

## Exploring the Influence of Millennial 'Social Butterflies' on Bootleg Innovation: A Study of Moderated Mediation Effects

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**Abstract.** The digital economy has brought about significant changes in the workplace, including the rise of virtual workspaces, organizational flattening, and virtualization. In this context, the mindset of millennial employees, characterized by a boundary-less perspective, social media competency, and future work self-salience, has emerged as a crucial factor influencing work behaviors. Drawing on the Self Determination Theory (SDT) and Social Exchange Theory (SET), this study employs structural equation modeling (SEM) to investigate the mechanisms that shape the relationship between millennial employees' boundary-less mindset and bootleg innovation. The findings of the SEM analysis indicate that the boundary-less mindset significantly influences bootleg innovation behavior among millennial employees. Moreover, social media competency plays a significant role in driving bootleg innovation behavior. Notably, social media competency acts as a mediating factor between the boundary-less mindset and bootleg innovation. Furthermore, the study reveals that future work self-salience has a significant moderating and mediating effect on these relationships. This study offers valuable insights for organizations seeking to understand and manage millennial employees' bootleg innovation behaviors, as well as other related "spillover" or "deviant" behaviors, within the virtual workplace. By recognizing these behaviors and their underlying mechanisms, organizations can implement effective management and governance mechanisms to foster a positive and innovative work environment.

**Keywords:** boundary-less mindset, social media competency, future work self-salience, bootleg innovation behaviour

## 1. Introduction

In the era of digital economy, cross organizational forms (bilateral and multilateral platforms, online communities, etc.) are constantly emerging (Wei et al., 2021). Organizations need to frequently establish connections or collaborations with external stakeholders (suppliers, partners, competitors, etc.) by crossing organizational boundaries to achieve their goals. The organizational structure is becoming more flat, the organizational boundary is becoming vaguer, and borderless organizations are emerging in large numbers. This series of changes has increased the opportunities for the millennial employees to move between different positions and organizations. The cross-border behavior of the millennial employees has become the norm at work. The widespread use of social media, such as DingTalk, Enterprise WeChat, Feishu, Yammer, LinkedIn, etc., as important carriers of cross-border behavior (virtual workspace) and tools, has also expanded the tentacles of innovation sources.

Although the external search and integration of information in the context of open work can improve the success rate of innovation (Rauter et al., 2018), from the perspective of organizational resource allocation, if the relationship between resources and innovation, management and innovation is unbalanced, millennial employees may have bootleg innovation behaviours in order to maintain the implementation of innovative ideas (Amabile, 1988). Bootleg innovation behaviour can affect the innovation ability and risks of millennial employees, as well as the innovation ability of the entire organization, which is not conducive to the orderly management of the organization (Augsdorfer, 2005; Criscuolo et al., 2014). At present, scholars mostly study bootleg innovation within traditional organizational frameworks (Augsdorfer, 1996; Gao et al., 2020; Ghosh, 2015; Globocnik & Salomo, 2015; Lin et al., 2015; Shukla & Kark, 2020; Xu & Zhao, 2020), while there is a lack of research on the impact mechanism of the borderless mentality of millennial employees in virtual workplaces on bootleg innovation. This is incomplete in both practice and theory.

Based on the above description of the internal and external reality environment faced by millennial employees, this paper will explore the impact mechanism of boundary-less mindset on bootleg innovation in the virtual workplace: (1) Simultaneously considering the relationship between four factors: boundary-less mindset, social media competency, future work self-salience, and bootleg innovation; (2) The use of quantitative analysis methods enables data analysis to have high reliability and accuracy.

The purpose of the research is to strengthen the identification of bootleg innovative behaviours among millennial employees; Assist managers in objectively and scientifically managing the bootleg innovative behaviour of millennial employees; Enhance the innovation capability of enterprises; Better attract and motivate millennial employees.

## 2. Literature Review

Knight (1967) first mentioned bootleg innovation in the process of conducting innovative research within organizations. He believed that organizations gave employees a high degree of autonomy to induce innovation, but they also used organizational rules and processes to constrain them, which could easily lead to conflicts between individual innovation and organizational research and development strategies and systems. If an individual firmly believed that their innovative ideas were expected to bring benefits to the organization, they might continue to engage in this innovative behavior in a covert manner. Knight coined the term 'bootlegging' to describe this innovative behavior that conflicts with organizations (Knight, 1967). Currently, scholars have studied bootleg innovation behavior at the individual, leadership, and organizational levels within traditional organizational contexts. (1) At the individual level (McCrae, 1992; Mount et al., 2006; Wang & Wang, 2020; Xu & Zhao, 2020), it is influenced by individual traits, self-awareness, psychological capital, etc. Moreover, young employees are more eager to receive recognition from company executives and colleagues, and are prone to deviant innovative behavior (Gao et al., 2020). (2) At the leadership level, it is influenced by leadership style

and pattern. Leaders have five reactions to employees' bootleg innovation, namely forgiveness, reward, punishment, neglect, and manipulation. The consequences of each reaction have different impacts on bootleg innovation (Amabile et al., 2004; Lai & Tan, 2021; Lin et al., 2015; Podsakoff et al., 2006). (3) At the organizational level, it is influenced by organizational goals, procedural management models, and resource conditions (Augsdorfer, 2008; Ghosh, 2015; Globocnik & Salomo, 2015). Although organizations find innovation and support for an innovation culture important (Urbancová, 2013), due to resource constraints, organizations cannot accept all innovation projects. When the innovative ideas of millennial employees are not accepted by the organization, they are more willing to adopt informal methods, resulting in bootleg innovative behavior (Mainemelis, 2010; Wang & Wang, 2020).

In summary, scholars mostly focus on the study of employees' bootleg innovation behavior in traditional organizational contexts; however, research on the differential driving mechanism of bootleg innovation behavior among individual social network relationships of millennial employees in the virtual workplace (work social media platforms) is relatively weak. In addition, most studies have not simultaneously evaluated the direct and indirect effects of boundary-less mindset, social media competency, future work self-salience, and bootleg innovation.

### **3. Research Hypotheses**

In order to study the bootleg innovation behavior of millennial employees in virtual workspaces, the theoretical basis of this paper involves the following topics: bootleg innovation, boundary-less mindset, social media competency, and future work self-salience.

#### **3.1. The Relationship between Boundary-less Mindset and Bootleg Innovation Behavior**

Previous literature has shown that the more connections and exchanges employees form in their interactions with others, the more conducive they are to finding the relevant information and skills needed for innovation (Perry-Smith & Shalley, 2003). These information and skills directly or indirectly contribute to employees' innovation.

