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Reproducing "academic successors" or cultivating "versatile experts": influences of doctoral training on career expectations of Chinese PhD students

Jianxiu Gu [1] · John S. Levin [2] · Yingzi Luo [1]

Abstract This investigation focuses on Chinese doctoral students' career expectations, and examines how the students' career expectations changed over time under the influence of doctoral training based on survey data of 1467 doctoral students from 8 Chinese universities. Doctoral students' evaluations of doctoral training were identified. The examination indicates that more than half of doctoral students expect a non-academic profession, and more than 70% of students did not alter their professional expectations radically over time. Logistic regression model results indicate that doctoral students' career expectations and their changes over time were influenced by doctoral training in their university environment, students' relationships with supervisors, and students' experiences of collaboration with non-academic organizations. Doctoral students are dissatisfied with doctoral training that does not encourage and prepare them for diverse career paths. We conclude that in the present environment, the goal of doctoral training should not only be the reproduction of "academic successors" but also be the cultivation of "versatile experts."

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Introduction to the problem

The relationships between the university and the labor market are not necessarily congruent or in equilibrium in all areas. In spite of claims that a market logic dominates universities world-wide (Seddon et al., 2013; Ward 2012), the preparation and socialization of doctoral students, may not fit the needs of the labor market. Thus, doctoral students' expectations for employment may not be fulfilled. That is, doctoral students who expect a career in a university may find that there are insufficient positions for them, and students who expect a non-academic career, in business and industry for example, may not be suitably prepared for their workplaces. A close examination of both doctoral students' career expectations and their graduate student experiences in China may reveal areas in university graduate preparation in need of attention if the Chinese nation is to match academic preparation with labor and economic needs. Indeed, the logic of the university (Levin 2017), or academic logic, at the doctoral level prioritizes academic learning and socialization, with the assumption that doctoral graduates will pursue employment as university faculty.

The scale of doctoral education in China has expanded dramatically in recent years. In the number of doctoral degrees awarded per year, China's system of doctoral education is the largest in the world, granting 58,113 doctorates in 2015, slightly ahead of the U. S. (China Academic Degrees & Graduate Education Development Center 2017). The Chinese case possesses special characteristics based upon the Chinese higher education context. Universities in China are divided into three levels: "985-project," "211-project," and ordinary universities. "985-project" universities are the top-ranked research universities, constituting only 1.5% of all regular higher education institutions in China. "211-project" universities have a lower rank than "985-project," which constitute 4.4% of all regular higher education institutions. The remaining universities are ordinary universities, which have lower prestige than "211-project" universities. Furthermore, universities in China are divided mainly into different types: comprehensive type, science and engineering type, normal type, and agriculture and forestry type (Ministry of Education of the People's Republic of China 2015).

In China, the vast majority of doctoral students are full time students in research degree programs without work experience before they enter doctoral study, and these students spend at least 3 years in their program. Generally, a Master's degree is required for application for doctoral programs. Courses in political ideology and English language are the main components of compulsory curricula in doctoral programs in China. Professional and elective courses comprise small proportions of programs (Shen and Wang 2010). As worldwide scholarship on doctoral education notes, there are three stages during the entire process of doctoral study; the same is the case in China (Baker et al. 2013; Baker and Pifer 2011). In China, Stage 1 includes the admissions process and the first year of course work, and Stage 2 entails a process that includes the development and defense of the dissertation proposal. Stage 3 is the final stage of the doctoral student experience, which includes completion of the dissertation and the job search (Baker and Pifer 2014). The complete process of doctoral study is guided by one supervisor or a supervisory group that includes two or three supervisors. There is no official dissertation committee that tracks a student's dissertation work, but there are approximately five professors from the student's research field who form a defense committee to participate in the student's oral defense of the dissertation proposal and the final dissertation itself. In China, the connection between doctoral students and supervisors is a close one. Historically, relations between masters and apprentices and between teachers and students were considered father-son and mother-daughter relations. As described in *guanxi* theory (Bian and Ang 1997), the

role of *guanxi* (literally means "relationship") for doctoral students and supervisors is significant in the whole process of doctoral students' study.

Globally, there is considerable diversity in doctoral graduates' career paths. China is no exception. Investigations show that in the U.S., before the 1970s, approximately 66% of doctoral graduates were employed in academia, but the proportion dropped to approximately 50% after the 1970s. In 2014, 49.3% of PhD holders were employed in the academic sector, while 32.2% worked in the industry or business (Wendler et al. 2012). In China, more than 59% of doctoral graduates worked in universities in 1995, while the proportion dropped to 29.9% in 2012 (Sun 2014). With the expansion of doctoral education, a reduced market for academic positions, and an expanded non-academic labor market, the career paths of Chinese doctoral graduates have become more diverse (Chen 2010; Shen et al. 2015).

There is considerable deviation between doctoral graduates' actual employment and the goals for traditional doctoral education. On the one hand, doctoral training continues to focus on reproducing researchers in academia. On the other hand, changes in labor markets have occurred: There are more doctoral graduates who seek jobs as professors and as basic researchers in academe than there are available positions. Furthermore, there is an increasing number of highly educated researchers needed by industry, and a large number of doctoral students choose to work outside academia.

Given that a majority of doctoral graduates will not join the academic community, the system of doctoral training fails to meet the employment needs of a larger percentage of its students as well as employers' needs. Stakeholders, including academic, governmental, and professional leaders and organizations, have lamented this disconnection and have suggested worthwhile adjustments. Yet, most of these alterations have led only to minor changes in graduate course offerings (Leshner 2015). It follows, then, that in order to meet and adapt to the needs of national social development in China, as well as the needs of doctoral students and employers, doctoral training objectives and training methods should become more diverse and comprehensive (Altbach 2004).

Within this context, related studies worldwide highlight the conditions and contributions of post-PhD employment and the need for adjustment to doctoral education based on doctorate holders' career development. In order to evaluate the effectiveness of doctoral education based on PhD recipients' employment status five to ten years after degree completion, several national studies in the United States (Nerad et al. 2004; Nerad et al. 2007; Sadrozinski et al. 2003) set out to investigate doctoral graduates' career development and their evaluation of their doctoral experience. Similar questions concern a number of countries, including Canada, Australia, the UK and other European countries, and also China. Yet, in light of the lack of such national investigations of doctorate recipients' career development and their post-graduate evaluation of doctoral education in China, the present investigation of the career expectations of doctoral students may suggest improvements in doctoral education.

