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The multifaceted influence of multidisciplinary background on placement and academic progression of faculty

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This study delves into the implications of faculty's multidisciplinary educational backgrounds on their academic placement and upward mobility, and underscores the moderating effects of gender and academic inbreeding. Grounded in the theories of knowledge recombination and limited attention, the study finds that having a multidisciplinary background tends to challenge favorable academic placements and upward mobility. However, it also shows that male faculty and those who have graduated from the same institution where they work (academic inbreeding) are better at overcoming these challenges. Additionally, elite universities seem to have a higher regard for multidisciplinary backgrounds. This study provides insights for individuals navigating academic careers and offers valuable information for university leaders and policymakers.

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Introduction

In academia, addressing complex problems and fostering creative competencies often involves conducting scientific investigations from various disciplinary perspectives (Körner, 2010). Universities play a vital role in nurturing creative individuals through multidisciplinary education (James Jacob, 2015). In the rapidly evolving field of artificial intelligence, exemplified by advancements like ChatGPT (Dwivedi et al., 2023; Odugbesan et al., 2023), scholars increasingly need the capacity for holistic academic collaboration and a multidisciplinary outlook to effectively navigate this landscape.

The foundational discipline definitions provided by Biglan's classification scheme serve as a basis for interdisciplinary and multidisciplinary studies (Simpson, 2017). Multidisciplinary education based on this scheme is an essential means for integrating knowledge and addressing complex problems (James Jacob, 2015). With knowledge recombination and limited attention perspective (Arts and Fleming, 2018; Xiao et al., 2022), faculty with a multidisciplinary education background exhibit proficiency across diverse disciplinary domains, boasting a rich and varied knowledge reservoir, thereby fostering an environment conducive to innovation. Therefore, multidisciplinary graduates are more likely to secure academic positions than non-multidisciplinary graduates (Morgan et al., 2022), although their depth of knowledge and competence in a single discipline may be questioned when applying for academic positions in academic institutions (Haider et al., 2018). While breadth of knowledge is undeniably valuable, there exists a concomitant risk of attenuating depth within specific disciplines (Arts and Fleming, 2018). Furthermore, elite universities are more inclined than ordinary universities to engage in high-level interdisciplinary research and offer positions, as suggested (Leahey et al., 2019; Li and Yin, 2023). This could be advantageous for scholars with multidisciplinary backgrounds in terms of placement opportunities. But there is currently no consensus on the influence of a multidisciplinary background on the academic career development of faculty, given the mixed results across the literature and the lack of empirical evidence. Thus, this study employs a Curriculum Vitae (CV) analytical approach to explore the academic career placement of faculty with multidisciplinary backgrounds.

This study makes several significant contributions by conducting a detailed analysis of the multifaceted impact of faculty's multidisciplinary education backgrounds on their academic careers. Firstly, it focuses on the influence of multidisciplinary education on faculty's academic placement and progression, extending the application scenario of Biglan's classification. Secondly, it resolves the dispute between knowledge recombination theory and limited attention theory regarding their contradictory predictions on multidisciplinarity by applying refined empirical evidence, differentiating elite universities with less prestigious universities. Thirdly, it explains the moderating effect of gender and academic inbreeding on faculty with multidisciplinary education backgrounds.

The following portion of this study, named "Theoretical background and literature review", goes into relevant literature, expounding on the theories that underpin the study's findings. The "Data and methodology" section that follows describes the dataset, variables, and research methodology used in this analysis. Following that, the "Results" section explains the statistical analysis and their associated findings. A full discussion is proposed based on these findings. In the final section, "Conclusion, limitations, and future research" concludes with a synthesis of its findings. Furthermore, this section highlights the study's limitations and suggests potential paths for future research.

Theoretical background and literature review

Biglan's classification of academic disciplines. Academic disciplines serve as pivotal matrices for the consolidation and dissemination of knowledge, thereby playing an indispensable role in the intellectual development of a society (Zahra and Newey, 2009). A classification model aimed at arranging these disciplines into discernible clusters, postulated by Biglan in 1973, has since been widely acknowledged and adopted as perhaps the most salient tool for delineating disciplines within the realm of higher education (Biglan, 1973). Biglan's categorization elucidates disciplines across three principal axes: firstly, the dichotomy of "hard" versus "soft"; secondly, the juxtaposition of "pure" against "applied"; and thirdly, the distinction between disciplines pivoted towards biological entities—commonly referred to as "life disciplines"—and those that revolve around abstract or non-biological paradigms, termed "nonlife disciplines" (Simpson, 2017; Stoecker, 1993).

A plethora of empirical investigations have rigorously assessed the veracity and utility of Biglan's classification, cementing its position as a mainstay in academic discourse. The observed wage disparities across the pure/applied, hard/soft, and life/nonlife spectrums serve as robust testimonials to the validity of Biglan's categorization (Muffo and Langston, 1981). Such a compendium of research has corroborated the model's malleability and versatility. Pioneering efforts by scholars like Smart and Elton (Smart and Elton, 1982) and Stoecker (Stoecker, 1993) employed discriminant function analysis to probe into Biglan's classification, facilitating the incorporation of emergent academic fields. Adrian Simpson (Simpson, 2017) elucidated the alignment of Biglan's framework underscoring the enduring significance of academic disciplines in shaping the educational topography. The widespread use of Biglan's disciplines classification scheme attests to its importance (Lindblom-Ylanne et al., 2011). Extensive researches utilizing Biglan's classification have been conducted on academic territories, knowledge combinations, students' academic performance and learning styles and so on (Chan et al., 2022; Dwivedi et al., 2023; Mcdossi, 2022). The research of multidisciplinary and interdisciplinary are conducted widely based on Biglan's classification. Academics and universities have been well aware of the benefits of them. To handle complex situations and improve individual's employment competitiveness, students be encouraged to choose and participate in multidisciplinary or interdisciplinary education.

In some research, the terms "multidisciplinary" and "interdisciplinary" are often used interchangeably (Wiggins and Sawyer, 2012). A multidisciplinary approach respects and maintains the distinctiveness of each discipline, it just juxtaposes disciplines (Frodeman, 2010). Some scholars have referred to multidisciplinarity as a variant of "incipient interdisciplinarity" or even "quasi-interdisciplinarity" which implies an engagement with multiple disciplines sans profound integration (Feng et al., 2023). While multidisciplinary education engages in the pedagogical exploration of various disciplines in silos or different study stages, each retaining its integrity without extensive intermingling of knowledge or methods, interdisciplinary education leans on depth achieved through the synthesis of multiple disciplines to attain a holistic comprehension (Holley, 2009). Although there is a conceptual discrepancy between the two, in educational practice, so-called "interdisciplinary" curricula or education carried out by universities or institutions are actually a multidisciplinary assemblage of disciplinary courses, including programs of general education and interdisciplinary fields that ask students to take a selection of department-based courses (Frodeman, 2010). If someone has attained interdisciplinary education, he or she has received a multidisciplinary education in fact, whether through learning from multiple disciplinary courses or transitioning between disciplinary fields at different stages of their studies. As thus, in this study, the multidisciplinary

educational background in higher education could be expressed in two situations: one is participating in courses covering multiple disciplines, and the other is transitioning between disciplinary fields at the undergraduate, graduate, or postgraduate stage.

Based on Biglan's disciplines classification, multidisciplinary education is considered to acquire powerful knowledge and enhance learning skills (Hudson et al., 2023; Marbach-Ad et al., 2019), enabling students to achieve higher academic achievement but may feel challenged (O'Donovan, 2019). The influence of a multidisciplinary education background on post-graduation outcomes and career placement have also received attention (Tseng et al., 2023). In conclusion, According to Biglan's classification, multidisciplinary education enables individual access more diverse knowledge and improves their ability to deal complex problems or situations. Further, individual who has multidisciplinary education background will perform better in the job market. Biglan's classification is one of the best-known and most widely used classifications of academic disciplines or fields of study (Paulsen and Wells, 1998; Simpson, 2017). It has been widely used in many research fields and education (Staupe-Delgado et al., 2022). But it is noted that the two dimensions of Biglan's classification (i.e., life/non-life) are less considered and applied by scholars (Rosman et al., 2020). In recent years, with the expanding utilization of Biglan's classification, current literature has advocated for its comprehensive application to yield more fruitful insights(Lim and Richardson, 2022; Zadravec and Kočar, 2023). In response to this call within the literature, this study adopts Biglan's classification as a standard for disciplinary categorization and designs a multidisciplinary education background based on its principles.

Knowledge recombination and the merit of multidisciplinary education. From the lens of the knowledge recombination paradigm, innovation emerges from the fusion of disparate knowledge units, each rooted in foundational scientific or technical paradigms (Xiao et al., 2022). Due to the boundaries and closed nature of knowledge in different external domains, and the emergence of key new ideas and information in the field poses challenges to enterprises and institutions (Ehls et al., 2020). Openness to external knowledge has gained popularity as a means for firms and institutions to complement and leverage internal knowledge in the pursuit of innovation outcomes (Wang et al., 2020). Solving complex problems requires knowledge and information from multiple disciplines, and it is difficult to rely on a single discipline or knowledge domain for solutions (Kurtzberg, 2005; Nandan and London, 2013; Wang et al., 2020). In science, integrating perspectives, theories, information, and tools from two or more disciplines or fields are manifested as multidisciplinarity (Frodeman, 2010), which will address complex problems by combining knowledge from different disciplinary fields (Petersen et al., 2021; Xiao et al., 2022). In addition, multidisciplinary teams or individuals with knowledge in multiple disciplines are regarded as possess creative competencies, enabling for rich combinations of otherwise disconnected pools of ideas, including more radical ideas and solutions adjusted to complex problems (Hero and Lindfors, 2019; Kearney and Gebert, 2009). Forming multidisciplinary research teams with professionals from diverse disciplinary backgrounds can effectively address scientific and societal problems (Fontana et al., 2022; Nagle and Teodoridis, 2020).

