College Seniors' Plans for Graduate School: Do Deep Approaches Learning and Holland Academic Environments Matter?

**Louis M. Rocconi · Amy K. Ribera ·
Thomas F. Nelson Laird**

Abstract   This study examines the extent to which college seniors' plans for graduate school are related to their tendency to engage in deep approaches to learning (DAL) and their academic environments (majors) as classified by Holland type. Using data from the National Survey of Student Engagement, we analyzed responses from over 116,000 seniors attending 499 four-year institutions. Findings revealed a significant positive relationship between seniors' uses of DAL and plans for earning a graduate degree. Further, seniors majoring in Investigative and Social environments were more likely to hold higher degree expectations. Significant interaction effects by DAL and Holland academic environment were also found. The impact of DAL on graduate degree expectations was greater for seniors majoring in Artistic environments than otherwise similar students in Investigative, Enterprising, or Social environments. In addition, the impact of DAL on degree expectations was greater for seniors in Enterprising environments than otherwise similar students in Social environments

Keywords   Degree aspirations · Degree expectations · Deep approaches to learning · Holland's theory

Introduction

Formal education is the primary pathway towards countless careers and many occupations, such as medicine, law, physical therapy, and counseling, that require education beyond a

L. M. Rocconi (✉) · A. K. Ribera · T. F. Nelson Laird
Indiana University Center for Postsecondary Research, Indiana University Bloomington , 1900 E.
Tenth Street, Suite 419, Bloomington, IN 47406, USA
e-mail: lrocconi@indiana.edu

A. K. Ribera
e-mail: akribera@indiana.edu

T. F. Nelson Laird
e-mail: tflaird@indiana.edu

baccalaureate degree. Over the past 35 years, college first-year students' plans to earn master's or doctoral degrees (excluding first-professional degrees such as an M.D. or J.D.) have risen from around 40 % in 1974 to over 60 % in 2009 (Bell 2010). Despite the overall increase, there are valid concerns among academic leaders about the state of graduate education. In nursing, for example, there are an inadequate number of undergraduate students furthering their education beyond a bachelor's degree to replace the baby-boomer faculty population (Clearly et al. 2007). And, in psychology, some are troubled about the lack of diversity among doctoral graduates joining the faculty ranks (Maton et al. 2006). Although earning a graduate degree is not the gold standard for every discipline (Grafton and Grossman 2011), it does present a problem for those wanting to promote and support diversity in their respective field or profession.

Individuals with advanced degrees tend to earn higher salaries compared to those with only a high school diploma and individuals with a bachelor's degree (Baum et al. 2013). Additional years of education are not only associated with higher levels of earning, but lower rates of underemployment, greater fringe benefits (retirement/health plans) during employment, and higher participation in civic and community affairs (Baum et al. 2013). Graduate education not only provides colleges and universities with researchers and professors but also gives society highly skilled workers capable of developing new ideas and technologies (Stewart 2010). While aspiring to a higher degree may not be right for everyone, and in certain cases earning a higher degree can lead to underemployment or employment in a position other than one that is desired [e.g., according to Mikaelian (2014) hundreds of PhD graduates in history will not get the academic positions they want], the overall pattern of benefits for graduate education is clear. Given the substantial benefits associated with additional years of education, research aimed at understanding how to increase or maintain students' interest in earning a graduate degree is valuable.

Expectedly, plans for graduate school are not always at the forefront of students' minds in the first few years of college. Many students, especially those from historically underrepresented populations, are focused on overcoming barriers affecting their sense of belonging and integration into the college experience rather than planning life after graduation (Hurtado and Carter 1997; Strayhorn 2012). Yet, one of the many challenges colleges and universities face is supporting and retaining students from diverse backgrounds. This issue certainly impacts the structural diversity of graduate students, and ultimately, faculty teaching undergraduate students (Chesler et al. 2010; Clearly et al. 2007; Maton et al. 2006). One effective way to address this cycle is to identify factors controllable by the institution that can encourage and support students' motivation to attend graduate school.

Recently, academic departments have started to propose using effective educational practices (e.g., types of student engagement and high-impact practices) as ways to improve enrollment in graduate programs, particularly in the STEM fields. Strayhorn (2010) offered that encouraging participation in undergraduate research may help socialize students into the STEM fields, and help increase educational aspirations. Johnson and Sheppard (2004) urged faculty in engineering to interact with students and become more involved to "demystify" the journey to graduate school. Yet, none have closely examined the potential impact of deep approaches to learning (DAL) as an effective educational practice to boost students' educational aspirations.

Besides pre-college individual characteristics such as socio-demographics and personal aspirations and goals, Carter (2002) postulated college students' educational aspirations are attributable to four primary influences controllable by the institution—academic achievement, institutional context (e.g., financial aid, campus climate, involvement with

students), experiences with structural characteristics (e.g., size, selectivity, diverse student enrollments) and external support with employers and family. However, the model does not go into great detail on specific aspects of academic achievement and institutional context. Carter (2002) suggested "students may adjust their aspiration level in college based on their college academic performance" (p. 164). It is conceivable that if students are required by faculty to engage in DAL then it may have a positive impact on their academic achievement, and thus, degree aspirations. It is also possible that faculty in various academic contexts will shape students' educational aspiration through socialization. This study aims to contribute to a discussion about the socialization process of students into disciplinary-based academic environments and the role faculty may play in encouraging higher degree aspirations.

Specifically, the purpose of this study is to investigate the extent individual learning behaviors and disciplinary-based academic environments affect college students' plans to earn a graduate degree. That is, do seniors who approach learning more deeply (i.e., with higher intentions to gain knowledge beyond a surface-level understanding) also tend to hold higher degree expectations[1]? And, importantly, does the disciplinary culture in which the student operates matter? Using Holland's (1997) theory to describe academic environments within colleges and universities, this study sets out to reveal qualities of academic environments associated with higher degree expectations, and whether or not the effect of DAL on graduate school plans is moderated by disciplinary culture. Addressing these questions has practical implications for academic units looking for ways to bolster graduate school enrollments. Results also provide empirical evidence pinpointing specific learning behaviors to future academic plans, which may help to extend Carter's model (2002) of graduate degree aspirations.

The following research questions guided this study:

1. How does the amount seniors use DAL relate to their plans to earn a graduate degree?
2. How do Holland academic environments relate to seniors' plans to earn a graduate degree?
3. Do Holland academic environments moderate the relationship between DAL and seniors' plans to earn a graduate degree?

Literature Review

Individual and Institutional Factors Affecting Degree Aspirations

Carter (2002) offers a theoretical model to illustrate the ways graduate degree aspirations may be affected by students' pre-college characteristics, initial aspirations, academic and career goals, experiences and involvement in college, and academic achievement. The conceptual model pays particular attention to the role individual qualities have in shaping students' educational aspirations. It also highlights the impact structural characteristics of the institution and social environments within institutions may have on future academic plans.

---

[1] Given the wording of our question (What is the highest level of education you ever expect to complete?), we use the phrase "degree expectations" rather than "degree aspirations" which is typically used in the literature.

Several studies examining differences in students' pre-college characteristics have corroborated Carter's conceptual model. Specifically, studies have reported differences in degree aspirations by students' racial and ethnic background (Pascarella et al. 2004a; Perna 2004), gender (Perna 2004), parental education and socioeconomic status (Walpole 2003; Pascarella et al. 2004b; Paulsen and St. John 2002), self-efficacy (Museus and Hendel 2005), and academic achievement as measured by college GPA (Walpole 2008). Some studies are beginning to tap into students' behaviors by examining differences in degree aspirations through the lens of academic and social engagement. For example, in a study exploring college experiences of first-generation students, Pike and Kuh (2005) concluded lower degree aspirations were partly explained by their lack of engagement in social and academic activities. As a measure of academic engagement, Kim and Sax (2009) reported a positive relationship between course-related student-faculty interactions and degree aspirations. They also concluded research-related interactions with faculty lead to an increase in educational aspirations.

Researchers have also found institutional context matters as well. A study by Ethington and Smart (1986) exploring the pathways to graduate education, found both institutional selectivity and enrollment size had direct effects on undergraduate students pursuing a graduate degree. Additionally, they revealed a positive relationship between social and academic involvement and the likelihood of attending graduate school. They concluded that academic and social integration were both important for persistence through the educational process.

