement of this variable adopts the 20-question scale adapted by [Lottle and Williams. \(2016\)](#). An example of situation correction is "leaders will change the situational factors that have a negative effect on me at work" (the Cronbach coefficient of the scale is 0.907). An example of cognitive change is "leaders try to change my mood by changing my view of the environment" (the Cronbach coefficient of the scale is 0.882). An example of attention allocation is "leaders will divert my attention from issues that will lead to my negative emotions" (the Cronbach coefficient of the scale is 0.901). An example of response adjustment is "when I complain in front of the leader, he or she will persuade me to stop immediately" (the Cronbach coefficient of the scale is 0.899).

Work autonomy

The measurement of this variable selected three items describing work autonomy in the psychological empowerment scale developed by [Spreitzer \(1995\)](#), which was later revised by [Li et al. \(2006\)](#) according to the local situation. It includes three questions: "I have great autonomy in my work," "I can decide how to complete my work" and "I have the opportunity to independently decide the way to complete my work." The Cronbach coefficient of the scale is 0.816.

Perceived corporate social responsibility of employees

The measurement of this variable extracted some items from the employee perceived corporate social responsibility scale developed by [Turker \(2009\)](#). The scale involves the perception of corporate responsibility in four aspects: employees, consumers, social and non-social stakeholders and the government. The scale design focuses on exploring employees' perception of corporate responsibility behaviour under the background of an epidemic situation. This paper draws lessons from [Wang et al. \(2020\)](#) and revises the perception dimension of employees' social responsibility, including "enterprises provided me with a safe working environment during the epidemic," "enterprises took feasible measures to encourage employees to improve their skills during the epidemic" and "enterprises implemented flexible policies to balance and adjust employees' work and life during the epidemic." The Cronbach coefficient of the scale is 0.937.

Innovation behaviour

The measurement of this variable is compiled concerning the six-item scale developed by [Scott and Bruce, \(1994\)](#) and the content of the theoretical model of innovative talents constructed by [Zhao et al. \(2012\)](#). The scale has 12 items,

TABLE 1 Results of factor analysis of main variables.

| Model | X2/df | GFI | CFI | NFI | IFI | RMSEA |
|---------------|-------|-------|-------|-------|-------|-------|
| Single factor | 4.433 | 0.867 | 0.874 | 0.843 | 0.793 | 0.103 |
| Double factor | 3.497 | 0.846 | 0.864 | 0.842 | 0.813 | 0.092 |
| Three factors | 2.895 | 0.898 | 0.893 | 0.876 | 0.886 | 0.076 |
| Four factors | 2.143 | 0.912 | 0.926 | 0.882 | 0.931 | 0.486 |
| Five factors | 2.006 | 0.944 | 0.953 | 0.906 | 0.961 | 0.048 |

including the generation of innovative ideas, the demonstration and promotion of ideas and the implementation and application of ideas. Specific topics include "I often pay attention to new industry knowledge, new technology and new ideas," "I can demonstrate new ideas with team members," "I have a work plan for the implementation of new methods," "I can solve problems in work with creativity," *etc.* The Cronbach coefficient of the innovation behaviour scale is 0.902, and the Cronbach coefficients of the three dimensions of the generation of innovative ideas, the demonstration and promotion of ideas and the implementation and application of ideas are 0.829, 0.791 and 0.785, respectively.

Discriminant validity test

The software Amos 23.0 was used to test the discriminant validity of five factors: positive psychological quality, leaders' interpersonal emotion management, work autonomy, employees' perceived corporate social responsibility and innovative behaviour. The results are shown in [Table 1](#). The fitting indices of single- and two-factor models are not ideal, and the fitting indices of three-, four- and five-factor models all meet the fitting requirements. Among them, the five-factor model has the best fitting effect ($x^2/DF = 2.006$, $GFI = 0.944$, $CFI = 0.953$, $NFI = 0.906$, $IFI = 0.961$ and $RMSEA = 0.048$). The overall fitting indices of all variables meet the evaluation criteria.

Common method deviation inspection

To avoid the common method deviation caused by all items being filled in by the same employee, this paper focuses on not reflecting the variable name when preparing each item and explains the confidentiality of the survey data to the investigated employees in the survey process. In addition, SPSS 22.0 was used to conduct exploratory factor analysis on the collected data. Five factors were extracted after principal component analysis. The maximum common factor could explain 31.48% of the variation, not more than 50%. [Table 1](#) also shows that the fitting degree of the five-factor model is ideal, and the common method deviation of the above data is within the acceptable range.