An empirical analysis of the employment expectations of doctoral students, effects of doctoral training on changes to doctoral students' career expectations, and doctoral students' evaluation of doctoral training based on their career expectation demands can provide not only a basis for policy directed at PhD programs, but also a foundation for institutions to adjust training objectives, training processes, and quality evaluation criteria for doctoral education to link doctoral training with labor market demands. Therefore, this project raises important questions concerning the relationship between doctoral training and doctoral students' career expectations.

Based on survey data of 1467 doctoral students from 8 Chinese universities and the use of logit regression models, this investigation responds to the following questions: What are the employment expectations of Chinese doctoral students: academic or non-academic career? How do doctoral students' career expectations change during the course of their doctoral studies? What are the effects of doctoral training on doctoral students' career expectations and the evolution of career expectations?

This investigation uses career development theory (Ginzberg 1972; Super 1980) to divide doctoral students' career expectations into four periods. It uses ecological systems theory (Bronfenbrenner 1979) to select seven aspects of doctoral training factors, and explains the influences of those factors on doctoral students' employment expectations and the development of their expectations over time. Finally, doctoral students' evaluation of doctoral training is addressed.

Literature review

The larger international body of literature on doctoral students and doctoral education provides a scholarly context for this investigation. In numerous graduate programs and disciplines, and conveyed in the research literature, there is an assumption that doctoral students are in search of faculty careers. Golde and Dore (2001) indicated, however, that this is not always the case, especially among disciplines that have close industry ties such as those in the science, technology, engineering, and mathematics (STEM) fields. A review of common labor market explanations in relation to Ph.D. career path data suggests that there is a need to view the academic labor market as just one segment of the broader labor market (Aanerud et al. 2007). The literature on China's doctoral education reveals the lack of connection between academic logic—that doctoral education is aimed at the development of the professoriate—and a market logic—that advanced education is needed to meet the needs of knowledge production outside of the university (Gu and Luo 2016). The understanding of the employment experiences of recent doctoral graduates is a vital way to ensure that PhD programmes are designed effectively to prepare these graduates for a range of careers (Manathunga et al. 2009).

The literature that focuses on doctoral students' employment addresses two specific topics. The first branch of literature focuses on doctoral students' career expectations during doctoral training (Fuhrmann et al. 2011; Golde and Dore 2001; Mason et al. 2009) and doctoral graduates' career choices (Neumann and Tan 2011; Wendler et al. 2012; Zhao and Shen 2010). The second branch focuses on factors that contribute to doctoral students' career expectations and choices (Enders 2002; Schoot et al. 2012; Zhao and Shen 2010).

The diversity of career paths of doctoral students

The majority of studies that discuss doctoral students' career choices often focus on the employment positions that doctoral students choose in different sectors of the economy, whether they are inside or outside academia (Enders 2002; Fox and Stephan 2001; Gemme and Gingras 2012; Schoot et al. 2012). The traditional idea of the career path of PhDs is a linear pipeline, in which a doctoral degree is the entrance ticket to the academic profession alone. Yet, doctoral students' options may not follow this linear path (Nerad 2004; Neumann and Tan 2011; Wendler et al. 2012).

Surveys find that public and private sectors that employ doctoral students have become increasingly diverse, that is, more and more doctoral students choose to work outside academia (Enders 2002; Mason et al. 2009; Wendler et al. 2012). In regard to doctoral students' career expectations during their doctoral training, the survey of doctoral students' views of their future career plans from the University of California system found that the majority of doctoral students rejected tenure-track faculty positions in research-intensive universities as their primary career goal. When they started their PhD programs, 45% of the male doctoral students and 39% of the female doctoral students indicated that they wanted to pursue careers as professors with a research emphasis, and during the period of their doctoral education 36% of men and 27% of women stated that this was their career goal at the time of the survey. A substantial proportion of doctoral students redirected their sights to positions outside of academia altogether—careers in business, government, or industry (Mason et al. 2009). Golde and Dore found that most students entered graduate school with strong convictions for a faculty career, but during their graduate school education and training, students reported a change in interest for this career path (Golde and Dore 2001). Large numbers of students in basic biomedical sciences consider career paths beyond academe—and beyond research. This change in career preference occurs early in graduate school. Midway through graduate training, students consider a broad range of career options, with one-third intending to pursue a non-research career path (Fuhrmann et al. 2011).

For doctoral graduates' career choices, from a long-term perspective, the trend from the mid-1990s shows declining proportions of doctoral graduates employed in academic positions, whether in Germany (Enders 2004), France (Paul and Perret 1999), the United States (Council of graduate schools 2007), Australia (Neumann and Tan 2011), or China (Chen 2010). Investigations show that in the U.S., before the 1970s, approximately 66% of doctoral graduates were employed in academia, while the proportion dropped to about 50% after the 1970s (Wendler et al. 2012). In Europe, large-scale surveys reveal that although the majority of the PhD holders are employed in the higher education and research sector, a high proportion found further employment in other sectors and occupations (Ender and Weert 2004). In 2010, French data show that approximately 45% of doctoral graduates have employment in the education sector, a percentage similar to that in the UK (OECD 2011). In Australia, in 2014, nearly 49% of research Masters/PhDs were employed in the education sector, including both higher education and other levels of education. In Germany, according to the findings of the 2011 national PhD graduate survey conducted by the International Centre for Higher Education (INCHER) of Kassel University, 25% of doctoral graduates work in the university and research sector, while 75% are employed in non-academic sectors, a trend that is historical for Germany (Enders 2002). Because the initial period of employment involves competition for a decreased supply of tenure-track positions and numerous, but temporary, contracts, both PhD graduates and postgraduate researchers hold negative perceptions about their career opportunities in academia (Enders 2002; Mason et al. 2009; Wendler et al. 2012).