It is clear from these studies that institutional context, individual characteristics, and what students do in college, particular their academic engagement, can play an important role in shaping educational aspirations. Yet, these studies leave some effects unexplored or underexplored. In particular, more work is needed to understand the impact of academic context (i.e., major field of study) and students' uses of DAL, a specific measure of academic engagement, on aspirations to earn a graduate degree. According to Carter (2002), college students' degree goals are a "function of their individual background and circumstances, their institutional choices (such as they are), and the socializing influences of the institution" (p. 149). Carter also proposed the social environment in colleges and universities play a role in shaping students' degree aspirations. While Ethington and Smart (1986) have provided evidence that institutional characteristics affect college students' degree aspirations, very little is known about the role disciplinary-based academic environments play.

Disciplinary-Based Academic Environments as Socializing Agents

Higher education scholars often look to Holland's (1997) theory of vocational choice to understand the socialization process of academic environments on college students' attitudes, values, and behaviors (Feldman et al. 2004, 2008; Smart et al. 2009, 2000; Smart and Umbach 2007). At the core of Holland's (1997) theory is the premise that individuals and environments can be classified into one or more types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Holland's theory assumes that most people can be classified into one of these six personality types based upon their attitudes, competencies, and interests. Holland also describes six corresponding environments that are based on the dominant personality type of individuals within a given group (see Appendix 1 for brief description of each environment). For example, an Artistic environment is dominated by people who have an Artistic personality type. Holland hypothesizes that people tend to gravitate towards environments that correspond to their personality type and in turn, these

environments reinforce and reward different individual behaviors and values based on their personality type. For instance, an Investigative environment emphasizes analytical or intellectual activities and encourages mathematical and scientific competencies. People in Investigative environments are rewarded for their display of scientific values and problem solving skills.

The three basic propositions of Holland's theory as applied to college students and their academic disciplines are: (1) students search for and select majors that are compatible with their personality type (self-selection); (2) academic disciplines reinforce and reward certain behaviors, values, and interest (socialization); and (3) students are more likely to have higher levels of satisfaction and achievement in environments that are congruent to their personality type (congruence).

Scholars have provided support for all three propositions. Examining patterns of change and stability in the attitudes and interest of college students over a four-year period, Smart and Feldman (1998) found that the intended academic majors of first-year students were generally consistent with their personality types. They also noted that students majoring in Artistic and Enterprising environments showed an accentuating or sharpening of these attitudes and interest over a four-year period, providing support for Holland's socialization proposition. Scholars have also provided support for the congruence hypothesis. Antony (1998) found that the congruence of one's personality type and environment was related to students' medical career aspirations. While examining the relationship between intended college major and students' expectations for college, Pike (2006) observed that expectations were generally consistent with students' personality types and that the relationship was strongest when intended major and personality type were congruent.

Research also strongly supports Holland's socialization hypothesis. Testing this hypothesis, Smart and colleagues (Smart et al. 2000; Feldman et al. 2008) examined changes in students' abilities and interest after 4 years from time of college entry. The researchers found that students in a Holland academic environment gained in their abilities and interest related to that environment, irrespective of whether their personality type was congruent with that environment. For instance, students in Investigative environments showed increases in their Investigative abilities and interest after 4 years of college while students in non-Investigative environments declined in their Investigative interest and abilities.

The socialization aspect of Holland's theory proposes that academic environments contribute to students' learning and development and this occurs primarily through faculty. Faculty play a significant role in the socialization process by rewarding students and reinforcing preferred values of the field through various teaching methods and emphasis on certain learning outcomes (Smart and Umbach 2007; Smart et al. 2009). Moreover, researchers (Feldman et al. 2004, 2008; Smart et al. 2000) found evidence that socialization occurs even if the person-environment fit was incongruent. That is, even when a students' personality type differed from the dominant type in their major field of study, the academic environment still exerts an influence on students' growth and development in college.

Interestingly, Holland (1997) theorized educational aspirations would vary by personality types. He claimed people with Investigative and Social personality types were more likely to hold higher educational aspirations. A study by Gasser et al. (2004) found this to be true. By examining the educational aspirations of college students in an introductory psychology course, the study revealed students with Investigative personality types tended to hold higher degree aspirations. Given the abundance of support for Holland's theory, it

appears that disciplinary-based academic environments can serve as strong socializing agents for students.

While we concentrate on Holland's theory for this study, it is worth noting that other scholars have also argued for the importance of academic disciplines in the socialization process of undergraduate students. For example, Weidman (1989) developed a conceptual framework intended to understand confounding aspects of the socialization process that undergraduate students experience in college. He described undergraduate socialization as a process that occurs over a period of time, and students' interaction with the normative contexts, both academic and social, may help to reinforce, change, or maintain their initial personal goals, values, and aspirations. Further, Weidman (1989) stated the importance of faculty and academic departments as key socializing agents, and added "faculty evaluation of student's performances in class-related activities as well as in other settings can be a significant influence on students' goals and aspirations" (p.306). In addition, Weidman recommends using Holland's six environmental types as a way to better understand the norms the disciplinary-based environment presses on students.

Deep Approaches to Learning as an Effective Educational Practice

A DAL is a desirable educational practice derived from the works of Marton and Säljö (1976a, b). Compared to a surface approach, students who engage in DAL are more likely to retain information for longer periods of time (Svensson 1977), earn better grades (Zeegers 2004; Zhang 2000), be more satisfied by the learning process (Tagg 2003), develop critical thinking skills (Chapman 2001), and integrate and transfer information at higher rates (Prosser and Millar 1989).

Marton and Säljö (1976a, b) were the first to find qualitative differences in how students processed information. For example, they described deep-level processing as extracting personal meaning and integrating or relating material to previous knowledge. Alternatively, students who processed information by attempting to memorize disconnected pieces of information without imposing any coherent structure on the materials engaged in surface-level processing. Levels of processing were closely related to qualitative differences in learning outcomes (Marton and Säljö 1984; Svensson 1977). Students who used deep-level processing were more likely to gain deep learning outcomes that resulted in a greater retention and understanding (Svensson 1976, 1984).

To be inclusive of students' motivation and intentions for learning, scholars adopted the concept "approaches to learning" as opposed to "levels of processing" (Entwistle et al. 1979; Entwistle and Ramsden 1983). Biggs (1979) furthered this line of research by coupling motives and strategies to characterize students who took on a deep or a surface approach to learning. For example, a student who had a fear of failure and a narrow focus for learning was likely to take on a surface approach, leading to a surface-level outcome. And, a student who took on a deep approach to learning was likely to be intrinsically interested in the subject matter and apply a learning strategy that maximized its meaning, leading to a deep-level outcome. Biggs argued those who take on a deep approach are also personally involved with the material and gain knowledge that is highly structured.

DAL are known to foster several liberal learning outcomes related to personal and cognitive growth (Mayhew et al. 2012; Nelson Laird et al. 2014; Pascarella and Blaich 2013; Pascarella et al. 2008) and increase engagement in other effective educational

practices (National Survey of Student Engagement 2012). However, very little is known about their relationship to developing students' educational expectations. It is conceivable that students who engage in DAL may also have the desire to further their education beyond a bachelor's degree. Weidman's (1989) ideas about undergraduate socialization connect well to current studies exploring the positive relationship between good teaching practices and student uses of DAL (e.g., Kuh et al. 2004; Lizzio et al. 2002; Wang et al. (2014)). In general, such studies suggest students follow the lead of faculty especially when good teaching practices are present. A study of Australian college students revealed variation in how students approached learning based on their perception of the learning environment (Lizzio et al. 2002). They concluded perceptions of a good teaching environment influenced students to engage in DAL while those who perceived the environment to have bad teaching practices were pressed to take on a surface approach. The appropriateness of faculty assessment was one of many factors used to qualify "good" and "bad" teaching.

A recent study by Wang et al. (2014) on US college students concluded students increased the use of DAL when they were exposed to clear and organized instruction. And, moreover, a related study by Kuh et al. (2004) showed institutions where faculty emphasize good teaching practices such as active and collaborative learning, diverse experiences, and higher-order learning, students reported higher levels of engagement in the same areas. Taken together, these studies support the notion that faculty have a valuable influence on shaping the learning environment.

Zhang (2004) was one of the first to apply Holland's (1997) theory to examine the differences in learning approaches among college students. However, in his study the focus was on individual personality type rather than socialization of academic environments. Using of sample of 203 college students attending a teaching-training university in China, Zhang found, out of the six personality types, Artistic and Investigative students were more likely to use DAL. That is, students with Artistic and Investigative personality types were more likely to adopt a learning strategy that maximizes the meaning of the content at hand. Zhang speculated the positive relationship was due to creative-thought processes that Investigative and Artistic students were more likely to employ when confronted with an issue or problem they did not understand.

