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Money Matters: The Influence of Financial Factors on Graduate Student Persistence

By Terrell L. Strayhorn

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National statistics indicate that approximately 50 percent of all graduate students fail to complete their degree; thus, understanding the factors that influence their persistence is an important research objective. Using data from a nationally representative sample of bachelor's degree recipients, the study aimed to answer three questions: What proportion of 1992-1993 bachelor's degree recipients enrolled in graduate school by 2003? Of those, what proportion persisted in graduate school? Controlling for background and academic differences, what effect do financial factors have on persistence in graduate school? Descriptive and hierarchal binomial logistic regression results suggest that 36 percent of bachelor's degree recipients has enrolled in a graduate program by 2003; 74 percent of initial enrollees has persisted by 2003, and financial factors (e.g., total loan, tuition reduction, deferment status) were related to persistence. Implications for future policy, practice, and research are highlighted.

Research in higher education largely focuses on undergraduate education and, in contrast, has devoted comparatively little attention to post-baccalaureate (post-BA) or graduate education (Burgess, 1997). In fact, as Burton Clark (1993) commented:

> The first degree level has historical primacy, predominates numerically and possesses a deep hold on traditional thought and practice. It comes first in budget determination, public attention and the concerns of governments. Graduate or advanced education is then prone to develop at the margin as an add-on of a few more years of unstructured work for a few students. (p. 356)

Perhaps related to the inattention to graduate education in the research literature, national statistics consistently indicate that approximately 50% of all graduate students fail to complete their degree (Berelson, 1960; Bowen & Rudenstein, 1992; Lovitts, 1996), whereas only 30-50% of undergraduates leave their institution before earning their bachelor's (BA) degree. Graduate attrition rates can be higher among women and historically underrepresented minority groups (Lovitts, 2001).

Despite these alarming "drop out" rates, relatively few studies have been conducted to examine the factors that influence persistence in graduate school. Instead the literature focuses almost exclusively on undergraduate students' persistence at 2- and 4-year institutions (McGrath & Braunstein, 1997; Perna, 1998; Tinto, 1993; Williamson & Creamer, 1988). Such information has limited applicability to post-BA contexts (Baird, 1993b). We know from prior research that significant differences exist between undergraduate and graduate education. For instance, the costs associated with attending graduate school tend to be significantly higher than the average cost of tuition for undergraduate study (Choy & Li, 2006). Federal student aid formulas generally assume that undergraduates are financially dependent on parents or guardians until the age of 24 years; graduate students are usually considered independent

regardless of age. And while this may make graduate students eligible for more financial aid than undergraduates, there are no major federal grant programs for graduate students, which limits the type of aid awarded; various studies have found that the *type* of aid—not the amount—is most strongly related to graduate attrition (Lovitts, 2001). Additionally, there are significant differences in the undergraduate "general education" curriculum and the highly specialized, technical focus of graduate education (Golde & Walker, 2006). Therefore, it is reasonable to suspect that there may be differences in the factors that influence or inhibit student persistence in graduate school. Specifically, financial aid and related variables may be more or less influential on graduate student persistence and it is out of this context that the need for the present study grew.

The purpose of this study was to examine the influence of financial aid and other related variables on graduate student persistence. Using data from the National Center for Education Statistics' *Baccalaureate and Beyond Longitudinal Study* (B&B:1993/2003) database, the following research questions were explored:

(a) What proportion of 1992-1993 bachelor's degree recipients enrolled in graduate school by 2003?

(b) Of those, what proportion persisted in graduate school?

(c) Controlling for background and academic differences, what effect do financial factors have on persistence in graduate school?

This study is intended to add to our knowledge about student persistence in general and the body of knowledge relative to graduate student persistence, in particular. Indeed, graduate student persistence is an area of critical need according to the Council of Graduate Schools and several leading scholars on post-BA education (Baird, 1993a; DePauw, 2004; Nyquist & Woodford, 2000). As Baird (1993b) noted:

> Whether measured in budget, increases in enrollment, or attention from administrators, graduate education is assuming a large role at most institutions…[it is] the most expensive area of higher education…[and] the training ground for some of the most valued graduates of our universities…Thus, for reasons of both cost and social importance, the progress of students in graduate education becomes a critical matter. (p.1)

Brief Literature Review

The literature on graduate education and graduate students can be organized into three categories: theoretical essays on the nature and quality of graduate education in the United States; research studies on graduate student experiences in graduate school; and a handful of empirical studies that estimate the influence of variables related to graduate student retention. Most scholarship on graduate education is of the first-order—that is, essays about the process of post-baccalaureate education (Borkowski, 2006; Golde & Walker, 2006; Kohl & LaPidus, 2000; LaPidus, 2000). The weight of evidence suggests that "graduate education is a major part of American higher education…" (Baird, 1993b, p. 3).