Thus, engaging in multidisciplinary education to cultivate individuals with knowledge in multiple disciplines becomes an alternative means for recombining knowledge and addressing complex problems, especially in higher education (James Jacob, 2015). Diversified researchers have a more pronounced ability to explore new knowledge domains (Nagle and Teodoridis, 2020). Those possessing a vast intellectual reservoir, garnered from multiple disciplines, inevitably cultivate a more adaptable cognitive framework. This diverse foundation capacitates individuals to adeptly synthesize multifaceted knowledge, leading to the genesis of novel and inventive outcomes (Arts and Fleming, 2018). Individuals who have received multidisciplinary education are considered to have a multidisciplinary education background (Frodeman, 2010). Not only for the benefits in multidisciplinary approaches but also with the consideration of promoting students' employment, interdisciplinary courses and majors are implemented (Costa et al., 2019; Huang et al., 2020a, 2020b). Graduates with a multidisciplinary background are more competitive in the job market and it is certain that the benefits of a multidisciplinary background become more evident over time (Tseng et al., 2023). Notably, some academics have begun to focus on interdisciplinary education's influence on academic career and placement (Holley, 2018).

The research of academic career has received scholars' amount of attention and is becoming mature. The career development of doctoral students and scholars, as well as various factors influencing academic careers such as academic productivity, have been under spotlight (Long et al., 1998; Ryazanova and Jaskiene, 2022). In particular, the influence of multidisciplinary education on the academic career of faculty is pointed out (Holley, 2018; Tseng et al., 2023). Academic placement is one of the important aspects of academic career, which is closely related to faculty hiring and employment (Zheng et al., 2022; Zhu and Yan, 2017). The initial placement of doctoral students will be influenced by the learning experience during the doctoral stage and the research networks at the time of the appointment (Kaslow et al., 2018; Yang et al., 2022). For university faculty, scholars have found through surveys that interdisciplinary graduates are more likely to secure academic positions than non-interdisciplinary graduates (Millar, 2013). The level of academic placement can be expressed by the prestige of the universities where the faculty employed, and universities' prestige is associated with formal university rankings such as the U.S. News and World Report Best Global Universities Rankings or the Times Higher Education Ranking (Cowan and Rossello, 2018). Scholars divide the universities into different ranking levels to evaluate faculty post-doctoral academic placement (Smeets et al., 2006). However, in the aspect of multidisciplinary education, there is still a lack of statistical empirical evidence for the academic placement of faculty, although it has been paid attention to (Holley, 2018).

The current literature focuses on the benefits of multidisciplinary education and acknowledges its influence on the academic careers of doctoral students and faculty. And it is important to note that elite universities place more emphasis on funding support, research center construction, and faculty positions for multidisciplinary and interdisciplinary initiatives (Leahey et al., 2019). They are more willing to engage in high-level interdisciplinary research (Li and Yin, 2023), which could benefit the employment opportunities for faculty with multidisciplinary backgrounds. The elite universities have explicitly prioritized the recruitment of faculty with multidisciplinary backgrounds in recent years. Both MIT and Stanford have specifically stated in their recruiting criteria that they favor candidates with a multidisciplinary background for the 2023 recruitment drive[1]. But little is known about the academic placement situation of individuals with a multidisciplinary education background, as there is still a lack of statistical empirical evidence within literature (Holley, 2018).

Limited attention and the curse of multidisciplinary education. In contrast to the benefits of multidisciplinary education and its

positive impact on academic placement, it is imperative to acknowledge that attention is a finite and valuable resource, and any allocation of attention comes with associated opportunity costs (Hirshleifer and Teoh, 2003). The issue of limited attention in managing vast amounts of information and knowledge can lead to decision biases in both individuals and organizations, often stemming from constraints in attention and processing capacity (Choi and Choi, 2019). Individuals' attention is frequently susceptible to external influences such as media, and they may be easily distracted or misled (Weng et al., 2012).

Compared to the advantages of multidisciplinary education rooted in knowledge recombination theory, a more prevalent concern is that individuals who secure faculty positions may encounter various barriers (Boden et al., 2011). The multidisciplinary foundation capacitates individuals to adeptly synthesize multifaceted knowledge, leading to the genesis of novel and inventive outcomes (Arts and Fleming, 2018). Therefore, researchers should possess both knowledge depth (i.e., understanding of a specific field) and knowledge breadth (i.e., extent of knowledge across multiple fields) (Mannucci and Yong, 2018). Knowledge depth enhances an individual's expertise in a specific field, but it is important to note that it may result in a loss of flexibility in terms of problem-solving, adaptation, and creative idea generation (Dane, 2010). However, blindly pursuing knowledge breadth to enhance the flexibility of knowledge structure may be susceptible to the impact of limited attention, leading to a reduction in knowledge depth and a decline in specialization. It is evident that we simply cannot process and respond to all the information and knowledge in the environment that may be relevant to our tasks (Scalf et al., 2013). Graduates with a multidisciplinary background express a lack of disciplinary belonging and encounter challenges (Balaban, 2018; O'Donovan, 2019). The flexibility between disciplinary knowledge and limited personal attention may lead to questions about the knowledge depth and capacity in a single discipline when applying for academic positions in academic institutions (Dane, 2010; Haider et al., 2018). While breadth of knowledge is undeniably valuable, there exists a concomitant risk of attenuating depth within specific disciplines (Arts and Fleming, 2018).

The theories of knowledge recombination and limited attention present conflicting perspectives on the role of multidisciplinary education in academic placement. While some studies have found that interdisciplinary graduates are more likely to secure academic positions (Millar, 2013), others argue that the limited attention allocation may disadvantage students and faculty with multidisciplinary education backgrounds in academic placement (Dane, 2010; K. A. Holley, 2018). As empirical evidence on the academic placement of individuals with multidisciplinary education backgrounds is lacking, this study seeks to address this dilemma by exploring two key questions: Firstly, how does a faculty member's multidisciplinary background influence their academic placement? Secondly, does such a background contribute to an upward trajectory in their academic career?

The moderating effect of gender and academic inbreeding. The relationship between a faculty's multidisciplinary education background and their academic placement can be influenced by various confounding factors, some of which may simultaneously affect both multidisciplinarity and placement outcomes. Previous studies have suggested that several other variables can influence individual academic placements, including academic titles, international mobility status (Ryazanova and McNamara, 2019), academic productivity (Fontana et al., 2020; Rosman et al., 2020), faculty's H-index (Fontana et al., 2022), and various other factors. These elements collectively contribute to the intricate landscape of academic placement.

In particular, the roles of gender and academic inbreeding in this context deserve examination, as they intersect with multidisciplinarity in complex ways. Gender disparity remains palpable within the scientific workforce, with females often encountering professional barriers (Chubb and Derrick, 2020; Huang et al., 2020a, 2020b). The academic world has been a subject of discourse regarding the proverbial "glass ceiling" that female academicians face. The dynamics of these interactions, especially when intertwined with multidisciplinarity, have been relatively underexplored.

Research has shown that women tend to be in a relatively disadvantaged position both in terms of academic publications and in the workplace compared to their male counterparts (Chubb and Derrick, 2020; Huang et al., 2020a, 2020b). Interestingly, studies have found that female scientists are more inclined to transcend disciplinary boundaries than their male peers (Rhoten and Pfirman, 2007). While there is limited literature examining whether the academic success of individuals with a multidisciplinary background differs between males and females, it is plausible to assume that gender can indeed influence both multidisciplinary education backgrounds and individual placements, given the existing gender bias in academia (Lundine et al., 2019).

Additionally, academic inbreeding, which refers to the practice of institutions hiring their own graduates, can have adverse effects on multidisciplinary studies. Academic inbreeding has been shown to inhibit the influx of new and fresh ideas (Horta, 2022; Mazzoleni et al., 2021). Studies suggest that faculty engaged in academic inbreeding tend to maintain research subjects throughout their careers, potentially increasing the risks associated with multidisciplinarity and weakening creativity among faculty (Morichika and Shibayama, 2015). However, despite these risks, the practice of universities hiring their own graduates still persists (Altbach et al., 2015). This practice can circumvent concerns about the depth of knowledge and research flexibility for faculty members with multidisciplinary backgrounds. Consequently, academic inbreeding is likely to exert an influence on both faculty members' choices regarding multidisciplinarity and their academic placements.

Taken together, we specifically explore the moderating effect of gender and academic inbreeding on the relationship between multidisciplinary background and academic placement and progression in this study.

Data and methodology

Data procurement and assimilation. This study employed a Curriculum Vitae (CV) analytical methodology. Our data collection process began with a systematic web scraping operation, aimed at extracting faculty CVs from the official portals of universities worldwide. The gathered data was then carefully curated and converted into a format suitable for sophisticated statistical analyses.

For the foundational framework of our data collection, we referred to the 2022 U.S. News World University Rankings[2]. This involved a comprehensive evaluation of the top 1,000 universities as ranked in this list. Employing a stratified sampling method, our selection included 183 universities, ensuring a representative cross-section that spans a broad spectrum of ranking categories. We operationalized faculty rankings—encompassing undergraduate, graduate, and placement levels—using the 2022 U.S. News World University Rankings as our standard metric.

Our extensive, cross-national data gathering encompassed six key countries: the United States, Canada, the United Kingdom, Australia, New Zealand, and Singapore. This broad scope encompassed faculty members with doctoral degrees awarded

Table 1 Disciplines of the Biglan's classification.

Task area	Hard		Soft	
	Nonlife system	Life system	Nonlife system	Life system
Pure	Astronomy, Chemistry, Geology, Math, Physics, Other Natural Sciences, etc.	Botany, Entomology, Microbiology, Physiology, Zoology, etc.	English, German, History, Philosophy, Russian, Communications, Other language and cultural disciplines, etc.	Anthropology, Political science, Psychology, Sociology Social sciences related to human beings and society, etc.
Applied	Ceramic engineering, Civil engineering, Computer science, Mechanical engineering, Other Engineering, etc.	Agronomy, Dairy science, Horticulture, Agricultural economics, etc.	Accounting, Finance, Economics, Business and Commerce, etc.	Educational administration and supervision, Secondary and continuing education, Special education, Vocational and technical education, Law, Public Administration, etc.

from 1973 to 2022. This meticulous process resulted in the compilation of ~500,000 faculty CVs. These CVs provided crucial data points such as gender, academic titles, and disciplinary affiliations, in addition to yielding valuable insights into their academic and professional journeys.

To enhance the robustness and comprehensiveness of our dataset, we incorporated publication metrics, extracting publication counts, citations, and H-index of faculty members up to March 2023 from the Scopus database. This integration provided a comprehensive view of each faculty member's academic productivity.

