

CAREER FEATURE

An effective matching method for a scientific mentoring program

A questionnaire based on a popular personality assessment test contributes to the success of a new mentorship program.

Few people embrace the art of mentoring. The mentorship connection establishes a personal relationship between a mentor and a mentee, sometimes becoming more than a simple professional interaction and giving rise to a lasting friendship. By definition, a mentor is a teacher, counselor or guide. As such, everyone has had mentors in one way or another, even if they have not been formally mentored.

Mentorship programs stand or fall with how well the mentoring objectives are defined. We developed Fostering Grads (<https://ecusacomunity.org/fostering-grads>) with a very specific goal: provide PhD students from Spain with the opportunity to work in US research laboratories for a period of three to four months. To do so, we implemented a mentor–mentee third-party relationship separated from the potential host institutions. Our mentors played the role of advising their mentees while they sought host laboratories in the United States.

We launched our pilot program at the beginning of 2018 with 15 PhD students from the University of La Laguna (ULL) in Spain. All PhD students were accepted at high-level institutions across the United States, including the National Institutes of Health; Purdue University; Columbia University; the University of California, San Diego; and others. The key to this success was finding good matches between the mentee and the outside mentor before contacting laboratories at potential host institutes. To ensure compatible mentor–mentee matches, we used the Myers-Briggs Type Indicator (MBTI) questionnaire based on personality parameters, while also considering mentors' and mentees' areas of expertise. Combining these two factors provided us with a toolset not commonly used for the mentor matching process. Here, we describe our initial experiences with this program, focusing on a paradigm shift in the mentoring matching process, in the hope of providing a useful template for similar programs elsewhere.

Mentoring as an art

Mentoring has existed since ancient Greece: in the *Odyssey*, Homer describes a person

called Mentor in charge of Odysseus's son Telemachus. Although informal mentoring always existed in educational and scientific environments, it is a relatively new tool in business. In a study of more than 350 organizations, the more successful developmental practices were mentoring, action-oriental programs and feedback 360¹. There are, however, few studies analyzing features and behaviors of effective mentoring relationships. One study with five organizations² concluded that skills required from a mentor are active listening,

communication, patience, knowledge of the industry and organization, ability to 'read' and understand others, honesty and trust.

One area of potential risk is excess dependence on the mentor, and mentoring is described as one of the ten main causes of executive derailment³, although it causes fewer difficulties than problems with interpersonal relationships⁴. Putting this all together, the definition of a good mentor in science is a person with teaching abilities, a critical thinker and someone who provides good network opportunities,

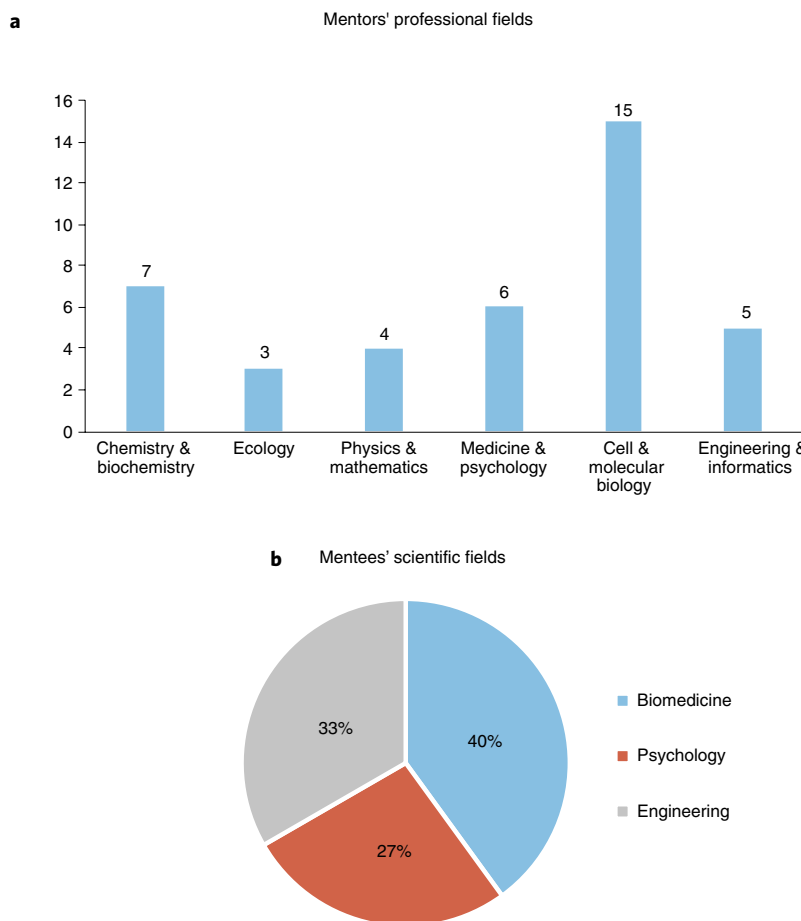


Fig. 1 | Fostering Grads mentors' and mentees' professional fields. **a**, Number of mentors per professional field ($n=40$ mentors). **b**, Percentage of mentees split in three broad scientific fields ($n=15$ mentees).