Factors that contribute to the employment of doctoral students

Studies divide the factors that influence doctoral students' employment expectations and intentions into three groups: 1) demographic variables (gender and individual and family demands) [Fox and Stephan 2001; Kulis et al. 2002; Mason et al. 2009; Schoot et al. 2012; Zhao and Shen 2010]; 2) doctoral students' academic performance (participation in research

and cooperative projects, and in paper publication) [Gemme and Gingras 2012; Schoot et al. 2012]; and, 3) doctoral training variables (discipline, doctoral program, and supervisors' guidance) [Enders 2002; Fox and Stephan 2001; Gemme and Gingras 2012; Huisman et al. 2002; Neumann and Tan 2011].

Gender has a significant influence on doctoral students' employment. Schoot et al. (2012) proposed that gender and level of academic performance are important factors that affect doctoral recipients' career status. In non-academic employment, male doctoral recipients have a significantly greater chance of having a permanent contract in comparison to female doctoral recipients. Furthermore, doctoral recipients with higher levels of academic performance in terms of having more publications, higher levels of research, and shorter time to degree, are more likely to have a permanent contract rather than a temporary position in academia. Mason et al. (2009) highlighted that work and life balance is the most important reason why doctoral students changed their career goal away from becoming faculty members with an emphasis on research.

Students' discipline, their relationships with supervisors, and their involvement in research and with researchers influence career expectations and intentions, as well. Doctoral students in humanities are the most likely to secure initial employment in academia. In contrast, those in engineering prefer employment, initially, in industry (Wendler et al. 2012); a similar pattern pertains to China (Zhao and Shen 2010). Moreover, integration into the scientific community during doctoral studies has a positive effect on further career attainment in the higher education and research sector. Conversely, integration has little or no effect on income and status for those employed outside the higher education and research sector (Enders 2002). Cooperation between firms and universities has a positive effect on employment of doctoral students in industry (Garcia-Quevedo et al. 2012). Furthermore, scientific activities, research, and publications have positive effects on doctoral students' expectations for academic employment. It also appears that students who, from the start, demonstrate an interest in academic careers have privileged relationships with their supervisors, and this nurtures the development of core academic skills. The supervisor is considered pivotal in influencing PhD graduate employment pathways (Platow 2012) and career motivations. Supervisors influence employment outcomes through the nurturing of networking, such as presenting at and attending conferences and encouraging publications—these are significant recruitment criteria in academe—and advising students on a range of career options.

Golde and Dore (2001) examined interest in and preparation for an academic career for doctoral students from different disciplinary backgrounds. They found that several factors positively influenced decisions to pursue faculty careers: employment in teaching, working on a university campus, enjoyment of research, faculty life style, faculty encouragement, enjoyment of service, and exposure to other careers. Factors that negatively influenced decisions to pursue faculty careers include the tenure and promotion process, academic job market in any field, work load expectations, amount of research funding, and salary levels. Jackson and Michelson (2015) identified the major factors that account for the initial full-time employment of Australian-trained PhD graduates. Based on national survey data, they found that previous work experience, attendance at a research-intensive university, the completion of one's degree off campus, part-time status, the use of certain job search strategies, access to research culture and networking opportunities, and particular demographic characteristics influence initial post-graduation job attainment.

The primary gaps in the literature

Studies of doctoral students' employment expectations and options, and the factors that influence these expectations, have not been addressed systematically in China. These omissions lead to inadequate understandings of this topic. Furthermore, although the array of literature contributes to a comprehensive understanding of doctoral students' employment, there are three primary gaps in the literature on doctoral students' employment and influential factors for students' employment needs to be fulfilled. First, current research literature on doctoral students' employment and factors that contribute to their employment focuses mainly on doctoral students' career choices after their graduation. Few studies discuss doctoral students' career expectations during their doctoral study. Second, factors that influence doctoral students' career expectations, especially doctoral training factors addressed in the literature, are fragmented and not well classified. Third, a substantial portion of the literature on the influential factors of doctoral students' employment based upon survey and statistical analysis is missing the application of relevant theories. The scholarly literature offers descriptive statistical analyses based on the selection of doctoral students' employment areas and professions.

The aim of this article is to address these gaps through an investigation of the career expectations of doctoral students in China at the third-year level, or above to explain what influences career expectations among those doctoral students who face graduation and employment. Furthermore, this article examines the ways in which the students' career expectations may have changed over time under the influence of doctoral training. Doctoral students' evaluation of doctoral training based on their career development demands will be addressed as well, and this examination can serve as a foundation for policy recommendations for doctoral training reform.

Theoretical framework

Career development theory (Ginzberg 1972; Super 1980) proposes that one's career decision is not made at a static point in time, but is a dynamic process which can be divided into several periods. Ginzberg (1972) divided the individual's career development into three periods: interested period, tentative period, and established period. Super (1980) divided the individual's career development into five periods: growth period, exploration period, establishment period, maintenance period, and decline period. Ginzberg focused on career development of young people, while Super attributed career development to the whole of one's life. Therefore, the application of Ginzberg (1972) and Super (1980) together to the study of doctoral students' career development is inappropriate. However, in that career development is a dynamic process, we use only the terms of each period rather than the contents of career development theory proposed by Ginzberg (1972). Thus, we categorize doctoral students' career development into four periods: interested period, tentative period, beginning of the established period, and established period.

Career choice begins with the interested period before moving to the other stages. In this period, doctoral students express expectations for their employment options, which largely determine their actual employment choices after they graduate. Personal expectation is a component of the decision. That is, one may have an expectation of a career and then make a decision to have that career as a goal. Personal expectation is a major determinant of an

individual's final choice of employment. In our investigation (shown in Fig. 1), doctoral students' career expectations before entering doctoral study, as well as their employment preferences during doctoral study, can be considered as their career choices in the interested period and tentative period, respectively, periods which can contribute to their final employment decisions. Moreover, given that all doctoral students received our survey in their third year or above level of their doctoral study, at a time when they faced graduation and employment immediately, their employment expectations can be considered as their career choices at the beginning of the established period, as well.