That is, boundary-less mindset helps individuals engaged in bootleg innovation gather necessary support from various stakeholders. The support of other stakeholders enables the creative performance and innovation ability of core employees to be better utilized. Therefore, in high-level boundary-less mindset, the relationship between bootleg innovation and positive outcomes of creative expression may be strengthened. When employees have low boundary-less mindset, they are less likely to understand the needs, desires, emotions, attitudes, and behaviors of other stakeholders within the organization. This may lead to them using organizational resources (time, talent, money, etc.) to develop ideas that are more easily rejected by others, leading to resource waste (Shukla & Kark, 2020).

Therefore, for individuals with high boundary-less mindset, the relationship between bootleg innovation and positive outcomes of creative performance may be strengthened. Therefore, this study proposes hypothesis *H1: boundary-less mindset positively affects the bootleg innovation behavior of the millennial employees.*

#### **3.2. The Relationship between Boundary-less Mindset and Social Media Competency**

Research has found that young employees particularly prefer "cross-border" and "mobile" (Wang et al., 2015), with a stronger tendency towards boundary-less thinking, that is, a passion for creating and maintaining work that crosses boundaries (Briscoe & DeMuth, 2003). In the digital economy era, the virtual workplace has become an important carrier of cross-border behavior, which leads to boundary-less mindset affecting the social skills and communication abilities of millennial employees.

Social media serves as a communication platform where employees can build relationships, interact with information, and benefit from valuable resources in this work environment. Social media can enhance the level of trust among employees (Song et al., 2019). The reason for this is that continuous interaction and sufficient communication provide necessary conditions for interpersonal trust (Panahi

et al., 2012; Schlagwein & Prasarnphanich, 2014).

Social media influences the interaction between individuals, organizations, and the environment by controlling employees' social behavior and to some extent determines the allocation of social resources, which directly affects employees' job performance (Zhang et al., 2019).

It can be seen that social media skills are also based on individual traits and psychological perception traits influenced by the environment, which may be influenced by boundary-less thinking. Therefore, this study proposes hypothesis *H2: boundary-less mindset positively affects the social media competency of the millennial employees.*

### **3.3. The Relationship between Social Media Competency and Bootleg Innovation Behavior**

In a given social environment, social skills can affect the choice of social roles, membership of social groups, and individual social behavior (Mcfall, 1982). Organizations are complex social structures, and individuals with stronger social skills who have more social connections are stronger than others (Friedman et al., 1980). Research has shown that social skills can help collect social support and form friendly relationships, leading to emotional resources flowing to the focus individuals (Cohen et al., 1986). Emotional bonds are more predictive of positive work related bonds between individuals than instrumental bonds (Casciaro & Lobo, 2008).

Because under strong emotional bonds, individuals are more likely to persuade others that their ideas are useful, and in turn, they can obtain the necessary peer support to implement the idea. This will increase the chances for individuals involved in bootleg innovation to successfully implement creative ideas. Individuals who participate in bootleg innovation and possess stronger social skills are more likely to influence their colleagues, team members, and role bearers in the organization (finance, human resources, research and development, etc.), and even gain their understanding and support; On the contrary, employees with weaker social skills will not be able to obtain the support required to successfully implement their ideas, resulting in a smaller opportunity for their ideas to develop into innovative products. Therefore, in situations where social skills are weak, bootleg innovative behavior will also be less common.

In the era of the digital economy, social skills are more reflected in social media competencies. Therefore, this study proposes hypothesis *H3: Social media competency positively affects the bootleg innovation behavior of the millennial employees.*

Considering H1-H3 comprehensively, this paper proposes the mediating role hypothesis H4 of social media competency. *H4: Millennial employees' social media competency plays a mediating effect in the relationship between boundary-less mindset and the bootleg innovation behavior.*

### **3.4. Moderating Effect of Future Work Self-Salience**

Future work self-salience is the motivation and driving force of individual behavior, which encourages employees to take proactive actions to achieve self-consistency (Strauss, 2009); It is closely related to the characteristics of diligence, dedication, planning, foresight, and efficiency in individual work and life (Aspinwall & Leaf, 2002).

And social media competency refers to the formation of cognitive interactions from the perspectives of oneself and others, in order to continuously sort out and understand individual traits and psychological perception traits of one's current state, resources, and abilities. On this basis, they combine their own ideals and reasonably expect to estimate and achieve their understanding of future work self-salience (Zhang et al., 2021). Therefore, millennial employees with high boundary-less mindset and high future work self-salience may have higher social media competency.

As a result, this thesis proposes hypothesis *H5: millennial employees' future work self-salience positively moderates the relationship between boundary-less mindset and social media competency, i.e., the stronger the positive relationship between boundary-less mindset and social media competency at higher levels of future work self-salience.*

On the other hand, individuals who excel in looking forward to the future not only have insight and foresight into innovation trends that others cannot perceive, but also consider their future image and career growth in the organization. Based on their boundary-less mindset and social media competencies, they are more inclined to engage in bootleg innovation, which is a forward-looking and expected innovation activity with expected benefits. In addition, future work self-salience can help individuals better control and avoid future uncertainties and risks (Aspinwall & Leaf, 2002), thus enabling them to engage in relatively safe and effective bootleg innovative behaviors. Individuals with low future work self-salience have lower long-term career planning and development needs (Lou & Ye, 2019), and lack strategic and forward-looking predictions and grasp of future innovation breakthroughs. They are relatively self-enclosed, and in this situation, the role of social media competencies in bootleg innovation will be weakened.

Based on this, hypothesis H6 is proposed: *Future work self-salience positively regulates the relationship between social media competency and bootleg innovation, that is, the higher the future work self-salience, the stronger the positive relationship between social media competency and bootleg innovation.*

### 3.5. Moderated Mediating Effect

Based on the previous research and hypothesis of mediation effect and moderation effect (Baron & Kenny, 1986; Edwards & Lambert, 2007; Muller et al., 2005), Hypothesis 4, Hypothesis 5 and Hypothesis 6 together constitute a moderated mediation effect, that is, social media competencies mediates the effect of boundary-less mindset on millennial employees' bootleg innovation behavior, and the size of this mediation effect depends on the level of future work self-salience.

As a result, hypothesis H7: *millennial employees' future work self-salience positively moderates the mediating effect of social media competency on the relationship between boundary-less mindset and bootleg innovative behavior, i.e., the mediating effect of social media competency in the relationship between boundary-less mindset and bootleg innovative behavior is more significant when the level of future work self-salience is higher.*

To sum up, this research takes millennial generation R&D technicians as the research object, and from the perspective of self-determination theory and social exchange theory, explores the mediating effect of social media competency between boundary-less mindset and bootleg innovation, and tests the moderating effect of future work self-salience on this mediating effect by constructing a moderated mediation model (Figure 1).