TABLE 2 Mean, standard deviation and correlation coefficient of variables.

| Variable | Mean value | Standard deviation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--|------------|--------------------|---------|-----------|---------|---------|--------|----------|----------|----------|----------|-------|
| 1 gender | 1.394 | 0.523 | 1.000 | | | | | | | | | |
| 2 age | 2.392 | 0.622 | -0.029 | 1.000 | | | | | | | | |
| 3 working years | 4.586 | 0.865 | -0.124 | 0.600*** | 1.000 | | | | | | | |
| 4 education | 4.501 | 0.820 | -0.018 | -0.071 | 0.032 | 1.000 | | | | | | |
| 5 industry nature | 3.182 | 0.589 | -0.056 | 0.372 | 0.210 | 0.014 | 1.000 | | | | | |
| 6 positive psychological quality | 4.912 | 0.643 | -0.089 | -0.094*** | 0.023 | 0.215 | 0.007 | 1.000 | | | | |
| 7 leaders interpersonal emotion management | 4.527 | 0.824 | -0.097 | -0.078 | 0.032 | 0.262 | 0.013 | 0.029*** | 1.000 | | | |
| 8. Work autonomy | 4.417 | 0.682 | -0.041 | -0.030 | -0.042 | 0.449 | -0.053 | 0.586*** | 0.464*** | 1.000 | | |
| 9 employees' perceived corporate social responsibility | 4.360 | 0.728 | -0.074 | 0.196 | 0.209* | 0.050** | 0.067 | 0.493*** | 0.474*** | 0.344*** | 1.000 | |
| 10 Innovative behavior | 4.158 | 0.947 | -0.200* | 0.190** | 0.097** | 0.373* | 0.040 | 0.544*** | 0.671*** | 0.494*** | 0.446*** | 1.000 |

$N = 639$, * for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$.

Data analysis and results

Descriptive statistics and correlation analysis

In this paper, the software SPSS 22.0 is used for the descriptive statistical and correlation analyses of the collected data. The results are shown in Table 2. The table shows that a significant positive correlation between innovation behaviour and positive psychological quality exists, and leaders' interpersonal emotion management, work autonomy and employees' perceived corporate social responsibility ($p < 0.001$). The correlation coefficients are 0.544, 0.671, 0.494 and 0.446, respectively. A significant positive relationship between positive psychological quality and leaders' interpersonal emotion management, work autonomy and employees' perceived corporate social responsibility work autonomy ($p < 0.001$) can also be observed. The correlation coefficients were 0.029, 0.586 and 0.493, respectively. A significant positive correlation between leaders' interpersonal emotion management and job autonomy and employees' perceived corporate social responsibility ($p < 0.001$) can also be seen. The correlation coefficients were 0.464 and 0.474, respectively. Job autonomy and employees' perceived corporate social responsibility ($p < 0.001$) can also be found, and the correlation coefficient was 0.344. The determination of the correlation between the main variables laid a foundation for further verification of the research hypothesis.

Direct effect test

SPSS was used for regression analysis, taking gender, age, working years, education and industry nature as control variables

to analyse the influence relationship between variables. The results are shown in Table 3. Model 2 that positive psychological quality has a significant positive impact on employees' innovation behaviour ($\beta = 0.442$, $p < 0.01$), assuming that H1 is true. It can be seen from model 2 that leaders' interpersonal emotion management has a significant positive effect on employees' innovation behaviour ($\beta = 0.301$, $p < 0.001$), assuming H5 is true. In model 8, positive psychological quality has a significant positive effect on employees' work autonomy ($\beta = 0.436$, $p < 0.001$). Leaders' interpersonal emotion management has a significant positive effect on employees' work autonomy ($\beta = 0.309$, $p < 0.001$). According to model 3, work autonomy has a significant positive effect on the innovation behaviour of knowledge workers ($\beta = 0.510$, $p < 0.001$), assuming that H2 is true.

