

How do career values boost STEM students' perceived employability? A sequential mediation model

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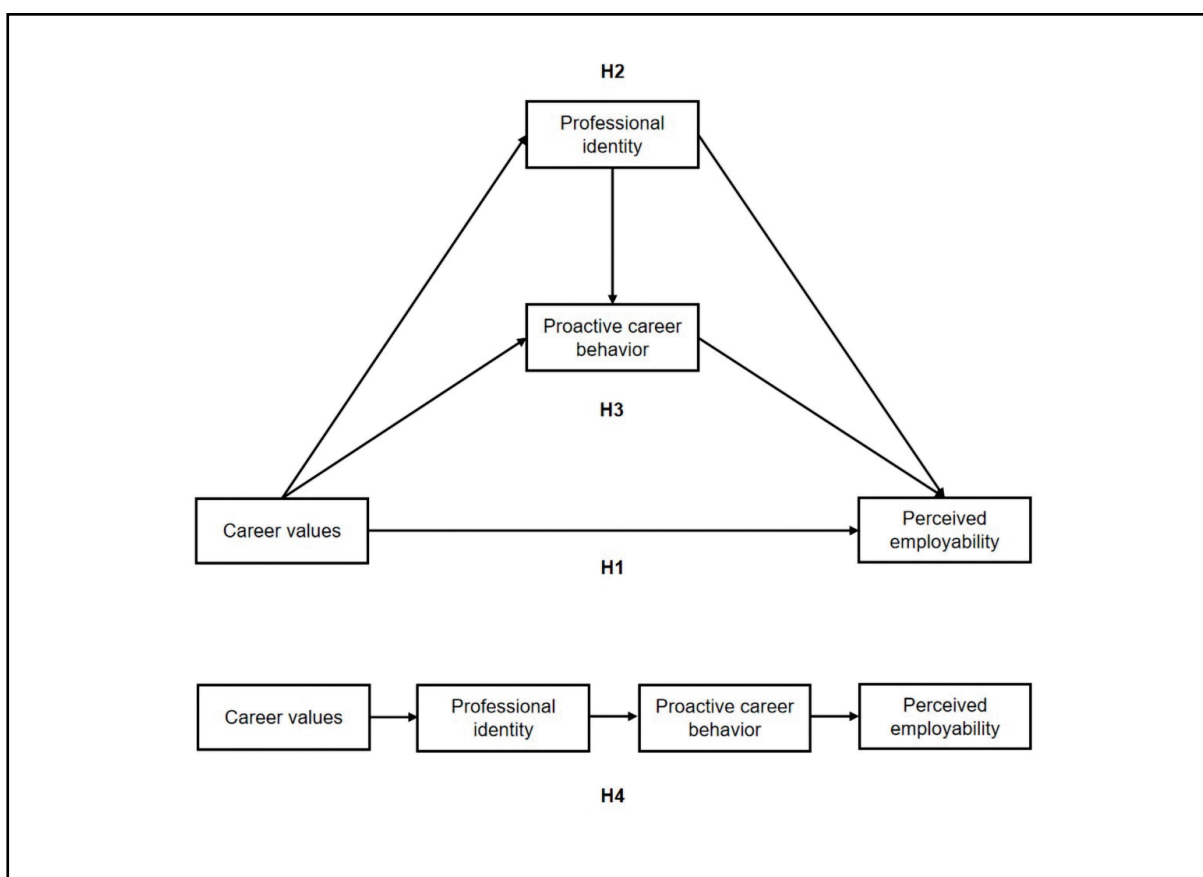
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Graphical abstract



A sequential mediation model of how career values relate to STEM students' perceived employability.

Public summary

- Career values are positively associated with STEM students' perceived employability.
- Professional identity mediates the association between career values and employability.
- Proactive career behavior also mediates this association and is linked to higher employability.
- Professional identity and proactive career behavior jointly form a sequential mediation pathway.

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Cite This: *JUSTC*, 2026, 56(5): 0505 (10pp)



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Supporting Information

Abstract: In the era of boundaryless careers, science, technology, engineering, and mathematics (STEM) students need to actively shape their future careers and manage their career preparedness to enhance their employability. Drawing on career motivation theory, this study examines how career values are associated with perceived employability through professional identity and proactive career behavior. We conducted two studies with STEM students from the United States (Study 1) and China (Study 2). Across both studies, career values were positively associated with students' perceived employability, and professional identity significantly mediated this relationship. Moreover, Study 2 revealed a significant sequential indirect effect of career values on perceived employability through professional identity and proactive career behavior. Finally, we discuss the theoretical and practical implications of these findings and directions for future research.