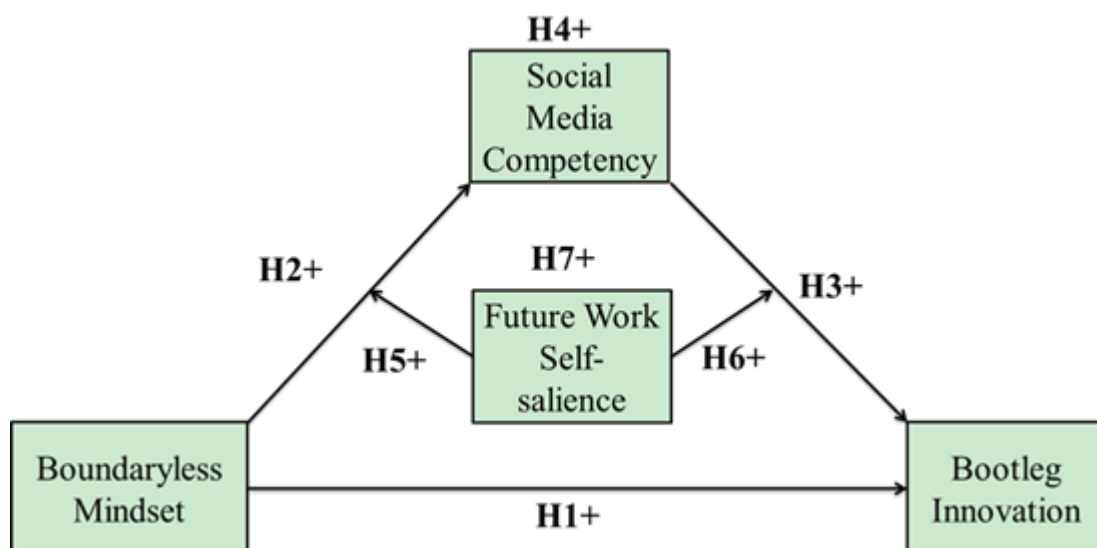


Fig. 1: Theoretical model

## 4. Data Collection and Variable Measurement

### 4.1. Data Collection

The specific process is: through acquaintances (family, friends, classmates, etc.), select technology-based SMEs in East China (Zhejiang, Jiangsu, and Shanghai). The head of the human resources department is the person entrusted with the questionnaire. Due to the use of online research (<https://www.wjx.cn/>, a platform providing functions equivalent to Amazon Mechanical Turk), the questionnaire data will be collected automatically through the system in real time, without special training on questionnaire distribution and collection for the entrusted personnel. The measurement items of research variables come from the maturity scale. The questionnaire was conducted online from July to September 2022 by means of an electronic questionnaire.

In this study, 500 questionnaires were sent out, and 387 valid questionnaires were collected. The effective recovery rate was 77.4%. Among 387 survey samples, 242 were males, accounting for 62.5%; 145 women, accounting for 37.5%. It basically conforms to the gender composition of R&D technicians. Age distribution of respondents: 36 people aged 25 and below, accounting for 9.3%; 150 people aged 26 to 30, accounting for 38.8%; 201 people aged 31 to 40, accounting for 51.9%. 55 respondents with educational background or below, accounting for 14.2%; The number of undergraduate students is the highest, with 287 people, accounting for 74.2%; 45 people with a master's degree or above, accounting for 11.6%. Job distribution of respondents: Among them, there are 189 ordinary R&D technical personnel, accounting for 48.8%; 126 grassroots R&D technology managers, accounting for 32.6%; 57 middle level R&D technology managers, accounting for 14.7%; there are 15 senior R&D technology managers, accounting for 3.9%.

### 4.2. Variable Measurement

Due to the fact that the research scales are all from foreign scholars, this study conducted a "translation back translation" program to avoid the impact of semantic differences. The questionnaire used the seven level Likert scale, from 1 (very disagree) to 7 (very agree) representing different levels.

**Boundary-less mindset** scale drew on the three item scale developed by Briscoe et al. (2006), and the internal consistency of variables was good; Cronbach's  $\alpha$  coefficient was 0.91 (Briscoe et al., 2006). Include items such as "I enjoy tasks in my work that require me to go beyond my own department" and "I enjoy working on projects with people from many organizations".

**Social media competency** was measured using a 6-item scale developed by Gonzalez et al. (2013). The internal consistency of variables was good; Cronbach's  $\alpha$  coefficient was 0.808 (Gonzalez et al., 2013). Include items such as "I often use social media to discuss work projects with stakeholders (colleagues, clients, or suppliers)", "I am considered a good problem-solving opinion provider in social media workgroups", "Social media can make it easier for me to establish close connections with the target audience", etc.

**Bootleg innovation** scale was measured using a 8-item scale developed by Lin et al. (2015), emphasizing the clear and direct rejection pressure from organizations and management in bootleg innovation behavior. Internal consistency of variables was good; Cronbach's  $\alpha$  coefficient was 0.82 (Lin et al., 2015). Including items such as "Even if my superiors do not approve, I will continue to adhere to and develop these research and development ideas", "I often consider how to improve unlicensed ideas", "I will use some of my normal working time to continue researching and developing rejected creative projects", etc.

**Future work self-salience** was measured using a 5-item scale developed by Strauss et al. (2012), with internal consistency of variables was good; Cronbach's  $\alpha$  coefficient was 0.92 (Strauss et al., 2012). Include items such as "I can easily imagine the future of my job" and "I am very clear about who I want to be and what kind of person I want to be in my future job".

### 4.3. Analysis Tools and Methods

This study utilized SPSS 26.0 and AMOS24.0 Analyze data. The steps for data analysis are as follows: The first step is to use SPSS 26.0 and AMOS24.0 to conduct a common method bias test among various research dimensions; The second step is to test the reliability and validity of the boundary-less mindset scale, social media competency scale, and bootleg innovation scale; The third step is to construct a structural equation model to test the direct effect and mediating effect among the variables of boundary-less mindset, social media competency, and bootleg innovation; The fourth step is to use the PROCESS 4.0 macro (Hayes, 2022) to test the moderated mediation model.

## 5. Research Results

### 5.1. Common Method Bias Testing

The problem of common method bias may arise when collecting data using the questionnaire method. Considering that Harman's single factor test is an insensitive testing method, this study then adopted the latent error variable control method. In the structural equation model, common method bias is added as a latent variable to the model. If the significant fit of the model with method bias latent variables is better than without common method bias latent variables, then it indicates the existence of common method bias.