Intermediary effect test

For the mediating role of work autonomy, this paper uses the mediating role test method proposed by Baron and Kenny, (1986) to test positive psychological quality, work autonomy and innovative behaviour. First, it tests the effects of positive psychological quality and leaders' interpersonal emotion management on innovation behaviour. Then it examines the effects of the positive psychological quality and leaders' interpersonal emotion management on job autonomy. Finally, we test the common effects of positive psychological quality, leaders' interpersonal emotion management and work autonomy on innovation behaviour to observe the changes in the effects of positive psychological quality and leaders' interpersonal emotion management on innovation behaviour. According to this method, positive psychological quality, leaders' interpersonal emotion management, work autonomy and innovation

TABLE 3 Regression analysis results of variables.

| Variable | Innovative behavior | | | | | | Work autonomy | |
|--|---------------------|-----------|-----------|-----------|-----------|-----------|---------------|----------|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| independent variable | | | | | | | | |
| Positive psychological quality | | 0.442** | | 0.397*** | | 0.314** | | 0.436*** |
| Leaders' Interpersonal Emotion Management | | 0.301*** | | 0.299** | | 0.295** | | 0.309*** |
| mediating variable | | | | | | | | |
| Work autonomy | | | 0.510*** | 0.370*** | | | | |
| adjustment variable | | | | | | | | |
| Employee Perceived Corporate Social Responsibility | | | | | 0.392*** | 0.311** | | |
| control variable | | | | | | | | |
| gender | -0.041 | -0.103* | 0.053* | -0.013* | 0.045* | 0.112** | -0.109* | -0.105** |
| age | 0.209 | 0.212 | 0.200 | 0.237* | 0.072 | 0.117 | 0.253 | 0.337* |
| working years | -0.122* | -0.121** | -0.088** | -0.184* | 0.095** | 0.075* | -0.034 | -0.067 |
| education | 0.065 | -0.011*** | -0.001 | -0.021 | 0.018 | 0.052** | 0.029* | 0.229** |
| industry nature | 0.020 | 0.071 | 0.042** | 0.041* | 0.035* | 0.066 | 0.004 | 0.005 |
| interactive item | | | | | | | | |
| Positive Psychological Quality * perceived corporate social responsibility of employees | | | | | | 0.322*** | | |
| Leaders' interpersonal emotion management * perceived corporate social responsibility of employees | | | | | | 0.234*** | | |
| R ² | 0.264 | 0.598 | 0.781 | 0.654 | 0.614 | 0.594 | 0.709 | 0.058 |
| Adjust R ² | 0.229 | 0.477 | 0.760 | 0.630 | 0.579 | 0.579 | 0.678 | 0.040 |
| F | 2.595*** | 10.152*** | 29.554*** | 19.926*** | 19.587*** | 25.816*** | 3.890*** | 2.043** |

$N = 639$, * for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$.

behaviour are subjected to regression equation in the regression analysis. Model 4 in Table 3 shows that the standardization coefficient of positive psychological quality on innovation behaviour decreases from 0.442 to 0.397, which meets the requirements of the intermediary test, The standardization coefficient of leaders' interpersonal emotion management on innovation behaviour decreased from 0.301 to 0.299, indicating that work autonomy plays a partial intermediary role in the relationship between positive psychological quality, leaders' interpersonal emotion management and innovation behaviour. Hypothesis H3 is true.

In addition, to ensure the preciseness of the research, the mediation effect of work autonomy is verified again by using the plug-in process in SPSS. Model 4 was selected and analysed using the deviation corrected booting method, and 1000 booting times were carried out. The results show that the total effect of direct and indirect effects is 0.498. The confidence interval of work autonomy in the model of positive psychological quality and leaders' interpersonal emotion management affecting innovation behaviour does not include 0, which further verifies the existence of the mediation effect.

Regulation effect test

This paper uses the method proposed by Wen et al. (2005) to test the regulatory role of employees' perceived social responsibility. First, the control variables including gender, age, working years, educational background and industry nature are included in the regression equation. Second, the positive psychological quality after standardization and employees' perceived corporate social responsibility are included in the regression equation. Finally, the interaction between the standardized positive psychological quality and employees' perceived corporate social responsibility is included in the regression equation. Model 5 in Table 3 shows that employees' perceived corporate social responsibility has a positive effect on innovation behaviour ($\beta = 0.392$, $p < 0.001$). Model 6 shows the interaction between positive psychological quality and employees' perceived corporate social responsibility has a significant effect on innovation behaviour ($\beta = 0.322$, $p < 0.001$). The interaction between leaders' interpersonal emotion management and employees' perceived corporate social responsibility has a significant impact on innovation behaviour ($\beta = 0.0234$, $p < 0.001$). Thus, H4 is verified.