A second set of studies focus on graduate students' experiences while enrolled in graduate school such as their involvement (Gardner & Barnes, 2007), research collaborations (Saddler, 2008), and degree progress (Abedi &

Benkin, 1987; Girves & Wemmerus, 1988). For example, Girves and Wemmerus analyzed data from 324 masters and 158 doctoral students to determine the most significant influences on graduate degree progress, which was operationalized as time-to-degree (in years). They found differences by degree level and enrollment status; involvement in the academic department through a teaching- or research assistantship was important to timely degree progress.

Representing a related but smaller line of inquiry, several studies focus on determinants of graduate student attrition or, conversely, persistence to degree attainment (Andrieu, 1991; Asker, 2001; Langlosis, 1972; Luan & Fenske, 1996; Lyn, 1998; Strayhorn, 2009). Langlois surveyed 10,000 students who dropped out of graduate school at the University of California at Berkeley and found that financial factors were the most frequently cited reason for not completing the degree. And in one of the first national studies on graduate student persistence, Andrieu analyzed *National Postsecondary Student Aid Study* (NPSAS) data to study within-year persistence of graduate students. She found that financial factors, along with background and program-related variables, influenced persistence within-year.

While useful, the existing literature is limited in a number of ways. Most research on graduate student persistence is based on single-institution or relatively small cohort-based samples (e.g., Vaquera, 2007-2008) rather than nationally representative samples. Second, some previous researchers combined masters, doctoral, and first-professional students (e.g., Luan & Fenske, 1996) while others combine or aggregate all graduate programs and majors (Asker, 2001). Clearly, not all graduate degree programs or degrees are the same as they attract different types of students and may be governed by different norms or paths for socialization to the profession (LaPidus, 2000). Thus, studies are needed that account for such nuances. This is the gap addressed by the present study.

Method

The purpose of this study, which is part of a larger research program on graduate education, was to examine the influence of financial variables on graduate student persistence using a nationally representative sample of students. Using a conceptual frame consisting of background, academic, and financial variables proposed elsewhere (Strayhorn, 2005), this research was designed to assess the relationship between financial factors and student persistence in graduate school, controlling for an array of confounding influences. This section describes the methodology used to achieve these purposes. It begins by providing an overview of the database, including the study's sample, main variables, and the analytical techniques employed.

Data Source

Data were drawn from the National Center for Education Statistics' *Baccalaureate & Beyond Longitudinal Study* (B&B:1993/2003). The B&B:1993/2003 longitudinal study follows baccalaureate degree completers over time to provide information on work experiences after college and on progress and persistence at the graduate level. In fact, using the 1993 *National Postsecondary Student Aid Study* (NPSAS:93) as the base year, the B&B:93/03 longitudinal study follows baccalaureate degree completers nine to ten years beyond their undergraduate graduation. This is particularly useful given the fact that graduate programs vary in length and time-to-degree (Baird, 1993b).

The third-year follow-up survey provides a unique opportunity to gather information concerning delayed entry into graduate education, graduate school aspirations, progress and persistence to degree, and the interaction between work and education beyond obtaining a bachelor's degree. These data were deemed appropriate for this investigation by the National Center for Education Statistics (P. Knepper, personal communication, July 1, 2006) and, thus, a restricted database was licensed to the principal investigator for a period of five years. All analyses were based on the restricted-use data.

Sample

The analytic sample was drawn from the total pool of respondents to the B&B:1993/2003 survey. Of all 1992–93 bachelor's degree recipients (see Table 1), 52% reported "no additional degree program" by 2003 while 31% had enrolled in a masters degree program and 5% had enrolled in a doctoral degree program. Additionally, 5% of BA recipients had enrolled in a first professional degree program. However, given differences found between masters, doctoral, and first-professional students—one of which is related to the cost of education and amount/type of aid awarded generally—this analysis only includes those individuals who enrolled in either a masters or doctoral degree program. Excluding first-professional students from subsequent analyses also makes sense because it costs much more to train first-professional students (e.g., doctors and lawyers) than traditional graduate students; and, conversely, it usually takes longer to educate a doctoral student than a first-professionals student (LaPidus, 2000). Academic qualifications for first-professional students can also be markedly different from other graduate student groups (e.g., MCAT vs. GRE).

Thus, the analytic sample consisted of graduate students (persons pursuing masters and doctoral degrees; excluding first-professional students, including MBA students) who responded to the B&B:93/03 third-year follow-up study. The weighted sample size was approximately 1.2 million participants. Of these, the majority (55%) were women and those seeking masters degrees (86%). Eighty-three percent described themselves as Caucasian/White, 6 percent as African American/Black, 5 percent as Hispanic, 5 percent as Asian/Pacific Islander, and 1 percent as American Indian/Alaska Native. Table 2 presents additional information about the analytic sample.