Based on the literature review, we find that there are several factors that influence doctoral students' career expectations. According to ecological systems theory (Bronfenbrenner 1979), the human ecological environment has an important effect on individual development. The educational eco-environment plays a vital role in the nature and development of one's education, which includes both external and internal educational environments and macro and micro educational environments. Doctoral students' development is affected by the political, economic, and campus environments. Above all, the campus environment influences doctoral students' professional development and academic socialization significantly, and this environment includes the institution's training systems and management and services environments. Therefore, we selected seven aspects of doctoral training, including training environment, supervisor guidance, students' research experience, international communication, social practice, career guidance, and students' satisfaction evaluations of doctoral training, in order to explore the effects of doctoral training on employment aspirations of students. Within universities, there is an implicit assumption that the doctorate is a preparation for an academic career, and that doctoral training controls the supply of scientists and researchers, which influences doctoral students' career expectations and development. With the transformation of the knowledge production mode (Gibbons et al. 1994), academic institutions seek to increase collaboration with non-academic organizations, including businesses and industries. A number of initiatives aiming, directly or indirectly, at increasing the exposure of graduate
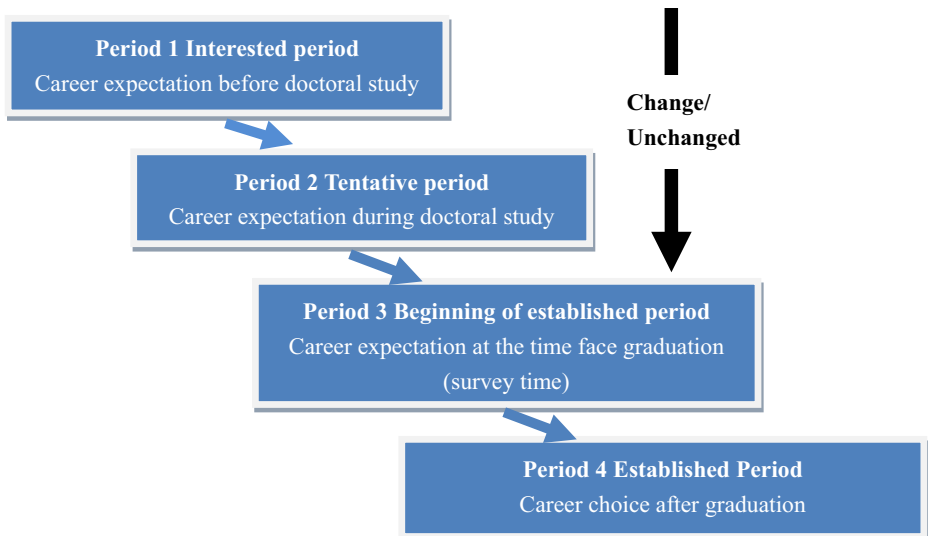

Fig. 1 Four periods of career development

students to non-academic research problems are evident in numerous countries (Gemme and Gingras 2012).

Research design and methodology

Research questions

Based on the theoretical framework of personal career development stages, the career expectations of doctoral students in our investigation can be considered as their career intentions at the beginning of the established period, since all doctoral students received our survey in their third year or later during their doctoral study, at a time when they faced graduation and employment almost immediately. That is, they had a clear goal of their future career choices and had cognition of what that career entails, as well as the likelihood of their attainment of that career. Regardless of students' career aspirations, in order to achieve their aspiration of an employment position, they had to be certain about their goals and begin to enact the requisite professional identity (Baker and Pifer 2014). Furthermore, they could change their employment expectations during their doctoral study under the influence of internal or external elements and conditions. Our investigation, then, proposed the following three research questions:

1: What are the employment or career expectations of Chinese doctoral students: academic or non-academic?
2: What are the changes in doctoral students' career expectations during the course of their doctoral studies?
3: What are the effects of doctoral training on doctoral students' career expectations and on the development of career expectations?

Data collection

To understand the employment expectations of PhD students and provide knowledge for doctoral training, we administered a survey questionnaire to doctoral students to investigate their career expectations at 8 universities of different types in Jiangsu province in China. In our survey, for university prestige, there are two "985-project" key universities, three "211-project" key universities, and three ordinary universities; for university type, there are two comprehensive universities, three science and engineering universities, two agriculture and forestry universities, and one normal type university. We communicated with the dean of the graduate school in each university and, subsequently, with the deans' assistance, questionnaires were forwarded to each university. 1700 questionnaires were sent to full time research-oriented PhD students at third year or above, at a time when they faced graduation and employment, and 1554 questionnaires were completed and returned. There was a 91.4% response rate, and 1467 valid questionnaires are used in this investigation. Descriptions of data characteristics are displayed in Table 1. It should be noted that 46.8% of the students were in the field of Engineering, and this percentage is slightly higher than the percentage of doctoral students in Chinese doctoral programs.

Table 1 Data Characteristics

Measures	Items	N	Percent
Individual information			
Gender	Female	568	38.7
	Male	899	61.3
Total		1467	100.0
Age	25–30	1251	89.1
	Above 30	153	10.8
Total		1404	100.0
University information			
University prestige	"985"-project	746	50.8
	"211"-project	531	36.2
	Ordinary 4 years	190	13.0
Total		1467	100.0
Discipline	Literature/History/Philosophy	133	9.1
	Economics	40	2.7
	Law	34	2.3
	Education	13	0.9
	Science	292	20.0
	Engineering	684	46.8
	Agriculture	213	14.6
	Management	52	3.6
Total		1461	100.0

Research variables

This research focuses on the employment expectations of PhD students and the doctoral training factors that influence doctoral students' employment expectations. Therefore, the dependent variables are divided into three categories: (1) type of professional expectations, that is, academic and non-academic, (2) whether or not students changed their career expectations over time from prior to doctoral study to the time of the survey, and (3) the kinds of changes in type of profession selected prior to doctoral study and at the time of the survey. The existing literature pays particular attention to doctoral students' career choices, either inside or outside of academia. Thus, type of profession is subdivided into academic profession (AP) and non-academic professions (NAP). The variables of whether the students' career expectations have been changed can be divided into changed and not changed. Not changed can be subdivided into constant for AP and constant for NAP. The changes in type of profession over time from prior to doctoral study to the time of the survey are subdivided into transfer from AP to NAP and transfer from NAP to AP (shown in Table 2).