For the purpose of this study, we systematically categorized the faculty's educational background and disciplinary focuses. Following Biglan's classification framework, we divided disciplines into eight distinct categories, based on three critical dimensions: hard/soft, pure/applied, and life/nonlife. A detailed breakdown of these categories is presented in Table 1.

Variables

Dependent variable. In alignment with the existing literature (Cowan and Rossello, 2018; Yang et al., 2022), the study's dependent variables encompass "Placement of University Faculty", "Upward Success in Placement Compared to Undergraduate", and "Upward Success in Placement Compared to Graduate".

"Placement of University Faculty" is defined by the faculty's current institutional affiliation as ranked in the 2022 U.S. News World University Ranking. This ranking is utilized as a concrete indicator of the faculty's academic standing and accomplishments.

"Upward Success in Placement Compared to Undergraduate" and "Upward Success in Placement Compared to Graduate" are conceptualized as binary indicators. A value of 1 indicates that the faculty's current institutional ranking exceeds that of their undergraduate or graduate institutions, respectively. In contrast, a value of 0 indicates no advancement or a decline in their placement relative to their previous institutions. It is important to note that the terms "graduate stage" or "graduate university" refer specifically to master's and doctoral levels of education. In cases where faculty proceeded directly to doctoral studies, the data from these doctoral engagements were prioritized.

To control for the impact of outliers, a truncation approach was applied to the variables related to university rankings, trimming data points beyond the 5th and 95th percentiles. This method was employed to ensure a more representative dataset and to refine the precision of the analysis.

Independent variable. The essence of this research is the examination of the consequences of faculty's multidisciplinary backgrounds. Employing Biglan's framework, faculty disciplines were classified at three academic stages: undergraduate, graduate, and placement. A disciplinary shift between any of these stages was considered indicative of a multidisciplinary background.

This multidisciplinary background was further dissected into three components: "Multidisciplinary Frequency", "Temporal Multidisciplinary Shifts", and "Nature of Multidisciplinary Transition", each reflecting aspects of faculty multidisciplinarity.

"Multidisciplinary Frequency" measures the number of times a faculty member changes disciplines throughout their academic journey, ranging from 0 (no change) to 2 (two changes).

"Temporal Multidisciplinary Shifts" assesses the timing of these disciplinary transitions, categorized as: 0 for no transition, 1 for a transition between undergraduate and graduate stages, 2 for a shift from graduate to placement, and 3 for transitions occurring at both stages.

Lastly, "Nature of Multidisciplinary Transition" delineates the type of disciplinary transition, such as a shift from a nonlife discipline (e.g., computer science) to a life discipline (e.g., biology). This led to the identification of six distinct transition types, each encoded as a binary variable to denote the presence or absence of a specific transition type.

Moderating variables. Gender: This variable is represented as a binary indicator, where a value of 1 denotes male faculty, and 0 indicates female faculty.

Academic Inbreeding: This binary variable distinguishes between faculty who have secured their placement within their alma mater (either graduate or undergraduate institutions) and those who have ventured to external institutions. A value of 1 is assigned to inbred faculty, while a 0 signifies external placement (Kwiek and Roszka, 2022).

Control variables. To bolster the rigor of our analyses, several control variables were incorporated:

Faculty's Academic Titles: This ordinal variable reflects academic seniority, classified into four levels. The categorization ranges from full professors (0), to associate professors (1), assistant professors/lecturers (2), and postdoctoral/other academic personnel (3), providing a hierarchical representation of academic positions (Sherman and Tookes, 2022).

International Mobility: Encoded as a binary variable, this factor accounts for the faculty's international academic exposure. A

value of 1 indicates international mobility, while 0 represents solely domestic academic experiences (Ryazanova and McNamara, 2019).

Academic Productivity: In line with extant literature (Liang et al., 2022; Waltman, 2016), academic productivity was measured using two indices: total publications and publication quality (total citations). Total publications quantify the aggregate number of scholarly articles published by a faculty member within a specific timeframe, whereas publication quality evaluates citations received by these publications. Both indices were sourced from the Scopus database up to March 2023.

Academic Influence: Drawing from established metrics (Fontana et al., 2022; Hirsch, 2005), the H-index was utilized as an author-level metric to assess the cumulative academic influence of individual researchers. The H-index data for each faculty member was also extracted from the Scopus database until March 2023.

In our primary estimations, along with the aforementioned control variables, gender and academic inbreeding were also accounted for to ensure robust estimations. Moreover, fixed effects pertaining to the faculty's current geographic location and the year of their doctoral graduation were incorporated. This was done to ensure the robustness of our estimations and to control for time-invariant geographical variations and time-variant academic age-related differences (Kwiek and Roszka, 2022). This approach allows for a more granular analysis by considering regional and temporal variations.

Analytical approach. In addressing the fundamental research inquiries concerning the implications of faculty members' multidisciplinary backgrounds on their academic progressions, we deployed a comprehensive analytical framework.

To commence, we employed Ordinary Least Squares (OLS) regressions to gauge the impact of multidisciplinary backgrounds on faculty placement. This initial inquiry was further complemented by specific subgroup OLS regressions, which meticulously examined the effect of multidisciplinary background on the different phases of faculty members' educational journeys, encompassing their undergraduate, graduate, and placement stages. These academic institutions' rankings were subsequently stratified into distinct categories, following the classifications of previous studies (Leahey et al., 2019; Smeets et al., 2006), including the top 50, 51–100, 101–200, 201–300, 301–500, and 501 onwards.

To attain a more nuanced comprehension of the phenomenon, we integrated Quartile Regression techniques, providing elucidation on how multidisciplinary backgrounds exerted influence across diverse strata of university ranking tiers. Subsequently, we embarked on an exploration of the potential moderating effects of gender and academic inbreeding on the complex nexus between multidisciplinary backgrounds and faculty placements. The investigative journey culminated with a granular examination of the intricacies surrounding the timing and the specific nature of disciplinary transitions.

Transitioning to our second core inquiry—namely, whether a multidisciplinary background facilitates upward mobility in faculty academic progression—we embarked on a phased analytical expedition. Logit regressions formed the cornerstone of this phase, systematically evaluating the correlations between multidisciplinary backgrounds and the trajectories of upward academic progression. This analysis was further fortified by subgroup logit analyses, which delved into the dynamics of rank-centric changes across the undergraduate, graduate, and placement phases of faculty members' academic careers. Subsequent layers of analysis delved into the moderating roles played by gender and academic inbreeding within this context. The analytical suite concluded with a meticulous exploration of how both the timing and the nature of multidisciplinary transitions intersected with faculty members' prospects for upward mobility.

Results

Descriptive analysis and correlation. Table 2 delineates descriptive nuances in detail. Within the examined sample, an intriguing revelation is that 39.06% of faculty have navigated through a multidisciplinary trajectory. Dissecting this further, 28.71% transitioned disciplines once, while a more selective 10.36% did so twice. Among all of the faculty, 14.92% experienced a disciplinary shift during their transition from undergraduate to graduate studies, 13.79% encountered a similar transition during the shift from the graduate stage to their current placement, and 10.36% underwent disciplinary transitions at both stages[3].

Table 3 outlines the correlations between various studied variables. There is a modestly positive correlation ($r = 0.045$) observed between multidisciplinarity and faculty placement rankings, indicating a relationship between diverse academic backgrounds and higher institutional affiliations. However, there appears to be no significant correlation between the frequency of disciplinary transitions and upward mobility from undergraduate levels. In contrast, a slightly negative correlation ($r = -0.061$) is noted between the frequency of disciplinary changes and upward mobility from graduate institutions.

Figure 1 graphically depicts the relationship between the rankings of undergraduate, doctoral, and placement universities for the faculty. It shows that faculty members, on average, originated from undergraduate institutions ranked at 240 and completed their doctoral studies at institutions ranked at 198. Interestingly, their eventual placement was predominantly in universities with an average rank of 259. This observation underscores a tendency for faculty placements to marginally fall below the rankings of both their undergraduate and doctoral institutions.

Multidisciplinary background and placement

Baseline estimations. Our initial analytical endeavor aims to discern the potential influence of multidisciplinarity on faculty placements. Recognizing that multidisciplinarity spans from 0 to 2 disciplinary transitions, we operationalized it as a categorical entity in foundational regressions to assess any variability when conceptualized continuously. The results of these OLS regressions are elucidated in Table 4.

Models (1) and (2) scrutinize multidisciplinary frequency as a continuous construct concerning faculty placement. Following the integration of auxiliary variables and fixed effects in models (2) and (4), a discernible elevation in the multidisciplinary coefficient is observed, increasing from 26.904 to 29.260, signifying statistical significance at the 0.01 threshold. When portrayed categorically in Models (3) and (4), multidisciplinary frequency maintains a similar statistical stature. Notably, experiencing two disciplinary transitions registers more substantial coefficients ($\beta = 67.253$; $\beta = 69.228$) relative to a solitary transition ($\beta = 12.463$; $\beta = 17.081$). It is crucial to highlight that due to the reverse scale of university rankings, a positive coefficient implies an inverse influence on the ranking outcome, indicating that multidisciplinary background relates to less prestigious placement, while the more frequent of disciplinary transitions, the more severe the inhibitive effect on current placement.

Further analyses. In our subsequent analytical phase, we segmented the faculty sample based on the respective undergraduate, graduate, and placement university rankings. Table 5 presents the

Table 2 Descriptive statistics.