Although Zhang (2004) opened the conversation about the use of Holland's theory in examining DAL, the focus was on individual qualities rather than the learning environment. We know uses of DAL are dependent upon a number of factors; one of them being the role of faculty in creating the conditions to learning (Ramsden 1997). Ample evidence suggests faculty can shape student behavior, and quite possibly their educational goals, through teaching and assessment. It is also plausible that faculty members who encourage students who engage in DAL are indirectly encouraging students' to hold higher degree aspirations. If this is the case, results may equip faculty with a tangible tool to guide students to higher learning. While Zhang (2004) and Smart and colleagues (Feldman et al. 2004, 2008; Pike et al. 2012; Smart and Feldman 1998; Smart et al. 2000, 2009; Smart and Umbach 2007) have highlighted the importance of personal characteristics and academic environments in learning behaviors, it is unclear if degree expectations are also affected. Overall, the goal of this study is to examine the role academic environments play in cultivating students' attitudes and decisions about pursuing a graduate degree and the impact of students' own learning behaviors on future academic decisions.

Methods

Data and Sample

Data for this study were taken from the 2013 administration of the National Survey of Student Engagement (NSSE). We examined responses from over 116,000 seniors attending 499 baccalaureate-granting institutions. Seniors were chosen for this study because it was presumed that these students would have the best knowledge of their expectations to earn a graduate degree, and since we were interested in the relationship between academic environment and degree expectations, we presumed that first-year students were unlikely to have had sufficient time to be socialized in an academic environment. Approximately, 64 % of the seniors were female and 68 % were traditional age (i.e., less than 25 years old). About 74 % of the respondents were White, 4 % were Asian, 8 % were African-American/Black, 8 % were Hispanic, 3 % were multiracial, and 4 % identified with another racial/ethnic group (e.g., Native American). The sample used in this study was similar to the profile of respondents to NSSE and generally typical of the national profile of undergraduate students in the US (Table 1), except females and White students tended to be over-represented.

Variables

The dependent variable, seniors' graduate degree expectations, was derived from a question on the survey that asked students the highest level of education they ever expect to complete. Responses ranged from less than a bachelor's degree to doctoral or professional degrees. Responses were subsequently dichotomized into graduate degree expectations or lower. Approximately, 70 % of the sample expected to earn a graduate degree. Bell (2010) likewise notes that around 75 % of college freshmen in 2009 indicated a desire to earn a graduate degree.

The survey also asked students how often they engaged in activities associated with DAL. The DAL scale was developed from eleven items that focused on higher-order

Table 1 Characteristics of sample and undergraduate population at US bachelor's degree-granting institutions

	Sample (%)	National profile[a] (%)
Gender		
Male	36	44
Female	64	56
Race/ethnicity		
African-American/Black	8	13
Asian	4	6
Caucasian/White	74	62
Hispanic/Latino	8	12
Multiracial	3	2
Other race/ethnicity	4	5
Enrollment status		
Full-time	83	81
Part-time	17	19

[a] National profile based on data from the fall 2011 IPEDS institutional characteristics and enrollment data

learning and reflective and integrative learning. Items on the survey asked students how much they believed their coursework emphasized higher-order or advanced thinking skills such as applying facts to practical problems, analyzing an idea in depth by examining its parts, evaluating a point of view, and forming a new idea or understanding from various pieces of information. In addition, the survey asked students how often they combined ideas from different courses, connected their learning to societal problems or issues, included diverse perspectives in course discussions or assignments, examined the strengths and weaknesses of their views on a topic, tried to better understand someone else's views, learned something that changed the way they understand an issue, and connected ideas from courses to prior experiences and knowledge. See Appendix 2 for the exact wording of the items. Following procedures outlined in (Nelson Laird et al. 2006), responses on the eleven items were averaged together to calculate a composite measure ($\alpha = .89$) to represent seniors' level of use of DAL. The DAL scale used in this study is an updated version of the scale defined by Nelson Laird et al. (2006) that came from the revisions to the NSSE instrument launched in 2013.

The survey asked students to identify their major field of study, which was then used to assign students to appropriate academic environments of Holland's theory using the Dictionary of Holland Occupational Codes (Gottfredson and Holland 1996) and academic majors classified in Smart et al. (2000). Because only one academic major, accounting, was classified as a Conventional field, students in that field were excluded from the study (as done by Antony 1998; Feldman et al. 2008; Pike et al. 2012; Smart et al. 2000). The number of students in each of the remaining groups of academic majors was as follows: Artistic (n = 10,842), Enterprising (n = 22,631), Investigative (n = 34,561), Realistic (n = 5,391), and Social (n = 43,165). See Appendix 1 for examples of academic majors in each Holland environment.

We also included several background characteristics and institutional variables identified by Carter (2002) as possible influences on students' degree plans in order to control for their influence. Descriptive statistics are presented in Table 2. The student-level control variables included gender, race-ethnicity (with White as the reference group), age, enrollment status, transfer status, parental education, and self-reported college grades. Age was dichotomized into traditional age students (those less than 25 years old) and non-traditional age (those 25 years of age and older). Parental education was derived from an item that asked students the highest level of education completed by either of their parents or those who raised them. Responses ranged from did not finish high school to doctoral or professional degree. For this study, response categories were collapsed into no bachelor's degree, bachelor's degree, and graduate degree. While Carter identified several other student characteristics that may impact students' graduate degree plans, such as socio-economic status, support from family, initial aspirations, and careers goals, none of these measures were available in our data. Institutional characteristics included in our study were the institution's 2010 Basic Carnegie classification (with Master's large institutions as the reference group), institutional control, and selectivity. Selectivity of the institution was operationalized using Barron's profile of American colleges and ranged from noncompetitive to most competitive. Figure 1 depicts our conceptual model.

Analysis

Given the nested structure of the data (students within institutions), we used the hierarchical generalized linear modeling (HGLM) approach of Raudenbush and Bryk (2002) to examine the influence Holland academic environments and DAL had on seniors' graduate

Table 2 Descriptive statistics

	Mean[b]	SD	Min.	Max.
Student-level variables				
Graduate degree expectations	0.70	0.46	0	1
Female	0.64	0.48	0	1
Asian	0.04	0.19	0	1
African-American/Black	0.08	0.27	0	1
Hispanic	0.08	0.27	0	1
Multiracial	0.03	0.16	0	1
Other race-ethnicity	0.04	0.19	0	1
White[a]	0.74	0.44	0	1
Transfer student	0.45	0.50	0	1
Traditional age (<24 years)	0.68	0.47	0	1
Full-time	0.83	0.37	0	1
Self-reported grades: mostly A's	0.53	0.50	0	1
Self-reported grades: mostly B's	0.43	0.49	0	1
Self-reported grades: mostly C's[a]	0.05	0.21	0	1
Parent's education: no bachelor's degree	0.46	0.50	0	1
Parent's education: bachelor's degree	0.28	0.45	0	1
Parent's education: graduate degree[a]	0.26	0.44	0	1
Deep approaches to learning	3.01	0.58	1	4
Artistic	0.09	0.29	0	1
Enterprising	0.19	0.40	0	1
Investigative[a]	0.30	0.46	0	1
Realistic	0.05	0.21	0	1
Social	0.37	0.48	0	1
Institution-level variables				
Research Universities (very high research activity)	0.04	0.21	0	1
Research Universities (high research activity)	0.10	0.30	0	1
Doctoral/Research Universities	0.07	0.25	0	1
Master's Colleges and Universities (larger programs)[a]	0.30	0.46	0	1
Master's Colleges and Universities (medium programs)	0.11	0.31	0	1
Master's Colleges and Universities (smaller programs)	0.05	0.23	0	1
Baccalaureate Arts & Sciences Institutions	0.15	0.36	0	1
Baccalaureate diverse institutions	0.18	0.38	0	1
Private	0.62	0.49	0	1
Barron's selectivity rating	3.25	1.06	1	6