Keywords: career values; professional identity; proactive career behavior; perceived employability; career motivation theory

CLC number: C913.2; F272.92

Document code: A

1 Introduction

At present, the situation of science and technology development is gradually becoming grimmer both domestically and internationally, and the demand for scientific research and innovation talent in China is increasing. At the national macro level, how to cultivate scientific research talent at the undergraduate level has become an urgent issue in China. As a result, science, technology, engineering, and mathematics (STEM) education has been highly emphasized among educators, researchers, and practitioners^[1]. In recent years, scholars have begun to concentrate on the students themselves, that is, the career development behaviors of students with scientific research potential during their study period. As the era of lifelong employment has passed, STEM students need to pay more attention to their employability to ensure stability and flexibility in their employment^[2]. Research suggests that employability is often underestimated and undertrained in STEM education^[3], but good employability can help STEM students better complete the identity transition from school to society and contribute to the smooth development of their careers^[3]. Therefore, the development of STEM students' employability should be examined.

Scholars argued that universities' efforts to enhance students' employability ought to focus not only on employability skills but also on supporting the development of students' values^[4]. The school period is a key stage for the formation of students' career values, which affect their career development. For STEM students who have not yet entered the workplace, career values are their source of motivation in actively

preparing for their careers and performing job-seeking behavior in advance^[5]. As an important personal resource, career values can help STEM students actively shape their future careers and manage their career preparedness to achieve positive career outcomes^[6], such as increasing their employability^[7]. Previous studies have shown that values are important predictors of workers' employability^[8]. However, there is still a lack of empirical investigations on the association between STEM students' career values and their perceived employability. Specifically, the mechanism concerning whether and how career values affect STEM students' perceived employability remains unclear, which limits our understanding of how to educate and train STEM students for their career preparation^[9]. Therefore, understanding how STEM students' career values influence their perceived employability is essential for advancing our understanding of their career development.

According to career motivation theory^[10,11], in the process of making career choices and pursuing career development, the more stable individuals' career values are, the more easily these values can be integrated into their self-concepts, forming a strong sense of identity and satisfaction with the fields in which they want to work. At the same time, when individuals make career choices based on their career values, whether motivated by anticipated career outcomes or by the work itself, they continuously seek alignment between themselves and their chosen careers, thereby strengthening their identification with those careers^[10,12]. Professional identity, a type of career motivation, is closely related to students' active career

exploration behavior (e.g., proactive career behavior)^[10,35,49]. Through continuous career exploration, students may gain positive career outcomes^[14], such as employability. Therefore, the current research establishes a sequential mediation model in which career values act on employability. Specifically, STEM students' career values affect their professional identity, which, in turn, promotes their proactive career behavior and ultimately enhances their perceived employability. This research further refines the mediating mechanism of the effect of career values on perceived employability and integrates the above two paths. The conceptual model of this study is shown in Fig. 1.

To examine the proposed model, we conducted two studies with STEM student samples from the United States and China. Study 1 examined the mediating role of professional identity, whereas Study 2 replicated and extended Study 1 by testing professional identity and proactive career behavior as sequential mediators.

2 Literature review and hypothesis

2.1 Career values and perceived employability

Economic constraints and labor market uncertainty make career transitions increasingly challenging^[15]. Accordingly, employability is particularly important for students preparing to enter the labor market, as it reflects their perceived ability to attain sustainable employment appropriate to their qualifications^[16]. STEM students have a deeper understanding of science, technology, engineering, and mathematics, and they are equipped to solve complex problems. The development of STEM students is receiving attention in the context that focuses on scientific and technological innovation and development. Accordingly, STEM students should take the initiative to shape their future careers and actively establish careers to facilitate their identity transition from school to society and enhance their perceived employability^[3]. We define perceived employability as the perceived ability of STEM students to obtain, sustain, and regain employment in the face of role shifts and environmental changes^[17]. Empirical studies have shown that individual factors, such as human capital and social capital, affect individual employability^[18,19]. Hence, we argue that STEM students' career values (i.e., important individual resources) are closely related to their perceived employability.

We define career values as concrete expressions of individuals' life goals and attitudes toward their career choices^[20]. Scholars have classified career values into intrinsic career

values, which refer to the sense of accomplishment and enjoyment derived from work itself, including interest and autonomy, and extrinsic career values, which refer to rewards and conditions associated with work, such as income, prestige, safe working conditions, and employment opportunities^[21]. Accordingly, career values describe the career goals and career outcomes that individuals aspire to achieve during their careers and reflect the motivations that inspire and guide their career development^[22]. Career motivation theory conceptualizes personal characteristics as needs, interests, and personality traits that may be relevant to individuals' careers. Furthermore, the more stable these career-related personal characteristics are, the greater their direct impact on individuals' career decisions and behaviors^[11]. Career values, as important personal characteristics that shape how individuals construct their careers, include career interests, the need for achievement, the willingness to take risks, and other aspects^[6]. These values reflect individuals' self-concepts and embody their pursuit of future career goals^[7]. Career values can help STEM students clarify their career interests, understand their strengths and weaknesses, and develop the ability to adapt to changing environments, thereby providing them with greater advantages in the labor market and enhancing their perceived employability^[19]. Therefore, we propose the following hypothesis:

Hypothesis 1. Career values are positively related to STEM students' perceived employability.