Firstly, construct a confirmatory factor analysis model M1, and secondly, construct a model M2 that includes method factors. The analysis results are shown in Table 1. Comparing the main fitting indices of model M1 and model M2, it can be concluded that:  $\Delta\chi^2/df=0.001, \Delta IFI=0.003, \Delta TLI = 0.002, \Delta CFI=0.002, \Delta RMSEA=0.001$ . The changes in the main fitting indices are all less than 0.003 indicates that the fitting indicators of the model did not improve after adding common method factors, indicating that the common method bias problem in this study is not significant (Podsakoff et al., 2003).

Table 1: Potential Error Variable Control Method for Testing Common Method Bias

model	$\chi^2$	df	$\chi^2/df$	RMSEA	IFI	TLI	CFI
M1	683.571	164	4.168	0.091	0.905	0.889	0.904
M2	687.885	165	4.169	0.092	0.902	0.887	0.902

Note: M1: Model without common method bias; M2: Model with common method bias

### 5.2. Analysis of Descriptive Statistics

Descriptive statistics mainly show the mean, standard deviation, and correlation coefficient of each variable (as shown in Table 2). Gender, age, educational background, position, and development stage were set as control variables in this paper. Boundary-less mindset was significantly and positively correlated with social media competency ( $r=0.586, p<0.01$ ); Boundary-less mindset was significantly and positively correlated with bootleg innovation ( $r=0.401, p<0.01$ ), and social media competency was significantly and positively correlated with bootleg innovation ( $r=0.547, p<0.01$ ). It provides some evidence for further argument of the hypothesis in this study.

Table 2: Correlation analysis

Variables	Mean	SD	gender	age	edu	Position	DEV	BI	SMC	BM
gender	0.37	0.485								
age	2.43	0.657	-.096							
edu	1.97	0.508	.113*	.087						
Position	1.74	0.850	.052	.276**	.146**					
DEV	2.83	0.850	.181**	.093	.062	.189**				
BI	4.566	1.153	.014	.050	.043	.153**	-.087			
SMC	5.267	1.109	.202**	.107*	.032	.211**	.147**	.547**		
BM	5.426	0.865	.022	.172**	-.038	.222**	.057	.401**	.586**	
FWSS	5.398	1.033	.086	.099	.032	.075	.080	.508**	.518**	.516**

Note: edu: educational background; DEV: development stage; BM: boundary-less mindset; FWSS: future work self-salience; SMC: social media competency; BI: bootleg innovation; \* significant correlation at the 0.05 level

(two-tailed); \*\* significant correlation at the 0.01 level (two-tailed).

### 5.3. Convergence Validity, Constituent Reliability, and Discriminant Validity

In order to test the reliability and validity of the three latent variables of boundary-less mindset, social media competency, and bootleg innovation, this study first used confirmatory factor analysis to make judgments. The factor load of the three latent variables ranges from 0.649 to 0.863, the average variance extracted (AVE) ranges from 0.519 to 0.659, and the compositional reliability (CR) ranges from 0.763 to 0.92, all of which meet the standards recommended by scholars (Wu, 2010), indicating that the measurement of the three latent variables has good reliability and validity (Table 3).

Table 3: Confirmatory Factor Analysis

variables	item	Estimation of parameter significance			factor loading Std.	reliability		convergent validity AVE
		Unstd.	S.E.	t-value		SMC	CR	
boundary-less mindset	A1	1.096	0.184	5.971	0.682	0.465	0.763	0.519
	A2	1.637	0.164	10.003	0.783	0.613		
	A3	1			0.691	0.477		
social media competency	B1	1.02	0.065	15.698	0.769	0.591	0.913	0.636
	B2	1.053	0.062	16.882	0.83	0.689		
	B3	1.363	0.082	16.578	0.822	0.676		
	B4	1.242	0.076	16.362	0.815	0.664		
	B5	1.048	0.064	16.319	0.784	0.615		
	B6	1			0.761	0.579		
bootleg innovation	C1	0.858	0.042	20.496	0.829	0.687	0.92	0.659
	C2	0.889	0.04	22.379	0.863	0.745		
	C3	0.935	0.045	20.657	0.832	0.692		
	C4	0.913	0.045	20.32	0.814	0.663		
	C5	0.67	0.047	14.26	0.649	0.421		
	C6	1			0.863	0.745		

Secondly, conduct a correlation analysis on the relationship between the three latent variables. There is a positive correlation between boundary-less mindset and bootleg innovation ( $r=0.464$ ,  $p<0.001$ ); There is a positive correlation between boundary-less mindset and social media competency ( $r=0.697$ ,  $p<0.001$ ); There is a positive correlation between social media competency and bootleg innovation ( $r=0.615$ ,  $p<0.001$ ), which provides a prerequisite for further testing the hypotheses of this study.

Finally, the AVE method was used to analyze the differential validity between the latent variables. The AVE open root values of the three latent variables were all greater than the paired correlation coefficients (Table 4), indicating a certain degree of differential validity among the three latent variables (Fornell & Larcker, 1981).

Table 4: Correlation Coefficient and Differential Validity Analysis

variables	Basic Statistics		Correlation Coefficient and Differential Validity Analysis		
	M	SD	social media competency	boundary-less mindset	bootleg innovation
social media competency	5.267	1.109	<b>0.797</b>		
boundary-less mindset	5.426	0.865	0.697***	<b>0.72</b>	
bootleg innovation	4.566	1.153	0.615***	0.464***	<b>0.812</b>

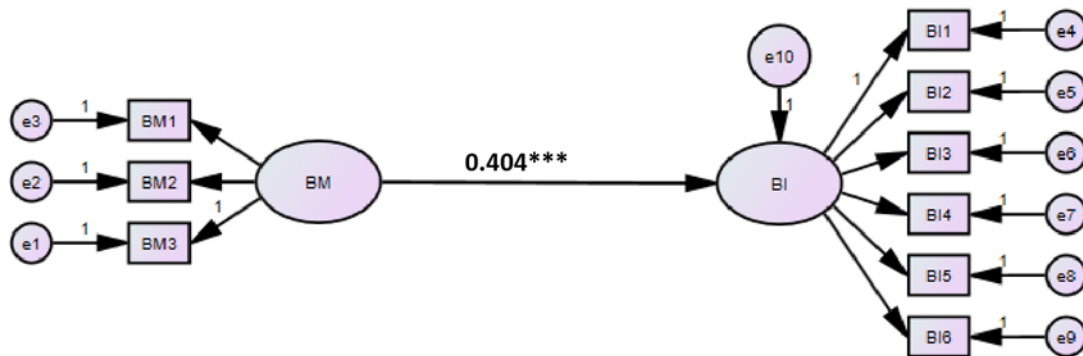
Note: (1) Bold font represents the square root value of latent variable AVE; (2) \* $p<0.05$ ; \*\* $p<0.01$ ; \*\*\* $p<0.001$



### 5.4. Direct Effect Testing

This study examines whether the three direct impact relationships of boundary-less mindset on bootleg innovation, boundary-less mindset on social media competency, and social media competency on bootleg innovation are valid. This study reports on several of the most commonly used adaptation indicators in previous studies using structural equation modeling (Jackson et al., 2009).