[a] Reference group

[b] Means for dichotomous items represent proportions

degree expectations controlling for student and institutional characteristics. Interaction effects by Holland academic environments and DAL were also examined in order to investigate whether the impact of DAL on degree expectations varied for students in different Holland academic environments. First, we estimated a base model that included no predictors at either level in order to assess the variability in degree expectations that was
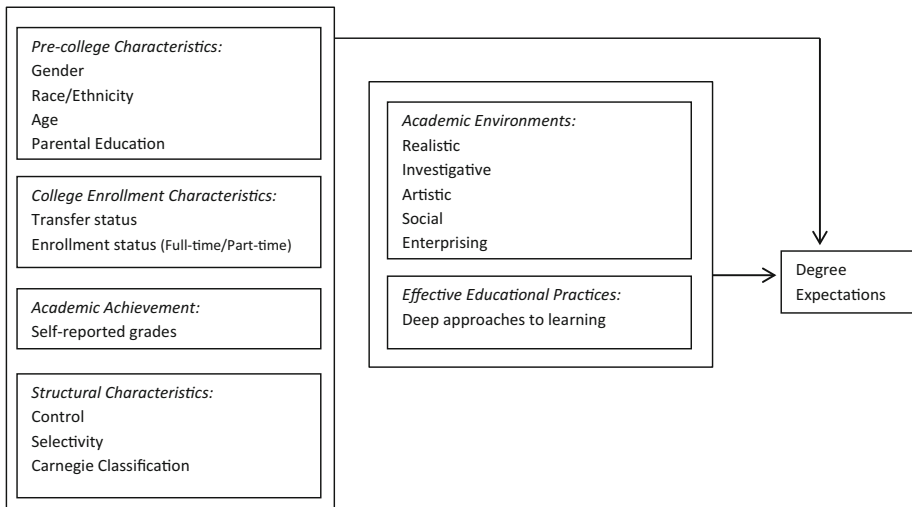
Fig. 1 Conceptual model of the factors influencing college seniors' graduate degree expectations (adapted from Carter 2002)

due to differences between institutions and differences among students. Since the level-1 random effect is constrained, having a standard logistic distribution with a variance of $\pi^2/3$, this term, along with the level-2 random effect ($\tau_{00} = .1623$), can be used to assess the intraclass correlation (Hox 2010; Powers and Xie 2008; Snijders and Bosker 2012). Results from the base model indicate that 4.7 % of variability in degree expectations was due to differences between institutions (ICC = $.1623/(.1623 + \pi^2/3) = 0.047$). We also evaluated box-plots of the Empirical Bayes residuals to examine the extent of variation across institutions. These plots also suggested variation across institutions in students' average likelihood of expecting to earn a graduate degree. While most of the variability in graduate degree expectation is among students, we decided to continue with the multilevel model to more accurately account for nesting effects in the data. Moreover, using a single-level regression model to analyze multilevel data can result in underestimated standard errors for parameters (Hox 2010; Raudenbush and Bryk 2002). Next, a full model was estimated that included student characteristics at level-1 and institutional characteristics at level-2. Finally, interaction effects by Holland academic environment and DAL were added to the model. Since dummy variables were used to represent Holland environments, one of the five had to serve as a reference group. In order to examine all possible combinations of environments, five sets of analyses were conducted each with a different Holland environment serving as the reference category. All independent variables were grand mean centered. Finally, we compared model-based standard errors and robust standard errors to identify possible misspecification of the distribution of random effects (Raudenbush and Bryk 2002). An equation of the full model, with Investigative environment as the reference group, is presented below:

Level-1 (Student-level model)

$$Prob\left(GraduateDegreeExpectations = 1|\beta_j\right) = \phi_{ij}$$

$$\log\left[\frac{\phi_{ij}}{1-\phi_{ij}}\right] = \beta_{0j} + \beta_{1j}(Female) + \beta_{2j}(Asian) + \beta_{3j}(Black) + \beta_{4j}(Hispanic)$$

$$+ \beta_{5j}(Multiracial) + \beta_{6j}(Otherrace) + \beta_{7j}(Transfer)$$

$$+ \beta_{8j}(TraditionalAge) + \beta_{9j}(Fulltime) + \beta_{10j}\left(MostlyA's\right)$$

$$+ \beta_{11j}\left(MostlyB's\right) + \beta_{12j}(ParentEd:NoBachelor)$$

$$+ \beta_{13j}(ParentEd:Bachelor) + \beta_{14j}(DAL) + \beta_{15j}(Artistic)$$

$$+ \beta_{16j}(Enterprising) + \beta_{17j}(Realistic) + \beta_{18j}\left(Social + \beta_{19j}(DAL*Artistic)\right)$$

$$+ \beta_{20j}(DAL*Enterprising) + \beta_{21j}(DAL*Realistic) + \beta_{22j}(DAL*Social)$$

Level-2 (Institution-level model)

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Carnegie:RUveryhigh) + \gamma_{01}(Carnegie:RUhigh)$$

$$+ \gamma_{01}(Carnegie:Doctoral) + \gamma_{01}(Carnegie:Master'sMedium)$$

$$+ \gamma_{01}(Carnegie:Master'sSmall) + \gamma_{02}(Carnegie:BaccalaureateArts\&Science)$$

$$+ \gamma_{03}(Carnegie:BaccalaureateDiverse) + \gamma_{04}(Private)$$

$$+ \gamma_{05}(Barron'sSelectivityIndex) + u_{0j}$$

$$\beta_{Pj} = \gamma_{P0}$$

$$where \; P = 1,2,\ldots,22$$

Limitations

Care should be taken not to overgeneralize the results of this study. Our sample is a convenience sample in which institutions self-selected to participate in NSSE. While institutions in the study represent a wide cross-section of U.S. baccalaureate institutions and the students responding to the survey generally mirrored the population at their respective institution (National Survey of Student Engagement 2013), the combination of self-selected institutions and students requires some caution when generalizing these results to all seniors at four-year colleges and universities.

This study is also limited by the cross-sectional nature of the research. As such, we were not able to fully replicate Carter's (2002) model of the factors influencing college students' degree plans. Important factors such as students' initial degree aspirations and career goals were not available. Initial degree aspirations, or students' plans to earn a graduate degree at the start of college, are important to consider since they have been shown to be strongly related to senior year degree plans; typically being one of the strongest predictors of future degree plans (Carter 2002; Pascarella et al. 2004b). Despite the importance of initial degree aspirations, no information on students' initial degree plans was available in the data. In addition, Carter includes variables on external context, such as employers and family, which were also not present in the available data. Despite the fact that we cannot fully replicate Carter's model, we do not believe it invalidates the results. Considering that the results for the background characteristics, students' grades, and parental education

Table 3 HGLM model predicting graduate degree expectations without interaction effects[a]

Fixed effects	Coefficient	Odds ratio[b]	S.E.	t-ratio
Intercept	1.00	2.72	0.016	62.99***
Student-level variables				
Female	−0.09	0.92 (1.09)	0.043	−2.01*
Asian	−0.02	0.98 (1.02)	0.039	−0.48
African-American/Black	0.36	1.43	0.037	9.78***
Hispanic/Latino	0.23	1.26	0.028	8.29***
Multiracial	0.26	1.29	0.045	5.73***
Other race-ethnicity	0.23	1.26	0.044	5.23***
Transfer student	−0.11	0.90 (1.12)	0.020	−5.55***
Traditional age (< 25 years)	0.19	1.21	0.031	6.24***
Full-time	0.36	1.43	0.030	12.12***
Self-reported grades: Mostly A's	1.04	2.83	0.047	22.1***
Self-reported grades: Mostly B's	0.54	1.71	0.036	14.82***
Parent's education: no bachelor's degree	−0.51	0.60 (1.67)	0.026	−19.76***
Parent's education: bachelor's degree	−0.46	0.63 (1.58)	0.026	−17.98***
Deep approaches to learning	0.46	1.58	0.014	33.58***
Artistic	−0.60	0.55 (1.82)	0.031	−19.2***
Enterprising	−0.79	0.45 (2.20)	0.032	−24.7***
Realistic	−0.41	0.67 (1.49)	0.047	−8.68***
Social	0.01	1.01	0.031	0.44
Institution-level variables				
Research Universities (very high research activity)	−0.06	0.94 (1.06)	0.062	−0.95
Research Universities (high research activity)	0.09	1.10	0.046	1.95
Doctoral/Research Universities	0.10	1.10	0.059	1.64
Master's Colleges and Universities (medium programs)	−0.04	0.96 (1.04)	0.052	−0.75
Master's Colleges and Universities (smaller programs)	0.09	1.09	0.066	1.34
Baccalaureate Arts & Sciences Institutions	0.19	1.21	0.061	3.18**
Baccalaureate Diverse Institutions	−0.12	0.88 (1.14)	0.057	−2.19*
Private	0.09	1.10	0.036	2.51*
Barron's selectivity rating	0.06	1.06	0.017	3.45***

* $p < .05$; ** $p < .01$; *** $p < .001$

[a] Investigative as reference category for Holland academic environment

[b] Parentheses indicate inverse odds ratios for negative coefficients

confirmed previous work investigative graduate degree aspirations, we do not suspect that model misspecification led to severely unstable coefficient estimates.