2.2 Mediating role of professional identity

Professional identity is defined as a student's explicit perception of their own interests, competencies, goals, and values related to the occupation to be pursued, and it is a sense of meaning that links these self-perceptions to the occupational role^[23]. Professional identity is an individual's positive evaluation of the occupation in which he or she will be engaged and provides STEM students with a direction to find jobs that match their personal preferences, strengths, aims, and interests^[24]. Previous studies have confirmed that professional identity is generated through career preparatory activities, is influenced by individual factors such as interest and motivation, and can influence work-related outcomes^[23,25].

London's career motivation theory suggests that professional identity is developed through information processing whereby individuals use self-relevant and environmental information to establish meaningful and lasting professional identities^[10]. Career values include individuals' job-seeking tendencies and motivations underlying their career choices. Career values help individuals clarify what they consider important in their careers^[26]. Accordingly, we propose that career values may contribute to the development of a clearer professional identity. More specifically, during career development, career values, as important personal resources, can become integrated into individuals' self-concepts, thereby fostering a strong sense of identity and satisfaction with the fields in which they aspire to work^[6]. Moreover, STEM students with stable and positive career values are better able to identify their career aspirations and develop clear self-awareness of the career paths they want to pursue, which makes it easier for them to develop a stronger sense of

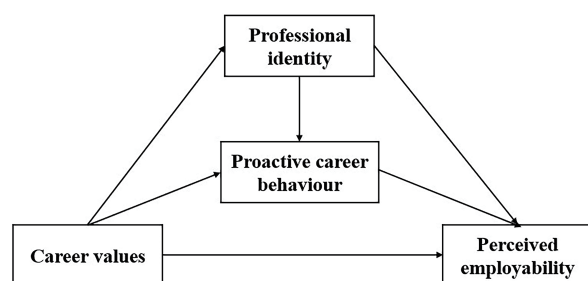


Fig. 1. Conceptual model.

professional identity^[27]. Thus, career values are expected to be positively related to professional identity.

In an increasingly competitive labor market, STEM students' perceived employability plays an important role in ensuring that they have sustainable and successful careers^[28]. Research among young professionals suggests that personal career resources, particularly career competencies, are positively associated with perceived employability^[29]. According to London's model of career motivation, professional identity, as an important personal characteristic, is a significant structural dimension of career motivation that elicits and sustains individuals' decisions about career planning, behaviors, and decision-making^[10]. We argue that STEM students with higher professional identity perceive higher levels of employability. On the one hand, studies have demonstrated that professional identity is associated with positive career-related outcomes, such as greater work meaningfulness^[23] and lower career distress^[30], which, in turn, lead individuals to feel more optimistic and confident about their future career paths and to perceive higher employability. On the other hand, a higher level of professional identity provides STEM students with motivational resources to help them clarify their career goals, broaden their personal ambitions, better integrate their self-role with their work role, and enhance their perceived employability^[31–33].

Therefore, the development of career values enables STEM students to focus on their occupational self-concepts and choose careers based on their own characteristics and values. Career values can thereby strengthen students' sense of professional identity in the fields in which they aspire to work and sustain their motivation to develop their employability. Accordingly, career values are positively associated with professional identity, which, in turn, is positively related to perceived employability. Based on this reasoning, the following hypothesis is proposed:

Hypothesis 2. Professional identity mediates the relationship between career values and perceived employability.

2.3 Mediating role of proactive career behavior

In the era of boundaryless careers, organizations are changing the traditional form of lifetime employment to more flexible forms of short-term employment^[34]. Therefore, it is particularly important for STEM students to adopt proactive career behavior before they enter the competitive job market to successfully find employment paths in the present and future and improve their perceived employability. Strauss et al.^[35] conceptualized proactive career behavior as encompassing four types of activities: developing career-relevant skills, building professional networks, seeking career advice, and engaging in career planning. STEM students' proactive career exploration of themselves and their environment enables them to fully understand their internal mental state and desired career state^[14], which helps them seize job opportunities and remain competitive in the labor market. Proactive career behavior is the key to taking the initiative in the job search and staying competitive in the job market.

According to career motivation theory, individuals' work behavior and career decisions are largely driven by their desire and motivation to achieve their career goals^[21,36]. Career

values, as one of the key factors influencing individual career motivation, have an important influence on individuals' active use of career resources to adapt to a dynamic work environment and engage in proactive behavior to build their careers^[4]. Specifically, under the framework of career motivation theory, intrinsic career values enable STEM students to focus on their self-interest and values, which can in turn clarify their career goals in reconceptualizing themselves and stimulate more proactive career behavior to adapt to the job market^[37]. Additionally, rather than emphasizing external career values such as income and prestige, STEM students prioritize career planning that enables them to realize their self-worth and pursue intrinsic life values—such as greater autonomy, more challenging work, and promising career prospects—which in turn motivates them to engage in proactive career behavior to enhance their competitiveness^[38]. Thus, a positive relationship exists between career values and STEM students' proactive career behavior.