This study first constructed an impact model on the relationship between boundary-less thinking and deviant innovation, and tested hypothesis H1 (Figure 2). Model Fit  $\chi^2/df=6.531$ , GFI=0.904, AGFI=0.834, TLI=0.897, CFI=0.926, RMSEA=0.096, SRMR=0.084, which basically meets the model's fitting index standards, and the model has a good fitting degree. Standardized regression coefficient of boundary-less mindset on bootleg innovation is 0.404 ( $p<0.001$ ), indicating that boundary-less mindset has a positive impact on bootleg innovation. The above test results provide

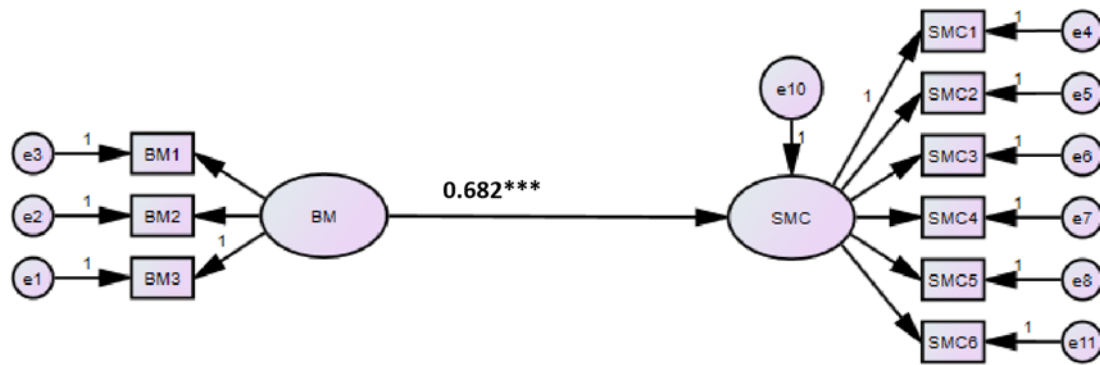


evidence support for the establishment of hypothesis H1.

Note: (1)BM: boundary-less mindset; BI: bootleg innovation; (2)\* $p<0.05$ ; \*\* $p<0.01$ ; \*\*\* $p<0.001$

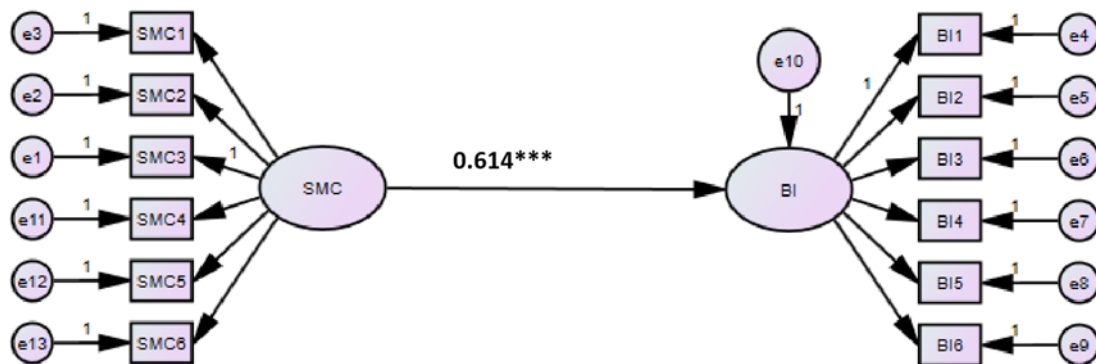
Fig. 2: Relationship between boundary-less mindset and bootleg innovation

This study constructed an impact model on the relationship between boundary-less mindset and social media competency, and tested hypothesis H2 (Figure 3). Model Fit  $\chi^2/df=7.213$ , GFI=0.902, AGFI=0.831, TLI=0.88, CFI=0.914, RMSEA=0.098, SRMR=0.069, basically meeting the model fitting index standards, and the model fitting degree is good. Standardized regression coefficient of boundary-less mindset on social media competency is 0.682 ( $p<0.001$ ), indicating that boundary-less mindset has a positive impact on social media competency. The above test results provide evidence support for the establishment of hypothesis H2.



Note: (1)BM: boundary-less mindset; SMC: social media competency; (2)\*p<0.05;\*\*p<0.01;\*\*\*p<0.001  
 Fig. 3: Relationship between boundary-less mindset and social media competency

This study constructed an impact model on the relationship between social media competency and bootleg innovation, and tested hypothesis H3 (Figure 4). Model Fit  $\chi^2/df=5.342$ , GFI=0.891, AGFI=0.84, TLI=0.914, CFI=0.931, RMSEA=0.093, SRMR=0.0475, basically meeting the model fitting index standards, and the model fitting degree is good. Standardized regression coefficient of social media competency on bootleg innovation is 0.614 (p<0.001), indicating that social media competency has a positive impact on bootleg innovation. The above test results provide evidence support for the establishment of hypothesis H3.



