

The Effect of Immigration Status on Physics Identity and Physical Science Career Intentions

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Abstract. Using data collected from a nationally-representative sample of first-year college students, we examine how students' identity development as physics persons and their likelihood to pursue a career in physical science is predicted by differing immigrant experiences. We consider broad factors having a social, economic, or cultural nature as covariates in a propensity score model that assesses differences due to immigrant generation. Our results show that, when controlling for such factors as race/ethnicity, socio-economic status, and gender, students' physics identities and the likelihood of choosing a career in physical science are significantly higher amongst first generation students than second generation (or later) students. We conclude that physical science as a career option can be influenced by the experiences of being an immigrant and through the relationship between origin and host culture.

Keywords: career choice, immigrant generation, cultural identity, propensity score matching

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INTRODUCTION

The APS's renewed interest in increasing the number of physics bachelor's degrees is consistent with US educational, economic, strategic and even civic needs [1]. Current trends show a small increase in the ratio of physics degrees to all bachelor degrees but it still falls short of these needs. These trends continue into graduate education and beyond. Similar low graduation rates have been identified in other STEM disciplines. Moreover, foreign-born individuals are over-represented in STEM [2]. While there is some variation in different fields, overall the trend has increased in recent years and is particularly prevalent in physics. These observations beg a closer investigation of the process through which individuals choose a career in physics and, in particular, differences between foreign- and US-born individual in their choice of a future career in the physical sciences.

Students' choice of major and their persistence in pursuing a major are related to their performance and competence during their undergraduate studies. But these are not the only important factors. Recent work has shown that students' physics identity, which integrates students' beliefs about their performance (carrying out physics tasks), competence (capability of understanding physics content), recognition (by others), and interest (desire/curiosity to learn physics) is an important perspective to understanding the intersection between personal and social factors [3].

Another informative perspective on career choices is given by the social cognitive career theory (SCCT) [4],

centered on socio-cognitive mechanisms such as self-efficacy, outcome expectations and goal representations. The gradual evolution from career interests, through selective focus on certain goals and activities and ending in the attainment of career-related goals, is seen as stemming from learning experiences which help build an individual's self-efficacy and outcome expectations. In turn, learning experiences depend on personal characteristics, such as predispositions, gender, race/ethnicity, health status, and on the contextual background in which the educational experiences take place. These characteristics further moderate the choice of career goals as well as the choice of specific actions.

The SCCT model is focused on the cognitive aspects of career choices while the affective components, although not completely neglected, have less importance. In this work, we consider, in addition, the formative cultural influences upon the development of interest and recognition as a physics person, which, in turn, can reinforce beliefs about performance and competence. SCCT gives more detail at the individual level, while the cultural effects are more visible from other perspectives. Our study investigates the impact of an individuals' move from one culture to another on their physics identity and the likelihood of choosing a career in physics. For the purpose of this study, we distinguish between first generation immigrants, who were foreign-born; second generation immigrants (born in the US from foreign-born parents); and third generation immigrants (locally-born individuals whose parents were also US-born) [5, 6]. First generation immigrants develop from their initial culture

toward US culture (thus following a path of “acculturation”), third generation immigrants develop within US culture (following a path of “enculturation”), while second generation immigrants experience an intermediate socio-cultural trajectory.

In order to connect individual experiences with social-cultural factors, it is necessary to characterize the position of an individual with respect to their social niche. This connection is helpfully provided by Bourdieu’s concepts of field, habitus, and capital [7, 8]. Firstly, fields are social spaces in which people live their lives. In any society, fields have a characteristic complexity and belong to a hierarchical structure which is apparent to individuals as rules, procedures, or boundaries. They may be seen as the “rules of the game”. Secondly, habitus, a personal dimension, is a “system of internal, personal, enduring dispositions through which people perceive the world.” It can be seen as the “feel of the game”. People acquire a certain habitus through personal experiences or experiences within a group. Habitus is populated by values, interests, and motivations. There is a feedback relationship between field and habitus - the constraints of a field are internalized over time to become part of one’s habitus, while one’s field is shaped by individual actions arising from the habitus. Third is the concept of capital. Aside from economic capital, of importance in this discussion are social capital (a person’s network of relationships) and cultural capital. This partly takes the form of durable dispositions of habitus and partly the form of acquired cultural products and academic titles.

For the current investigation, we can identify the “field” to be one’s career (an individual moving through a particular social context), career “capital” means the sort of capital valued in this field [9], and the “habitus” takes the form of “knowing why, knowing how, knowing whom”. In STEM, the habitus begins its formation through disciplinary content learning and develops as individuals undergo a successive set of career choices, ultimately leading to practice in their chosen profession.