In the current volatile economic market, STEM students actively engage in career-related behaviors to gather more career information and gain career-related experience, which helps them better understand the current unstable employment situation and focus more on their own career development needs and the sustainability of their careers^[18]. Previous studies suggest that proactively constructing their future careers is an essential way for students to promote their employability^[7,35]. Under the framework of career motivation theory^[10], proactive career behavior provides STEM students with sufficient career motivation to actively manage their future careers and help them develop creative thinking and explore new possibilities for themselves, thereby clarifying their career paths and enhancing their perceived employability^[39]. This finding indicates that proactive career behavior is positively related to perceived employability.

Thus, we suggest that career values, as important personal resources, can motivate STEM students to engage in proactive career behavior, which in turn helps improve their future employability. This means that proactive career behavior plays a mediating role in the relationship between career values and STEM students' perceived employability.

Hypothesis 3. Proactive career behavior mediates the relationship between career values and perceived employability.

2.4 The sequential mediation model

According to London's career motivation theory, professional identity specifies the direction of occupational motivation and can directly influence an individual's career decisions and behaviors^[26]. STEM students with a strong professional identity are better able to align their personal motivations and abilities with their prospective professional roles^[40], thereby motivating them to pursue personally meaningful career goals and proactively explore career opportunities to remain competitive in the labor market^[18,37]. Furthermore, STEM students with a high level of professional identity tend to have positive evaluations and emotions regarding their own careers and are more willing to engage in proactive career behavior such as career exploration and career skill development to enhance their understanding of the employment environment and achieve sustainable career development^[13,41]. Thus, a high

level of professional identity stimulates more proactive career behavior among STEM students.

On the basis of the above assumption, we infer that STEM students' professional identities and proactive career behavior successively mediate the relationship between career values and employability. More specifically, within the framework of career motivation theory^[26], STEM students with more stable career values can develop more accurate views and evaluations of their careers, thus motivating them to have a positive professional identity^[21]. As an important source of career motivation, professional identity can motivate STEM students to actively manage their careers, actively engage in career behavior related to career exploration and planning, work hard to achieve their desired career goals, and improve their employability^[10,23,42]. In summary, this study develops a sequential mediation model in which professional identity and proactive career behavior serve as sequential mediators between career values and STEM students' employability. Thus, we propose the following hypothesis:

Hypothesis 4. STEM students' professional identity and proactive career behavior sequentially mediate the positive relationship between career values and perceived employability.

3 Study 1

3.1 Methods

3.1.1 Samples and procedure

We conducted a survey in Study 1 to test the mediating effect of students' professional identity on the relationship between career values and perceived employability. Specifically, we invited STEM students from different universities in the United States to complete questionnaires. With the help of a student assistant at a university in the Western area, one of the authors randomly sent participation invitations to 5000 students at five universities via e-mail. The e-mails included the research topic and relevant guidelines (e.g., their responses would be kept confidential and only used for research purposes), and students were informed that the survey was open exclusively to STEM students. After confirming the willingness of 519 STEM students to participate, we distributed the questionnaires to them via e-mail. These students were asked to rate their career values, professional identity, and perceived employability, alongside reporting their demographic information including gender and age. After deleting invalid responses, we obtained the final sample of 341 useful participants. Among them, 200 were male (58.70%). Most of them were 22–25 years old (55.10%), and most held Master's degrees (60.10%).

3.1.2 Instruments and measures

Participants rated all items on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Career values. We used an eight-item scale from Sortheix et al.^[21] to assess participants' career values. A sample item was "I would choose an interesting job." The Cronbach's α value was 0.71.

Professional identity. We used a four-item scale from Dobrow and Higgins^[43] to assess participants' professional

identity. A sample item was "I have developed a clear career and professional identity." The Cronbach's α value was 0.90.

Perceived employability. We used a sixteen-item scale from Rothwell et al.^[33] to evaluate participants' perceived employability. A sample item was "I achieve high grades in relation to my studies." The Cronbach's α value was 0.91.

Control variables. We controlled for the following variables: gender (1 = male; 2 = female), age (1 = under 18 years; 2 = from 18 to 21 years; 3 = from 22 to 25 years; 4 = from 26 to 30 years; 5 = over 30 years of age) and educational level (1 = technical school diploma/Associate's degree; 2 = Bachelor's degree; 3 = Master's degree; 4 = Ph.D. degree or above).