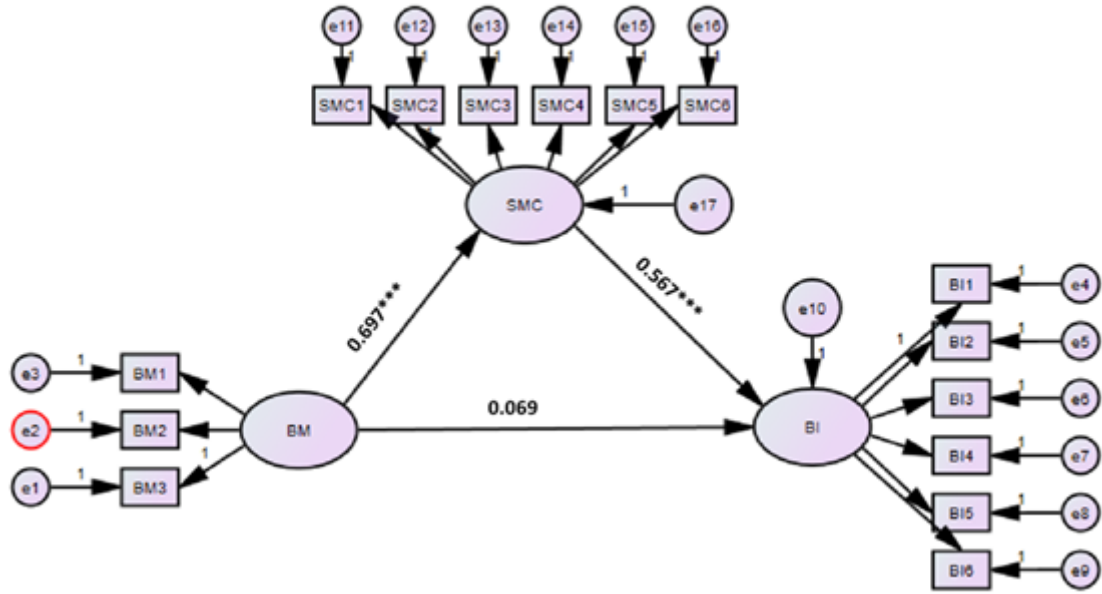
Note: (1)SMC: Social Media Competency; BI: Bootleg Innovation; (2)\*p<0.05; \*\*p<0.01; \*\*\*p<0.001  
 Fig. 4: Relationship between social media competency and bootleg innovation

### 5.5. Mediating Effect Test

After incorporating social media competency into the structural equation model, this study constructed a relationship impact model between boundary-less mindset and social media competency on bootleg innovation (Figure 5). Model Fit  $\chi^2/df=4.872$ , GFI=0.87, AGFI=0.821, TLI=0.892, CFI=0.91, RMSEA=0.095, SRMR=0.065, which basically meets the model fitting index standards, indicating that the relationship between boundary-less mindset and social media competency on bootleg innovation has a good fitting degree of the model.

In the model, boundary-less mindset has no significant positive predictive effect on bootleg innovation compared to not incorporating social media competency into the model ( $\beta=0.069$ ,  $p>0.4$ ). In addition, boundary-less mindset has a positive predictive effect on social media competency ( $\beta=$

0.697,  $p < 0.001$ ), social media competency has a positive predictive effect on bootleg innovation ( $\beta = 0.567$ ,  $p < 0.001$ ).



Note: (1)BM: Boundary-less Mindset; SMC: Social Media Competency; BI: Bootleg Innovation; (2) \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

Fig. 5: Relationship between boundary-less mindset, social media competency and bootleg innovation

In order to further verify the mediating effect of social media competency, this study set bootstrap method to self-sample 2000 times to estimate the 95% confidence intervals of the mediating effect of social media competency, and found that the 95% confidence intervals of the percentile and bias corrected are [0.236, 0.611] and [0.209, 0.578] respectively, which do not contain 0, indicating that the above test results meet the relevant conditions to determine whether hypothesis H4 is true. Hypothesis H4 holds, that is, in the process of boundary-less mindset affecting bootleg innovation, social media competency play a mediating effect and is completely mediating (the direct effect is not significant, with 95% confidence intervals for percentage and bias corrected being [-0.14, 0.411] and [-0.137, 0.423], respectively, including 0). Among them, the indirect effect is 0.395, and the direct effect is 0.069, accounting for 85.13% and 14.87% respectively (Table 5).

Table 5: Direct, Indirect, and Total Effects of the Model

	Point estimation	Coefficient multiplication term		Bootstrapping				Relative effect size
		SE	Z	Bias-Corrected 95% CI		Percentile 95% CI		
				Lower	Upper	Lower	Upper	
Total Effect	0.464	0.076	6.105	0.321	0.618	0.335	0.638	-
Indirect Effect	0.395	0.12	3.292	0.236	0.611	0.209	0.578	85.13%
Direct Effect	0.069	0.158	0.437	-0.14	0.411	-0.137	0.423	14.87%

Note: Set the bootstrap method to self-sample 2000 results.

### 5.6. Moderated Mediating Effect Test

To verify the moderating effect of future work self-salience, the SPSS macro program PROCESS 4.0 developed by Hayes (2022) was used for testing.

In this study,  $\pm 1$  standard deviation is taken as the high and low value of the interaction variable and Bootstrap method is used to test the difference of moderating effect between the two values of the interaction variable (Hayes, 2018). Regression analysis was conducted using the PROCESS 4.0 model 58 (Model 58 assumes that the first and second half paths of the mediation model are moderated, which is consistent with the theoretical model of this study. The results of after decentralization of the relevant data are shown in Table 6 and Table 7). Test the moderated mediation model while controlling for gender, age, education level, position, development stage, etc. The results showed that after incorporating future work self-salience into the model, the interaction term between boundary-less mindset and future work self-salience significantly positively predicted social media competency ( $\beta=0.187$ ,  $P<0.001$ ); The mediating effect is significant when the future work self-salience is -1SD and+1SD. Significant positive prediction of bootleg innovation in the interaction between social media competency and future work self-salience ( $\beta=0.143$ ,  $P<0.001$ ); The effect of future work self-salience is significant when taking -1SD and+1SD.

Therefore, the moderating effect of future work self-salience is significant. And according to the index value of the moderated mediating effect is 0.048, the 95% confidence interval is [0.01, 0.096], and the interval does not contain 0, it can be inferred that there is a significant moderated mediating effect in the model.

Table 6: Moderated Mediating Effect Test

	Social Media Competency			Bootleg Innovation		
	coeff	se	t	coeff	se	t
constant	-0.632	0.25	-2.529*	4.924	0.277	17.793***
BM	0.604	0.06	10.048***	-0.003	0.069	-0.05
FWSS	0.322	0.048	6.739***	0.418	0.057	7.343***
BM*FWSS	0.187	0.045	4.173***			
SMC				0.406	0.055	7.42***
SMC*FWSS				0.143	0.039	3.623***
gender	0.367	0.089	4.13***	-0.159	0.098	-1.623
age	-0.008	0.067	-0.119	-0.094	0.073	-1.301
EDU	0.042	0.084	0.495	0.129	0.092	1.4
position	0.086	0.053	1.621	0.114	0.058	1.983*
DEV	0.069	0.051	1.369	-0.214	0.055	-3.879***
R-sq		0.469			0.43	
F		41.8			31.571	

Note: \*  $p<0.05$ ; \*\*  $p<0.01$ ; \*\*\*  $p<0.001$ . BM: boundary-less mindset; SMC: social media competency; FWSS: future work self-salience; EDU: education level; DEV: development stage.