Table 1: Percent Distribution of 1992-93 Bachelor's Degree Recipients' Graduate and Non-graduate Enrollment, by Selected Student Characteristics, 2003

Variables	No Addtl. Degree Program	Non-Graduate Degree or Certificate	Masters Degree	Doctoral Degree	First Professional Degree
Total	**52.1**	**7.2**	**31.2**	**4.5**	**5.0**
Gender					
Male	54.4	6.3	27.4	5.7	6.2
Female	50.2	7.9	34.4	3.5	4.0
Race					
White	53.0	7.0	31.1	4.4	4.5
Black	46.4	7.5	35.7	5.4	5.1
Hispanic	48.6	7.9	33.0	5.9	4.6
Asian/Pacific Islander	50.0	7.5	25.7	3.4	13.4
American Indian/ Alaska Native	49.7	20.4	23.3	3.8	2.8
Parent's highest education					
HS or less	58.5	6.6	29.4	2.5	3.1
Some post-secondary education	52.9	7.3	32.3	3.3	4.3
Bachelor's	52.4	7.4	29.7	5.3	5.2
Advanced degree	43.4	7.4	34.5	7.3	7.5
Age at receipt of bachelor's t					
24 or younger	49.8	6.7	31.6	5.6	6.2
25-29	62.2	8.4	25.6	2.0	1.8
30 or older	55.5	7.8	33.0	1.8	1.9
Amount borrowed (undergraduate)					
None	52.9	6.6	30.3	4.8	5.4
Less than $5,000	52.5	8.1	31.6	4.1	3.7
$5,000-9,999	51.0	7.0	34.0	3.8	4.2
$10,000-14,999	51.0	9.3	30.0	4.8	4.8
$15,000 or more	51.9	6.2	32.1	4.6	5.3

Table 2: Description of Those Enrolling in Graduate School, B&B:93/03

Characteristic	Percent
Graduate Program	
Masters	86
Doctoral	14
Gender	
Male	45
Female	55
Race/Ethnicity	
White	83
Black	6
Hispanic	5
Asian/Pacific Islander	5
American Indian/Alaskan Native	1
Other	low *n*
Undergraduate Grade Point Average	
2.9 or less	33
3.0 to 3.3	30
3.4 to 3.6	21
3.7 to 4.0	16
Marital Status	
Married	67
Single, never married	21
Cohabitating/living with partner	5
Separated	1
Divorced	6
Widowed	low *n*
Parental highest education	
High school or less	30
Some college	18
Bachelor's degree	23
Advanced degree	25
Age at receipt of bachelor's degree	
24 or younger	72
25-29 years	12
30 or older	16
Amount borrowed (undergraduate)	
Did not borrow	48
Less than $5,000	15
$5,000 to $9,999	13
$10,000 to $14,999	10
$15,000 or more	12

Variables

The dependent variable reflects respondent's persistence status in graduate school by 2003. The variable was constructed using responses to several items from the longitudinal database. First, the researcher restricted the B&B:1993/2003 sample to only respondents who reported being enrolled in a masters or doctoral degree program after receiving their bachelor's degree. Then, of those, all who had earned their graduate degree by 2003 or remained enrolled in their graduate degree program were considered "persisters." All those who had enrolled in graduate school since receiving their BA degree but did not remain enrolled by 2003 were coded "non-persisters." Thus, the dependent variable was coded dichotomously ranging from 0 ("non-persisters") to 1 ("persisters").

Three sets of independent variables were included in this analysis in consonance with the conceptual model. For instance, several background and demographic variables were included such as age, race, gender, parent's level of education, students' educational expectations (Carter, 2001), and expected family contribution (EFC) which served as a proxy for the student's financial situation. It is important to note that the EFC of independent students does not include parental information; rather it consists primarily of the contribution expected from the students themselves. Thus, the measure is useful for modeling students' financial circumstances, which has been done in prior research (Choy & Bobbitt, 2000), and their ability to pay for graduate school. Parent's level of education was measured using 4 levels ranging from 0 ("high school of less") to 3 ("advanced degree").

Academic factors included undergraduate grade point average (GPA), performance on the Scholastic Aptitude Test (SAT) (or ACT equivalent), and total score on the Graduate Record Exam (GRE). SAT/ACT scores were measured in quartiles ranging from 0 ("did not take SAT/ACT") to 4 ("highest quartile"). Similarly, GRE scores were measured in quartiles ranging from 1 ("Top 25% on all 3 exams") to 4 ("middle 50% on all 3"); a fifth category ("did not take GRE/other") was used to omit those who did not take a particular test from the statistical analyses. Prior research has shown that the academic department or field of study is critically important when studying graduate student outcomes (Bowen & Rudenstein, 1992; Nerad & Miller, 1996); therefore, the study included a single item measuring whether respondents were enrolled in science, technology, engineering, or math-related (STEM) graduate fields of study (0 = no; 1 = yes). STEM was defined in accordance with guidelines provided by the National Science Foundation, which includes all related fields (e.g., physical sciences, biological sciences, engineering, math, computer science) but excludes health, medicine, and social sciences.