3.2 Results

3.2.1 Validity analyses

First, we assessed the risk of common method bias (CMB) in this study. In particular, we conducted Harman's single factor test via principal axis factoring (PAF) as an extraction method to test whether most of the variance could be explained by a single factor^[44,45]. The first non-rotated factor accounted for only 36.81% of the total variance extracted. In addition, we compared the hypothesized three-factor model with a model that included a latent common method factor. Adding the common method factor did not consistently improve model fit: The RMSEA, CFI, and IFI remained unchanged, and the TLI decreased from 0.90 to 0.89, whereas the SRMR improved from 0.10 to 0.06. Taken together, the results provided no consistent evidence that common method variance was a major concern. Next, to assess the discriminant validity of the measures in the study, we performed a confirmatory factor analysis (CFA) for career values, professional identity, and perceived employability. As shown in Table 1, our proposed three-factor model provided an acceptable fit to the data ($\chi^2/df = 2.64$, RMSEA = 0.07, CFI = 0.91, IFI = 0.91, TLI = 0.90, SRMR = 0.10) and fitted the data better than the two-factor and one-factor models. These results generally supported the discriminant validity of the three constructs.

The descriptive statistics, reliabilities, and correlations for all the variables in the study are presented in Table 2. Career values were positively correlated with professional identity ($r = 0.31$, $p < 0.01$) and perceived employability ($r = 0.39$, $p < 0.01$). Moreover, professional identity was positively related to perceived employability ($r = 0.63$, $p < 0.01$).

3.2.2 Hypothesis testing

Hierarchical regression analyses were used to examine the indirect effect between career values and perceived employability. In Model 4 of Table 3, the results indicate that after controlling for the effects of students' gender, age and, education, career values were positively related to perceived employability ($\beta = 0.40$, $p < 0.001$), thereby providing support for H1.

Model 2 showed that career values were positively related to professional identity ($\beta = 0.32$, $p < 0.001$). When professional identity was included in Model 5, it significantly predicted perceived employability ($\beta = 0.57$, $p < 0.001$), whereas the relationship between career values and perceived employability was reduced ($\beta = 0.22$, $p < 0.001$). In addition, we conducted a bootstrap with 5000 in the study to produce

Table 1. Confirmatory factor analysis (Study 1).

Variables	χ^2/df	RMSEA	CFI	IFI	TLI	SRMR
Three-factor model + CMV	2.73	0.07	0.91	0.91	0.89	0.06
Three-factor model	2.64	0.07	0.91	0.91	0.90	0.10
Two-factor model	6.79	0.13	0.66	0.66	0.63	0.13
One-factor model	8.28	0.15	0.57	0.57	0.53	0.12

CMV: common method variance. $N = 341$; three-factor model: career values, professional identity, and perceived employability; two-factor model: career values + professional identity and perceived employability; and one-factor model: career values + professional identity + perceived employability.

Table 2. Means, standard deviations, and correlations among the variables (Study 1).

	Mean	SD	1	2	3	4	5
1. Gender	1.41	0.49					
2. Age	3.17	0.72	0.03				
3. Education	3.18	0.67	−0.05	0.22**			
4. Career values	2.89	0.36	0.03	−0.01	0.17**		
5. Professional identity	3.66	0.67	0.09	−0.04	−0.02	0.31**	
6. Perceived employability	2.97	0.49	0.02	−0.01	0.01	0.39**	0.63**

$N = 341$; ** $p < 0.01$.

Table 3. Results of regression analyses (Study 1).

	Professional identity		Perceived employability		
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Gender	0.09	0.08	0.02	0.003	−0.04
Age	−0.04	−0.02	−0.01	0.01	0.02
Education	−0.01	−0.07	0.01	−0.06	−0.02
Independent variable					
Career values		0.32***		0.40***	0.22***
Mediator					
Professional identity					0.57***
R^2	0.01	0.11	0.001	0.16	0.44
ΔR^2	0.01	0.10	0.001	0.16	0.29
F	1.11	10.28***	0.06	15.48***	52.86***

$N = 341$; *** $p < 0.001$.

bias-corrected confidence intervals (CIs) of 95% yield. Specifically, the bootstrapped confidence interval [95% CI: (0.17;0.34)] did not include zero. Thus, the mediating effect was significant, supporting H2.

3.3 Discussion of Study 1

Study 1 examined the relationship between career values and perceived employability and the mediating role of professional identity among STEM students in the United States. The results supported our expectations that career values were positively associated with perceived employability and that professional identity mediated this relationship. However, Study 1 had several limitations. First, professional identity only partially mediated the relationship between career values and perceived employability, suggesting that additional mechanisms may help explain this relationship. Accordingly, Study 2 examined proactive career behavior as an additional intervening mechanism. Second, to assess whether the findings could be replicated in a different cultural context, Study

2 re-examined the hypothesized relationships using a sample from a different cultural background. Third, the cross-sectional design of Study 1 did not allow us to establish the temporal ordering of the focal variables. To partially address this limitation, Study 2 adopted a two-wave design with a one-month interval. Finally, perceived employability in Study 1 was assessed using a scale originally developed for Western students. Study 2 employed an alternative measure of perceived employability, thereby providing a constructive replication of the findings. Overall, Study 2 was designed to address some of these limitations and extend the findings of Study 1.