Table 7: Moderated Mediating effect and comparison on different levels of future work self-salience

	index	Effect	BootSE	BootLLCI	BootULCI
Moderated Mediating effect	eff1(M-1SD)	0.106	0.035	0.038	0.177
	eff2(M)	0.245	0.05	0.15	0.348
	eff3(M+1SD)	0.441	0.088	0.273	0.616
Comparison of Moderated Mediating effect	eff2-eff1	0.139	0.03	0.081	0.199
	eff3-eff1	0.335	0.079	0.187	0.499
	eff3-eff2	0.196	0.05	0.105	0.302

Note: M-1SD represents the situation where the moderating variable is below one standard deviation, and M+1SD represents the situation where the moderating variable is above one standard deviation. Bootstrap samples 5000 times.

In order to fully reflect the overall picture of the mediating effect affected by the moderating variable (in this study, the moderating variable is a continuous variable). Using the Johnson Neyamn method and Bootstrap sampling method (Preacher et al., 2007), the specific values of the 95% confidence band

and significance domain were calculated (data is not centralized), and the conditional mediating effects under the continuous values of the moderating variables were more clearly displayed in graphical form. The straight line in the figure represents the moderating effect on the dependent variable, which is a linear function of the moderating variable, and the dotted line represents the corresponding confidence band. As shown in Figure 6 and Figure 7.

From Figure 6, it can be seen that when the future work self-salience is greater than 3.217 (7 points is the maximum score, the same below), it significantly affects the relationship between boundary-less mindset and social media competency. From Figure 7, it can be seen that when the future work self-salience is greater than 3.778, it significantly affects the relationship between social media competency and bootleg innovation.

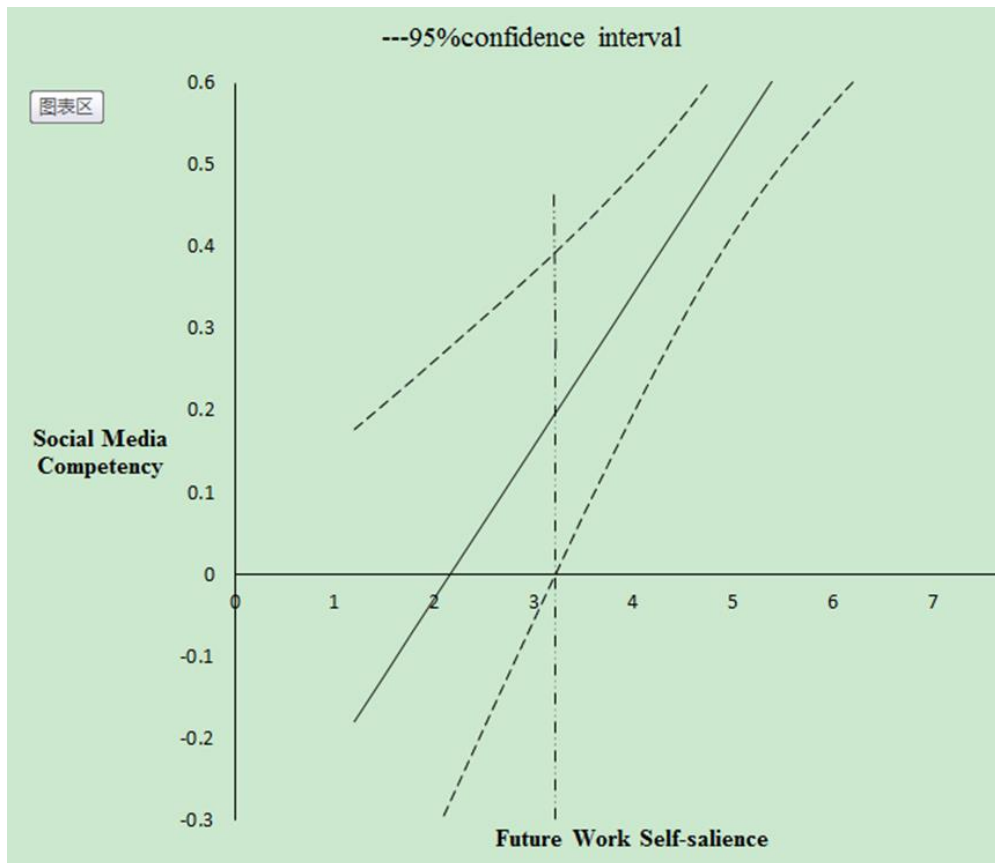


Fig. 6: Moderating effect of future work self-salience on the relationship between boundary-less mindset and social media competency

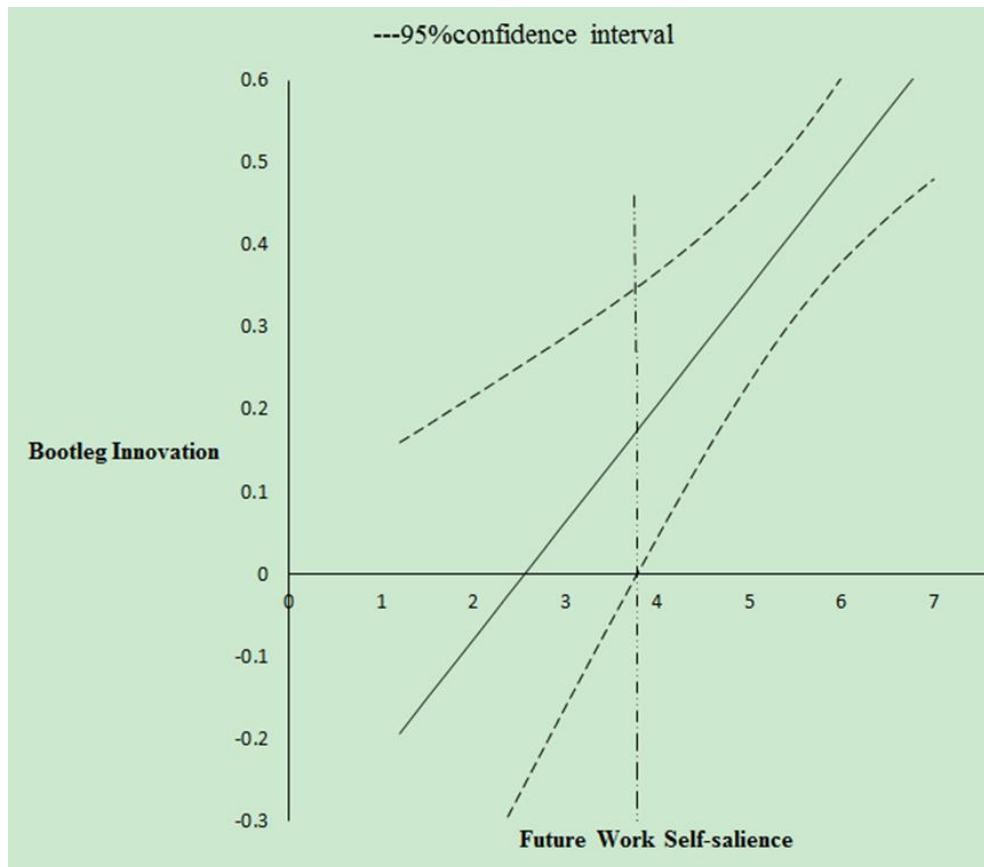


Fig. 7: Moderating effect of future work self-salience on the relationship between social media competency and bootleg innovation

