

Combatting Stereotypes in Computing using Personality Type

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Abstract—This Innovative Practice Work in Progress focuses on encouraging the persistence of computing majors. Research has shown that one factor in whether or not a student persists in a computing major is a sense of belonging. We are using Myers-Briggs personality types to help students see that even if they feel they are currently in a minority, others who are similar to them are successfully enjoying a computing career. It is our hope that our discussion of Myers-Briggs personality types also facilitates students' understanding of the value of diversity in a computing environment.

Keywords—*personality types, stereotypes in computing, belonging, persistence*

I. INTRODUCTION

Our Department, along with many other computer science (CS) departments across the country, have struggled to retain majors, particularly through their first year. Numerous research studies have examined this issue. Consequently, various interventions are incorporated into early programming courses. Programming assignments might be taken from a broad range of disciplines and application tracks created to allow students to program problems in an area of interest [1]. Pair programming might be utilized during lab sessions to demonstrate the team approach to software development and help students see the value of communication and collaboration [2]. Separate introductory courses may be offered for novice and experienced programmers [3], [4].

In this research, we consider another factor identified in multiple studies as impacting a student's decision to remain in computing, that is, a student's sense of belonging or fit. If students perceive that their values and sense of identity are different from their peers or what they associate with the practice of the discipline, they may assume that they do not fit. As a consequence, they may change majors even if they are performing well in the early courses. Besides impacting our student retention, this behavior can result in less diversity in our graduating classes and ultimately in the profession.

It is difficult to change the dominant culture in a given environment. Our focus instead is on students who may feel they are in a minority and who may question if they belong in the major. We aim to help these students see that there are others similar to them who are succeeding in and enjoying a career in computing. Simultaneously, we want to encourage each of the students to better appreciate the value that diverse perspectives can bring to a problem-solving environment. As

one step in accomplishing these goals, we are experimenting with the use of a Myers-Briggs (MB) personality assessment in a first semester CS course. We find the use of a personality assessment to be a less threatening way to talk about differences and the value of diversity on a team. Ideally, if all students in the major understand the value of diversity, it may reduce the kind of peer-to-peer interaction that can diminish some students' sense of belonging.

Along with a discussion on diversity, students are provided a table of personality types containing the job title and job description of an alum for each given personality type. This allows each student to see what someone with his or her personality type is doing with a degree in CS and why the alum enjoys the job. Given that there are 16 unique MB types, it also provides students with a list of 16 possible job descriptions to broaden their perspective on potential future opportunities.

In this paper, we will discuss our initial experience with using this approach to discuss diversity with CS students and share some insights and lessons learned from our early experiences. We do not anticipate that this alone will be sufficient to deal with stereotype and culture issues. It may be one of several tools needed to help students who are in a minority see a place for themselves in computing and for all students to recognize the value of diversity on a team.

II. BACKGROUND

A. Sense of belonging

A study by Biggers et al. [5] found that students who left CS "have an overwhelming perception that CS is an asocial, coding-only field with little connection to the outside world". They also found that 80% of the women and a bit over 50% of the men did not feel as if they belonged. More recently Veilleux et al. [6] discussed the relationship between a sense of belonging and perceived ability in CS. They pointed out an interesting distinction between feelings of belonging based on social context ("Do I feel socially appropriate and welcomed in this environment?") and belonging based on ability ("Do I have the ability to perform/succeed in this discipline?").

Lewis et al. [7] developed a model of students' decision to major in CS based on ability, fit, enjoyment, utility and opportunity cost. In a follow-on study [8], they suggested showing students that stereotypes are not actually a function of typical CS careers. Students in their study initially identified

TABLE I
OVERVIEW OF MBTI FACTORS

E / I	The extent to which individuals prefer focusing on the external world and communicating to process ideas (E) versus focusing on the inner world and processing ideas internally (I)
S / N	The extent to which individuals prefer focusing on facts and details (S) versus a preference for identifying complex patterns and adding interpretations (N)
F / T	The extent to which an individual prefers making decisions considering people and special circumstances (F) versus making decisions based dispassionately on logic (T)
P / J	The extent to which an individual prefers waiting for additional information (P) versus getting decisions made and having firm plans (J)

the stereotypical computer scientist as being someone who has a singular focus and is asocial, competitive, and male. They found that countermeasures could help students who did not match that stereotype maintain their interest in a CS career. One approach that countered the stereotype was a one-credit seminar course focused on encouraging “a broad, accurate view of computer science and related fields” through company visits, research presentations and interactions with upper-level students and alums.