OBJECTIVES

In the current work, we focused on investigating the influence of immigrant generation on three categories of outcomes: physics identity, physics outcome expectations and physics career goal representations.

DATA

The current study is based on data from the PRiSE Project (NSF Grant No. 0624444), collected in 2007. The survey was applied to a national sample of 7505 university and four-year college students enrolled in in-

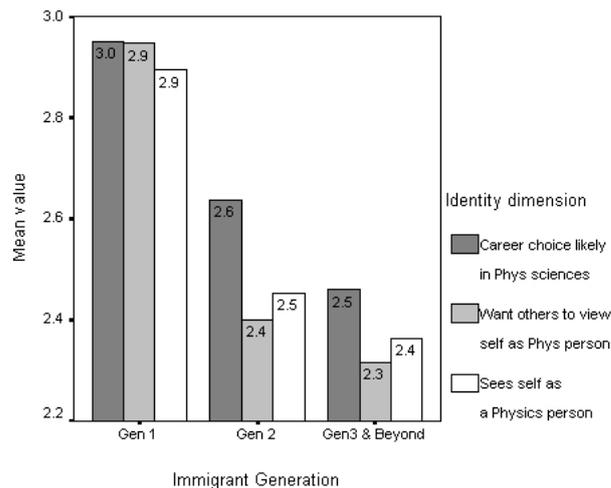


FIGURE 1. Average values of dependent variables for each immigrant generation.

troductory English courses. Survey questions referred to demographics, science interest, past school experiences related to taking science courses, the respondents’ perceived identification with physics, as well as their likelihood to pursue a career in physical sciences. The variables in this study were operationalized as follows:

- Three immigrant generations were identified: first, second and third (beyond second) generation.
- Physics identity was assessed as the degree to which subjects saw themselves as physics persons (6-pt scale: “not at all” to “very much”).
- Physics outcome expectation was taken as the degree to which students wanted to be seen as physics persons (6-pt scale).
- Physics career goal representation was the likelihood of the students’ choice of a career in the physical sciences (6 pt scale).

ANALYSIS AND RESULTS

Using the variables as defined, the effects of immigrant generation on the physics identity, outcome expectation and goal representation were first evaluated by comparing responses for subjects belonging to the three immigrant generations. Mean responses for these groups are indicated graphically in Figure 1. A robust test, independent of the shape of variable distribution, is the Kruskal-Wallis nonparametric test with the Bonferroni correction for a total adjusted level of significance. As seen in Table 1, the results of this test indicate that first generation immigrants are significantly different from all other generation students with respect to all three outcomes ana-

lyzed, while there are no significant differences between second and third generations (throughout this analysis, a strict cutoff of $\alpha = 0.05$ was applied in all tests of significance). However, while the distribution of the entire sample across genders and races/ethnicities as well as immigrant generation closely followed nationally-available data on college students, distributions within different immigrant generations were not similar due to the fact that they reflect US immigration trends at different times in the past, as seen in Figure 2. Thus, the comparisons made between dependent variables for the three immigrant generations need to be analyzed with caution because any differences may be, in fact, due to their different race/ethnicity composition and not to actual career differences between immigrant and US-born students. In order to control for several factors (including gender and race/ethnicity), a more sophisticated test had to be performed - a propensity score matching method.

Propensity Score Matching

In simple or well-controlled cases, covariates can be accounted for by performing comparisons between groups in which subjects are paired with respect to the covariates. In these scenarios, a t-test can be applied and the results are not dependent on the covariates. When there is a wider array of covariates or the data is not as well-controlled (such as the cross-sectional data used here), this problem is more complicated. A particularly useful method in these cases is propensity score matching [10]. In order to determine whether an experimental treatment impacts the outcome of interest, each unit in the treatment group is matched to its closest unit from the control group; the matching is made based on a propensity score, calculated from the data and estimated by logistic regression. A variant of this method that was used in the current paper, genetic matching, includes an optimization routine which minimizes the discrepancy between treatment and control group covariates through an iterative bootstrapping process.

Propensity score matching has the advantage of being applicable to more general collections of data, including non-experimental data with uneven numbers of units in different categories, which can then be treated as if the data came from an experimental design. In the present study, we employed propensity score matching to compare immigrant generation groups while controlling for a set of covariates. The method can only simultaneously compare two groups (the “treatment” and “control” groups), so we defined the “treatment” to be first generation immigrant status while the “control” included the other immigrant generations, consistent with the results of the Kruskal-Wallis tests (Table 1) that found only first