Results

Despite these limitations, results indicated several factors that relate to seniors' graduate degree expectations. Our first research question sought to evaluate whether a positive relationship existed between seniors' use of DAL and seniors' graduate degree plans. Main effects from the multilevel model (Table 3) indicated that the students who used DAL

Table 4 Graduate degree expectations and average deep approaches to learning (DAL) scores by Holland environment

Holland type	Graduate degree expectations (%)	Average DAL score
Artistic	67	3.06
Enterprising	56	3.00
Investigative	75	2.91
Realistic	63	2.75
Social	76	3.13
Total	70	3.01

more had greater odds of graduate degree expectations than those who used such approaches less. Thus, students more engaged in DAL were more likely to aspire to go to graduate school. Specifically, scoring one unit higher on the DAL scale was, on average, associated with 58 % higher odds of students' having graduate degree expectations.

The second research question explored the impact academic disciplines have on seniors' graduate degree expectations. Holland (1997) hypothesized that Investigative types have the highest educational aspirations, followed by Social, Artistic, Conventional, Enterprising, and Realistic. Descriptive findings generally supported Holland's claim. Table 4 presents the graduate degree expectations and average DAL scores for each Holland environment. As can be seen, students majoring in Social or Investigative fields had the highest percentage of students with plans to earn a graduate degree while Enterprising and Realistic had the lowest. The main effects for Holland academic environment from our HGLM models using different Holland types as reference groups indicated that students majoring in Investigative and Social fields had between 50 and 200 % greater odds of aspiring to achieve a graduate degree than their Artistic, Enterprising, and Realistic counterparts. In addition, Artistic and Realistic majors had between 20 and 50 % greater odds of graduate degree expectations than Enterprising majors while Realistic majors had around 20 % greater odds of graduate degree expectations than Artistic majors.

The addition of the interaction effects answered our third research question regarding whether or not the influence of DAL on graduate degree expectations was the same across academic environments. Results demonstrated statistically significant interaction effects for DAL and certain Holland academic environments, indicating that the influence of DAL on seniors' graduate degree expectations was different depending on their academic environment. Table 5 displays the coefficient estimates and odds ratios for each pair of Holland academic environment along with its interaction with DAL. The ten contrasts presented represent all possible pairwise combinations among environment types. Coefficients for each comparison represent differences in the effects of the first Holland environment type compared with the second Holland environment type (e.g., Investigative compared with Artistic). The coefficient for the opposite comparison (e.g., Artistic compared with Investigative) is the same except the sign of the relationship is reversed.

Examining the interaction effects (Table 5), we see statistically significant interaction effects for DAL for students studying in Artistic fields compared with students in Investigative, Social, and Enterprising environments. These results indicated that the impact of DAL on graduate degree plans was greater for seniors in Artistic fields than otherwise similar students in Investigative, Social, or Enterprising environments. These findings indicated that increased use of DAL increased Artistic students' odds of expecting to earn a graduate degree by a factor of 1.13, 1.18, and 1.22, or between 13 and 22 %, compared with seniors studying in Enterprising, Investigative, and Social fields, respectively.

Table 5 Coefficient estimates and odds ratios from full model for Holland academic environments and interaction effect with deep approaches to learning (DAL)

|	Coefficient	Odds ratio[a]	Interaction with DAL	Odds ratio[a]
Investigative/Artistic	0.60***	1.82	−0.17***	0.85 (1.18)
Investigative/Social	−0.02	0.98 (1.02)	0.03	1.03
Investigative/Enterprising	0.79***	2.20	−0.04	0.96 (1.04)
Investigative/Realistic	0.39***	1.48	−0.05	0.95 (1.05)
Artistic/Social	−0.62***	0.54 (1.85)	0.20***	1.22
Artistic/Enterprising	0.19***	1.21	0.13*	1.13
Artistic/Realistic	−0.20***	0.81 (1.23)	0.12	1.13
Social/Enterprising	0.81***	2.24	−0.07*	0.93 (1.07)
Social/Realistic	0.41***	1.51	−0.08	0.93 (1.08)
Enterprising/Realistic	−0.40***	0.67 (1.49)	−0.01	0.99 (1.01)

* $p < .05$; ** $p < .01$; *** $p < .001$

[a] Parentheses indicate inverse odds ratios for negative coefficients

Similarly, the impact of DAL on degree expectations was greater for those in Enterprising environments than otherwise similar students' majoring in Social disciplines. Thus, increased use of DAL increased Enterprising students' odds of expecting to earn a graduate degree by 7 % compared with otherwise similar students' in Social fields.

Figures 2 and 3 graph the predicted probabilities (Table 6) from the full model with interaction effects (with the other variables in the model held at their mean). Examining these figures we see that the probability that a student in an Artistic discipline plans to earn a graduate degree increased at a higher rate, albeit not drastically, than otherwise comparable students in Social and Investigative fields as seniors' use of DAL increases. It is also interesting to note that more frequent use of DAL places seniors in Artistic environments on par with their peers in Investigative and Social disciplines who less frequently use DAL in terms of graduate degree expectations. In other words, students in Artistic environments with high levels of DAL have roughly the same predicted probability of graduate degree expectations as students in Investigative and Social environments with low level of DAL.

In regards to the other variables in the model, males were more likely to have graduate degree expectations than females. African-American/Black, Hispanic, and multiracial students were more likely to have graduate degree expectations than White students. In fact, these minority groups had between 26 and 43 % greater odds of graduate degree expectations than their White counterparts. Traditional aged students had around 20 % greater odds of graduate degree expectations than their older peers. Full-time students had over 40 % greater odds of graduate degree expectations than seniors attending school part-time. Parental education was also related to graduate degree expectations. Seniors whose parents had earned a graduate degree had between 58 and 67 % greater odds of aspiring to attend graduate school than their peers whose parents' do not have a graduate degree. Students who reported grades of mostly A's or mostly B's had about two times greater odds of graduate degree expectations than those who report grades of C or lower. In regards to the institutional characteristics, students attending baccalaureate arts and sciences institutions had 20 % greater odds of graduate degree expectations compared with Master's large institutions. On the other hand, students attending baccalaureate diverse
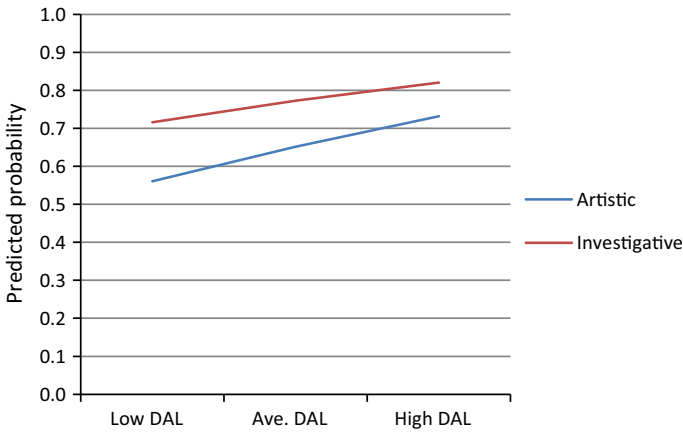
Fig. 2 Predicted probability of graduate degree expectations for students Artistic and Investigative environments with differing levels of deep approaches to learning (DAL). *Note: low DAL* corresponds to around one standard deviation below the mean and *high DAL* corresponds to around one standard deviation above the mean
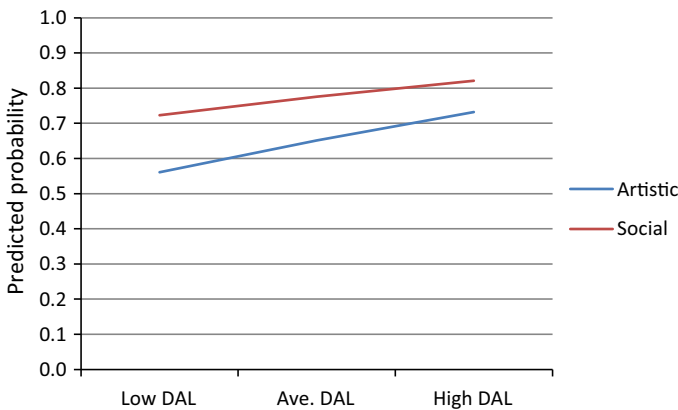
Fig. 3 Predicted probability of graduate degree expectations for students Artistic and Social environments with differing levels of deep approaches to learning (DAL)

institutions had lower odds of graduate degree expectations compared with Master's large institutions. Finally, students attending private institutions and more selective institutions tended to have higher degree expectations than their counterparts at public and less selective institutions.