Table 1 | Hosting research institutions for Fostering Grads pilot program mentees, 2018

PhD student scientific field	Host institution	University or agency	State
Biomedicine	Porter Neuroscience Research Center	National Institutes of Health	Maryland
Biomedicine	School of Medicine	University of California, Irvine	California
Biomedicine	School of Biological Sciences	University of California, Irvine	California
Biomedicine	College of Pharmacy	University of Utah	Utah
Biomedicine	Cardiovascular and Pulmonary Branch	National Institutes of Health	Maryland
Biomedicine	College of Physicians and Surgeons	Columbia University	New York
Psychology	Florida Center for Reading Research	Florida State University	Florida
Psychology	School of Education	University of Delaware	Delaware
Psychology	Institute for Social Research	University of Michigan	Michigan
Psychology	College of Health and Human Sciences	Purdue University	Indiana
Engineering	College of Liberal Arts and Sciences	Iowa State University	Iowa
Engineering	Institute for Computational Engineering and Science	University of Texas Austin	Texas
Engineering	Center for Energy Research	University of California, San Diego	California
Engineering	Materials Research Laboratory	University of California, Santa Barbara	California
Engineering	Department of Coatings and Polymeric Materials	North Dakota State University	North Dakota

encouragement and personal advice⁵. Some of the key elements needed for a successful mentoring program⁶ are design and planning, management of the program, operations, and evaluation of the program. We tried to address all these elements in Fostering Grads.

A mentorship program for Spanish scientist trainees

Pursuing an academic path is one of the main options for PhD students. Even though it has become increasingly difficult to pursue an academic career as a faculty member^{7,8}, a high percentage of PhD students still seek a postdoctoral position. To be successful, other important skills should be developed along with the skills used in research. Unfortunately, current Spanish PhD programs rarely include mentorship help when considering potential career paths and skill development.

Fostering Grads is a program developed by the association of Spanish Scientists in the USA (ECUSA; <http://www.ecusa.es/>) with the purpose of guiding PhD students in Spain who face additional barriers to success to achieve their highest potential by introducing professionally supported relationships with caring and committed mentors.

The Fostering Grads pilot program was created to improve the future career opportunities of Spanish PhD students in the United States by empowering them to take responsibility for their own career development while receiving support and guidance from professional mentors.

The pilot program was launched in 2018 in collaboration with the ULL in Spain. The program has 40 professionals from different fields acting as mentors (Fig. 1a). The requirements for becoming a Fostering Grads mentor are living and working in the United States through 2018 and having a PhD or demonstrating five or more years of experience in a particular field. All mentors are to have participated in a mentorship training course provided by the Fostering Grads program.

Up to 15 PhD students from biomedicine, psychology and engineering career paths (Fig. 1b) were initially recommended by the ULL to participate in the pilot program. After students were selected to participate in Fostering Grads, they were asked to provide information about their thesis and their interest in working abroad. At the same time, both mentors and students were required to complete the Myers-Briggs Type Indicator (MBTI) questionnaire. All 15 mentees were matched with 15 out of 40 mentors on the basis of the MBTI results and their professional fields. Once the matching process was completed, we designed a follow-up document to track the progress of each mentorship pair. After each meeting, the mentor and mentee together filled out this form, which documented their progress with respect to their previous follow-up document. Each document highlighted issues or obstacles to be addressed before the next meeting. Mentees started approaching

various laboratories of interest while receiving advice and suggestions from their mentors. After three months of work, all mentees were accepted at different research institutions across the United States (Table 1).

The failure of mentoring relationships and methods used to assess these failures have been studied by others. In our experience, the MBTI questionnaire was a powerful tool for ensuring optimal matches between mentors and mentees and decreasing the chances of a misunderstanding between them.

The Myers-Briggs Type Indicator questionnaire

The MBTI questionnaire uses two basic approaches. First, the trait approach considers the behavioral features that each person has to different degrees. One theory⁹ considers 16 features that define each person, while the type theory of personality^{10,11} proposes 4 psychological functions with 2 opposite preferences (Fig. 2a). These functions are as follows: (i) from where you get energy (extroversion, from the outside; introversion, from inside); (ii) how you get information (sensing: through the senses, facts and data; intuition: through concepts and ideas); (iii) how you make decisions (thinking: objective, critical; feeling: subjective, in search of harmony); and (iv) how you deal with the outside world (judging: in an organized way; perception: in a flexible, emerging way). These four functions with opposite preferences generate a set of 16 combinations that are called 'psychological types' describing specific patterns of behaviors that are observable, predictive and repetitive. These types are predictive of occupational preferences¹².