Finally, several financial variables were included in the estimated statistical model. Variables included total aid borrowed for graduate school, total aid borrowed for undergraduate, and total educational *loans* borrowed (including both undergraduate and graduate degrees); response options were coded from 0 ("none") to 4 ("40,000 or more"). While the latter is related to the first two items, tests indicate that collinearity was not a problem for this investigation. Analyses were run with and without the total loans measure to see if its inclusion altered statistical results; similar results were found in both cases. Two items measured the *type* of aid received for graduate school. One item asked respondents, *did you receive loans to pay for graduate school?* Responses were coded dichotomously: 0 ("no, did not receive") to 1 ("received").

Four items measured respondent's educational debt situation based on information that student loan debt has nearly doubled in recent years (Kim & Eyermann, 2006). One item determined the amount of undergraduate educational debt owed (by 2003); responses were coded from 0 (none) to 4 ($12,600 or more). A separate item measured the amount of total education debt, including undergraduate and graduate loans, with the highest category (4) indicating "$40,000 or more" in total educational debt. Two dichotomous variables measured whether respondents had ever deferred or defaulted on their educational loans.

Finally, given the various types of financial support available to graduate students, the study included three dichotomous variables indicating whether respondents received a research assistantship, teaching assistantship, or tuition reduction for graduate study. The appendix presents the model's specification and coding scheme.

Data Analysis

Data analysis proceeded in three stages. First, data were prepared for analysis using data reduction techniques, data cleaning strategies (Meyers, Gamst, & Guarino, 2006), and recoding of the original variables. Next, a combination of frequencies and descriptive statistics were calculated using the weighted B&B:1993/2003 sample to answer the first two research questions.

Third, in response to the third research question, advanced regression procedures and specialized data analysis software (*AM* beta version 0.06.03; American Institutes of Research, 2002) for complex sample designs were used to estimate the relationship between financial variables and the criterion. Given the nature of the dependent variable and the study's goal of controlling for differences in background and academic characteristics, the study employed hierarchical binomial logistic regression procedures to analyze data instead of ordinary least squares (OLS) regression which assumes equality of variance in the dependent variable (Keith, 2006). Hierarchical regression analysis is "a method of regression analysis in which independent variables are entered into the regression equation in a sequence specified by the research in advance. The hierarchy (order of the variables) is determined by the researcher's theoretical understanding of the relationships among the variables" (Vogt, 1999, p. 129). This design allowed assessment of the "net effect" of financial variables on graduate student persistence. And, using logistic regression is a widely accepted method for examining binary outcomes (Aldrich & Nelson, 1984; Kerlinger & Pedhazur, 1973). In fact, logistic regression is deemed "the more popular method [for analyzing binary outcomes] at the current time" (Keith, 2006, p. 206).

To evaluate the overall strength of statistical relationships, the author calculated and interpreted several statistics — including calculated predicted probabilities, predicted odds, and adjusted odds ratios (Keith, 2006; Pampel, 2000) where necessary. Probabilities relate to the probability of persisting in graduate school relative to the independent variable(s), controlling for all others. Predicted odds, on the other hand, measure the odds of persisting in graduate school relative to the influence of an independent variable, controlling for all others. Odds ratios are "a ratio of the odds for each group" (Meyers, Gamst, & Guarino, 2006, p. 230); that is, they represent the effect of a unit change in the independent variable on the odds of being retained relative to dropping out. These statistics were derived using the following formulas:

$$\text{Predicted probabilities} = \quad p' = \quad \frac{1}{1+e^{-(Bo+B1X1+\cdots+BiXi)}}$$

$$\text{Predicted odds} = \text{odds}' = (\text{constant Exp}(\beta))\ (\text{Exp}(\beta)\text{IV})^{\text{IV(value)}}$$

$$P_i \,/\, P_j = {}_eB_{i0} + B_{i1}X1 + \cdots + B_{ip}X_p = {}_eB_{i0}\ eB_{i1}X_1 \cdots {}_eB_{ip}X_p \quad \text{or}$$

$$\text{odds ratio} = \quad \frac{\text{odds}'_1}{\text{odds}'_2}$$

Finally, the author interpreted several tests to assess the validity of the model including the likelihood ratio test, omnibus test of model coefficients, and several modified R^2 values (referred to a pseudo-R^2) which measure the overall strength of association between independent and dependent variables (Pampel, 2000).

Due to the complex sampling technique employed in the B&B:1993/2003, appropriate sampling weights must be applied to the data before analysis. The B&B:1993/2003 panel weight was appropriate for approximating the population of 1992-1993 bachelor's degree recipients in the longitudinal study. To minimize the influence of large sample sizes on standard errors while also correcting for oversampling of some groups (e.g., those in teaching fields), each case was weighted by the B&B panel weight divided by the average weight of the sample (Thomas & Heck, 2001) using the following equation:

$$\text{Relative weight} = w_i \,/\, \bar{w}$$

where w_i = original panel weight and $w = \sum w_i/n$.