The independent variables represent the doctoral training factors that influence doctoral students' employment expectations and are grouped into seven categories displayed

Table 2 Assignment of changes in type of profession

Prior to doctoral study	At the time of the survey	Changes of career expectations
1 (AP)	1 (AP)	0 (no changed: constant for AP)
0 (NAP)	0 (NAP)	0 (no changed: constant for NAP)
1 (AP)	0 (NAP)	1 (changed: transfer from AP to NAP)
0 (NAP)	1 (AP)	1 (changed: transfer from NAP to AP)

as variables, shown in Table 3: (1) training environment: university prestige and discipline; (2) supervisor guidance: students' relationship with supervisors; (3) research experience: participation in research projects; (4) international communication: experiences include study abroad and participation in international conferences; (5) social practice: collaborative experiences with non-academic organizations; (6) career guidance: career guidance provided during doctoral training; and (7) students' satisfaction with doctoral training. Because the dependent variables are binary classification variables, the Binary-Logistic regression model was used. *STATA* 13.0 is the statistical software in this investigation.

Table 3 Assignment of dependent and independent variables

Type of Variables	Variables	Sub-factors	Assignment	Mean	SD
Dependent variables	Career expectations	Type of profession	1 = AP; 0 = NAP	0.48	0.50
		If change the type of profession	1 = Change; 0 = No change	0.27	0.44
		Changes in type of profession (1)	1 = transfer from AP to NAP; 0 = constant for AP	0.33	0.47
		Changes in type of profession (2)	1 = transfer from NAP to AP; 0 = constant for NAP	0.16	0.36
Independent variables	Training environment Supervisor	University prestige	1 = "985"; 2 = "211"; 3 = ordinary	1.61	0.70
		Discipline	1 = liberal arts; 2 = social science; 3 = science; 4 = engineering science; 5 = agricultural science	3.48	1.13
		Relationship with supervisor	1 = good;0 = not good	0.91	0.29
	Research experience	Participation in research projects	1 = has;0 = none	0.96	0.20
	International communication	Participation in international conference	1 = has;0 = none	0.71	0.46
		Study abroad	1 = has;0 = none	0.15	0.37
	Social practice	Collaboration with non-academic organization	1 = has;0 = none	0.40	0.49
	Career guidance	Career guidance and counseling	1 = has;0 = none	0.62	0.49
	Students' satisfaction of doctoral training	Gave adequate information about career	1 = satisfied; 0 = dissatisfied	0.85	0.36
		Satisfied students' diverse demands	1 = satisfied; 0 = dissatisfied	0.64	0.48
		Encouraged students diverse options	1 = satisfied;0 = dissatisfied	0.52	0.50
		Prepared students good for AP	1 = satisfied; 0 = dissatisfied	0.78	0.41
		Prepared students good for NAP	1 = satisfied; 0 = dissatisfied	0.54	0.50
Control variables	Gender		1 = male; 0 = female	0.61	0.49

Data analysis results

Descriptive analysis

The questionnaire set forth the question, "What was your career expectation before entering doctoral study?" in order to investigate students' professional expectations prior to their doctoral study. Descriptive analysis results show that 59.4% of students access doctoral study in order to carry out future teaching and research work in a university. Acquisition of a faculty role is the largest career expectation of doctoral students, followed by an expectation of conducting research or practicing management in firms (14.0%), working in a research institution (9.6%), and carrying out administrative work in a university (4.6%).

Furthermore, the questionnaire asked the question, "What is your career expectation right now?" in order to collect data of students' career expectations at their third-year level or above. The results show that 47.9% expect to have an AP and 52.1% expect to have an NAP. Specifically, 82.0% of students in the disciplinary areas of literature / history / philosophy (L/H/P) hope to have an AP, followed by Law (64.7%) and management (63.5%). Additionally, engineering is the discipline where the largest percentage (62.9%) of students expect an NAP (shown in Table 4).

Compared to students' career expectations prior to their doctoral study, some students' career expectations, at the time of administration of the survey, changed. That is to say, after three years or more doctoral training, some students continued to maintain their initial career expectations and others did not. The statistical results indicate that more than 70% of doctoral students did not alter their professional expectations radically over time. Yet, there were more than 26% of doctoral students whose career expectations changed. Specifically, 42.1% of doctoral students' type of professional expectation was constant for AP, while 31.2% was constant for NAP. 20.9% transferred their professional expectations from AP to NAP, and 5.8% changed their expectations from NAP to AP at the time of the survey (shown in Table 5). Most expectations from a "985″ university were constant for AP, similar to students from a "211″ university. Yet, 41% of students' expectations from an ordinary university were constant for NAP. Students'who transferred their employment expectations from AP to NAP were higher among students from an ordinary university than students from the other two university types.

We considered the self-reporting of how satisfied a PhD student was with their doctoral training. This investigation adds information about Chinese doctoral students' evaluation of

Table 4 Different professional disciplines distribution about doctoral students' employment expectations at the time of the survey (%)

Disciplines	Academic profession	Non-academic profession
L/H/P	82.0	18.0
Economics	52.5	47.5
Law	64.7	35.3
Education	53.8	46.2
Science	54.8	45.2
Engineering	37.1	62.9
Agriculture	45.1	54.9
Management	63.5	36.5
Total	48.0	52.0

Table 5 University prestige distribution differences about changes of doctoral students' employment expectations during doctoral study (%)

University prestige	Constant for AP	Constant for NAP	Transfer from AP to NAP	Transfer from NAP to AP
"985"-project	45.5	29.1	18.4	7.0
"211" -project	41.3	30.6	22.9	5.2
Ordinary	30.9	41.0	25.5	2.7
Total	42.1	31.2	20.9	5.8

doctoral training based on demands of their career expectations. The questionnaire contained five components of doctoral training for evaluation: (1) doctoral training gave students adequate information about career development prospects; (2) doctoral training met the diverse demands of students' future career development; (3) doctoral training prepared students for the academic profession; (4) doctoral training prepared students for a non-academic profession; and, (5) doctoral training encouraged students to choose diverse employment paths. Items were presented in statement format with a Likert type five-point scale ranging from not at all satisfied (1 point) to very much satisfied (5 points).