4 Study 2

4.1 Methods

4.1.1 Sample and procedure

We used a survey design to collect data. Specifically, we

invited STEM students in China to participate in the study. We used a time-lagged research design and informed students in advance that the questionnaires were filled out anonymously and were strictly confidential. One of the authors was responsible for contacting the students and distributing the questionnaires at two different points with a one-month interval.

At Time 1, a total of 400 STEM students were asked to complete a questionnaire measuring their career values and professional identity, as well as to provide demographic information. After excluding invalid responses, we obtained 343 usable responses. One month later, at Time 2, we sent a questionnaire to all 343 students and asked them to rate their proactive career behavior and perceived employability. We received 303 responses, of which 290 were retained after data screening.

In the final sample ($N = 290$ complete responses), the average age of the respondents was 21.59 years ($SD = 3.28$), 167 were male (57.60%), and the most frequently reported education level was third-year undergraduate (28.60%).

4.1.2 Measures

We used a translation-back-translation procedure to translate the English scales used in this study into Chinese^[46]. The respondents rated each item on a 7-point scale, with 1 representing strongly disagree and 7 representing strongly agree, unless otherwise noted.

Career values. We employed the same scale used in Study 1^[21]. The Cronbach's α value was 0.88.

Professional identity. We employed the same scale used in Study 1^[43]. The Cronbach's α value was 0.86.

Proactive career behavior. A 13-item scale from Strauss et al.^[33] was used to evaluate students' proactive career behavior. A sample item was "I am planning what I want to do in the next few years of my career." The respondents rated each of the items on a 5-point scale from 1 = strongly disagree to 5 = strongly agree. The Cronbach's α value was 0.94.

Perceived employability. We asked the students to self-rate their employability with three items from Hodzic et al.^[47] A sample item was "In the current job market situation, I think it is possible to find a job that I am prepared for or have experience in." The Cronbach's α value was 0.91.

Control variables. We controlled for the following variables: gender (1 = male; 2 = female), age (in years), and educational level (1 = first-year undergraduate; 2 = second-year undergraduate; 3 = third-year undergraduate; 4 = fourth-year undergraduate; 5 = first-year Master's student; 6 = second-year Master's student; 7 = third-year Master's student; 8 = first-year Ph.D. student; 9 = second-year Ph.D. student; 10 = third-year Ph.D. student).

4.2 Results

4.2.1 Validity analyses

First, we assessed the risk of CMB in this study. Specifically, we conducted Harman's single factor test with PAF as an extraction method to test whether most of the variance could be explained by a single factor^[44,45]. The first non-rotated factor accounted for only 39.78% of the total variance extracted.

Consequently, we found no evidence of severe CMB in this study. Second, two validity subtypes were examined: convergent validity and discriminant validity. Convergent validity was examined by measuring reliability, composite reliability (CR), and average variance extracted (AVE). Table 4 presents the AVE and CR for all the constructs. In the current study, AVE and CR values exceeded 0.50 and 0.70, respectively. Hence, all the criteria for convergent validity were fulfilled. When the squared correlation of variables is lower than the AVE of the variable itself, discriminant validity exists^[48]. As presented in Table 5, the AVE for career values, professional identity, proactive career behavior, and perceived employability exceeded the squared correlations of the four variables. Therefore, the scales adopted in this study demonstrate good discriminant validity.

The descriptive statistics, reliabilities, and correlations for all the variables in the study are presented in Table 6. In line with our expectations, career values were positively correlated with professional identity ($r = 0.37$, $p < 0.01$), proactive career behavior ($r = 0.54$, $p < 0.01$), and perceived employability ($r = 0.36$, $p < 0.01$). Meanwhile, professional identity ($r = 0.50$, $p < 0.01$) and proactive career behavior ($r = 0.44$, $p < 0.01$) were positively related to perceived employability.

Table 4. Convergent validity (Study 2).

Constructs	Items	Loading	AVE	CR
Career values	CV1	0.77	0.51	0.89
	CV2	0.56		
	CV3	0.56		
	CV4	0.64		
	CV5	0.77		
	CV6	0.81		
	CV7	0.75		
	CV8	0.80		
Professional identity	PI1	0.80	0.61	0.86
	PI2	0.56		
	PI3	0.88		
	PI4	0.85		
Proactive career behavior	PCB1	0.81	0.54	0.94
	PCB2	0.78		
	PCB3	0.75		
	PCB4	0.78		
	PCB5	0.67		
	PCB6	0.80		
	PCB7	0.77		
	PCB8	0.60		
	PCB9	0.65		
	PCB10	0.71		
	PCB11	0.77		
	PCB12	0.71		
	PCB13	0.70		
Perceived employability	EM1	0.83	0.77	0.91
	EM2	0.93		
	EM3	0.87		

Table 5. Discriminant validity (Study 2).