A study by Semmens et al. [9] adds to the evidence that stereotypes held by students may be malleable. High school students were asked to list adjectives describing themselves and a computer scientist before and after an 8-week summer CS program. After the program, the descriptions of a computer scientist were more positive than before the workshop and the phrases used by the students after the workshop to describe themselves and the computer scientist had more similarities.

Interestingly, there is some evidence that stereotypes may be changing. A large study of students in grades 7-12, parents, teachers, principals, and superintendents [10] found that students overall had a positive perception of CS.

B. Personality Types in Computing

The numerous images in the media portraying the classic stereotype of software developers is part of why the stereotype persists. Research on personality types indicates there may also be a basis in reality for the classic CS stereotype. There are a multitude of personality type assessments, but we will primarily focus on research using the MB system [11]. The MB system has been used in a number of studies examining students and professionals in computing. Briefly, the MB system, which is based on Jung’s type theory, consists of 16 personality types determined from an individual’s preferences on four scales: extroversion(E)/introversion(I), sensing(S)/intuition(N), thinking(T)/feeling(F) and judgment(J)/perception(P). See Table I for brief definitions of these factors. The 16 types are represented by the four letter combinations that are an indication of an individual’s preferences on these four scales. See Table II.

A series of studies over two decades starting in 1985 [12]–[15] found disproportionately more introverts and thinkers among computing professionals compared to the general population. A study of computing students by Chandler et al. [16] also indicated that the student population preferences

TABLE II
MB TYPES

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

tended toward sensing, judging and introversion. These types are not inconsistent with the image of those in computing being asocial and singularly focused.

Various researchers have suggested a need for greater diversity in terms of personality types in software development teams and computing occupations. Capretz and Ahmed [17] discuss the range of personality types and how individuals of each type might be effective in software engineering related professions. Even twenty years ago, a study by Teague [18] suggested that a broad range of personality types are needed in computing occupations. In 2005, Karn and Cowling [19] studied the impacts of personality type on the performance of software engineering teams and observed that homogeneous teams, particularly those dominated by introverts, encountered difficulties arising from the “no debate trap”, an unwillingness to bring up issues. Using the DISC personality test, Lykourantzou et al. [20] also found that heterogeneous groups performed better.

There are some indications that the mix of personality types in software engineering may be changing. A review of multiple studies between 1985 and 2010 [21] showed that the types of individuals attracted to computing may be changing to more extroverts versus introverts and more feeling versus thinking types. However, because of the varying sample sizes and differing countries in which the studies were conducted, this may not accurately reflect the trend in any given location.

III. USING MB IN AN EARLY CS COURSE

Over the years, we have talked with numerous students who indicated that they enjoyed programming, but, consistent with the literature, indicated they had doubts that a computing major was the right choice for them. Generally, these discussions included indications that an underlying issue is the sense of “not belonging”. Often these students indicated interests and skills that are consistent with successful careers in computing, but the environment and their perceptions of the career opportunities caused them to doubt their initial choice of major. Many of these students ultimately switched majors. Providing such students with appropriate career information prior to doubts setting in is likely to be more effective than providing information after doubts have taken root. In this section, we will discuss our use of MB personality types as a way of showing all students that there can be a place in computing for them.

A. Our context

Our Department is in a technological university with roughly 7,000 students enrolled in primarily STEM-related degree programs. As such, the student population does not

match the standard profile in the United States for MB personality types. For instance, we tend to attract more introverts and more thinkers. This latter is likely also a function of our male/female imbalance with only 27% females campus-wide. The Department is in a College of Sciences and Arts and has the largest number of undergraduates in the college. Since students at our University are admitted directly into a major, most of our majors begin taking their required computing courses their first semester.