As shown in Fig. 2, doctoral students' highest level of satisfaction was that doctoral training informed them about their future career prospects (4.21), followed by doctoral training prepared students for the academic profession (4.05). Overall, students were dissatisfied with doctoral training's encouragement for diverse career paths and preparation for non-academic professions.

We divided doctoral students' career development into four stages: (1) interested period in which doctoral students had career expectations prior to doctoral study; (2) tentative period in which doctoral students' career expectations may change during doctoral study; (3) beginning of the established period in which doctoral students had a clear career goal at the time of the survey, that is, at the time they faced graduation; and, (4) established period in which doctoral students acquired their career goal after graduation. Based on descriptive analysis results of the data, we found that most doctoral students (more than 70%) did not alter their employment expectations from stage 1 to stage 3. That is, employment expectations of students in stage 1 contributed to their employment expectations in stage 3. Factors of the interested period had continuing effects on the established period. Additionally, there were a minority of doctoral
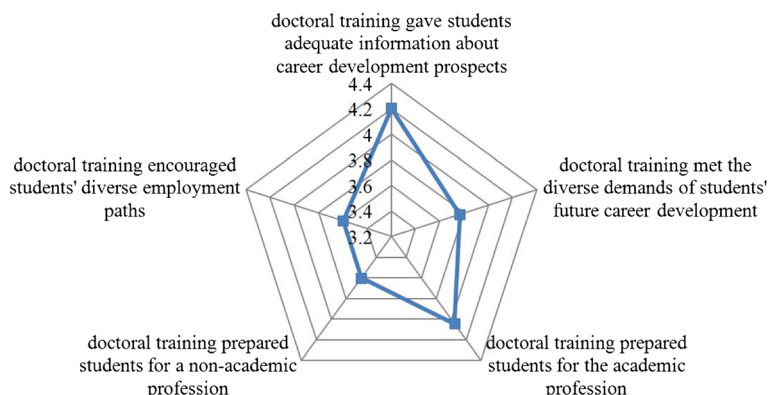

Fig. 2 Doctoral students' satisfactory evaluation of doctoral training

students (above 26%) who altered their original career expectations after they received doctoral training. The influence of doctoral training on the changes of students' career expectations is explored and discussed in the regression analysis of the data.

Regression analysis

Due to the number of samples of different disciplines and consideration of data analysis, we divided the disciplines into five groups: liberal arts, social sciences, science, engineering, and agriculture. Specifically, we amalgamated literature, history, and philosophy as liberal arts, and we integrated economics, law, education, and management into social sciences. The results of regression analysis focus on the influences of doctoral training on students' career expectations and the evolution of their expectations. As shown in Table 6, compared to female students, male students expect a NAP ($p < 0.05$). Students from "985″ universities are more likely to expect an AP than students from ordinary universities ($p < 0.05$). Discipline is heavily tied to expectations of doctoral students' type of profession. Compared to students from agricultural sciences, those from liberal arts ($p < 0.001$) and social sciences ($p < 0.05$) are more likely to expect an AP. Furthermore, students who have a good relationship with their supervisors are more likely to expect an AP ($p < 0.05$), while students' experiences of collaborating with non-academic organizations have a significant, positive association with students' expectation for a NAP ($p < 0.01$).

Table 7 indicates that students from liberal arts ($p < 0.001$), social sciences ($p < 0.001$), and engineering ($p < 0.01$) are more likely to remain constant in their career expectations. Students

Table 6 The binary Logistic regression results for doctoral students' professional expectations

Independent variables	Dependent variables: Type of profession Academic profession/Non-academic profession	
	Coefficient (Z value)	Odds Ratio
_cons	−0.606 (−1.44)	0.546
Gender(Female)	**−0.260**[*](−2.26)	0.771
University prestige(Ordinary)		
"985-project" key universities	**0.404**[*] (2.16)	1.497
"211-project" key universities	0.262 (1.37)	1.300
Discipline(Agricultural)		
Liberal arts	**1.576**[***](5.38)	4.836
Social science	**0.560**[*](2.31)	1.750
Science	0.341 (1.68)	1.406
Engineering	−0.252 (−1.40)	0.778
Relationship with supervisor	**0.425**[*] (2.16)	1.529
Participation in the project	−0.026 (−0.08)	0.975
Participation in the international conference	0.058 (0.44)	1.059
Experience of study abroad	0.129 (0.79)	1.137
Collaboration with non-academic organization	**−0.365**[**](−2.99)	0.695
Career guidance	−0.029 (−0.24)	0.971
N	1450	
Pseudo R2	0.0671	
LR chi2 (13)	134.70	
Prob > chi2	0.0000	
Log likelihood	−936.77934	

Note: [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$;Base group in brackets

Table 7 The binary Logistic regression results if doctoral students change their professional expectations

Independent variables	Dependent variables: If change the type of profession Changed/No changed	
	Coefficient (Z value)	Odds Ratio
_cons	−0.179 (−0.41)	0.836
Gender(Female)	−0.131(−1.04)	0.877
University prestige(Ordinary)		
"985-project" key universities	0.014 (0.07)	1.014
"211-project" key universities	−0.049 (−0.24)	0.952
Discipline(Agricultural)		
Liberal arts	**−1.126**[***](−3.60)	0.324
Social science	**−0.947**[***](−3.37)	0.388
Science	−0.210 (−0.97)	0.810
Engineering	**−0.559**[**](−2.91)	0.572
Relationship with supervisor	0.210 (0.96)	1.234
Participation in the project	−0.487 (−1.51)	0.614
Participation in the international conference	0.170 (1.17)	1.186
Experience of study abroad	−0.229 (−1.28)	0.795
Collaboration with non-academic organization	**0.413**[**] (3.09)	1.511
Career guidance	**−0.432**[***](−3.30)	0.649
N	1450	
Pseudo R2	0.0268	
LR chi2 (13)	44.95	
Prob > chi2	0.0000	
Log likelihood	−816.71336	

Note: [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$;Base group in brackets

who had experiences of collaborating with non-academic organizations are more likely to change their professional expectations ($p < 0.01$), whereas students who received career guidance during their doctoral study are more likely to maintain their original career expectations ($p < 0.001$).