Variables	Observations	Percentage	Mean	Standard deviation	Minimum	Maximum
Independent variables						
Multidisciplinary Frequency	84,910		0.494	0.676	0	2
0 = No Transitions in Discipline	51,740	60.94				
1 = Transitioned Discipline Once	24,376	28.71				
2 = Transitioned Discipline Twice	8794	10.36				
Temporal Multidisciplinary Shifts	84,910		0.600	1.024	0	3
0 = No transition in discipline	51,740	60.94				
1 = the undergraduate to graduate stage	12,667	14.92				
2 = the graduate to placement stage	11,709	13.79				
3 = Transitioned in both stages	8794	10.36				
Nature of Multidisciplinary Transition (the Undergraduate to Graduate Stage)						
Hard-Soft	84,910		0.0358	0.186	0	1
0 = No	81,867	96.42				
1 = Yes	3043	3.58				
Pure-Applied	84,910		0.101	0.302	0	1
0 = No	76,323	89.89				
1 = Yes	8587	10.11				
Nonlife-Life	84,910		0.0822	0.275	0	1
0 = No	77,928	91.78				
1 = Yes	6982	8.22				
Soft-Hard	84,910		0.0400	0.196	0	1
0 = No	81,516	96.00				
1 = Yes	3394	4.00				
Applied-Pure	84,910		0.0359	0.186	0	1
0 = No	81,862	96.41				
1 = Yes	3048	3.59				
Life-Nonlife	84,910		0.0260	0.159	0	1
0 = No	82,702	97.40				
1 = Yes	2208	2.60				
Nature of Multidisciplinary Transition (the Graduate to Placement Stage)						
Hard-Soft	84,910		0.0677	0.251	0	1
0 = No	79,165	93.23				
1 = Yes	5745	6.77				
Pure-Applied	84,910		0.169	0.375	0	1
0 = No	70,547	83.08				
1 = Yes	14,363	16.92				
Nonlife-Life	84,910		0.158	0.365	0	1
0 = No	71,493	84.20				
1 = Yes	13,417	15.80				
Soft-Hard	84,910		0.0752	0.264	0	1
0 = No	78,523	92.48				
1 = Yes	6387	7.52				
Applied-Pure	84,910		0.0665	0.249	0	1
0 = No	79,266	93.35				
1 = Yes	5644	6.65				
Life-Nonlife	84,910		0.0499	0.218	0	1
Dependent Variables						
Placement of University Faculty	84,910		259.5	276.9	1	989
Upward Mobility in Placement Compared to Undergraduate	40,348		0.410	0.492	0	1
0 = No	23,810	59.01				
1 = Yes	16,538	40.99				
Upward Mobility in Placement Compared to Graduate	67,987		0.350	0.477	0	1
0 = No	44,213	65.03				
1 = Yes	23,774	34.97				
Control Variables						
Gender	60,430		0.599	0.490	0	1
0 = Female	24,205	40.05				
1 = Male	36,225	59.95				
Title	84,910		2.300	1.159	1	4
0 = Full professors	31,276	36.83				
1 = Associate professors	13,718	16.16				
2 = Assistant professors and lecturers	23,064	27.16				
3 = Postdoctoral and other personnel	16,852	19.85				
Academic Inbreeding	84,910		0.228	0.419	0	1
0 = No	65,575	77.23				
1 = Yes	19,335	22.77				

Table 2 (continued)

Variables	Observations	Percentage	Mean	Standard deviation	Minimum	Maximum
Country	84,910		5.943	11.79	1	50
United States	65,884	77.59				
Canada	2561	3.02				
Australia	4198	4.94				
New Zealand	2302	2.71				
United Kingdom	9535	11.23				
Singapore	430	0.51				
International Mobility	84,910		0.251	0.434	0	1
0 = No	63,561	74.86				
1 = Yes	21,349	25.14				
Academic Productivity						
Total publications	84,910		30.87	44.57	0	212
Total citations	52,051		1071	1143	4	7,108
Academic Influence	52,051		12.44	6.521	1	35

Table 3 Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Placement of University Faculty											
(2) Upward Mobility Success Compared to Undergraduate	−0.455***										
(3) Upward Mobility Success Compared to Graduate	−0.462***	0.419***									
(4) Multidisciplinary Frequency	0.045***	−0.013	−0.061***								
(5) Temporal Multidisciplinary Shifts	−0.039***	0.021**	0.012	0.022**							
(6) Title	−0.041***	−0.020**	−0.043***	0.003	0.009						
(7) Gender	−0.024***	0.021**	0.023***	−0.033***	−0.001	0.059***					
(8) Academic Inbreeding	−0.044***	−0.172***	−0.265***	0.023***	−0.017**	−0.022**	−0.041***				
(9) Total publications	0.024***	−0.029***	−0.002	0.003	0.006	0.012	−0.003	−0.033***			
(10) Academic Influence	−0.028***	0.030***	0.015*	0.029***	−0.003	0.042***	0.026***	−0.012	0.003		
(11) Total citations	−0.042***	0.027***	0.017**	0.025***	−0.003	0.035***	0.013	−0.001	0.002	0.826***	
(12) International Mobility	0.099***	0.112***	−0.005	0.028***	−0.013	−0.018**	0.014*	−0.133***	0.009	0.017**	0.004

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

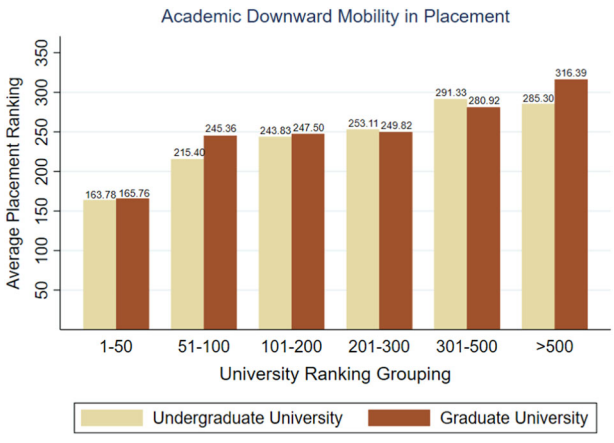

Fig. 1 The average placement ranking corresponding to graduate university ranking grouping. The yellow bars refer to the average undergraduate university ranking of university faculty, while the brown bars indicate the average graduate university ranking of university faculty. The horizontal axis represents the ranking group of the placement of university faculty. The vertical axis indicates the average university ranking.

outcomes of these stratified regressions, with all models incorporating relevant control variables and fixed effects.

Models (1)–(6) are dedicated to the subset of undergraduate university rankings. A recurrent theme that emerges across these models is the adverse impact of a multidisciplinary background on faculty members' academic placements. This detrimental trend is particularly pronounced for faculty members who completed their undergraduate education at institutions of lesser prestige, specifically for universities ranked between 301–500 ($\beta = 25.980$, $p < 0.001$), as illustrated in Model (5). The impact is even more significant for universities ranked below the 500th position ($\beta = 59.879$, $p < 0.001$), as depicted in Model (6).

The subsequent set of models, Models (7)–(12), corroborate the earlier findings. They suggest that multidisciplinarity appears to have a detrimental effect on achieving top-tier faculty placements, with statistical significance observed at the 0.01 threshold. Moreover, the adverse effect is amplified for faculty members whose graduate universities are ranked below 300.

Shifting our focus to Models (13)–(18), which are contingent on faculty members' placement university rankings, the effect of multidisciplinarity manifests with greater complexity. A consistent pattern with the earlier results emerges; multidisciplinary backgrounds appear to hinder academic placements, particularly

Table 4 Baseline estimations: multidisciplinary and the placement of university faculty.

Variables	Placement Ranking			
	(1)	(2)	(3)	(4)
Multidisciplinary Frequency	26.904***	29.260***		
	(1.45)	(2.28)		
Multidisciplinary Frequency				
Transitioned Disciplines Once			12.463***	17.081***
			(2.13)	(3.32)
Transitioned Disciplines Twice			67.253***	69.228***
			(3.36)	(5.35)
Gender		9.675***		9.736***
		(2.97)		(2.97)
Academic Inbreeding		−34.591***		−34.406***
		(3.50)		(3.50)
Academic Productivity				
Total Publications		0.085***		0.083**
		(0.03)		(0.03)
Total Citations		−0.015***		−0.015***
		(0.00)		(0.00)
Academic Influence		0.647		0.659
		(0.47)		(0.47)
International Mobility		−0.137		−0.445
		(3.61)		(3.61)
Constant	246.162***	214.503***	248.915***	216.560***
	(1.17)	(5.01)	(1.20)	(5.01)
Observations	84,910	32,215	84,910	32,215
Adjusted R-squared	0.004	0.132	0.005	0.133
Title FE	No	Yes	No	Yes
Country FE	No	Yes	No	Yes
Year of Ph.D. Graduation FE	No	Yes	No	Yes

OLS regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

for universities ranked below the 200th position. However, for elite universities, a different narrative unfolds. Multidisciplinary backgrounds are associated with improved placements, as indicated in Models (13) to (15), especially for global top 50 universities and institutions ranking between 101 and 200. In these cases, multidisciplinarity can be considered a distinct advantage in the placement process.

To further dissect the nuanced influence of multidisciplinarity across diverse university rank strata, we employed quantile regression techniques. Figure 2 crystallizes this variance across the 5th to 95th quartiles, with all coefficients reflecting significance at the 0.05 level. The multifaceted character of multidisciplinarity's influence is evident, especially noting the 5th and 25th quartiles, registering values of −0.000 and −2.150. The central 50th quartile presents a coefficient of 14.919, encapsulating an initial rise followed by a subsequent decline across quartile gradations. Conclusively, Fig. 2 underscores a perceptible multidisciplinary inflection in the elite 30% of global universities. To summarize succinctly, faculty members with multidisciplinary backgrounds are notably well-positioned for placements in prestigious institutions, while their prospects appear to diminish for universities ranked below the top 30% threshold.

The moderating effect of gender and academic inbreeding. We further delved into the moderating effects of gender and academic inbreeding on the relationship between multidisciplinarity and academic placement. The analytical outcomes of these interactions are meticulously delineated in Table 6.

Models (1) and (3) report the interaction of multidisciplinary and gender on academic placement, with model (3) incorporate more control variables and fixed effects. As suggested in Model (3), the coefficient for "Multidisciplinary*Gender" interaction stands at −15.984 ($p < 0.01$), This finding underscores a mitigated adverse effect of multidisciplinarity for male faculty members when compared to their female counterparts. Similarly, Models (2) and (4) report the interaction of multidisciplinary and inbreeding on academic placement, with model (4) incorporate more control variables and fixed effects. Model (4) reveals a coefficient of −10.187 ($p < 0.05$), for "Multidisciplinary*Inbreeding", suggesting a mitigated adverse impact of multidisciplinarity for academically inbred faculty members in comparison to their non-inbred peers.