Our majors are required to take a one-credit course aimed at broadening their perspective of CS as a discipline and exposing them to a range of career opportunities. This course was established over 20 years ago to ensure that beginning students understand that CS is more than “just programming”. During the semester students are exposed to a broad range of computing disciplines through lectures by faculty members. They also learn about career opportunities through presentations from industry representatives and alums, and through attendance at the University’s Career Fair. Students typically take this course their first semester. In addition to this course, nearly all students in the class are also taking an introductory programming course. Depending on their programming background, students might be enrolled in one of several possible programming courses.

B. The Assignment

The inspiration for this assignment came from an experience with a career assessment tool [22] which appeared to have a fairly narrow definition of the type of individual who enjoys a career in computing. We wanted to show students that a narrow interpretation of the field was inconsistent with reality.

In preparation for the assignment, we recruited volunteers from our alums who were willing to share their MB type along with their job title and a brief description of why their job was a good fit for their personality. Not surprisingly, we had a preponderance of some types and had difficulty finding other types. Ultimately we had at least one example of an alum currently working in a computing-related occupation for each of the 16 MB personality types. The descriptions were edited for anonymity and to fit within limited space. See Table III for an example of the job descriptions. We chose to include a broad range of job titles including some that we assumed students were unlikely to associate with their major as shown in Table IV. We also included three Senior Software Engineering job descriptions associated with three different personality types to illustrate that MB types and job titles are not a one-to-one match. See Table V for the Senior Software Engineer descriptions. In order to make this point explicit the following was included in the preamble to the chart (along with an acknowledgment to the alums) [23] :

The intent [of this chart] is to show the diversity of personality types that find satisfaction in computing jobs. It is by no means intended to indicate that a certain job title is the best fit for a given type; indeed many alums with different personality types had similar job titles. The working environment, types

TABLE III
SAMPLE JOB DESCRIPTIONS

INFJ – Data Analyst	
Job:	I compile and analyze data from many different sources and then share my results either in a presentation or as an interactive tool.
Fit:	This job is a good fit for my personality type because I’m curious and always interested in new information. As an analyst, I am on the forefront of the company’s business knowledge in many areas.

TABLE IV
TYPES AND JOB TITLES INCLUDED IN PERSONALITY MATRIX

ISTJ	Technical Analyst
ISTP	DevOps Engineer
ISFJ	Senior Software Developer
ISFP	Senior Software Engineer
INTJ	Principle Scientist
INTP	Software Developer
INFJ	Data Analyst
INFP	Senior Software Engineer
ESTJ	Product Security Engineer
ESTP	Worldwide Executive
ESFJ	R&D Manager
ESFP	Software Engineer, Manager
ENTJ	Senior Software Engineer
ENTP	Product Group Delivery Manager
ENFJ	Software Development Engineer
ENFP	Supervisory Computer Scientist

of projects, processes used, and colleagues may all have a part in determining if a given position is a good fit for an individual’s personality type. Indeed, experience and research show that teams made up of diverse personality types typically outperform teams with limited diversity.

Before giving the assignment, a class hour is devoted to talking about diversity. Research showing that diverse teams perform better is presented. We briefly enumerate different types of diversity including diversity of expertise, education, age, and socioeconomic status. Finally, we talk about MB personality types. A few quotes from alums provide support for the value of having a mixture of personality types on a development team and make reference to MB types. Finally, we describe each of the four pairs of preferences which make up the MB types. As we do this, students are asked to identify what benefit an individual with each preference might bring to a team. In our experience students are quickly able to suggest how each preference would be valuable and are able to identify ways such individuals could help a team be successful.