Limitations

Before presenting the results of the present study, several limitations should be discussed. First, some variables in this study are limited by the magnitude of missing data. Variables with the largest share of missing data were those pertaining to financial matters such as loan debt, though no variables were missing from more than 10% of cases. In some cases, listwise deletion would reduce the analytic sample significantly and possibly result in a non-representative sample. Thus, to avoid the substantial reduction in sample size, the author took several steps to address missing cases. In some instances, mean scores were imputed for missing values on continuous independent variables. This procedure may result in an underestimation of standard errors by 10-20% and increase the chances of making a type-1 error (Thomas & Heck, 2001), so a more rigorous threshold of statistical significance was adopted when interpreting test results.

When data were missing on non-continuous (e.g., scale, etc.) variables, the study used trend equations to impute values for missing cases (except in cases where missing values where no more than 1% of cases). Trend equations predict missing values using information provided on valid cases in the sample. And, consistent with advice from others (Galloway, 2004), missing cases for the dependent variable were excluded from the analysis.

Perhaps another limitation relates to secondary data analysis. Despite widespread use in education, secondary data analysts are limited by the factors that can be defined, operationalized, and measured in a single study. That is, this study was limited to only those factors that can be measured, at least in part, by the *Baccalaureate & Beyond Longitudinal Study* (B&B). It is possible that the B&B did not measure all of the variables needed to explain the variance in graduate student persistence. Similarly, items from the B&B may be marginally related with the

constructs (e.g., prior achievement, graduate experiences, financial factors) that they purport to measure (Pascarella & Terenzini, 2005). To the extent that this is true, the study's findings may be limited.

While important, these limitations do not diminish the study's potential to contribute to understanding of the role that financial factors play in predicting graduate student persistence. The next section presents the results of this study followed by a discussion of their relevance to previous research.

Results

Descriptive statistics reveal that, by 2003, a majority (52%) of 1992-1993 bachelor's degree recipients had never enrolled in graduate school. That is, only 36 percent of BA degree recipients had enrolled in a masters or doctoral program by 2003.

The second research question focused on the proportion of 1992-1993 graduates who persisted in graduate school by 2003. Results indicate that approximately 74 percent of all those who enrolled in graduate school had persisted. Approximately 20 percent of BA recipients earned a masters degree, 2 percent earned a doctoral degree, and the balance remained enrolled in graduate school by 2003. On the other hand, 26 percent of all individuals who had enrolled in graduate school by 2003 left without earning a graduate degree (i.e., non-persisters).

In response to the third research question, hierarchical binomial logistic regression results were significant. The final model (including all control variables and predictors) is considered a "well-fitting" model based on several model fit indices including the change in scaled deviance (Δ - 2 log likelihood = 251.74); the model's chi-square results (X^2 (430 = 251.73, $p < 0.01$); and the Hosmer-Lemeshow test results (X^2 (8) = 14.85, n.s.). Additionally, Cox & Snell pseudo-R^2 was 0.08, Nagelkerke pseudo-R^2 was 0.12, and McFadden pseudo-R^2 (Cabrera, 1994) was 0.13 in the last and final model, indicating that a significant portion of the variance or change in probability of graduate student persistence is accounted for by the factors in the statistical model. Approximately 75 percent of all cases could be correctly classified using the final regression model that included financial variables along with the statistical controls. Taken together, these indices indicate an acceptable match between predicted and observed probabilities.

Several independent variables emerged as significant predictors of graduate student persistence, in the last and final model (at the $p < 0.01$ level): race, estimated family contribution, undergraduate GPA, receipt of graduate loan(s), total education loan, graduate loan amount, deferment status, research assistantship, and tuition reduction. A number of important relationships will be explicated further in the discussion section below. Table 3 presents the results of all three regression models.

Table 3: Logistic Regression Results

Factor	Model 1 (ß)	Model 2 (ß)	Model 3 (ß)
Parent's education			
High school or less	-0.179	-0.149	-0.206
Some postsecondary education	-0.013	0.030	0.022
Bachelor's	-0.016	-0.003	-0.105
Advanced degree (reference)	—	—	—
Age at receipt of bachelor's degree			
Below 24 years	0.116	0.153	-0.158
25-29 years	-0.222	-0.176	-0.346*
30 and above (reference)	—	—	—
Gender			
Female	—	—	0.136
Male (reference)	—	—	—
Race/Ethnicity			
American Indian/Alaska Native	0.681	0.681	0.899
Asian	-0.158	-0.171	-0.092
Black	0.423	0.526	0.482*
Hispanic	0.063	0.109	0.185
White (reference)	—	—	—
EFC			
No support	-0.776	-0.759	-1.151*
Less than $2,999	-0.570	-0.541	-0.652**
$3000-5,999	-0.049	-0.011	-0.018
$6,000-8,999	-0.413	-0.406	-0.320
$9,000 or more (reference)	—	—	—
Undergraduate GPA			
2.49 and below	—	-0.420	-0.634**
25. to 2.99	—	-0.168	-0.153
3.0 to 3.49	—	-0.085	-0.119
3.5 and above (reference)	—	—	—
SAT/ACT Scores			
Did not take SAT/ACT	—	-0.145	-0.029
Lowest quartile	—	-0.337	-0.139
Second quartile	—	-0.164	0.083
Third quartile	—	-0.172	-0.013
Highest quartile (reference)	—	—	—
Major			
STEM	—	-0.372**	-0.286**
Non-STEM (reference)	—	—	—