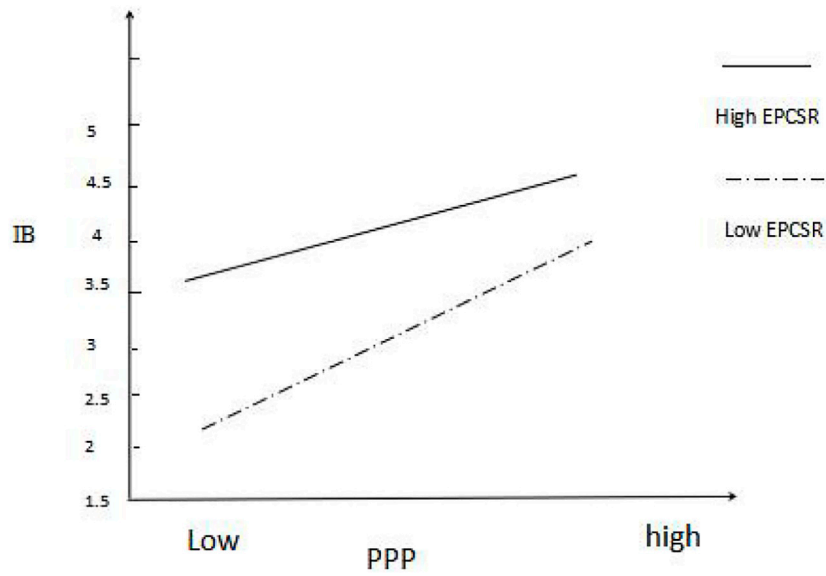


FIGURE 1
The moderating effect of employees' perceived corporate social responsibility (EPCSR) on the relationship between positive psychological quality (PPP) and Innovative behavior (IB).

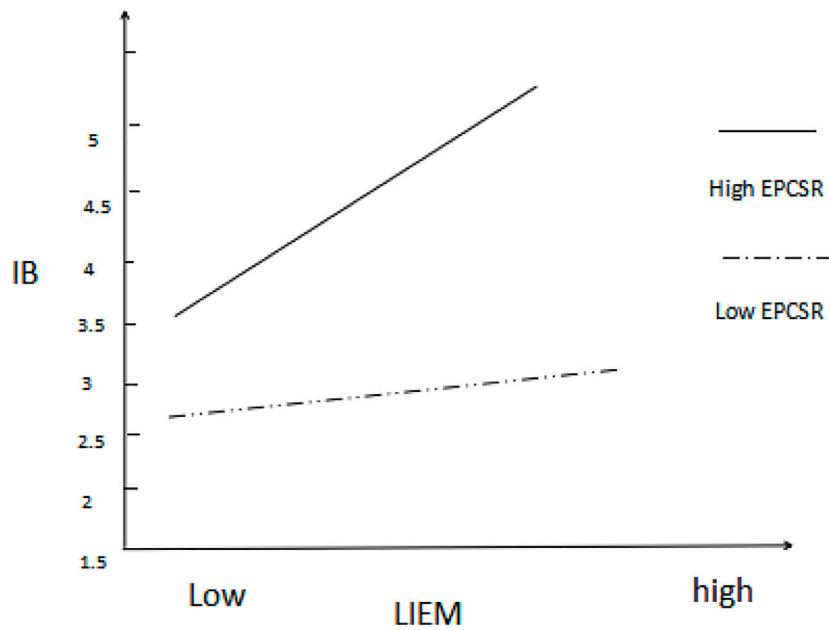


FIGURE 2
The moderating effect of employees' perceived corporate social responsibility (EPCSR) on the relationship between leaders' interpersonal emotion management (LIEM) and Innovative behavior (IB).

Through the regulation effect diagram, this paper intuitively shows the regulation effect of employees' perceived corporate social responsibility on the positive relationship between positive

psychological quality, leaders' interpersonal emotion management and innovation behaviour. Figure 1 shows that compared with the lower degree of corporate social responsibility

TABLE 4 Results of robustness test.

