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CAN PSYCHOSOCIAL FACTORS PREDICT FIRST-TO-SECOND YEAR COLLEGE RETENTION ABOVE AND BEYOND STANDARD VARIABLES?

A Mixed Effects Multinomial Regression Analysis



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Abstract

We examined the validity of 10 psychosocial factors for predicting retention status (stay, transfer, or drop out) at the start of the second year of college by fitting a mixed-effects multinomial logistic regression model. Data consisted of retention records of 9,364 students from 31 four-year institutions. Predictors included commonly used variables for predicting college retention (i.e., high school grade point average [HSGPA], ACT Composite score, gender, family income, and race/ethnicity) and 10 psychosocial factors. We examined the differential effects of psychosocial factors on retention status, namely which psychosocial attributes differentiated students who stayed from those who transferred or dropped out, and which psychosocial factors differentiated students who transferred from students who dropped out. Our results indicated that *Academic Discipline*, *Commitment to College*, *Social Connection*, and *Academic Self-Confidence* incrementally predicted first-to-second year retention status above and beyond the commonly used variables. Specifically, students with higher *Academic Discipline*, *Commitment to College*, or *Social Connection* were *more* likely to stay at their institutions than to drop out or transfer; whereas students with higher *Academic Self-Confidence* were *less* likely to stay than to drop out or transfer, and also *less* likely to transfer than to drop out. These results were confirmed using a follow-up cross-validation analysis on a holdout sample of 4,804 students. These findings may have implications for interventions aimed at identifying students at risk of dropping out of college and for improving retention to the second year of college.

Keywords: psychosocial factors, college retention, validity research, multilevel modeling

Can Psychosocial Factors Predict First-to-Second Year College Retention Above and Beyond Standard Variables? A Mixed Effects Multinomial Regression Analysis

Recent statistics on student retention indicates that approximately 25% of students at four-year institutions left their original institutions for some reason (e.g., dropped out, transferred) between the first and second year (ACT, 2017, Figure 2). The percentage is even higher when results are based on students attending either a four-year or two-year institution. Specifically, according to research published by the National Student Clearinghouse (NSC, 2016),¹ the overall percentage of college freshmen who returned to the same institution for the second year (first-to-second year retention rate) was close to 60% for cohorts entering in the fall of 2009 through the fall of 2014. This suggests that about four in ten incoming college students who enrolled in a fall term failed to return to the same college for the fall semester of the second year. The study also found that about one in nine students who started college in a fall semester transferred to different college in the following fall term (Research Center, NSC, 2016). As a result of this considerable decline in second-year enrollment, college retention research often focuses on measuring variables related to first-to-second year retention (e.g., Herzog, 2005; Belloc, Maruotti, Petrella, 2011).²

Students leave college for a number of reasons, including academic issues (McGrath & Braunstein, 1997), personality characteristics (Tross, Harper, Osher, & Kneidinger, 2000), attitudes toward college (Rivas, Sauer, Glynn, & Miller, 2007), and financial hardship (Ishitani & DesJardins, 2002). One line of research has focused on psychosocial factors (PSFs) and study skills as predictors of college retention (Robbins, Lauver, Le, Davis, Langley, & Carlstrom, 2004; Le, Casillas, Robbins, & Langley, 2005). PSFs are important predictors of college retention because they can be used to identify students at risk of leaving college (Allen, Robbins, & Sawyer, 2010). PSFs have been found to significantly predict third-year college retention, even after accounting for standard variables such as high school grade point average (HSGPA), ACT Composite score, gender, family income, and race/ethnicity (Allen, Robbins, Casillas, & Oh, 2008). Considering the substantial decline in second-year enrollment, the current study focuses on the relationship between PSFs and first-to-second year college retention.

Although retention is often operationalized as a binary outcome (i.e., student stays versus student does not stay), the dichotomy may confound important within-group differences among students who do not stay for various reasons. Of particular interest in the retention literature are differences between students who drop out and students who transfer (Herzog, 2005). A study examining the relationship between PSFs and retention to the third-year of college found that students with higher first-year academic performance were *more* likely to transfer than drop out (Allen et al., 2008). This finding was corroborated in a case study on retention at Italian universities that found students with a better educational background to be *more* likely to transfer and *less* likely to drop out (Belloc, Maruotti, & Petrella, 2011). Given these differences, the current study also examined the differential effects of PSFs on students who transferred and students who dropped out.

Objectives of the Current Study

The primary goal of the current study was to examine the validity of 10 PSFs for predicting first-to-second year college retention. In that regard, we investigated the following research questions:

1. Are PSFs related to first-to-second year retention?
2. Do PSFs incrementally predict college retention beyond academic and demographic variables?
3. Which PSFs differentiate students who stay at their institution from students who transfer or drop out, and/or differentiate students who transfer to other institutions from those who drop out?
4. How do estimates from the current study compare with estimates from an earlier study examining these PSFs?
5. Can the PSFs identify students at risk of leaving their institutions?
6. Do the PSFs provide useful information for creating effective interventions and increasing first-to-second year retention rates?