In order to further investigate the influences of doctoral training on the specific changes of doctoral students' career expectations, we added variables of students' satisfaction with doctoral training into the regression model. We defined students who chose 5 or 4 points on a Likert-type scale as satisfied with doctoral training, and those who chose 3, 2, or 1 as dissatisfied with doctoral training. As shown in Table 8, compared to those who transfer their AP expectations to NAP expectations, students from liberal arts ($p < 0.001$) and social sciences ($p < 0.01$) remained constant for AP over time. Students who had experiences of collaborating with non-academic organizations were more likely to transfer their AP expectation to NAP expectation ($p < 0.001$). Moreover, students who received career guidance ($p < 0.05$) and were satisfied with doctoral training as a preparation for AP ($p < 0.001$) were more likely to remain constant for AP. As shown in Table 9, compared to constancy for NAP, students from "985″ universities and liberal arts were more likely to transfer their NAP expectation to an AP expectation ($p < 0.05$). Furthermore, career guidance had a positive and significant effect on the constancy of students' NAP expectations ($p < 0.05$).

Based on the regression models results, we find that gender, university prestige, disciplines, the relationship with supervisor, and the experience of collaborating with non-academic organizations have a significant association with doctoral students' career expectations. Moreover, the changes of doctoral students' career expectations over time from prior to doctoral

Table 8 The binary Logistic regression results for changes in doctoral students' professional expectation (1)

Independent variables	Dependent variables: Changes in type of profession Transfer from AP to NAP/Constant for AP	
	Coefficient (Z value)	Odds Ratio
_cons	0.633 (1.13)	1.882
Gender(Female)	0.027 (0.18)	1.027
University prestige(Ordinary)		
"985-project" key universities	−0.326 (−1.33)	0.722
"211-project" key universities	−0.260 (−1.03)	0.771
Discipline(Agricultural)		
Liberal arts	**−1.890*****(−4.61)	0.151
Social science	**−1.022**** (−3.16)	0.360
Science	−0.386 (−1.50)	0.680
Engineering	−0.244 (−1.05)	0.784
Relationship with supervisor	−0.159 (−0.54)	0.853
Participation in the project	−0.283 (−0.67)	0.754
Participation in the international conference	−0.027 (−0.15)	0.973
Experience of study abroad	−0.361 (−1.57)	0.697
Collaboration with non-academic organization	**0.474*****(2.80)	1.606
Career guidance	**−0.362*** (−2.25)	0.697
Doctoral training gave adequate information about career	0.070 (0.28)	1.072
Doctoral training satisfied students' diverse demands	0.252 (1.31)	1.287
Doctoral training encouraged students diverse options	0.034 (0.18)	1.034
Doctoral training prepared students good for AP	**−0.704***** (−3.39)	0.495
Doctoral training prepared students good for NAP	0.321 (1.73)	1.379
N	909	
Pseudo R2	0.0711	
LR chi2 (18)	81.62	
Prob > chi2	0.0000	
Log likelihood	−532.80635	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Base group in brackets; Based on a subsample

study to the time they are about to graduate are influenced significantly by discipline, the experience of collaborating with non-academic organizations, and career guidance that students received during doctoral education. That is, the doctoral training environment, the doctoral program, and the education and training process have considerable effects on doctoral students' employment aspirations. Specifically, collaboration with non-academic organizations has a positive influence on students' constancy in their expectation for NAP and, as well, on their changes of career expectations from AP to NAP. Given doctoral students' opportunities to interact with non-academic entities, these doctoral students have more varied experiences during doctoral education than those without these experiences, and those interactions likely increase doctoral students' employment outside of the academic field after graduation (Garcia-Quevedo et al. 2012).

Discussion and conclusions

This investigation, based on survey data of 1467 doctoral students from 8 Chinese universities, adds new knowledge to literature on employment expectations of Chinese doctoral students, including the factors that influence students' expectations. This investigation also explores and

Table 9 The binary Logistic regression results for changes in doctoral students' profession expectation (2)

Independent variables	Dependent variables: Changes in type of profession Transfer from NAP to AP/Constant for NAP	
	Coefficient (Z value)	Odds Ratio
_cons	−1.752 (−1.74)	0.173
Gender(Female)	−0.375 (−1.39)	0.687
University prestige(Ordinary)		
"985-project" key universities	**1.079*** (2.05)	2.943
"211-project" key universities	0.791 (1.48)	2.207
Discipline(Agricultural)		
Liberal arts	**1.668***(2.55)	5.299
Social science	−0.499 (−0.77)	0.607
Science	0.668 (1.34)	1.951
Engineering	−0.369 (−0.80)	0.692
Relationship with supervisor	0.324 (0.78)	1.382
Participation in the project	−0.798 (−1.24)	0.450
Participation in the international conference	0.535 (1.57)	1.707
Experience of study abroad	−0.021(−0.06)	0.979
Collaboration with non-academic organization	**0.618*** (2.15)	1.854
Career guidance	**−0.588*** (−2.05)	0.555
Doctoral training gave adequate information about career	−0.205 (−0.53)	0.815
Doctoral training satisfied students' diverse demands	−0.561(−1.70)	0.571
Doctoral training encouraged students' diverse options	−0.293 (−0.93)	0.746
Doctoral training prepared students well for AP	0.295 (0.90)	1.343
Doctoral training prepared students well for NAP	0.045 (0.14)	1.046
N	528	
Pseudo R2	0.1116	
LR chi2(18)	51.64	
Prob > chi2	0.0000	
Log likelihood	−205.52995	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$;Base group in brackets; Based on a subsample

explains the relationship between doctoral training and doctoral students' career expectations. Furthermore, doctoral students' evaluation of doctoral training was addressed in this investigation.

There are four main findings in this investigation. First, there is clear evidence to show that, when starting PhD studies, students are often clear about what they are supposed to do in the future. Based on the statistical results, we find that Chinese doctoral students have diverse career expectations, and more than half of the students expect to obtain a NAP. The majority of them expressed constancy for AP or for NAP over time. That is, by the time students engage in a PhD program, they may know what career they want to pursue after graduation. Thus, we can identify the doctoral students' employment choices in the future based on their employment expectations during the interested period. Our results support the argument made by Gemme and Gingras (2012) that the academic researchers' professional preferences may be shaped by their individual level of "taste for science" rather than by environmental constraints in their PhD program. For those students who have changed career expectations from AP to NAP, these changes may have resulted from individual factors, doctoral training factors, or labor market factors.