The occurrence timing and nature of multidisciplinarity on academic placement. The emergent narrative of multidisciplinarity's less-than-favorable impact on faculty academic placement precipitates deeper inquiries: How do the occurrence timing and nature of disciplinary shifts influence academic placement? Table 7 presents a stratified exploration, with independent variables capturing both the timing and nature of these shifts. Models (1) and (2) pivot around the "Temporal Multidisciplinary Shifts", while Models (3) and (4) gravitate towards transitions during the "Undergraduate to Graduate" phase. Lastly, Models (5) and (6) pivot around the 'Graduate to Placement' stage. In each pairing, the even-numbered models incorporate essential controls and fixed effects.

Model (2) accentuates the constructive role of multidisciplinary transitions during the "Graduate to Placement" stage in enhancing academic placements, demonstrating statistical significance at the 0.1 level. This suggests a heightened receptivity to multidisciplinarity during this juncture compared to the undergraduate-graduate transition. Model (4) demarcates the effects of three specific transition types—"Hard-Soft", "Applied-Pure", and "Life-Nonlife"—and indicates that these transitions

Table 5 Further analyses: multidisciplinary and the placement of university faculty.

Variables	Undergraduate University Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(1)	(2)	(3)	(4)	(5)	(6)
Multidisciplinary Frequency	12.142**	18.672**	16.149**	16.963*	25.980***	59.879***
	(4.77)	(8.17)	(6.38)	(9.97)	(9.01)	(3.45)
Gender	−3.274	−25.886**	1.125	18.457	6.733	18.447***
	(6.42)	(12.31)	(9.49)	(14.53)	(12.78)	(3.91)
Academic Inbreeding	−103.218***	−102.070***	−118.178***	−11.006	20.774	12.254**
	(5.78)	(11.91)	(8.87)	(14.72)	(14.47)	(5.20)
Academic Productivity						
Total Publications	−0.086	0.331**	0.205**	0.614***	0.399***	0.043
	(0.06)	(0.15)	(0.10)	(0.18)	(0.14)	(0.04)
Total Citations	−0.024***	0.002	−0.015**	−0.004	0.004	−0.010***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.00)
Academic Influence	3.260***	−1.315	−0.297	−0.265	−2.867	−0.067
	(0.88)	(1.92)	(1.26)	(2.00)	(2.48)	(0.64)
International Mobility	27.452***	−13.637	−10.894	−7.793	−7.673	−11.811**
	(10.10)	(15.40)	(11.82)	(16.17)	(14.93)	(4.68)
Constant	149.350***	221.349***	266.725***	186.001***	248.379***	223.877***
	(10.74)	(20.46)	(15.80)	(23.71)	(23.24)	(6.66)
Observations	5129	1842	2588	1392	1881	19,368
Adjusted R-squared	0.135	0.176	0.171	0.115	0.085	0.151
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
	Graduate University Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(7)	(8)	(9)	(10)	(11)	(12)
Multidisciplinary Frequency	9.209***	24.426***	19.214***	38.591***	53.305***	45.421***
	(3.53)	(6.30)	(5.49)	(7.13)	(7.47)	(4.93)
Gender	8.406*	30.478***	14.026*	14.441	−0.815	5.565
	(4.58)	(8.77)	(7.41)	(9.56)	(9.31)	(5.90)
Academic Inbreeding	−141.331***	−110.980***	−123.638***	35.044***	56.988***	246.246***
	(4.11)	(9.39)	(6.54)	(8.83)	(10.50)	(9.56)
Academic Productivity						
Total Publications	0.046	0.049	0.038	0.128	0.122	0.082
	(0.05)	(0.10)	(0.08)	(0.11)	(0.10)	(0.07)
Total Citations	−0.009**	−0.006	−0.022***	−0.015*	−0.014	−0.013**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Academic Influence	0.286	−1.182	2.837**	−0.071	0.403	0.142
	(0.75)	(1.44)	(1.13)	(1.50)	(1.44)	(0.96)
International Mobility	14.995**	−12.106	2.460	30.115**	31.304***	−31.455***
	(6.55)	(11.05)	(9.41)	(13.26)	(11.90)	(6.50)
Constant	179.108***	226.055***	234.995***	168.443***	189.072***	260.199***
	(8.12)	(14.52)	(12.80)	(15.32)	(15.26)	(10.07)
Observations	9723	3836	4407	2,569	3439	8219
Adjusted R-squared	0.151	0.173	0.128	0.138	0.092	0.291
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
	Placement Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(13)	(14)	(15)	(16)	(17)	(18)
Multidisciplinary Frequency	−2.165***	−0.306	−0.560**	2.651***	0.849	4.241*
	(0.12)	(0.27)	(0.27)	(0.65)	(1.24)	(2.22)
Gender	0.030	2.122***	−0.631*	3.563***	7.469***	−14.929***
	(0.15)	(0.37)	(0.37)	(0.99)	(1.73)	(3.44)
Academic Inbreeding	1.097***	−1.510***	−1.918***	0.737	−1.756	−15.440***
	(0.18)	(0.44)	(0.45)	(1.04)	(2.56)	(4.65)
Academic Productivity						
Total Publications	−0.004**	0.001	0.002	−0.009	0.036*	0.016

Table 5 (continued)

	Placement Ranking					
	1-50	51-100	101-200	201-300	301-500	>500
	(13)	(14)	(15)	(16)	(17)	(18)
	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)	(0.04)
Total Citations	−0.000***	−0.000	−0.001***	−0.002**	−0.004**	0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.075***	0.023	0.056	0.572***	0.856***	−0.763
	(0.02)	(0.06)	(0.06)	(0.18)	(0.27)	(0.51)
International Mobility	0.308*	1.256***	−2.417***	−3.943***	9.194***	8.750**
	(0.19)	(0.41)	(0.42)	(1.18)	(1.96)	(3.79)
Constant	19.138***	72.135***	145.144***	257.582***	393.708***	763.249***
	(0.26)	(0.65)	(0.65)	(1.84)	(3.16)	(6.02)
Observations	11,098	2,489	7,214	2,269	3,394	5,731
Adjusted R-squared	0.438	0.121	0.362	0.414	0.118	0.042
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes

OLS regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

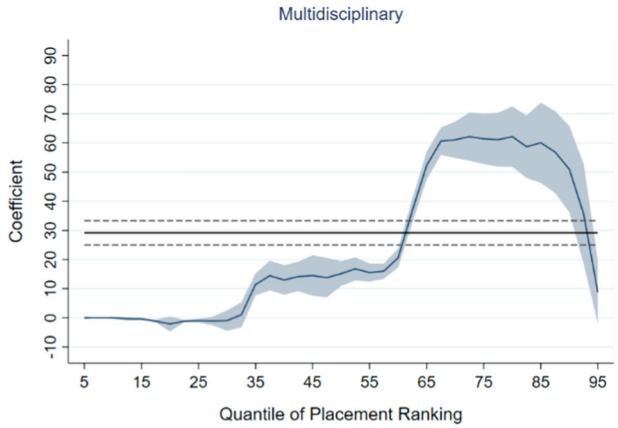

Fig. 2 Quantile regression result of multidisciplinary placement ranking. The black straight lines represent the average estimate and the 95% confidence interval (CI). The blue lines and shadows are multidisciplinary background's influence at different quantiles of faculty placement ranking and the 95% confidence interval (CI).

tend to lead to less favorable academic placements. This is contrary to expectations and warrants further investigation. Contrarily, Model (6) manifest that while all six types of transitions are statistically significant, only the "Pure-Applied" transition during the shift from graduate education to placement, with a coefficient of −33.679, correlates with enhanced placement potential. This specific transition appears to offer a notable advantage in academic placements. However, the remaining five typologies present mixed outcomes, potentially impacting placement prospects, particularly in top-tier institutions.

Multidisciplinary background and upward mobility in academic career

Baseline estimations. While our core analysis may have tempered the perceived advantages of multidisciplinary transitions for faculty placements, it is essential to underscore that such shifts often align with periods of professional transition, frequently oriented toward enrollment or placement. Consequently, delving into the influence of multidisciplinarity on faculty members' ascent in university rankings provides a nuanced perspective on academic mobility. Table 8 presents the results derived from a logit regression, examining the trajectory of multidisciplinary transitions in the context of upward mobility relative to undergraduate and graduate phases. To ensure a meticulous comparative framework, multidisciplinarity was assessed both as a categorical and continuous variable. The inclusion of control variables and fixed effects enhances the robustness of these models.

Model (1) surveys the implications of continuous multidisciplinary metrics on faculty's upward mobility compared to undergraduate benchmarks and fails to manifest statistical significance. However, a shift to categorical metrics in Model (2) unravels nuanced outcomes. Singular disciplinary transitions yield a positive coefficient, promoting upward mobility, whereas dual transitions register a reverse effect, inhibiting such advancements. As we transition to models (3) and (4), which focus on graduate benchmarks, a pronounced detrimental undertone emerges for multidisciplinarity, irrespective of its categorical or continuous incarnation. The inhibitory effect seems accentuated with more frequent disciplinary oscillations.

Further analysis. In our subsequent analytical phase, we mirrored previous analyses, also segmenting the faculty sample based on the respective undergraduate, graduate, and placement university rankings. Table 9 presents the outcomes of these stratified regressions, investigating the effect of multidisciplinarity on upward mobility when compared to the undergraduate stage as the benchmark. All models incorporate relevant control variables and fixed effects.

Models (1)–(6) focus on the subset of undergraduate university rankings. A recurring theme that emerges across these models is the adverse impact of a multidisciplinary background on the likelihood of faculty members' upward mobility when compared to their undergraduate university as the benchmark.

The subsequent set of models, Models (7)–(12), corroborates the earlier findings. These models suggest that multidisciplinarity appears to have a detrimental effect on the possibility of upward mobility in placement compared to the undergraduate stage as the benchmark. This effect is particularly pronounced for faculty members whose graduate universities are ranked below 500.

Shifting our focus to Models (13)–(18), which are contingent on faculty members' placement university rankings, the effect of

Table 6 The moderating effect of gender and academic inbreeding on the relationship between multidisciplinary and the placement of university faculty.