	1	2	3	4
1. Career values	0.51 ^a			
2. Professional identity	0.14 ^b	0.61 ^a		
3. Proactive career behavior	0.29 ^b	0.29 ^b	0.54 ^a	
4. Perceived employability	0.13 ^b	0.25 ^b	0.19 ^b	0.77 ^a

^a AVE. ^b Squared correlation.

In addition, a significant positive correlation existed between professional identity and proactive career behavior ($r = 0.54$, $p < 0.01$). Hence, the results of the correlation analysis are consistent with our theoretical expectations.

4.2.2 Hypothesis testing

We used hierarchical regression analyses to examine the mediating role of professional identity and proactive career behavior in the relationship between career values and perceived employability. In Model 7 of Table 7, the results indicate that after controlling for students' gender, age, and education, career values were positively associated with perceived employability ($\beta = 0.37$, $p < 0.001$), thus supporting H1.

Model 2 showed that career values are positively related to professional identity ($\beta = 0.38$, $p < 0.001$). As shown in Model 8 of Table 7, professional identity significantly predicted perceived employability ($\beta = 0.43$, $p < 0.001$), whereas the relationship between career values and perceived employability was reduced ($\beta = 0.21$, $p < 0.001$). Regarding the mediating effect, we conducted a bootstrap analysis with 5000 resamples to obtain 95% bias-corrected CIs. Specifically, as shown in Table 8, the bootstrapped confidence interval [95% CI: (0.10;0.32)] did not include zero. Thus, the mediating effect was significant, supporting H2.

Model 4 showed that career values were positively associated with proactive career behavior ($\beta = 0.57$, $p < 0.001$). After career values and proactive career behavior are both entered into Model 9, the results show that the relationship between career values and perceived employability was reduced ($\beta = 0.18$, $p < 0.01$). In addition, we tested the significance of the indirect effect via the bootstrapping technique. As shown in Table 8, the bootstrapped confidence interval [95% CI: (0.01;0.23)] did not include zero. As a result, the mediating effect was significant, which provides support for H3.

Furthermore, Model 5 of Table 7 shows that professional

Table 6. Means, standard deviations and correlations among the variables (Study 2).

	Mean	SD	1	2	3	4	5	6
1. Gender	1.42	0.50						
2. Age	21.59	3.28	-0.07					
3. Education	3.93	2.53	0.003	0.78**				
4. Career values	5.87	0.91	-0.11	0.10	0.15*			
5. Professional identity	4.15	1.26	0.04	0.14*	0.05	0.37**		
6. Proactive career behavior	3.38	0.76	0.05	0.06	-0.01	0.54**	0.54**	
7. Perceived employability	4.68	1.35	-0.03	0.03	-0.01	0.36**	0.50**	0.44**

$N = 290$; * $p < 0.05$, ** $p < 0.01$.

Table 7. Results of regression analyses (Study 2).

	Professional identity		Proactive career behavior			Perceived employability				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Control variables										
Gender	0.06	0.10	0.06	0.12*	0.09	-0.03	0.02	-0.03	-0.03	-0.04
Age	0.26**	0.28**	0.17	0.20*	0.09	0.10	0.12	0.001	0.05	-0.02
Education	-0.15	-0.22*	-0.14	-0.25**	-0.16*	-0.09	-0.16	-0.07	-0.08	-0.04
Independent variable										
Career values		0.38***		0.57***	0.42***		0.37***	0.21***	0.18**	0.14*
Mediators										
Professional identity					0.38***			0.43***		0.36***
Proactive career behavior									0.34***	0.18**
R^2	0.03	0.17	0.01	0.32	0.44	0.01	0.14	0.29	0.22	0.31
ΔR^2	0.03	0.14	0.01	0.31	0.12	0.01	0.13	0.15	0.08	0.17
F	2.89*	14.65***	1.29	34.07***	44.79***	0.49	11.59***	23.38***	15.91***	21.06***

$N = 290$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 8. Results of the mediation effects (Study 2).

Path	Indirect effects	Boot SE	95% CIs
CV-PI-EM	0.20	0.06	[0.10;0.32]
CV-PCB-EM	0.11	0.06	[0.01;0.23]
CV-PI-PCB-EM	0.04	0.02	[0.004;0.08]

N = 290; CV: career values, PI: professional identity, PCB: proactive career behavior, and EM: perceived employability.

identity is positively associated with proactive career behavior ($\beta = 0.38$, $p < 0.001$). Career values, professional identity, and proactive career behavior were simultaneously entered into the regression model. All three variables exerted significant positive effects on perceived employability ($\beta = 0.14$, $p < 0.05$; $\beta = 0.36$, $p < 0.001$; $\beta = 0.18$, $p < 0.01$). Moreover, as shown in Table 8, professional identity and proactive career behavior exerted a significant sequential mediating effect on the relationship between career values and perceived employability, with the 95% CI excluding zero [95% CI: (0.004;0.08)]. As a result, H4 was supported.