A brief homework assignment is then given. For the homework students are asked to take a free MB test online, if they do not already know their MB type. Once they know their type, they are to read the alum job description for their type and write about their reaction to the description. Finally, they are asked to see if some other job description seems to be a better match based on their interests. In a follow-on class, we provide the students with a summary of the personality types

TABLE V
TWO MB TYPES – SAME JOB TITLE

ISFP – Senior Software Engineer	
Job:	I work with a small group of people developing a web application used for testing financial systems. My main focus has been front-end development improving the look and feel of our application, creating better ways to display data to the user.
Fit:	I enjoy working with this small group. I've also enjoyed working on the front-end for our application. This has given me some freedom to combine my computer science knowledge with my design and creativity drive. I feel like these two things play a big role in why I enjoy this job and why this job matches this personality type.

INFP – Senior Software Engineer	
Job:	I maintain and add features to nearly every part of the software products in my department.
Fit:	I often act as a translator between people of different backgrounds and from different functional groups in the organization and occasionally as a mediator for disputes, which tends to be invaluable in engineering groups with problematic communications.

ENTJ – Senior Software Engineer	
Job:	Working on and leading team(s) that are creating products on top of our proprietary computing/data platform using full-stack Javascript.
Fit:	My job allows me to focus on engineering, while also utilizing my other skills in UX, data science, product, cross-functional collaboration, and team leadership

in the class and compare it with the population as a whole, as well as get some of their reactions to what they learned about career possibilities from the exercise.

IV. DISCUSSION AND CONCLUSION

Our students do not match the general US population when considering MB personality types. Nearly 2/3 of our students are introverts compared to less than 50% in the general population. Most noticeably, we had 20-25% INTJ's compared to 6% in the US population. As individuals who are often creative and like to see their solutions implemented, INTJ's are frequently associated with software engineering positions. On the other hand, each offering of the class also included individuals with each of the 16 personality types. Many students are now in an environment in which they are surrounded by students who may be quite different from those they encountered in high school. Some of these students, particularly those with a MB type vastly different from the dominant type, may indeed question if they belong in the major.

A. Lessons Learned

This MB assignment has now been given in two course offerings. Here are some of the lessons we have learned:

- Timing seems to be critical. The first year we gave this assignment it was given near the end of the semester. We assumed students would appreciate having a relatively easy homework while they were in the midst of completing major assignments for other classes. Some of the feedback indicated that the students were annoyed with the “distraction” of this assignment when they had “real” work for their other classes. The second year we gave the assignment during the second week of the semester. We were a bit concerned the students might not have had enough exposure to software development to appreciate the need for diversity, but that didn't seem to be the case. The class discussion was quite lively and students could identify and suggest strengths the different personality types might have in a software development environment.
- The first year the homework also required students to take two of the implicit bias tests available from Project Implicit [24]. Some students were quite skeptical of the validity of that test and that skepticism appeared to impact their openness to the MB portion of the homework assignment. Thus, we dropped the implicit bias tests the second year.
- Both in class and on the chart providing job descriptions, we emphasize that the point is to show the diversity of personality types that find satisfaction in computing-related positions. We also stress that there is not a direct mapping from personality type to computing career or a direct match between a given computing career and personality type. Some students did not get this distinction. One possibility for making this distinction more clear to students would be to have multiple positions for each personality type. The difficulty with that solution is acquiring multiple, unique job titles and descriptions for some of the personality types that are less common.

We have not yet done a formal evaluation of the effectiveness of using MB personality types to either facilitate a sense of belonging among our majors or to help students better value diversity. Based on our informal observations and the in-class discussion, students did learn something about the breadth of career options open to them and, in at least a few cases, did appear to be more engaged because of this. We did ask for students' reactions to the MB exercise in our course evaluation at the end of the term. In response to that question 43% of the students indicated they found it interesting to see a computing career associated with their personality type. Another 9% indicated that they questioned their personality type, but did find the career listed for that type to be of interest. Twenty percent indicated they enjoyed thinking about the ways diverse types of people can contribute to computing.

We hope to conduct a more formal evaluation of this particular lesson. A challenge is understanding the effect of this assignment given the range of activities the students are simultaneously engaged in that may also be influencing them.

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