Variables	Placement Ranking			
	(1)	(2)	(3)	(4)
Multidisciplinary Frequency	40.225***	31.204***	37.705***	27.330***
	(2.65)	(1.67)	(3.66)	(2.44)
Gender	−6.559***		10.021***	
	(2.25)		(2.98)	
Multidisciplinary*Gender	−11.338***		−15.984***	
	(3.44)		(4.62)	
Academic Inbreeding		2.033		−38.282***
		(2.28)		(3.28)
Multidisciplinary*Inbreeding		−17.764***		−10.187**
		(3.34)		(4.91)
Academic Productivity				
Total Publications			0.088***	0.074**
			(0.03)	(0.03)
Total Citations			−0.014***	−0.015***
			(0.00)	(0.00)
Academic Influence			0.648	0.154
			(0.47)	(0.40)
International Mobility			4.962	3.744
			(3.58)	(3.34)
Constant	240.260***	243.815***	201.223***	227.737***
	(2.15)	(1.31)	(5.09)	(4.30)
Observations	60,430	84,910	32,215	37,694
Adjusted R-squared	0.007	0.005	0.130	0.116
Title FE	No	No	Yes	Yes
Country FE	No	No	Yes	Yes
Year of Ph.D. Graduation FE	No	No	Yes	Yes

OLS regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

multidisciplinarity is different. A consistent pattern shows that multidisciplinary backgrounds appear to increase the possibility of faculty member's upward mobility compared to their undergraduate education as the benchmark, particularly for universities ranked between 101 and 200.

Table 10, which juxtaposes the results in Table 9, extends this exploration by using the faculty's graduate university as the benchmark. Across models (1) to (12), a recurring theme is the detrimental influence of multidisciplinarity on the likelihood of upward mobility when compared to the graduate stage, albeit with minor variations.

Conversely, as we progress to models (13)–(18), the narrative becomes more heterogeneous. While some segments emphasize the previously mentioned deleterious effects, others, especially Model (18), reveal a latent potential for multidisciplinarity to catalyze faculty members' upward mobility, particularly for those in universities ranked below 500.

The moderating effect of gender and academic inbreeding. Juxtaposing previous results, Table 11 elucidates the logit regression outcomes for the moderating effect of gender and academic inbreeding on the relationship between multidisciplinary and upward mobility. Ensuring analytical rigor, the models are meticulously fortified with pertinent control variables and fixed effects.

Interestingly, while the "Multidisciplinary*Gender" interaction yields statistically insignificant results across the models, the "Multidisciplinary*Inbreeding" interaction manifests significance at the 0.05 level in models (2) and (4) with coefficients of 0.111 and 0.110, respectively. This suggests that academic inbreeding offers a cushioning effect against the adverse effect of multidisciplinarity, attenuating its impact on upward mobility. In essence, for inbred academics, the multidisciplinary trajectory becomes less of an impediment.

The occurrence timing and nature of multidisciplinarity on the upward success. Given the nuanced adverse implications of multidisciplinarity on upward mobility, it becomes imperative to interrogate whether the specific chronology and nature of disciplinary transitions play pivotal roles. Table 12 outlines these dynamics, with independent variables centered on the "Temporal Multidisciplinary Shifts" and the specific "Nature of Multidisciplinary Transition". For comprehensive insights, control variables and fixed effects are integrated.

Model (1) underscores the salience of multidisciplinary transitions occurring during the Graduate to Placement phase, fostering faculty's upward mobility ($\beta = 0.152$) at the 0.01 significance level. In model (2), while specific disciplinary shifts during the undergraduate to graduate phase—specifically "Pure-Applied" and "Nonlife-Life"—emerge as potential catalysts for upward mobility ($\beta = 0.102$; $\beta = 0.105$), the "Life-Nonlife" transition appears counterproductive ($\beta = -0.235$). Model (3) further reinforces the efficacy of the "Pure-Applied" transition while spotlighting potential impediments inherent in "Hard-Soft", "Nonlife-Life", "Applied-Pure", and "Life-Nonlife" transitions.

Pivoting to the context of Graduate to Placement phase in model (4), an overarching detrimental undertone for multidisciplinary transitions surfaces ($\beta = -0.220$). Furthermore, model (5) accentuates the merits of the "Pure-Applied" transition, while other disciplinary oscillations predominantly emerge as hurdles. Conclusively, model (6) reinforces the deleterious implications of specific disciplinary transitions, intensifying the

Table 7 The temporal and nature of multidisciplinary transitions on the placement of university faculty.

Variables	Placement Ranking					
	(1)	(2)	(3)	(4)	(5)	(6)
Temporal Multidisciplinary Shifts						
the Undergraduate to Graduate Stage	−24.074***	−2.868				
	(2.84)	(4.63)				
the Graduate to Placement Stage	−12.470***	−8.547*				
	(3.28)	(4.90)				
Transitioned in both Stages	−7.191**	−4.580				
	(3.19)	(4.67)				
Nature of Multidisciplinary Transition (the Undergraduate to Graduate Stage)						
Hard-Soft			76.365***	58.172***		
			(5.75)	(9.41)		
Pure-Applied			−31.209***	−4.255		
			(3.53)	(5.31)		
Nonlife-Life			−6.506*	−4.485		
			(3.92)	(5.95)		
Soft-Hard			11.722**	2.778		
			(5.12)	(7.49)		
Applied-Pure			42.099***	41.305***		
			(5.79)	(9.37)		
Life-Nonlife			54.291***	56.986***		
			(6.54)	(10.05)		
Nature of Multidisciplinary Transition (the Graduate to Placement Stage)						
Hard-Soft					38.806***	18.954***
					(4.20)	(6.35)
Pure-Applied					−57.112***	−33.679***
					(2.76)	(4.35)
Nonlife-Life					46.697***	31.893***
					(2.92)	(4.46)
Soft-Hard					25.411***	17.594***
					(3.92)	(6.21)
Applied-Pure					82.693***	56.820***
					(4.40)	(6.63)
Life-Nonlife					94.177***	84.731***
					(4.97)	(8.37)
Gender		8.857***		9.522***		8.565***
		(2.98)		(2.98)		(2.97)
Academic Inbreeding		−31.494***		−32.620***		−32.970***
		(3.50)		(3.50)		(3.49)
Academic Productivity						
Total Publications		0.091***		0.085***		0.086***
		(0.03)		(0.03)		(0.03)
Total Citations		−0.014***		−0.014***		−0.013***
		(0.00)		(0.00)		(0.00)
Academic Influence		0.664		0.664		0.636
		(0.47)		(0.47)		(0.46)
International Mobility		1.486		−1.054		−0.873
		(3.61)		(3.62)		(3.61)
Constant	263.802***	227.468***	257.021***	223.147***	247.009***	217.643***
	(1.15)	(5.08)	(1.04)	(5.01)	(1.12)	(5.01)
Observations	84,910	32,215	84,910	32,215	84,910	32,215
Adjusted R-squared	0.001	0.127	0.006	0.131	0.024	0.139
Title FE	No	Yes	No	Yes	No	Yes
Country FE	No	Yes	No	Yes	No	Yes
Year of Ph.D. Graduation FE	No	Yes	No	Yes	No	Yes

OLS regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

narrative of multidisciplinarity's intricate relationship with upward mobility.

Discussion

Employing Biglan's classification of academic disciplines, this research analyzed the influence of university faculty's multidisciplinary backgrounds on their academic placement and career progression within universities. The study also investigated the effects of the timing and nature of disciplinary transitions made by faculty members. Utilizing data extracted from 500,000 publicly available curricula vitae (CV) of university faculty covering six countries, we conducted a finer-grained analysis. The

Table 8 Baseline estimations: multidisciplinary and upward mobility.

Variables	Upward Success			
	Compared to Undergraduate		Compared to Graduate	
	(1)	(2)	(3)	(4)
Multidisciplinary Frequency	−0.028		−0.248***	
	(0.02)		(0.02)	
Multidisciplinary Frequency				
Transitioned Disciplines Once		0.075**		−0.201***
		(0.04)		(0.03)
Transitioned Disciplines Twice		−0.123**		−0.542***
		(0.05)		(0.05)
Gender	0.032	0.031	−0.001	−0.001
	(0.04)	(0.04)	(0.03)	(0.03)
Academic Inbreeding	−0.812***	−0.811***	−2.021***	−2.022***
	(0.04)	(0.04)	(0.04)	(0.04)
Academic Productivity				
Total Publications	−0.001***	−0.001***	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000*	0.000*	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.001	0.001	−0.002	−0.002
	(0.01)	(0.01)	(0.00)	(0.00)
International Mobility	0.575***	0.581***	0.068**	0.069**
	(0.04)	(0.04)	(0.03)	(0.03)
Constant	0.068	0.049	0.180	0.161
	(0.18)	(0.18)	(1.26)	(1.28)
Observations	15,199	15,199	27,884	27,884
Pseudo R-squared	0.0541	0.0548	0.122	0.122
Prob>chi^2	0	0	0	0
Title FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes

Logit regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

results revealed that a multidisciplinary background has a generally negative impact on the placement and career advancement of faculty members in academic settings. However, it is essential to note that the effects of disciplinary transitions on career outcomes vary depending on their stage and specific type. Moreover, the analysis indicated that the adverse consequences of possessing a multidisciplinary background are mitigated in cases of male faculty members and those with a history of academic inbreeding.

This nuanced approach highlights the complex interplay between faculty members' educational backgrounds and their career trajectories, underscoring the importance of considering both individual and institutional factors in academic career development.

Theoretical implication. This study significantly enriches the discourse on multidisciplinary education, with a specific focus on its implications for academic faculty placement. The theoretical contributions are multifaceted.

First, this study recontextualized Biglan's classification. By applying Biglan's classification to the analysis of faculty educational backgrounds, this research extends the utility of this well-regarded disciplinary classification scheme (Hudson et al., 2023; Marbach-Ad et al., 2019; Paulsen and Wells, 1998; Simpson, 2017). Prior literature usually applied Biglan's classification in explaining the role of multidisciplinary courses on students' academic performance and post-graduation achievements (O'Donovan, 2019; Tseng et al., 2023). The study moves beyond the traditional application of Biglan's classification schema, demonstrating its relevance not only in categorizing disciplines but also in providing a nuanced understanding of the implications of faculty's educational backgrounds in both life and non-life disciplines. This novel application underscores the versatility of Biglan's framework in new contexts of multidisciplinary education (Rosman et al., 2020).

Second, this study lends empirical support to the Limited Attention Theory (LAT), suggesting that a multidisciplinary education background may impede faculty from obtaining optimal placements. This finding aligns with concerns in academia about the breadth-over-depth approach inherent in multidisciplinary education (Arts and Fleming, 2018; Balaban, 2018; Haider et al., 2018; Tseng et al., 2023; Wright and Vanderford, 2017), contributing to the ongoing debate on the balance between specialization and interdisciplinary learning in higher education.