In addition, on the three levels of future work self-salience, the mediating effect of social media competency in the relationship between boundary-less mindset and bootleg innovation behavior also shows an increasing trend (see Table 7), that is, with the improvement of subjects' future work self-salience, boundary-less mindset is more likely to induce bootleg innovation behavior by improving the social media competency of millennial employees. Hypothesis H5, Hypothesis H6 and Hypothesis H7 were supported.

## 6. Discussion

This study is based on Self Determination Theory (SDT) and Social Exchange Theory (SET), and uses SEM analysis to explore the impact of boundary-less mindset on bootleg innovation behavior, as well as the moderating role of future work self-salience through regression analysis. The results supported the hypotheses and confirm the research framework established in this study.

The empirical research results showed that: (1) Millennial employees with boundary-less mindset were more likely to stimulate bootleg innovation behavior. (2) Millennial employees' social media competency played a complete mediation in the relationship between their boundary-less mindset and their bootleg innovation behavior. (3) Millennial employees' future work self-salience played a moderated mediating effect through their social media competency in the relationship between their boundary-less mindset and their bootleg innovation behavior.

Firstly, this study found that the social media competency of millennial employees play a completely mediating role in the process of boundary-less mindset promoting bootleg innovation behavior. This indicates that on the one hand, the more connections and exchanges millennial employees form in their interactions with others, the more advantageous it is for them to find the relevant information and skills needed for innovation (Perry-Smith & Shalley, 2003). But on the other

hand, it also indicates that although boundary-less mindset is important in promoting bootleg innovation behavior, it still needs to be implemented through social media competency as a tool. Social media competency influences the interaction between individuals, organizations, and the environment by controlling millennial employees' social behavior and to some extent determines the allocation of social resources, which directly affects their job performance (Zhang et al., 2019). That is to say, in the virtual workplace, millennial employees need to seek the support of other stakeholders through social media to implement their bootleg innovative behavior. This is similar to the research conclusion of Frank & Stephen (2001), which suggests that employees who participate in bootleg innovation and possess stronger social skills are more likely to influence or even gain understanding and support from colleagues, team members, and role players in the organization (Frank & Stephen, 2001).

Secondly, the moderating effect of the future work self-salience of millennial employees is significant. Reflecting future work self-salience as a psychological quality is closely related to the characteristics of diligence, dedication, planning, foresight, and efficiency in the work and life of millennial employees (Aspinwall & Leaf, 2002; Strauss, 2009; Zhang et al., 2021). On the one hand, it indicates that the social media competency of millennial employees can form cognitive interaction with their future work self-salience. Millennial employees with high social media competency can continuously sort out and understand their current state, resources, and psychological perception characteristics of their abilities, and can combine their ideals to reasonably expect, estimate, and achieve an understanding of the future work self-salience (Zhang et al., 2021). On the other hand, it also indicates that millennial employees who are good at looking ahead have insight and foresight into innovation trends that others cannot perceive which can help them better control and avoid future uncertainties and risks (Aspinwall & Leaf, 2002). They are also more likely to engage in deviant innovation behavior, which is a forward-looking and expected innovation activity with expected benefits (Lou & Ye, 2019).

Finally, in the digital economy era, people's perception of time and space has undergone disruptive changes. Especially in the virtual workplace, the continuous enrichment of management tools (such as the use of technology enabled social media platforms) poses significant challenges in promoting individual innovative behavior through linear, objective, and unified time understanding patterns (Yuan & Zhang, 2015). The bootleg innovation behavior of millennial employees is characterized by detachment from time (flexible time) and space (physical and virtual organizations), which is similar to the research conclusions of Yuan and Zhang (2015). In fact, social exchange theory also suggests that the process of information exchange is a dynamic process of attraction, competition, differentiation, integration, and resistance (Schlosser, 2002; Yates et al., 1999). Therefore, managers should establish incentive or intervention mechanisms at different stages to correctly guide the piracy and innovation behavior of millennial employees.

## 7. Conclusion

This study established a moderated mediation model that integrates boundary-less mindset, social media competency, and future work self-salience to examine the impact mechanism of bootleg innovation behavior among millennial employees; this enriches the research on the antecedents of bootleg innovation behavior among millennial employees.

This study strengthens the identification of piracy and innovation behavior among millennial employees in the virtual workplace domain; can assist managers in objectively and scientifically managing the piracy and innovation behavior of millennial employees; to better attract and motivate millennial employees. The research results indicate that in addition to material incentives, there are other motivational factors for the bootleg innovation behavior of millennial employees. Their motivation for implementing bootleg innovation behavior is more focused on learning, improving self-efficacy, career potential, and community belonging.

Of course, there are also some shortcomings in this study. Firstly, all data are based on cross-

sectional surveys at the same time point, which may result in weaker inference of causal relationships between variables. Future research can design longitudinal data collection to deeply analyze the causal relationship between various antecedents and bootleg innovation, thus providing better insights for theory and practice.

Secondly, this study only selected future work self-salience as the moderating variable, but the management practice of bootleg innovative behavior includes many aspects, and more influencing factors should be explored for further exploration in the future.

Thirdly, the career attitude formed by boundary-less mindset includes two dimensions: boundary-less mental patterns and organizational mobility preferences (Briscoe et al., 2006). There is an essential difference between these two dimensions: employees with boundary-less mental models may be enthusiastic about collaborating across boundaries, but they will still stay within the current organization; Employees with organizational mobility preferences will serve other organizations outside of the current organization. The effects of these two different types of behavior may be different. Future research can continue to explore the dual or even multiple mechanisms by which different types of boundary-less mindset have both positive and negative impacts on individual creativity at the individual level.

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