Method

Operationalizing Retention

A limitation in modeling an outcome with three nominal categories (stay, transfer, or drop out) is that comparisons are typically performed between a reference level (e.g., drop out) and all other levels of the outcome variable (e.g., drop out versus transfer, drop out versus stay). These comparisons may preclude a comparison of substantive interest, such as *stay* versus *transfer* and *drop out*. As a solution, Hedeker (2003) suggested specifying $C - 1$ contrasts, where C is the number of levels of the outcome.

For the current study, the probability that the i th student in j th school has first-to-second year retention status c , conditional on random effects β , is given by:

$$\Pr(Y_{ij} = c | \beta) = \frac{\exp(z_{ijc})}{\sum_{h=1}^C \exp(z_{ijh})} \text{ for } c = 1, 2, \dots, C$$

where z_{ijc} is a multinomial logit equal to the sum of the weighted predictors and $C = 3$.

Customized contrasts between the three levels of retention (stay [$c = 3$], transfer [$c = 2$], or drop out [$c = 1$]) can be specified by multiplying the multinomial logits by the desired contrast coefficients. In the current study, orthogonal contrasts were specified for the three categories of retention status. The first contrast compared students who stayed (coefficient = $2/3$) against the combined average of students who transferred (coefficient = $-1/3$) and dropped out (coefficient = $-1/3$). The second contrast compared students who transferred (coefficient = $1/2$) against students who dropped out (coefficient = $-1/2$). Note that these two sets of contrasts are orthogonal, and therefore, fully account for non-overlapping variability in the retention outcome. By weighting the probability functions with these contrast coefficients, the multinomial logits, z_{ijc} , become interpretable as the log-odds of *stay* versus *transfer/drop out* and the log-odds of *transfer* versus *drop out*. (See Appendix A for an illustration of how the customized contrast coefficients compared to traditional dummy coding was expressed in the multinomial probability equation above).

Measuring Psychosocial Factors

This study examined 10 PSFs (*Academic Discipline, Academic Self-Confidence, Commitment to College, Communication Skills, General Determination, Goal Striving, Social Activity, Social Connection, Steadiness, and Study Skills*) measured by ACT Engage® College (ACT, 2012), an instrument formerly known as the Student Readiness Inventory (Le et al., 2005). The psychosocial constructs were developed based on previous research on the effects of nonacademic-related skills on academic outcomes. Following item development, the survey was administered to high school and college students, and an exploratory factor analysis was conducted to determine the number of interpretable factors to extract. Items that loaded on these factors were selected. To cross-validate the observed factor structure, a confirmatory factor analysis was conducted on a holdout sample with items reselected based on the magnitudes of the factor loadings. The first-order factors were then factored again to determine the structure of the second-order factors. The final model consisted of 10 first-order latent constructs, each measured by 10 to 12 graded response items, and three second-order constructs. The model provided a good-fit for the data ($\chi^2 (10,250) = 10,486.72$, CFI = .99, RMSEA = .012), and the factor structures were consistent with the *a priori* operational definitions of the 10 PSFs and the three higher-order domains.

A validation study showed three PSFs—*Academic Discipline, Commitment to College, and Social Connection*—were statistically significant predictors of second-to-third year college retention, even after accounting for the effects of academic achievement and demographic variables on retention (Allen et al., 2008). *Commitment to College* and *Social Connection* had direct effects on third-year retention, whereas *Academic Discipline* indirectly affected retention by means of first-year academic performance.

Data Preparation

The sample includes students who took the ACT college admissions test in high school and took the ACT Engage College assessment as incoming freshman students. The students completed high school from 2006 to 2011 and entered college the fall after high school completion. The sample is drawn from institutions that administered the ACT Engage College assessment to incoming freshman students. The Engage data were matched to ACT test data and enrollment data obtained from the NSC to determine first-to-second year college retention status (stay, transfer, drop out). The results indicated that 74.9% ($n = 10,792$) of the students stayed at the same institution, 13.1% ($n = 1,882$) transferred to another institution, and 12.1% ($n = 1,737$) dropped out of college.

Students with full information on required variables were retained for the analysis ($n = 14,411$; starting sample = 21,031). We randomly sampled and set aside one-third of the cases ($n = 4,804$) for the cross-validation analysis. We dropped institutions (level two units) with fewer than 10 students to improve the accuracy of the parameter estimates (Austin, 2010). Two-year colleges constituted less than 2% of the data with non-missing values in the required variables. Hence, we retained only four-year colleges with complete data. This resulted in a training set of 9,364 students nested in 31 four-year institutions.