Third, our findings illustrate the practical implications of the Knowledge Recombination Theory (KRT). We demonstrate that multidisciplinary backgrounds are viewed favorably in elite academic institutions. This observation validates the theory's premise that integrating knowledge from diverse fields is beneficial and sought after (Fontana et al., 2022; Petersen et al., 2021; Xiao et al., 2022), especially in top-tier universities (Leahey et al., 2019; Li and Yin, 2023). This observation echoes the theory's premise, highlighting the specific contexts where multidisciplinarity is particularly advantageous.

This research also reveals the duality in the impact of multidisciplinary backgrounds. While general university settings may view multidisciplinary backgrounds as less favorable (consistent with LAT), elite universities appreciate these backgrounds (aligned with KRT). This discrepancy signifies a divergence in recruitment strategies, indicating a progressive

Table 9 Further analyses: multidisciplinary and upward mobility compared to undergraduate stage.

Variables	Undergraduate University Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(1)	(2)	(3)	(4)	(5)	(6)
Multidisciplinary Frequency	0.077	−0.085	−0.115*	−0.326***	−0.197**	0.078
	(0.05)	(0.07)	(0.06)	(0.09)	(0.08)	(0.07)
Gender	0.128*	0.098	0.047	−0.155	−0.208*	−0.041
	(0.08)	(0.11)	(0.09)	(0.13)	(0.12)	(0.12)
Academic Inbreeding	−0.300***	−0.633***	−0.975***	−1.468***	−1.028***	−2.337***
	(0.09)	(0.14)	(0.11)	(0.16)	(0.13)	(0.12)
Academic Productivity						
Total Publications	−0.001	−0.005***	0.001	−0.004**	−0.002*	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000***	0.000	0.000**	0.000*	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	−0.015	−0.002	−0.004	−0.018	0.022	0.018
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
International Mobility	−0.081	0.137	0.214*	0.426***	0.219*	0.375**
	(0.11)	(0.14)	(0.11)	(0.15)	(0.13)	(0.15)
Constant	−2.022***	0.814	−0.174	0.580	0.862	1.916***
	(0.76)	(1.15)	(0.59)	(0.66)	(1.16)	(0.37)
Observations	5,031	1,816	2,579	1,383	1,873	2,243
Pseudo R-squared	0.0760	0.0694	0.138	0.150	0.126	0.238
Prob>chi2	0	9.50e-05	0	0	0	0
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
	Graduate University Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(7)	(8)	(9)	(10)	(11)	(12)
Multidisciplinary Frequency	0.037	0.053	−0.009	−0.069	−0.120	−0.171***
	(0.04)	(0.07)	(0.07)	(0.09)	(0.08)	(0.06)
Gender	−0.013	−0.106	0.075	0.183	0.197	0.101
	(0.06)	(0.11)	(0.10)	(0.14)	(0.12)	(0.09)
Academic Inbreeding	0.118*	−1.221***	−0.684***	−1.857***	−1.680***	−2.459***
	(0.07)	(0.15)	(0.11)	(0.17)	(0.16)	(0.15)
Academic Productivity						
Total Publications	−0.002***	−0.003**	−0.001	−0.000	−0.002	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000	0.000	0.000*	−0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.006	−0.011	−0.012	0.022	−0.003	−0.000
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
International Mobility	0.481***	0.737***	0.821***	0.433***	0.486***	0.447***
	(0.07)	(0.13)	(0.12)	(0.17)	(0.14)	(0.11)
Constant	−0.736*	1.155	0.697*	0.238	1.211*	0.228
	(0.39)	(1.05)	(0.38)	(0.66)	(0.69)	(0.42)
Observations	5526	1928	2196	1269	1521	2701
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.0316	0.109	0.0869	0.150	0.140	0.177
Prob>chi2	0	0	0	0	0	0
	Placement Ranking					
	1–50	51–100	101–200	201–300	301–500	>500
	(13)	(14)	(15)	(16)	(17)	(18)
Multidisciplinary Frequency	0.020	0.089	0.160***	−0.131	0.076	0.090
	(0.05)	(0.08)	(0.06)	(0.10)	(0.09)	(0.11)
Gender	0.045	−0.077	0.128	−0.048	−0.129	0.255
	(0.07)	(0.13)	(0.08)	(0.15)	(0.13)	(0.18)
Academic Inbreeding	−1.348***	−1.689***	−1.027***	−0.832***	−0.410**	−0.553**
	(0.07)	(0.16)	(0.10)	(0.17)	(0.17)	(0.23)
Academic Productivity						
Total Publications	−0.003***	0.000	−0.000	0.001	0.001	−0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	−0.000	−0.000	−0.000	−0.000	0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.006	0.024	0.007	0.031	−0.010	0.034
	(0.01)	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)
International Mobility	0.990***	1.138***	0.902***	0.822***	0.791***	0.596***
	(0.11)	(0.15)	(0.09)	(0.16)	(0.14)	(0.18)
Constant	0.557	−0.086	−0.194	0.898	−0.398	−2.341***
	(0.42)	(0.79)	(0.36)	(0.62)	(0.48)	(0.57)
Observations	5186	1456	3092	1210	1658	2295
Pseudo R-squared	0.105	0.152	0.0800	0.0973	0.0572	0.0649
Prob > chi^2	0	0	0	7.06e-07	0.00652	0.0127
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes

Logit regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 10 Further analyses: multidisciplinary and upward mobility compared to graduate stage.

Variables	Undergraduate University Ranking					
	1-50	51-100	101-200	201-300	301-500	>500
	(1)	(2)	(3)	(4)	(5)	(6)
Multidisciplinary Frequency	−0.202***	−0.188**	−0.175***	−0.159	−0.157**	−0.280***
	(0.05)	(0.08)	(0.07)	(0.10)	(0.08)	(0.03)
Gender	0.063	−0.021	0.112	−0.147	0.004	−0.035
	(0.07)	(0.12)	(0.10)	(0.14)	(0.12)	(0.04)
Academic Inbreeding	−0.908***	−1.256***	−1.544***	−2.503***	−2.353***	−2.904***
	(0.08)	(0.15)	(0.14)	(0.24)	(0.20)	(0.08)
Academic Productivity						
Total Publications	0.001	−0.005***	−0.000	−0.004*	−0.002	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000*	−0.000	0.000*	−0.000	−0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	−0.004	0.009	−0.015	0.013	0.026	−0.002
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
International Mobility	−0.212**	−0.099	0.148	−0.141	−0.104	0.124***
	(0.10)	(0.15)	(0.12)	(0.15)	(0.13)	(0.04)
Constant	−0.383	1.040	−1.227	−1.764	1.795*	1.731*
	(0.50)	(1.08)	(0.86)	(1.15)	(1.00)	(0.93)
Observations	4826	1684	2410	1265	1742	15,918
Pseudo R-squared	0.0742	0.0994	0.131	0.191	0.156	0.164
Prob>chi^2	0	9.04e-11	0	0	0	0
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
	Graduate University Ranking					
	1-50	51-100	101-200	201-300	301-500	>500
	(7)	(8)	(9)	(10)	(11)	(12)
Multidisciplinary Frequency	−0.139***	−0.182***	−0.240***	−0.505***	−0.375***	−0.287***
	(0.04)	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)
Gender	0.003	−0.126	0.040	−0.119	−0.003	0.068
	(0.06)	(0.08)	(0.08)	(0.10)	(0.09)	(0.09)
Academic Inbreeding	−1.636***	−1.310***	−2.314***	−2.873***	−2.265***	−3.361***
	(0.09)	(0.14)	(0.12)	(0.14)	(0.12)	(0.12)
Academic Productivity						
Total Publications	0.000	−0.001	0.001	−0.001	−0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000	0.000***	0.000***	0.000**	0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.006	−0.021*	−0.029**	−0.019	−0.009	0.011
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
International Mobility	−0.303***	−0.153	−0.026	−0.096	−0.116	−0.020
	(0.08)	(0.10)	(0.09)	(0.13)	(0.11)	(0.10)
Constant	−2.306***	−1.638***	−0.372	0.942**	1.177***	0.242
	(0.61)	(0.54)	(0.40)	(0.48)	(0.43)	(0.35)
Observations	9523	3788	4397	2548	3427	3870
Pseudo R-squared	0.107	0.0840	0.223	0.264	0.206	0.327
Prob > chi2	0	0	0	0	0	0
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes
	Placement Ranking					
	1-50	51-100	101-200	201-300	301-500	>500
	(13)	(14)	(15)	(16)	(17)	(18)
Multidisciplinary Frequency	−0.329***	−0.012	−0.142***	0.137	0.029	0.193**
	(0.04)	(0.07)	(0.05)	(0.09)	(0.08)	(0.10)
Gender	0.136**	−0.062	0.126**	0.087	−0.035	−0.121
	(0.06)	(0.10)	(0.06)	(0.14)	(0.11)	(0.16)
Academic Inbreeding	−3.133***	−1.942***	−2.439***	−1.905***	−1.783***	−0.954***
	(0.06)	(0.15)	(0.13)	(0.22)	(0.26)	(0.25)

Table 10 (continued)

	Placement Ranking					
	1-50	51-100	101-200	201-300	301-500	>500
	(13)	(14)	(15)	(16)	(17)	(18)
Academic Productivity						
Total Publications	−0.001	0.000	−0.000	−0.002	0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	−0.000**	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.016*	0.006	0.008	0.005	−0.007	−0.002
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
International Mobility	0.267***	0.388***	0.178**	0.503***	0.562***	0.176
	(0.08)	(0.11)	(0.07)	(0.15)	(0.12)	(0.16)
Constant	0.324	0.298	−0.405*	−0.883	−2.819***	−3.400***
	(1.31)	(0.56)	(0.23)	(0.54)	(0.76)	(0.76)
Observations	9732	2209	6189	1987	2978	4115
Pseudo R-squared	0.307	0.116	0.114	0.132	0.0760	0.0571
Prob>chi^2	0	0	0	0	2.65e-08	0.000515
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes

Logit regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 11 The moderating effect of gender and academic inbreeding on the relationship between multidisciplinary and the upward success.