Table 3: Logistic Regression Results (continued)

Factor	Model 1 (ß)	Model 2 (ß)	Model 3 (ß)
Graduate loan			
None	—	—	1.505*
Less than $9,999	—	—	1.060
$10,000-24,999	—	—	1.577**
$25,000 to 39,999	—	—	1.204*
$40,000 or more (reference)	—	—	—
Total educational loan (Undergraduate / Graduate)			
None	—	—	-2.175**
Less than $9,999	—	—	-2.073**
$10,000-24,999	—	—	-1.532*
$25,000 to 39,999	—	—	-1.566**
$40,000 or more (reference)	—	—	—
Graduate Loan			
Yes	—	—	0.504**
No (reference)	—	—	—
Tuition Reduction			
Reduction	—	—	0.451*
No reduction (reference)	—	—	—
Research Assistantship			
Yes	—	—	0.665**
No (reference)	—	—	—
Teaching Assistantship			
Yes	—	—	0.337
No (reference)	—	—	—
Default			
Yes	—	—	-0.532
No (reference)	—	—	—
Defer			
Yes	—	—	0.456*
No (reference)	—	—	—
Undergraduate debt owed			
None	—	—	0.875
Less than $9,999	—	—	0.629
$10,000-24,999	—	—	0.754
$25,000 to 39,999	—	—	-0.022
$40,000 or more (reference)	—	—	—

*$p < 0.05$. **$p < 0.01$.

Finally, the author conducted follow-up tests to check for multicollinearity. Multicollinearity exists when two or more independent variables are highly correlated or when "one independent variable is a near linear combination of other independent variables" (Keith, 2006, p. 199). This makes it difficult if not impossible to determine direct effects on the outcome variable. Results suggest that collinearity is not a problem for this investigation as all statistics approach "1," indicating near complete independence (Cohen, Cohen, West, & Aiken, 2003).

Discussion

The purpose of this study was to examine the influence of financial aid and other related variables on graduate student persistence. Using data from the National Center for Education Statistics' *Baccalaureate and Beyond Longitudinal Study* (B&B:1993/2003) database, three research questions were explored using descriptive and multivariate statistical techniques. Findings suggest a number of important conclusions that have implications for future policy, practice, and research in the area of student financial aid.

First, several background characteristics were related to the probability of persisting in graduate school. Race/ethnicity was significantly associated with persistence in graduate school, controlling for all other differences. African Americans were significantly more likely than their non-Black peers to persist in graduate school, holding all other variables constant. Specifically, Black students were 1.36 times more likely than Hispanics and 1.62 times more likely than Whites to persist according to this analysis. In addition, parent's level of education was expected to have a significant influence on graduate student persistence. Surprisingly, results were not consistent with the expected relationship, although the positive direction of this association was supported. That is, while the odds of persisting in graduate school were lower for students whose parents had no more than a high school education compared to their counterparts whose parents had more education, this relationship failed to meet the threshold for statistical significance. Finally, age was significantly associated with the graduate student persistence indicating that, consistent with prior research (Vaquera, 2007-2008), older students were more likely to persist than their younger counterparts.

Another important finding of this study was that expected family contribution (EFC) was found to be significantly related to persistence. Those with a zero EFC represent the smallest proportion of persisters. That is, having a zero EFC decreased one's probability of persisting in graduate school by 16 percentage points. Students whose expected family contribution was $10K or more (i.e., students from higher income families) were 3.20 more likely to persist than those with EFC equal to zero.

Only two academic variables were found to have a statistically significant relationship with persistence in graduate school: undergraduate grade point average (GPA) and graduate major. Predicted probabilities reveal that the lowest achievers in college (i.e., undergraduate GPA = less than 2.5) and those who major in STEM in graduate school represent the smallest proportion of persisters. Those with an undergraduate GPA's above 3.5 are nearly two times more likely to persist in graduate school than their lowest performing peers. And, STEM majors are 0.75 times less likely than non-STEM majors to persist in graduate school.