| Variable | Innovation performance | | | | | |
|--|------------------------|-----------|-----------|-----------|-----------|----------|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| independent variable | | | | | | |
| Positive psychological quality | | 0.507*** | | 0.501** | | 0.467*** |
| Leaders' Interpersonal Emotion Management | | 0.424*** | | 0.340** | | 0.369** |
| mediating variable | | | | | | |
| Work autonomy | | | 0.442*** | 0.394*** | | |
| adjustment variable | | | | | | |
| Employee Perceived Corporate Social Responsibility | | | | | 0.456*** | 0.346** |
| control variable | | | | | | |
| gender | -0.050 | -0.011* | 0.046 | -0.013* | 0.055 | 0.142 |
| age | 0.283 | 0.132* | 0.363** | 0.269* | 0.039* | 0.050 |
| working years | -0.139* | -0.020 | -0.074* | -0.201** | 0.146*** | 0.116* |
| education | 0.055** | 0.064*** | -0.033** | -0.036* | 0.009* | 0.018** |
| industry nature | 0.013 | 0.016 | 0.084* | 0.074* | 0.008 | 0.057* |
| interactive item | | | | | | |
| Positive Psychological Quality * perceived corporate social responsibility of employees | | | | | | 0.326*** |
| Leaders' interpersonal emotion management * perceived corporate social responsibility of employees | | | | | | 0.220*** |
| R ² | 0.700 | 0.914 | 0.765 | 0.718 | 0.695 | 0.830 |
| Adjust R ² | 0.558 | 0.889 | 0.737 | 0.677 | 0.677 | 0.793 |
| F | 11.878*** | 34.578*** | 23.313*** | 22.917*** | 30.205*** | 4.551*** |

N = 639, * for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$.

perception, the positive effect of employees' positive psychological quality on innovation behaviour is more significant under the condition of the higher degree of corporate social responsibility perception, which shows that employees' perceived corporate social responsibility plays a regulatory role between positive psychological quality and innovation behaviour. Similarly, as shown in Figure 2, leaders' interpersonal emotion management has a more significant positive effect on innovation behaviour, indicating that employees' perceived corporate social responsibility plays a regulatory role between leaders' interpersonal emotion management and innovation behaviour.

Robustness test

This paper adopts the method of replacing the explained variables to test the robustness and ensure the reliability of the research results and the scientific rationality of the model. Because the contents of innovative products and technologies, knowledge discovery, innovative workflow and working atmosphere involved in innovation performance are similar to the connotation of innovation behaviour, innovation performance is often studied as the outcome variables of work happiness, psychological capital, psychological contract and

other variables in the fields of management and organizational behaviour. Therefore, according to the research needs, this paper selects the innovation performance of employees to replace the innovation behaviour of knowledge employees for a robustness test.

The regression results are shown in Table 4. Model 2 shows that positive psychological quality can positively affect employees' innovation performance ($\beta = 0.507$, $p < 0.001$). Leaders' interpersonal emotion management can positively affect employees' innovation performance ($\beta = 0.424$, $p < 0.001$). Model 3 shows that job autonomy can positively affect employees' innovation performance ($\beta = 0.442$, $p < 0.001$). Model 5 also confirms that employees' perceived corporate social responsibility can positively affect employees' innovation performance ($\beta = 0.456$, $p < 0.001$). Model 4 shows that the integration effect of positive psychological quality and work autonomy is positively correlated with innovation performance, and the regression coefficient decreases slightly when it is significantly positive ($\beta = 0.501$, $p < 0.01$). The integration effect of leaders' interpersonal emotion management and work autonomy is positively correlated with innovation performance, and the regression coefficient decreases slightly when it is significantly positive ($\beta = 0.340$, $p < 0.01$) from Model 6, it can be seen that the interactive items of positive psychological quality and employees' perceived corporate social

responsibility are significantly positively correlated with innovation performance ($\beta = 0.326$, $p < 0.001$). The interactive items of leaders' interpersonal emotion management and employees' perceived corporate social responsibility are significantly positively correlated with innovation performance ($\beta = 0.220$, $p < 0.001$). Therefore, the direct effect and indirect effect of this paper are still valid, indicating that the research conclusion of this paper is stable.

Research conclusions

Under the background of the COVID-19 pandemic, this paper studies the motivating mechanism and influencing factors of innovative behaviour of employees from the aspects of positive psychological quality and leader's interpersonal emotion management. At the same time, taking work autonomy as the mediating variable, this paper verifies its mediating role on the effects of enterprise employees' positive psychological quality and leaders' interpersonal emotion management on innovation behaviour. Taking employees' perceived corporate social responsibility as the regulatory variable, this paper verifies its regulatory role in the relationship between employees' positive psychological quality, leaders' interpersonal emotion management and innovation behaviour. Through the statistical analysis of 639 valid questionnaires of employees in high-tech enterprises, the relevant model assumptions are verified, and the following conclusions are drawn.

Positive psychological quality and leaders' interpersonal emotion management have a significant positive effect on employees' innovative behaviour. This result shows that enterprise employees can adopt positive coping styles to overcome difficulties, especially during the epidemic prevention and control period, and they can adapt to the new work rhythm and maintain innovation enthusiasm to produce innovative behaviours. Leaders' interpersonal emotion management helps enterprise employees establish the principles of optimism, altruism and cooperation at work, to promote the promotion of new ideas and the output of innovative achievements.