Discussion

Overall, findings from this study suggest academic engagement in the form of DAL has a positive impact on degree expectations. Thus, the more cognitively intense effort students put into their academic work, the more likely they are to aspire to attend graduate school.

Table 6 Predicted probabilities

	Low DAL	Ave. DAL	High DAL
Artistic	0.56	0.65	0.73
Social	0.72	0.78	0.82
Investigative	0.72	0.77	0.82

While this also might relate to student's academic motivation, greater use of deep learning activities is related to higher graduate degree plans. By increasing opportunities for students to engage in these important skills, faculty members can encourage and support students' graduate degree plans. If faculty wish to increase enrollment in graduate school, evidence from this study suggests that they could structure their courses to emphasize higher-order, reflective, and integrative learning strategies in order to help achieve this task.

Not only does seniors' use of DAL influence their graduate degree expectations but, disciplinary-based academic environments are also a major contributor to students' plans to aspire to a graduate degree. As Holland (1997) proposes, and this study confirms, graduate education plans varied by academic environment. Students in Investigative and Social disciplines had the highest expectation to earn a graduate degree, followed by those in Artistic, Realistic, and Enterprising fields, respectively. We further found that the relationship between DAL and degree expectations is moderated by academic discipline (as represented by Holland academic environment), indicating that the impact of DAL on degree expectations is different in different educational contexts. For instance, engaging in DAL had a stronger influence on degree expectations for students in Artistic academic environments than students in Investigative, Social, or Enterprising fields. Additionally, we found that DAL had a greater impact on degree expectations for students in Enterprising fields than students in Social disciplines.

These findings suggest that the relationship between DAL, major field, and degree expectations is complex. It is not, for example, the case that DAL have the strongest effect on degree expectations in the fields that score the highest or lowest on DAL. Nevertheless, one distinct pattern emerges. The stronger influence of DAL on degree expectations seems to be concentrated in Artistic fields. In our study, students in Artistic fields had the second highest average score on DAL, meaning that Artistic environments encourage these sorts of educational activities, yet these students had lower graduate degree expectations than students in Social or Investigative fields (see Table 4). In an Artistic environment there is not only a culture that supports students' use of DAL but also room to improve students' graduate degree expectations. Thus, the effect can be larger. While this is an interesting observation, it raises the question of why we do not see a bigger impact of DAL in Enterprising fields where students have the lowest degree expectations yet use DAL more than other fields. We can look to Holland's (1997) theory for one explanation. Holland claims that the Enterprising environment will encourage people to seek out power, status, and monetary gains. It is possible that students are motivated and being socialized by faculty to engage in deep learning in order to gain material accomplishments rather than creating knowledge in the traditional sense. Instead, these students may be using DAL to build business relationships or develop plans for economic gain. More research is needed to investigate these relationships further and determine why the relationships between academic environment, DAL, and degree expectations play out these ways.

Some of the observed differences between environments could be due, in part, to fields requiring more education for certain careers. The influence of Holland academic environments on degree expectations tends to be what we would expect if we were predicting career choices that require substantial education. For instance, many students aspiring to become medical doctors or other advanced careers in the medical field, typically major in an Investigative field (e.g., biology, chemistry). Moreover, several disciplines in Social environments require study beyond the baccalaureate degree for licensure in the field (e.g., occupational, physical, and speech therapy). The observed differences could also be due to differences in teaching style and teaching focus that are well documented between the types of environments (Ramsden 1997; Smart and Umbach 2007; Smart et al. 2000, 2009). For example, the lack of a greater effect for DAL in Enterprising fields could be due to their focus on practical problems and group-based learning.

What is unclear from this study, however, is if disciplinary cultures implicitly or explicitly promote graduate studies. Holland's (1997) theory sets out, and many researchers have confirmed (Smart and Feldman 1998; Feldman et al. 2004, 2008; Smart et al. 2000), that students gravitate towards majors that are congruent with their personality type and that these environments (i.e., academic majors) promote and reward distinctive traits and values. Therefore, it is reasonable to assume that the academic environments represented in this study exhibit significant influence on students' attitudes, values, and decisions whether or not to pursue graduate education. Nonetheless, these findings suggest we should pay close attention to academic major when studying students' plans to attend graduate school particularly how the disciplinary context moderates the positive effect of students' uses of DAL on plans to attend graduate school.

This study also contributes to the literature on graduate degree aspirations by confirming several additional factors as influential on students' graduate degree expectations. For instance, our findings reveal that pre-college characteristics have a significant influence on seniors' plans to earn a graduate degree. Similar to Carter's (2002) claims, our study found that under-represented minority groups had higher graduate degree expectations than otherwise similar White students. We also found degree expectations to vary by age and gender, with traditional aged students and male students tending to have higher graduate degree expectations. Additionally, the amount of formal education students' parents received also impacted seniors' plans for graduate study. In general, the more education a student's parents had the more likely that student will have plans for a graduate degree. College enrollment characteristics and academic achievement were also shown to significantly relate to seniors' plans to attend graduate school. Students who transferred to their current institution and students attending school on a part-time basis reported lower expectations of earning a graduate degree than their peers. Academic achievement, as represented by self-reported college grades, had a strong relationship with seniors' plans for graduate school. In fact, seniors who reported earning grades of mostly A's were almost three times more likely to expect to earn a graduate degree than students who reported earning grades of C or lower.

In regards to the institutional characteristics, Carter (2002) claimed that students attending more selective institutions will hold higher degree aspirations and our results confirm this claim. However, results by Carnegie type were mixed. Degree expectations for students at doctoral/research universities and Master's medium and small institution were similar to students at Master's large institutions. Further, students attending baccalaureate arts and science institutions had greater degree expectations than students at Master's large institutions, while students at baccalaureate diverse institution had lower expectations. This effect could be due to the composition of academic majors at these institutions. The

baccalaureate diverse classification consists of institutions that award most of their bachelor's degrees outside of the arts and sciences whereas the baccalaureate arts and science designation consist of institutions that award at least half of their degrees in arts and sciences. Given that most of the sciences are Investigative environments; this could explain some of the differences we see between Carnegie classifications.

Implications

The findings of this study have a number of practical and policy implications for faculty, institutional leaders, and policy makers. Given the variability in graduate degree expectations across Holland academic environments, faculty who wish to encourage students to pursue graduate education can emphasize the use of DAL in their classrooms. Scholars are beginning to focus on effective educational strategies to bolster degree aspirations. Johnson and Sheppard (2004) urged faculty in engineering to interact more with students, particularly women and students of color, to help "demystify" the journey to graduate school. Strayhorn (2010) proposed encouraging students, especially underrepresented minorities, to participate in undergraduate research as a way to socialize students into the STEM fields, and help increase their educational aspirations. Taken together, these researchers imply one common element—academic disciplines as socializing agents—or better yet, faculty as key players to influence students' desires for attending graduate school. Faculty engaging students in the classroom by emphasizing DAL, like emphasizing higher-order thinking skills and integration of knowledge from different context in assignments and assessments as well as promoting reflection on one's learning, may be yet other ways to encourage students to pursue graduate education.

The findings of the current study also add to the collection of research studying the importance of disciplinary-based academic environments in contributing to students' college experiences. The current study along with others (Feldman et al. 2004, 2008; Nelson Laird et al. 2008; Smart et al. 2000, 2009; Smart and Umbach 2007) suggests that academic environments within institutions can play a key role in the assessment of student outcomes. To achieve the goal of fostering the development of college students, faculty, advisors, and student affairs personnel could use this information to cultivate the career aspirations or degree aspirations of students by using or implementing certain kinds of learning approaches, such as DAL, in different educational contexts where they may want to influence students' educational goals.