The central purpose of this study was to measure the influence of financial variables on graduate student persistence. Results suggest that borrowing a loan for graduate study exerted a significant and positive effect on the probability of persisting; those who borrowed were 1.66 times more likely to persist than those who did not borrow graduate loans. Since most students are eligible for loans, the difference may be that those who are willing or able to borrow are more likely to persist than those who are less willing or able due to extenuating circumstances such as poor credit history, defaulted educational loans, or worries about repayment (Long & Riley, 2008).

Related, graduate loan *amounts* were significantly related to the probability of persisting. Results suggest that the highest proportion of persisters was found among those who borrowed less than $25K. And, in fact, those who borrowed less were nearly five times more likely to persist than those who borrowed over $40,000. So while borrowing a loan for graduate school was associated with persistence, there is clear evidence of a sort of "tipping point" to the amount borrowed beyond which one is less likely to persist in graduate study.

In light of findings that undergraduate debt has nearly doubled in recent years (Kim & Eyermann, 2006), total educational debt was included in this analysis. Results were mixed with respect to undergraduate loans and total educational debt. Consistent with previous research (Choy & Li, 2006; Heller, 2001; Millett, 2003), this study found that undergraduate borrowing has little to no influence on graduate student outcomes such as persistence. However, total educational debt (including undergraduate and graduate loans) was significantly and positively related to persistence. This finding should be interpreted with a degree of caution as "borrowers" who remain enrolled in graduate school for a longer period of time or those who earn a graduate degree are more likely to accumulate larger loan debt than those who leave before earning their degree. This finding may indicate an intuitive relationship between "duration of enrollment" and "amount borrowed" much more than a true "advantage" that borrowing confers on graduate students.

Deferring repayment of one's educational loans increased the probability of persisting in graduate school. Deferrers are 1.6 times more likely to persist than those who do not defer. Defaulting on one's loans, however, was inversely related to persistence although this estimate only approached statistical significance ($p = 0.052$). Interpretation of the regression coefficient suggests that those who do not default on their loans are 1.72 times more likely than defaulters to persist in graduate school. And since students do not default on their loans while attending school, this finding likely relates to those who defaulted on educational loans prior to enrolling in graduate school. Defaulting on one's loans may put students under pressure to leave graduate school, start work, and begin (or resume) paying off loans. An alternative explanation exists as well. It may be that defaulting on undergraduate loans prior to entering graduate school makes it difficult for students to receive the financial support necessary for staying in graduate school. Without such support, students drop out before completing their degree (Sanford & Adelson, 1962; Tinto, 1993).

Two other forms of aid were related to graduate student persistence. Having a research assistantship (RA) and a tuition reduction were significant predictors of retention. Graduate students with RAs are nearly 2 times more likely to persist than those who do not have an RA, consistent with previous findings (Lovitts, 2001). This difference may be attributed to RAs' socialization and meaningful engagement with faculty and staff members. Students with a

tuition reduction are 1.6 times more likely to persist than those who do not receive such aid. Interestingly, having a teaching assistantship (TA) was not related to persistence. Prior research suggests that TAs may deter a student from pursuing a profession (Austin, 2002; Meyers & Prieto, 2000) or entail heavy teaching loads and teaching-related activities, which in turn, may either extend one's time-to-degree or compromise one's academic success resulting in attrition. Indeed, additional research is warranted especially in fields where TAs are widely used such as humanities, social sciences, and business.

That approximately 40 percent of those who enrolled in graduate school after completing their BA degree had dropped out of school by 2003 is a cause for alarm. Generally speaking, these results support startling graduate student retention rates found in other studies (Berelson, 1960; Bowen & Rudenstein, 1992). Still, consistent results are no consolation for the enormous loss of talent associated with such high attrition rates—what Lovitts (2001) calls the "invisible problem" (p. 2). Referring to this phenomenon, Knox (1970) noted the enormous "loss of time, effort, and resources to students and faculty when students leave graduate school." The results of the present study are cause for action to identify and develop new ways of ensuring the success of graduate students.

Implications

This study may be significant for several campus constituencies. One group that might benefit particularly from the results of this study includes financial aid administrators. Findings provide financial aid administrators with data about the importance of various types of aid to graduate student persistence. Financial aid professionals should consider these findings when planning aid packages that meet the "unmet" needs of graduate students. For instance, packages that include a combination of scholarships, research assistantships rather than a teaching assistantships, tuition reductions through fee waivers, and a modest loan may provide optimal levels of financial support without placing graduate students at risk of leaving before earning their degree. Moreover, financial aid administrators might use the results of this study to determine which source(s) of aid are most likely to help a student persist in graduate school on their campus.

These findings may also be helpful to graduate deans and coordinators of graduate degree programs. This study provides information about the influence of various types of financial aid on graduate student success. Coordinators and deans might consider these results when creating new programs that offer financial assistance to students. For instance, based on these findings, research assistantships should be offered where possible and use of loans to graduate students should be limited. One way to limit the amount of graduate students' loans is to diversify their aid package with other sources of support such as RAs, TAs, tuition reduction, and, to the extent possible, scholarships funded through private gifts and contributions.