Positive psychological quality and leaders' interpersonal emotion management can have a positive effect on innovation behaviour through work autonomy. The personal ability, interest and attitude covered by the positive psychological quality and the advantages shown in work can bring high enthusiasm, initiative and high efficiency. Leaders' interpersonal emotion management creates a good atmosphere for the resumption of work and production, improves innovation ability and helps innovation behaviour.

Employees' perceived corporate social responsibility can positively regulate the relationship between positive psychological quality, leaders' interpersonal emotion management and innovation behaviour. The higher the

employees' perception of corporate social responsibility, the stronger the positive effect of positive psychological quality on innovation behaviour. The more deeply employees feel the leader's interpersonal emotion management during the pandemic, the easier it is to help them reduce the sense of helplessness and anxiety caused by the pandemic when they create a safe working environment, care about psychological demands and pay attention to career development. Leaders' interpersonal emotion management can establish a positive attitude of employees to face work and life and finally bring innovative performance.

Practical implications

Enterprises that have felt the effects of the COVID-19 pandemic should pay attention to the cultivation of knowledge workers' positive psychological quality and enhance their psychological skills through management innovation. Enterprise managers should strengthen emotional management, make employees respond actively to difficulties at work, design work guidelines during the epidemic and avoid or alleviate the stress response when the epidemic occurs. Moreover, the management of team morale during the pandemic should be strengthened, stimulate employees' work enthusiasm, initiative and creativity, and make them full of courage and strength to face the work under the pandemic. A team communication platform should be built and innovative work modes, methods and achievements should be promoted to respond flexibly to the development and changes caused by the pandemic. In case of a public crisis, create a positive corporate culture to enhance employees' work innovation autonomy. Cultural rendering and edification promotes the formation of employees' positive psychological quality, improve employees' working state and make them devote themselves to innovation activities. It is an effective way to design an incentive salary system during the epidemic period to stimulate employees' potential and sense of responsibility and promote the generation and sharing of new ideas and methods.

Enterprises should pay attention to the cultivation of positive psychological quality of knowledge workers. In addition to building a high-quality information technology system, enterprises should improve the psychological skills of knowledge workers through management innovation. Enterprise managers should strengthen emotional management to enable employees to actively respond to difficulties at work, avoid or mitigate the stress response when the epidemic occurs, stimulate employees' work enthusiasm, and build a team communication platform. At the same time, we should also create a positive corporate culture to enhance the work autonomy of knowledge workers, which is conducive to promoting the formation and development of employees' positive psychological quality. Through a variety of ways,

employees can gain more work freedom and sense of achievement. Design incentive salary system during the epidemic period to stimulate employees' potential and sense of responsibility. When a public crisis occurs, an enterprise should shoulder its responsibility to its employees to promote high-quality work output. The enterprise shall provide employees with safe and hygienic working conditions and reduce their concerns about the working environment. Start the employee assistance plan during the epidemic period, and provide professional psychological assistance services to reduce employees' worries.

In case of a public crisis, enterprises should shoulder their responsibilities to employees to promote high-quality work output. Whether it is during telecommuting or preparing to return to work and production, ensuring employees' health, safety and work efficiency reflects the responsibility of the enterprise in major events. Therefore, high-tech enterprises should provide employees with safe and hygienic working conditions and reduce employees' concerns and concerns on the working environment. Enterprises should first understand the psychological problems, work difficulties and pressure under the epidemic situation, and what support they hope to get. During the pandemic, enterprises should create feasible conditions, provide employees with opportunities and platforms for learning and development and provide professional psychological assistance services to reduce employees' worries.

Research limitations and prospects

The study selected high-tech enterprise employees in high-risk areas as the sample source according to the needs. Research on the innovation behaviour of other employees in other industries in the conventional situation has been limited. Hence, in the future, we will attempt to collect relevant data and interview materials from employees or managers in other industries to test the universality of the research hypotheses. In the process of data collection, the author took some measures to avoid the deviation of common methods as far as possible, but the questionnaire was filled in by the employees themselves in the form of self-evaluation, which has a certain effect on the accuracy and scientificity of the research conclusion. In the future, we can try the experimental method to expand the sampling range to more comprehensively analyse the relationship between variables.

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Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board, Huzhou University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

The author is the sole contributor of this work and has approved it for publication.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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