The MBTI questionnaire ascertains these preferences. This questionnaire has been validated in English^{13,14} and Spanish¹⁵, among others¹⁶, and there are data from general populations¹⁷, from executives^{13,18} and even from scientists and engineers¹⁹.

Mentor-mentee matching process and results

For the best possible results in the mentor-mentee relationships, we conducted an analysis of the personal and professional profiles and MBTI personality types for all mentees and for all potential mentors. Results from the mentors' and mentees' evaluations at the beginning of the program (all 40 mentors and 15 mentees participated) are shown in Fig. 2b. We evaluated the area of expertise of each of the mentees and mentors to see which fields matched best. Some studies report statistically significant differences in the mentor-mentee relationship according to gender^{20,21}. We did not match mentors and mentees by gender in this case. There

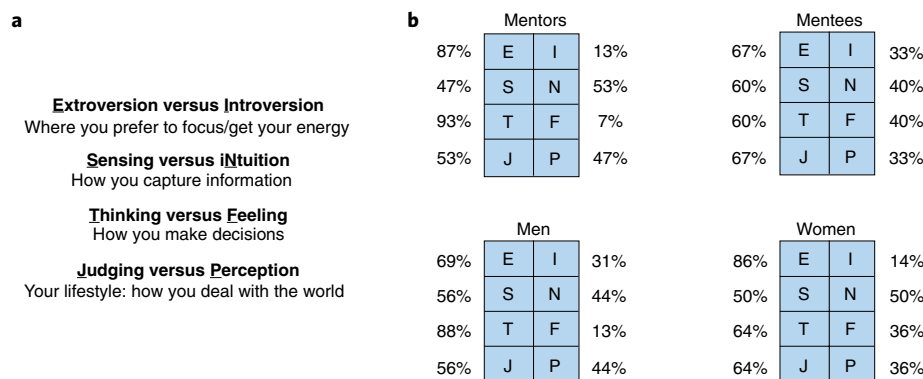


Fig. 2 | MBTI results based on the mentors and mentees from Fostering Grads. a, MBTI psychological opposite preferences comparison chart based on Jung¹⁰. **b**, Average of psychological functions broken down into the mentors and mentees and into the men and women who participated in the Fostering Grads pilot program ($n = 40$ mentors; $n = 15$ mentees).

was a relatively even distribution of mentors and mentees, with 47% male mentees and 53% female ones compared with 46% male mentors and 54% female ones.

With respect to MBTI types, we aimed to match mentor and mentee on the basis of two criteria. They should have similar preference in the extroversion–introversion function or, in case of discrepancy, the mentor should be extroverted and the mentee introverted, but not the reverse. We found we had 87% extroversion among the mentors but only 67% among the mentees. The second main matching criterion was the sensing–intuition function, regulating how we capture information (facts and data versus conceptually); this function is important to match because the way we capture information is the way we transmit the information; that is the way we communicate¹¹. We had no difficulty in matching this function either, as 60% of the mentees had a sensing preference and 40% an intuition preference, whereas 47% of the mentors had a sensing preference and 53% an intuition preference.

MBTI is widely used in the executive, educational and counselling world. According to Hammer¹², people with a scientific background are often characterized by the NT pair of psychological functions (intuition and thinking). Our mentors, with a 53% score for intuition and 93% for thinking, most often matched this pattern. By contrast, we found that our mentees most often had the ST (sensing and thinking) psychological functions, which means that the way they capture information is more through the senses, facts and data rather than concepts and ideas. Mentors focus on action (extroversion), capture information through concepts and ideas (intuition), decide objectively (thinking) and organize in a planned and controlled way (judging).

Considering all men and all women, both most often showed this same psychological type, ESTJ, with small variations within the percentages.

In summary, Fostering Grads' mentors had, on average, a psychological type of ENTJ while the mentees had one of ESTJ. We consider the matching process, especially in the areas of expertise, gender, extroversion–introversion and sensing–intuition, one of the key factors in the success of this mentorship program.

Conclusions and future objectives

Fostering Grads has fostered new professional interactions between Spain and US universities and research institutions, boosting collaborations and networking. We also provided mentors the opportunity and privilege of engaging in the interactive art of mentoring while supporting their mentee's professional development. The results of the matching process through the MBTI questionnaire directly contributed to the success of the pilot program. All 15 PhD students from the ULL came to the United States during 2018 and worked in several different research institutions. These 15 successful mentorships have given rise to new and meaningful relationships that are likely to endure over time. Because of the experience working abroad during their thesis research, all 15 PhD students will obtain international mentions in their doctoral theses. Fostering Grads encourages its mentees to further develop their own careers by taking advantage of the experienced mentors, who are eager to transmit their knowledge. We hope that this characterization of our pilot program will encourage other institutions²² and universities²³ that are running or considering developing similar mentoring programs to use the MBTI as a tool for ensuring meaningful relationships between mentor and mentee. □

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Competing interests

The authors declare no competing interests.