In regards to postsecondary education policy, Stewart (2010) argues that the future prosperity of America depends on strengthening and increasing participation in graduate education. Stewart points to graduate education for providing a highly skilled workforce and developing new ideas and technologies. Graduate education also provides scholars to teach undergraduates. Thus, higher education policy makers who are interested in strengthening graduate education and ensuring higher education institutions can continue to produce highly skilled workers can benefit from the findings of this study. Knowledge that DAL and academic environments play a significant role in shaping students graduate degree expectations can inform policies related to faculty development. For example, decision-makers who want to promote graduate degree aspirations may support programs (e.g., faculty learning communities) that could be used to encourage faculty to emphasize DAL. However, more work is needed to demonstrate the efficacy of such programs at achieving their desired goals. Policy makers interested in increasing participation in graduate school may also focus on funding additional research on DAL and academic environments. As we discuss next, further work is needed to confirm and extend the findings of our study.

Future Research

Scholars interested in undergraduate students' plans for graduate school, should try to confirm the results found in our study using additional sources of data and longitudinal data sources. Future research should also explore the role DAL and academic environments play for specific minority groups or separately for men and women. Investigating how these factors may influence specific subpopulations is critical to more fully understanding students' desires to attend graduate school. Moreover, additional research is needed to unpack the complex relationship between DAL, academic environments, and degree aspirations. Why is the impact of deep approaches on graduate degree expectations greater in certain environments? Is the socialization process aimed at different goals or does socialization actually occur differently? How do differences among teaching practices in different environments affect this process? Exploring the impact of DAL on degree expectations within each major may offer insights into these questions.

Future research could explore how person-environment fit, or the degree to which an individual's personality type is congruent with their environment, may impact students' degree plans. Holland (1997) contends that people will be more satisfied and successful in environments that are congruent with their personality types. More research is needed to explore how the congruence of ones' fit within the academic environment may impact their expectations for earning a graduate degree. Finally, we decided to categorize our dependent variable (degree expectations) as a dichotomous variable. This means that students with master's degree expectations, professional degree (e.g., J.D., M.D.), and doctoral degree (e.g., Ph.D., Ed.D.) expectation are all coded together. Future research could explore how deep learning and academic environments impact these different types of degree plans.

Conclusion

This study extends the conversation on degree plans by including individual learning behaviors and the environmental cultures of academic fields. We found differences in the proportion of students interested in graduate school by Holland environment type, with Investigative and Social fields having the highest proportion of seniors expecting to get graduate degrees. Our findings also demonstrated that greater use of DAL was associated with increased odds of plans to attend graduate school, but that this association varied by the type of Holland environment. Implications of our work include finding ways to improve DAL and further studying the complex relationships between DAL, academic environment, and graduate school plans.

Appendix 1

Brief Description of Holland Environments (adapted from Holland 1997):

- The Realistic environment emphasizes practical activities and the systematic use of objects, tools, machines, and animals. Example academic majors include Electrical or electronic engineering, mechanical engineering, materials engineering, military science.
- The Investigative environments emphasize technical, analytical, and intellectual activities aimed at the creation and use of knowledge. Example academic majors

include biology, finance, civil engineering, chemical engineering, anthropology, sociology.

- The Artistic environments emphasize ambiguous, free, unsystematized activity to create free art forms or products. Example academic majors include fine art, English language/literature, music, theater/drama, architecture, art/music education.
- The Social environments emphasize activities that involve the mentoring, treating, healing, or teaching of others. Example academic majors include history, philosophy, elementary education, nursing, psychology, social work, political science.
- The Enterprising environments emphasize activities that involve the manipulation of others to obtain organizational goals or economic gains. Example academic majors include business administration, marketing, industrial engineering, computer science.

Appendix 2

Relevant NSSE Survey Items

Degree Expectations

What is the highest level of education you ever expect to complete?
  [Recoded into 0 = Bachelor's degree or lower and 1 = Graduate degree]
  1 = Some college but less than a bachelor's degree
  2 = Bachelor's degree (B.A., B.S., etc.)
  3 = Master's degree (M.A., M.S., etc.)
  4 = Doctoral or professional degree (Ph.D., J.D., M.D., etc.)

DAL

During the current school year, about how often have you done the following?
  (Never, Sometimes, Often, Very often)

a) Connected your learning to societal problems or issues
b) Combined ideas from different courses when completing assignments
c) Included diverse perspectives in course discussions or course assignments
d) Examined the strengths and weaknesses of your own views on a topic or issue
e) Tried to better understand someone else's views by imagining how an issue loos from his or her perspective
f) Learned something that changed the way you understand an issue or concept
g) Connected ides from your courses to your prior experiences and knowledge

During the current school year, how much has your coursework emphasized the following? (Very little, Some, Quite a bit, Very much)

a) Applying facts, theories, or models to practical problems or new situations
b) Analyzing an idea, experience, or line of reasoning in depth by examining its basic parts
c) Evaluating a point of view, decision, or information source
d) Forming a new idea or understanding from various pieces of information

References

Antony, J. S. (1998). Personality-career fit and freshman medical career aspirations: A test of Holland's theory. *Research in Higher Education, 39*, 679–698.

Baum, S., Kurose, C., & Ma, J. (2013a). *How college shapes lives: Understanding the issues. Trends in Higher Education Series*. New York: College Board and Advocacy & Policy Center.

Baum, S., Ma, J., & Payea, K. (2013b). *Education pays 2013: The benefits of higher education for individuals and society Trends in Higher Education Series*. New York: College Board and Advocacy & Policy Center.

Bell, N. E. (2010). *Data sources: Graduate school aspirations of American freshmen*. Washington, DC: Council of Graduate Schools.

Biggs, J. B. (1979). Individual differences in study processes and the quality of learning outcomes. *Higher Education, 8*, 381–394.

Carter, D. (2002). College students' degree aspirations: A theoretical model and literature review with a focus on African-American and Latino students. In J. Smart & W. Tierney (Eds.), *Higher education: Handbook of theory and research* (pp. 129–171). New York: Agathon.

Chapman, B. S. (2001). Emphasizing concepts and reasoning skills in introductory college molecular cell biology. *International Journal of Science Education, 23*(11), 1157–1176.

Chesler, N. C., Barabino, G., Bhatia, S. N., & Richards-Kortum, R. (2010). The pipeline still leaks and more than you think: A status report on gender diversity in biomedical engineering. *Annals of Biomedical Engineering, 5*, 1928–1935.

Clearly, B., Bevill, J. W., Lacey, L. M., & Nooney, J. G. (2007). Evidence and root causes of an inadequate pipeline for nursing faculty. *Nursing Administration Quarterly, 31*, 124–128.

Entwistle, N., Hanley, M., & Hounsell, D. (1979). Identifying distinctive approaches to studying. *Higher Education, 8*, 365–380.

Entwistle, N., & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm.

Ethington, C. A., & Smart, J. C. (1986). Persistence to graduate education. *Research in Higher Education, 24*, 287–303.

Feldman, K. A., Smart, J. C., & Ethington, C. A. (2004). What do college students have to lose? Exploring the outcome of differences in person-environment fits. *The Journal of Higher Education, 75*, 528–555.

Feldman, K. A., Smart, J. C., & Ethington, C. A. (2008). Using Holland's theory to study patterns of college student success: The impact of major fields on students. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (pp. 329–380). New York: Springer.

Gasser, C. E., Larson, L. M., & Borgen, F. H. (2004). Contributions of personality and interests to explaining the educational aspirations of college students. *Journal of Career Assessment, 12*, 347–365.

Gottfredson, G. D., & Holland, J. L. (1996). *Dictionary of Holland occupational codes* (3rd ed.). Odessa, FL: Psychological Assessment Resources.

Grafton, A. T., & Grossman, J. (2011). No more plan B. The Chronicle of Higher Education. Retrieved September 10, 2014 from http://chronicle.com/article/No-More-Plan-B/129293/.

Holland, J. L. (1997). *Making vocational choices, third edition: A theory of vocational personalities and work environments*. Lutz, FL: Psychological Assessment Resources.

Hox, J. J. (2010). *Multilevel analysis: Techniques and applications* (2nd ed.). New York: Routledge.

Hurtado, S., & Carter, D. F. (1997). Effects of college transition on perceptions of the campus racial climate on students' sense of belonging. *Sociology of Education, 70*(4), 324–345.

Johnson, M. J., & Sheppard, S. D. (2004). Relationships between engineering student and faculty demographics and stakeholders working to affect change. *Journal of Engineering Education, 93*, 139–151.