Variables	Upward Success			
	Compared to Undergraduate		Compared to Graduate	
	(1)	(2)	(3)	(4)
Multidisciplinary Frequency	−0.063**	−0.067***	−0.081**	−0.025
	(0.03)	(0.02)	(0.04)	(0.02)
Gender	0.108***		0.026	
	(0.03)		(0.04)	
Multidisciplinary*Gender	0.020		0.065	
	(0.03)		(0.05)	
Academic Inbreeding		−1.115***		−0.825***
		(0.03)		(0.04)
Multidisciplinary*Inbreeding		0.111***		0.110**
		(0.03)		(0.05)
Academic Productivity				
Total Publications			−0.001***	−0.001***
			(0.00)	(0.00)
Total Citations			0.000*	0.000***
			(0.00)	(0.00)
Academic Influence			0.002	−0.002
			(0.01)	(0.00)
International Mobility			0.707***	0.537***
			(0.04)	(0.04)
Constant	−0.441***	−0.034**	−0.303*	−0.022
	(0.03)	(0.02)	(0.18)	(0.17)
Observations	29,050	40,348	15,199	17,884
Pseudo R-squared	0.000796	0.0392	0.0352	0.0507
Prob>chi^2	8.61e-07	0	0	0
Title FE	No	No	Yes	Yes
Country FE	No	No	Yes	Yes
Year of Ph.D. Graduation FE	No	No	Yes	Yes

Logit regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

shift in elite institutions (Holley, 2018; Huang et al., 2020a, 2020b), such as the 2023 recruitment at MIT and Stanford.

Last but not least, this research sheds light on the influence of gender and academic inbreeding within the sphere of multidisciplinary education. The study reveals that male faculty members and those with an academic inbreeding background can counterbalance the potential disadvantages of a multidisciplinary education (Lundine et al., 2019; Huang et al., 2020a, 2020b; Rhoten and Pfirman, 2007). Our findings suggest that inbred faculty not only offset the unfavorable impact of

Table 12 The temporal and nature of multidisciplinary transitions on the upward success.

Variables	Upward Success					
	Compared to Undergraduate			Compared to Graduate		
	(1)	(2)	(3)	(4)	(5)	(6)
Temporal Multidisciplinary Shifts						
the Undergraduate to Graduate Stage	−0.043			−0.220***		
	(0.06)			(0.05)		
the Graduate to Placement Stage	0.152***			0.035		
	(0.06)			(0.04)		
Transitioned in both Stages	0.026			−0.013		
	(0.05)			(0.04)		
Nature of Multidisciplinary Transition (the Undergraduate to Graduate Stage)						
Hard-Soft		−0.111			−0.478***	
		(0.08)			(0.08)	
Pure-Applied		0.102*			0.129***	
		(0.05)			(0.05)	
Nonlife-Life		0.105*			−0.052	
		(0.06)			(0.05)	
Soft-Hard		0.029			0.017	
		(0.07)			(0.07)	
Applied-Pure		−0.031			−0.224***	
		(0.08)			(0.08)	
Life-Nonlife		−0.235**			−0.305***	
		(0.09)			(0.09)	
Nature of Multidisciplinary Transition (the Graduate to Placement Stage)						
Hard-Soft			−0.133*			−0.285***
			(0.07)			(0.06)
Pure-Applied			0.160***			0.001
			(0.05)			(0.04)
Nonlife-Life			−0.210***			−0.213***
			(0.05)			(0.04)
Soft-Hard			0.065			0.057
			(0.08)			(0.06)
Applied-Pure			−0.183**			−0.271***
			(0.07)			(0.06)
Life-Nonlife			−0.310***			−0.568***
			(0.08)			(0.07)
Gender	0.032	0.032	0.037	0.004	0.003	0.009
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Academic Inbreeding	−0.810***	−0.818***	−0.812***	−2.034***	−2.035***	−2.039***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Academic Productivity						
Total Publications	−0.001***	−0.001***	−0.001***	−0.001*	−0.000	−0.001*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Citations	0.000*	0.000*	0.000*	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Academic Influence	0.001	0.001	0.001	−0.002	−0.002	−0.002
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
International Mobility	0.576***	0.588***	0.594***	0.052	0.072**	0.075**
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Constant	0.037	0.029	0.079	0.078	0.075	0.071
	(0.18)	(0.18)	(0.18)	(1.37)	(1.37)	(1.36)
Observations	15,199	15,199	15,199	27,884	27,884	27,884
Pseudo R-squared	0.0544	0.0552	0.0572	0.119	0.120	0.123
Prob>chi2	0	0	0	0	0	0
Title FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of Ph.D. Graduation FE	Yes	Yes	Yes	Yes	Yes	Yes

Logit regressions. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

multidisciplinary backgrounds on their chances of getting superior placement, but they also buffer the negative consequences of achieving upward mobility on academic placement. Although academic inbreeding is not regarded as beneficial, especially in terms of knowledge innovation (Horta, 2022; Morichika and Shibayama, 2015), previous studies find that it still plays a negligible role in the faculty placement (Altbach et al., 2015). Our results support these findings, and contribute to the discourse on gender inequality and the role of academic inbreeding in academia.

In summary, this study enhances the understanding of how multidisciplinary backgrounds influence academic placements and trajectories, offering new insights into the interplay of educational background, gender, and academic traditions in higher education. It prompts a reevaluation of multidisciplinary background in academia, especially in the context of faculty career advancement and placement strategies.

Practical implication. This study provides a roadmap for both academic institutions and individuals, highlighting the strategic importance of multidisciplinary education in faculty recruitment and career development within the complex landscape of higher education. This research offers valuable insights for universities and their recruitment committees, illuminating the complex dynamics of faculty placement associated with multidisciplinary academic backgrounds. The study underscores the importance of recognizing that the benefits of multidisciplinarity are not universally applicable, and are influenced by factors such as the nature and timing of disciplinary transitions. Elite academic institutions, which often spearhead cutting-edge research, may find particular value in embracing faculty with diverse academic backgrounds. These faculty members can contribute to an environment of broadened perspectives and enhanced innovation. Interestingly, our findings also reframe the conversation around academic inbreeding. Traditionally viewed in a negative light, academic inbreeding may, in fact, provide a buffer against the less favorable aspects of a multidisciplinary background. This nuanced understanding could guide institutions in their recruitment and promotion strategies, considering the potential advantages of academic inbreeding alongside its more recognized drawbacks.

For individual faculty, the strategic decision-making process regarding disciplinary transitions is crucial. Our study reveals that while a multidisciplinary path can facilitate entry into prestigious institutions, it may also present obstacles in certain contexts, particularly when interwoven with other variables such as gender and academic heritage. Early-career researchers should be particularly cognizant of the strategic timing and nature of their disciplinary shifts. Our findings suggest that transitioning disciplines during the early stages of academic training, specifically from undergraduate to graduate levels, can be advantageous for academic placement. Moreover, moving from pure to applied disciplines seems to not only enhance prospects of better placement but also aid in ascending the academic ladder. For faculty members originating from non-elite institutions, cultivating a multidisciplinary profile emerges as a promising avenue for career advancement. To maximize their potential for upward mobility within elite academic settings, individuals should approach discipline transitions with careful consideration, ideally beginning as early as their undergraduate education. A deliberate shift towards applied disciplines during this phase could lay the groundwork for a distinguished academic trajectory.

Conclusion, limitation, and future research

Using data from university faculty CVs, this study analyses the effects of multidisciplinary educational backgrounds on faculty placement and academic profession within Biglan's Discipline Classification. The findings highlight the difficulties that multidisciplinary backgrounds offer faculty in obtaining better placement and achieving upward mobility. It also responds to the application of knowledge recombination and limited attention theory in multidisciplinary and interdisciplinary education. It is crucial to note, however, that the impact of discipline transitions is different based on the occurrence timing and types of the transition. Furthermore, gender and academic inbreeding factors help to reduce the negative impact of multidisciplinary backgrounds. This research not only adds to the current body of research but also advances the multidisciplinary discussion.

However, it is critical to recognize the study's shortcomings. One major limitation is the data collection and refinement process. The dataset currently only includes faculty from six countries: the United States, Canada, Australia, New Zealand, the United Kingdom, and Singapore. As a result, larger inclusion could improve the sample's national representativeness. Furthermore, the creation and maintenance of a comprehensive, global CV database necessitate significant effort and time investment. Factors such as faculty demographics and the family's economic position are not easy to get throughout the CV data preparation process. Notably, the biographical section of the CVs was left out of this study because its comprehensive examination requires the involvement of a natural language model for further data refining and extraction. Future research efforts could considerably improve the representativeness of faculty CV data by increasing the breadth of nations and universities from which CV data is gathered. Furthermore, using natural language processing techniques to improve the personal autobiography part could provide deeper insights into faculty's career mobility experiences. This would allow for a more thorough evaluation of the long-term impact of a multidisciplinary background on academic profession.

In conclusion, this study unveils the multifaceted effects of multidisciplinarity on academic placements and career trajectories. While multidisciplinary backgrounds can be a double-edged sword, their potential benefits or pitfalls are not set in stone but depend on a myriad of factors. As academia continues to evolve, understanding these dynamics becomes ever more crucial for institutions, policymakers, and academics alike.

Data availability

The data used to support the findings of this study were obtained from public domain Scopus databases and faculty CVs available on universities' public websites.

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Notes

1 For further information regarding MIT's Digital Learning Lab's and the Stanford Centre for Biomedical Ethics' 2023 hiring requirements, please visit https://careers.peopleclick.com/careerscp/client_mit/external/jobDetails/jobDetail.html?jobPostId=24980&localeCode=en-us and https://facultypositions.stanford.edu/en-us/job/493558/stanford-center-for-biomedical-ethics-academic-scholar.

2 For further information about the 2022 U.S.NEWS World University Rankings, please visit https://www.usnews.com/education/best-global-universities/rankings.

3 Supplementary Figure S1 in this study includes a Sankey diagram indicating disciplines transitions among faculty across their undergraduate, graduate, and placement stages.

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Author contributions

WL and YH jointly designed the research, performed the analysis, and were actively involved in writing and revising the manuscript. And WL played a key role in conceptualizing the study and validating the findings. JL contributed by sharing essential data and reviewing the main results. All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

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Additional information

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