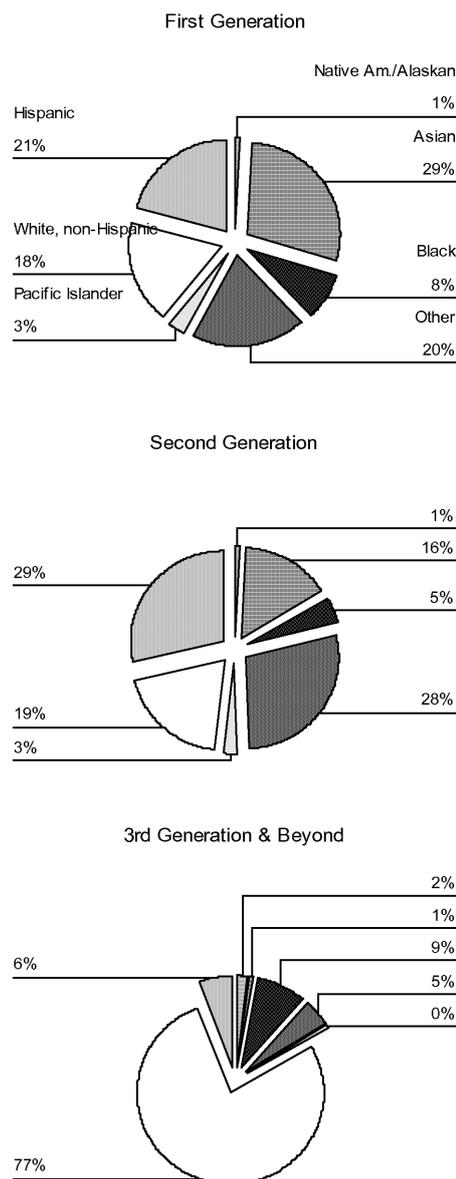


FIGURE 2. Racial/ethnic makeup of three immigrant generations, before propensity score matching.

generation immigrants to be significantly different.

In this way, the propensity score matching method yielded estimates of the effect of the treatment (first generation immigrant status) on the dependent variables of interest (physics identity, outcome expectations, and goal representation) while matching on the covariates of race, gender, ethnicity, socioeconomic status, and the level of home support for science. The results of these analyses are shown in Table 2. Note that, after matching, there were no significant differences between treatment and control groups on all of the covariates.

TABLE 1. Physics career-related variables. For the all three outcomes, first generation immigrants are significantly different, while means for second and third generation immigrants cluster together.

Variable	Chi-Square	p	Distinct Groups
Likelihood of choosing physical science career	38.311	< 0.001	2: Gen1 > Gen2, Gen3
Want others to see self as physics person	41.199	< 0.001	2: Gen1 > Gen2, Gen3
See self as physics person	30.822	< 0.001	2: Gen1 > Gen2, Gen3

TABLE 2. Propensity score matched comparisons between first generation immigrants and other students. Group sizes: treatment (first generation immigrant status) $N = 323$, matched control $N = 323$.

Variable	Estimated Effect Size (Standard Error)	t Statistic	p
Likelihood of choosing physical science career	0.390 (0.120)	3.251	0.001
Want others to see self as physics person	0.419 (0.138)	3.047	0.002
See self as physics person	0.357 (0.137)	2.608	0.009

DISCUSSION

Our results show that, even after matching for gender, race/ethnicity, socioeconomic status and home support for science, the effect of immigrant generation has a significant effect on each aspect of the socio-cognitive process involved in career development. That is, first generation immigrant status positively influences physics identity, physics outcome expectations and physical sciences goal representations.

The results obtained here are compatible with both the SCCT model and the sociological model based on Bourdieu's concepts of field, habitus and career capital. This reflects the fact that different cultural values within the same ethnic group, have distinct measurable influences on the entire process leading up to, and likely beyond, the choice of a career in physical sciences (although, as we have seen, differences between immigrant groups tend to decrease over time). It is important to note that the differences detected do not directly reference a discrepancy between groups with respect to physics performance, competence, or other explicit cognitive variables. Cultural values are more closely related to the individual emotional regulator processes, which, in turn, foster a higher degree of identification with physics.

A few shortcomings of the present analysis are due to limitations in the data: the instrument did not distinguish between third and later generation immigrants. Also, immigrant students are not distinguishable from international students who intend to return to their countries of origin.

Another concern is related to second generation immigrants, who are in a transitional stage between being a newcomer and being late generation American. Earlier research [11] has shown that this immigrant group does not behave simply as a combination of the two other immigrant groups. Rather, in some respects they behave like new immigrants, in other respects like late generation immigrants, and in some respects they behave like neither.

Further research is needed to give a more exact profile and understanding of this group.

Generally, immigrant generations in the U.S. consist of persons of heterogeneous national origin. So, in order to further investigate the consequences associated with change in habitus due to immigration, it would be interesting to make within-racial/ethnic group comparisons between generations of immigrants.

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