Second, doctoral education is characterized by both professional and specialized education. Specific conditions, environment, and the process of doctoral training have considerable

effects on employment expectations of doctoral students: University prestige has a significant influence on employment expectations of doctoral students. Doctoral students from universities with high prestige expect to have an AP, while those from universities with low prestige expect to have a NAP. This result can be explained in that students from universities with high prestige may exhibit higher academic performance than those from universities with low prestige. It also can be explained in the context of China's unique conditions and may be due to the problem of "discrimination by doctoral students' educational background" (Wang and Wang 2013, 37) in China's academic labor market. With the rapid expansion of doctoral education, increases in the supply of academic positions has not kept pace with the increases of doctoral graduates. Therefore, the academic labor market for doctoral graduates has altered from the original "seller's market" to a "buyer's market" (Wang and Wang 2013, 37). Moreover, because the PhD job market is imperfect, and with the problem of asymmetrical information, employers lack adequate ability to evaluate employees correctly (Wang and Wang 2013). Thus, employers evaluate and judge the overall quality and research capacity of employees in accordance with their level of educational background (Wang and Wang 2013). Most universities in China have rigid recruitment requirements for employees. Doctoral graduate candidates who apply for faculty jobs have to graduate from "985-project" or "211-project" universities. Due to this restriction, doctoral graduates from ordinary universities have to consider other employment sectors. That is, even students from ordinary universities who have higher academic performance than those from "985-project" or "211-project" universities have little or no chance to obtain an academic job in a specific university that discriminates on the basis of doctoral students' educational background. Because of the regular pattern of each discipline and labor market demands, students from different disciplines have different employment paths. Students in liberal arts and social sciences expressed constancy for AP more than those in engineering science.

Third, *guanxi* plays a significant role in doctoral students' career perceptions and goals for the future. A number of important articles have given us insight into the significant role of *guanxi* in personal development (Bian 1994, 1997). Although *guanxi* literally means "relationship" or "relation," its essence is a set of interpersonal connections that facilitate exchange of favors between people on a dyadic basis (Bian and Ang 1997; Hwang 1987). *Guanxi* is not merely a relationship but a tie through which parties exchange valued materials or favors (Bian and Ang 1997). Our regression analysis results indicate that during doctoral study good relationships with supervisors promoted students' expectations for AP. In China, historically, relations between masters and apprentices and between teachers and students were considered father-son and mother- daughter relations. These are not merely names people call each other. They set up a high moral standard that ties people together in a close relationship (Bian and Ang 1997). A positive relationship with supervisors means there is a strong social network or "bridge" for students to have close ties to academic resources to enable them to have extensive, in-depth understandings of faculty positions in targeted universities. Furthermore, supervisors can recommend their doctoral students to apply for a faculty position in specific university with which the supervisor has direct and indirect ties. Moreover, social networks for doctoral students or their supervisors with non-academic organizations such as businesses can strengthen the links between students and these organizations. Combined with *guanxi*, these links can increase students' confidence in maintaining their NAP expectations. Additionally, those students who were initially interested in academic careers but who became involved in high-intensity collaboration with non-academic organizations became attracted to NAP, and this increased the likelihood of their seeking employment outside of their academic field after graduation.

The fourth finding is that doctoral students expressed dissatisfaction with doctoral training's encouragement of and preparation for diverse career choices, especially NAP. Doctoral training focused on preparing the next generation of professors and ignored the diverse needs of students. This is a problem not only in China but also a global issue as well (Leshner 2015; Nerad 2004, 2009). For example, in the United States, the results of three comprehensive national PhD career path surveys showed that PhD holders questioned whether or not doctoral education prepared them adequately for the global environment and its diverse labor market (Nerad 2009). With the increased number of doctoral graduates and the decline in the number of faculty jobs in the academic labor market, not every doctoral student who wants to be faculty after graduation can realize this aspiration. As a result, there is a need to consider the reformation of existing and emerging doctoral programs in order to prepare doctoral students to meet the challenges of working both inside and outside academia within a context of globalization.

In the past two decades, the doctoral environment has changed, not only globally, but also in China. All available evidence worldwide proclaims that more than half of PhD graduates seek jobs in the non-academic marketplace, and thus there is a dual labor market for Ph.Ds. Doctoral graduates are faced with increasing demands to be mobile and adaptable in a competitive international marketplace (Lee and Danby 2012): their faculty supervisors want them to be professors in academia, while employers in the non-academic labor market are in need of human capital in the form of soft transferable and flexible skills. Yet, current doctoral education focuses on training academic successors rather than cultivating versatile and flexible experts. Given that doctoral education is under the spotlight and raises criticisms, stakeholders in doctoral education call for rethinking and reshaping doctoral education (Leshner 2015). Pressures to link doctoral education to the workplace and address social needs in China have created an altered climate for doctoral training, yet there is little response in China for reform. As universities struggle to accommodate new ways of structuring doctoral degrees and new ways of producing knowledge and cultivating students globally, there are indications that traditional structures, management processes, and doctoral training modes are under pressure to change.

There is considerable potential for change in China. There are suggestions that the emergence of a changing economic environment in China could provide opportunities for innovative practices for doctoral training in the design of new objectives, new curricula, new assessment methods, and new approaches to supervision (Chen 2010). Academic logic and market logic for doctoral training can be balanced, or co-exist, and even though doctoral training maintains its academic values, it can, to some extent, follow market demands. Therefore, to accomplish this, universities need to monitor the labor market and align doctoral training with market demands, including the quantities and qualities of doctoral graduates, as well as with social demands. Information about the labor market for doctoral students can be provided at the early stage of doctoral students' training, and career guidance can be supplied by supervisors, programs, and graduate schools throughout the students' learning process. Doctoral training can offer a broader range of career options to students, and allow students to gain a wider variety of knowledge and skills by increasing opportunities for students to collaborate with non-academic organizations and by training students in cross or multi-disciplinary ways, in order to be not only the reproduction of "academic successors" but also the cultivation of "versatile experts."

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