Kim, Y. K., & Sax, L. J. (2009). Student-faculty interaction in research universities: Differences by student gender, race, social class, and first-generation status. *Research in Higher Education, 50*, 437–459.

Kuh, G. D., Nelson Laird, T. F., & Umbach, P. D. (2004). Aligning faculty activities and student behavior: Realizing the promise of Greater Expectations. *Liberal Education, 90*, 24–31.

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of learning environments and academic outcomes: Implications for theory and practice. *Studies of Higher Education, 27*, 27–52.

Marton, F., & Säljö, R. (1976a). On qualitative differences in learning. I: Outcome and process. *British Journal of Educational Psychology, 46*, 4–11.

Marton, F., & Säljö, R. (1976b). On qualitative differences in learning. II: Outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology, 46*, 115–127.

Marton, F., & Säljö, R. (1984). Approaches to learning. In F. Marton, D. J. Hounsell, & N. J. Entwistle (Eds.), *The Experience of Learning* (pp. 39–58). Edinburgh, UK: Scottish Academic.

Maton, K. I., Kohout, J. L., Wicerski, M., Leary, G. E., & Vinokurov, A. (2006). Minority students of color and the psychology graduate pipeline: Disquieting and encouraging trends, 1989-2003. *American Psychologist, 61*, 117–131.

Mayhew, M. J., Seifert, T. A., Nelson Laird, T. F., Pascarella, E. T., & Blaich, C. F. (2012). Going deep into mechanisms for moral reasoning growth: How deep learning approaches affect moral reasoning development for first-year students. *Research in Higher Education, 53*, 26–46.

Mikaelian, A. (2014). The academic job market's jaded line: Number of ads placed drops for second year. Perspectives on history: The newsmagazine of the American Historical Association. Retrieved September 10, 2014, from http://www.historians.org/publications-and-directories/perspectives-on-history/september-2014/the-academic-job-markets-jagged-line.

Museus, S., & Hendel, D. (2005). Test scores, self-efficacy, and the educational plans of first-year college students. *Higher Education in Review, 2*, 63–88.

National Survey of Student Engagement. (2012). *Promoting Student Learning and Institutional Improvement: Lessons from NSSE at 13*. Bloomington, IN: Indiana University Center for Postsecondary Research.

National Survey of Student Engagement. (2013). *A fresh look at student engagement: Annual results 2013*. Bloomington, IN: Indiana University Center for Postsecondary Research.

Nelson Laird, T. F., Seifert, T. A., Pascarella, E. T., Mayhew, M. J., & Blaich, C. F. (2014). Deeply affecting first-year students' thinking: Deep approaches to learning and three dimensions of cognitive development. *Journal of Higher Education, 85*, 403–432.

Nelson Laird, T. F., Shoup, R., & Kuh, G. D. (2006). Measuring deep approaches to learning using the National Survey of Student Engagement. Paper presented at the Annual Forum of the Association for Institutional Research, Chicago, IL.

Nelson Laird, T. F., Shoup, R., Kuh, G. D., & Schwarz, M. J. (2008). The effects of discipline on deep approaches to student learning and college outcomes. *Research in Higher Education, 49*, 469–494.

Pascarella, E. T., & Blaich, C. B. (2013). Lessons from the Wabash National Study of Liberal Arts Education. *Change: The Magazine of Higher Learning, 45*(2), 6–15.

Pascarella, E. T., Pierson, C. T., Wolniak, G. C., & Terenzini, P. T. (2004a). First-generation college students: Additional evidence on college experiences and outcomes. *The Journal of Higher Education, 75*, 249–284.

Pascarella, E. T., Seifert, T. A., & Blaich, C. F. (2008). Validation of the NSSE benchmarks and deep approaches to learning against liberal arts outcomes. Paper presented at the annual conference of the Association for the Study of Higher Education, Jacksonville, FL.

Pascarella, E. T., Wolniak, G. C., Flowers, L. A., & Pierson, C. T. (2004b). The role of race in the development of plans for a graduate degree. *The Review of Higher Education, 27*, 299–320.

Paulsen, M. B., & St. John, E. P. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *The Journal of Higher Education, 73*, 189–236.

Perna, L. W. (2004). Understanding the decision to enroll in graduate school: Sex and racial/ethnic group differences. *The Journal of Higher Education, 75*, 487–527.

Pike, G. R. (2006). Vocational preferences and college expectations: An extension of Holland's principle of self-selection. *Research in Higher Education, 47*(5), 591–612.

Pike, G. R., & Kuh, G. D. (2005). First- and second-generation college students: A comparison of their engagement and intellectual development. *The Journal of Higher Education, 76*, 276–300.

Pike, G. R., Smart, J. C., & Ethington, C. A. (2012). The mediating effects of student engagement on the relationships between academic disciplines and learning outcomes: An extension of Holland's theory. *Research in Higher Education, 53*, 550–575.

Powers, D. A., & Xie, Y. (2008). *Statistical methods for categorical data analysis* (2nd ed.). Bingley, U.K.: Emerald Group Publishing.

Prosser, M., & Millar, R. (1989). The "how" and "why" of learning physics. *European Journal of Psychology of Education, 4*, 513–528.

Ramsden, P. (1997). The context of learning in academic departments. In F. Marton, D. J. Hounsell, & N. J. Entwistle (Eds.), *The experience of learning* (pp. 200–216). Edinburgh: Scottish Academic Press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical liner models: Applications and data analysis methods*. Thousand Oaks, CA: Sage Publications.

Smart, J. C., Ethington, C. A., Umbach, P. D., & Rocconi, L. M. (2009). Faculty emphases on alternative course-specific learning outcomes in Holland's model environments: The role of environmental consistency. *Research in Higher Education, 50*, 483–501.

Smart, J. C., & Feldman, K. A. (1998). "Accentuation effects" of dissimilar academic departments: An application and exploration of Holland's theory. *Research in Higher Education, 39*, 385–418.

Smart, J. C., Feldman, K. A., & Ethington, C. A. (2000). *Academic disciplines: Holland's theory and the study of college students and faculty*. Nashville, TN: Vanderbilt University Press.

Smart, J. C., & Umbach, P. D. (2007). Faculty and academic environments: Using Holland's theory to explore differences in how faculty structure undergraduate course. *Journal of College Student Development, 48*, 183–195.

Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). Thousand Oaks, CA: Sage.

Stewart, D. W. (2010). "Important, if true": Graduate education will drive America's future prosperity. Change: The Magazine of. *Higher Education, 42*(1), 36–44.

Strayhorn, T. L. (2010). Undergraduate research participation and STEM graduate degree aspirations among students of color. *New Directions for Institutional Research, 148*, 85–92.

Strayhorn, T. L. (2012). *College students' sense of belonging: A key to educational success for all students*. New York: Routledge.

Svensson, L. (1976). *Study skill and learning*. Gothenburg: Acta Universitatis Gothoburgensis.

Svensson, L. (1977). On qualitative differences in learning: 3. Study skills in learning. *British Journal of Educational Psychology, 47*, 233–243.

Svensson, L. (1984). Skill in learning. In F. Marton, D. J. Hounsell, & N. J. Entwistle (Eds.), *The experience of learning* (pp. 56–70). Edinburgh: Scottish Academic Press.

Tagg, J. (2003). *The learning paradigm college*. Boston, MA: Anker.

Walpole, M. (2003). Social mobility and college: Low SES students' experiences and outcomes of college. *The Review of Higher Education, 7*, 45–73.

Walpole, M. (2008). Emerging from the pipeline: African American students socioeconomic status, and college experiences and outcomes. *The Review of Higher Education, 49*, 237–255.

Wang, J. S., Pascarella, E. T., Nelson Laird, T. F., & Ribera, A. K. (2014). How clear and organized classroom instruction and deep approaches to learning effect growth in critical thinking and need for cognition. *Studies in Higher Education*. doi:10.1080/03075079.2014.914911.

Weidman, J. C. (1989). Undergraduate socialization: A conceptual approach. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (pp. 289–322). New York: Agathon.

Zeegers, P. (2004). Student learning in higher education: A path analysis of academic achievement in science. *Higher Education Research and Development, 23*, 35–56.

Zhang, L. (2000). University students' learning approaches in three cultures: An investigation of Biggs's 3P model. *The Journal of Psychology, 134*, 37–55.

Zhang, L. (2004). Learning approaches and career personality types: Biggs and Holland united. *Personality and Individual Differences, 37*, 65–81.