4.3 Discussion of Study 2

Study 2 replicated and extended the findings of Study 1 using a different sample, measure, and research design. The results showed that professional identity mediated the positive relationship between career values and perceived employability. In addition, professional identity and proactive career behavior sequentially mediated this relationship.

5 Conclusions

On the basis of career motivation theory, the current research, with two different studies, examined whether and how career values are related to STEM students' perceived employability through professional identity and proactive career behavior. The results from both Study 1 and Study 2 show that career values are positively associated with STEM students' perceived employability. Moreover, career values are indirectly and positively related to perceived employability via the sequential-mediating role of professional identity and proactive career behavior.

5.1 Theoretical implications

First, this study extends research on student employability by focusing on STEM students, who represent an important source of future scientific and technological talent. Although many studies have examined employability among students, comparatively less is known about the factors associated with STEM students' perceived employability^[1]. By focusing on STEM students, this study advances understanding of how their perceived employability develops during their education and preparation for future careers.

Second, this study advances understanding of career motivation theory by linking career values to STEM students' perceived employability. Career motivation theory suggests that relatively stable career-related characteristics guide individuals' career decisions and behaviors^[10,11]. Career values represent one such characteristic, reflecting individuals' self-concepts and future career goals^[6,7]. Consistent with career

motivation theory, we found that career values were positively related to STEM students' perceived employability. By linking career values to perceived employability, our study extends career motivation theory beyond career decisions and behaviors to individuals' perceptions of their ability to obtain employment.

Finally, this study helps explain how career values relate to perceived employability by identifying the mediating roles of professional identity and proactive career behavior. Across both studies, professional identity mediated the relationship between career values and perceived employability. Study 2 further showed that professional identity and proactive career behavior sequentially mediated this relationship. Together, these findings suggest that career values are associated with a stronger professional identity, which is related to greater engagement in proactive career behavior and, in turn, higher perceived employability. By considering both professional identity and proactive career behavior, our study provides a more complete explanation of how career values relate to STEM students' perceived employability.

5.2 Practical implications

The findings of the current study have several practical implications. First, given the benefits of career values, students should be encouraged to develop factors related to career values, such as interest and autonomy. For example, families, society, and schools should collaborate to support the development of STEM students' career values. In addition, teachers should help students to understand their values, motivations, and interests from an early stage of learning, which will help them pursue a consistent career path.

Furthermore, professional identity is also a key factor in enhancing STEM students' employability. To improve the professional identity of STEM students, schools should organize more students to participate in academic projects and provide timely feedback so that students can feel the sense of achievement and pleasure generated in scientific research activities. In addition, schools should pay greater attention to managing students' career development, provide student-centered teaching methods that can cultivate students' proactivity, encourage students to engage in more proactive career behaviors, and provide timely support and help.

5.3 Limitations and future research

The current study has a few limitations that should be noted. The first limitation involves the single-source dataset in both Study 1 and Study 2. STEM students' self-rated data were collected to test our hypotheses. While our test provided no evidence of severe CMB, we encourage future studies to introduce more variable measures from multiple sources. For example, following previous studies on students' employability, future studies are encouraged to invite teachers to rate STEM students' employability, which would provide more objective assessments. Specifically, teachers can rate STEM students' employability, such as the implementation of scientific ideas and collaboration, to narrow the gap between technological solutions and the practical needs of the workplace.

Second, although we employed a time-lagged research

design in Study 2 to establish the temporal ordering of the variables, it was conducted with only one-month intervals, and the data of the mediator (i.e., proactive career behavior) and the dependent variable (i.e., perceived employability) were collected at the same time (i.e., Time 2); thus, this limits our ability to draw strong causal inferences. Therefore, future research can use a longitudinal research design or an experimental research design to provide stronger evidence regarding causality. For example, since most STEM undergraduates spend four years at universities, in the future, scholars could collect data on students' employability and career values in both the first year and the fourth year. In this way, the real sequence of events can be better established to provide insights into cause–effect relationships.

The next limitation involves sample issues. Specifically, given that data from both the United States and China were gathered for this research, it would be interesting to conduct cross-national comparisons in the future. For example, existing research shows that Chinese STEM undergraduates, on average, do not gain critical thinking skills over four years of study^[50], future research could take this issue into consideration by exploring whether developing critical thinking skills plays a role in influencing STEM students' employability.

Finally, in addition to exploring the sequential mechanism through which career values contribute to STEM students' perceived employability, future scholars should identify the boundary conditions to better understand the association between career values and perceived employability. Moreover, future research is expected to further explore the impact of career values on career-related outcomes from multiple theoretical perspectives to expand the outcome effects of career values and extend the academic understanding of career values.

Acknowledgements

This work was supported by the USTC Research Funds of the Double First-Class Initiative (YD2160002010).

Conflict of interest

The authors declare that they have no conflict of interest.

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