Another group that might benefit from the results of this study consists of graduate faculty members. Findings suggest that having a research assistantship positively affects graduate student persistence while having a teaching assistantship has little to no effect on graduate retention. Thus, faculty members might consider this information when securing external grants to employ students. RAs may be more effective ways of assisting students. There are other benefits as well. RAs have been lauded as vehicles for socialization to a profession and means for becoming academically and socially integrated into a

department or institution (Tinto, 1993). Additional research is warranted to study the nature of RAs and benefits that accrue to students from such experiences. Socialization or social exchange theory may be appropriate perspectives for investigating this issue.

There are a number of other areas for future research that may clarify and extend the results of the present study. For instance, the study found that EFC is related to graduate student persistence with higher EFC's predicting higher odds for retention. To the extent that EFC is an appropriate proxy for socioeconomic status, these findings may provide reason for concerns about low-income graduate students whose experiences are virtually absent in the existing literature. Thus, additional research is needed to study this subgroup closely.

Consistent with previous studies (Bowen & Rudenstein, 1992; Geiger, 1997; Tinto, 1993), this study found that graduate major, serving as a proxy for department life and the nature of research in a given field, is related to the odds of persisting in school. In this analysis, science, technology, engineering, and mathematics (STEM) majors are significantly less likely to persist than their non-STEM counterparts. And in light of national imperatives to increase the number of individuals earning STEM degrees (Heller & Martin, 1994), more information is needed to understand this apparent "brain drain" from the STEM pipeline. Future researchers should design studies focusing exclusively on STEM graduate students or comparative studies that juxtapose them and their peers in other graduate fields.

Much remains to be learned about the role that finances play in predicting graduate student persistence. This study provides an initial foray into factors associated with graduate student persistence using a nationally representative sample. Further research is needed, though it is clear from the present study that money matters.

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Appendix: Model Specification: Factors, Variables, and Codes for the Integrated Model

Factors		Variables	Code
Dependent		Persistence	0 = non-persister
			1 = persister
Financial		Total aid borrowed for graduate school	0 = none
			1 = less than $9,999
			2 = $10,000-24,999
			3 = $25,000-39,999
			4 = $40,000 or more
		Total aid borrowed for undergraduate	0 = none
			1 = less than $9,999
			2 = $10,000-24,999
			3 = $25,000-39,999
			4 = $40,000 or more
		Total aid borrowed for undergraduate/graduate	0 = none
			1 = less than $9,999
			2 = $10,000-24,999
			3 = $25,000-39,999
			4 = $40,000 or more
	Aid Type	Graduate loans	0 = did not receive
			1 = received
		Aid Package	1 = loans, no grants
			2 = grants, no loans
			3 = grants and loans
			4 = other
			5 = no aid
	Debt	Undergraduate (amount owed)	0 = none
			1 = less than $4,000
			2 = $4,000-7,999
			3 = $8,000-12,599
			4 = $12,600 or more
		Total debt (Undergraduate/graduate)	0 = none
			1 = less than $9,999
			2 = $10,000-24,999
			3 = $25,000-39,999
			4 = $40,000 or more
		Default status	0 = defaulted on neither
			1 = defaulted
		Deferment status	0 = no deferment
			1 = deferment
	Institutional aid	Assistantship	0 = no
			1 = yes
		Tuition reduction	0 = no
			1 = yes

Appendix: Model Specification: Factors, Variables, and Codes for the Integrated Model (Continued)

Factors		Variables	Code
Academic	***Grades***	Undergraduate GPA	0 = 2.49 and under
			1 = 2.5 to 2.99
			2 = 3.0 to 3.49
			3 = 3.5 and above
		SAT/ACT Quartile score	0 = did not take SAT/ACT
			1 = lowest quartile
			2 = second quartile
			3 = third quartile
			4 = highest quartile
		GRE Sum score	1 = Top 25% on all 3
			2 = Top 25% on 2 of 3
			3 = Top 25% on 1 of 3
			4 = Middle 50% on all 3
		Major STEM	0 = non STEM
			1 = STEM
Background		Parent's level of education	0 = high school or less
			1 = some postsecondary, associate's degree
			2 = bachelor's
			3 = advanced degree
		Gender	0 = male
			1 = female
		Age at receipt of bacherlor's degree	0 = 24 years or younger
			1 = 25-29 years
			2 = 30 or older
		Expectations	1 = bachelor's or less
			2 = masters
			3 = PhD
			4 = First professional
		Race	1 = American Indian/Alaska Native
			2 = Asian
			3 = Black
			4 = Hispanic
			5 = Caucasian
	Socioeconomic Status	Expected Family Contribution	0 = no support
			1 = less than $2,999
			2 = $3,000-5,999
			3 = $6,000-8,999
			4 = $9,000 or more