First-to-second year college retention status by gender, family income, and race is shown in Table 1 (Appendix B). Gender was defined as a binary predictor, with male coded as “1” and female coded as “0.” Family income was defined as an ordinal predictor, with family income less than \$36,000 coded as “1,” income between \$36,000 and \$100,000 coded as “2,” and

income greater than \$100,000 coded as “3.” The 10 PSFs were each rescaled to have a mean of zero and a standard deviation of one.

Estimation Procedure

We estimated model parameters using adaptive Gaussian quadrature (Rabe-Hesketh, Skrondal, & Pickles, 2002) with the SAS Nonlinear Mixed Models procedure (PROC NLMIXED). The NLMIXED procedure allowed for direct implementation of the log likelihood function and the specification of custom contrasts in the multinomial logistic model. We specified both fixed effects (the student-level predictors) and random effects (the school-level intercepts). The random intercept for each contrast accounted for the clustering of students within schools. These intercepts were assumed to be multivariate normal, with the mean vector set to zero and the covariance matrix specified as an identity matrix.

Results

Demographic Characteristics and Retention Status

Table 1 (Appendix B) shows that first-to-second year college retention status varied by gender, family income, and race, with females, students from higher-income families, and Asian students being more likely to return as compared to males, students from lower-income families, and underrepresented minorities, respectively. In general, PSF scores were higher for students who stayed at their institutions than for students who transferred or dropped out and higher for students who transferred than for students who dropped out (Table 2 in Appendix B). For example, students who stayed at their institutions had higher standardized *Academic Discipline* scores (*average* = .09) than students who transferred (*average* = −0.14) or dropped out (*average* = −0.23).

Point-biserial correlations (r_{pb}) were calculated between the standardized PSF scales and the “stay versus drop out/transfer” and “transfer versus stay” contrasts; results are summarized in Table 3 (Appendix B). All correlations between PSFs and “stay versus drop out/transfer” were positive (r_{pb} = .01 to .12), indicating that the PSF scores of students who stayed at their institutions tended to be higher than the combined average PSF scores of students who transferred and students who dropped out. Furthermore, most of the correlations between the PSFs and “transfer versus drop out” were positive (r_{pb} = −.03 to .06), indicating that in general, students who transferred had higher PSF scores than students who dropped out, though most of the correlations were not statistically significant ($p > .05$).

We examined the relationship between PSFs and the “stay versus transfer/drop out” in greater detail by splitting each PSF into deciles (10 equal groups), and then calculated the retention rate (i.e., the percentage of students who stay at their institutions in the second year) at each decile. As displayed in Figures 1 through 10 (Appendix C), we found that the largest increases in retention occurred between the first and third deciles for each scale (i.e., bottom 20% of scores).

Six of the PSF scales were monotonically related to retention status. For example, retention rates increased at each decile of *Academic Discipline*, as shown in Figure 1 (Appendix C). In contrast, four of the PSFs, namely *Goal Striving*, *Social Activity*, *Study Skills*, and *Steadiness*, were *not* monotonically related to retention. For these scales, retention rates tended to peak in the 4th to 6th decile range and then decreased in the 8th to 10th decile range. For example,

retention rates peaked at the sixth decile of *Social Activity* and then decreased at higher deciles as shown in Figure 2 (Appendix C).

Incremental Prediction of PSFs

We assessed incremental prediction of PSFs beyond standard variables by specifying full and reduced regression models. The standard variables in the reduced model included academic achievement variables (HSGPA & ACT Composite score) and demographic variables (gender, race, and family income). The full model included these standard variables and the 10 psychosocial scales. We standardized all continuous predictors to facilitate the comparison of the estimated parameters and used effect coding for the categorical predictors for the purpose of interpreting the intercept as the overall estimated log-odds for a given contrast.

A likelihood ratio test³ was conducted to assess relative fit between the full and reduced models. The full model fitted the data significantly better than the reduced model ($\chi^2 (df = 20) = 147, p < .01$), indicating that PSFs from ACT Engage College incrementally predicted college retention beyond the standard variables. Two additional likelihood ratio tests were conducted to determine the necessity of including the random effects in the model. The first test compared the full model with independent random intercepts to the full model without random intercepts (i.e., fixed effects only). The model with independent random intercepts fit the data significantly better than the full model without random intercepts ($\chi^2 (df = 2) = 97, p < .01$). The second test compared the full model with correlated random intercepts (i.e., an additional parameter estimate measuring the correlation between random intercepts) to the full model with independent random intercepts. The full model with correlated random intercepts did not fit the data significantly better than the full model with independent random intercepts, with $\chi^2 (df = 1) = 3$ and $p = .051$. Therefore, the model with independent random intercepts was retained.

Relationship Between PSFs and First-To-Second Year of College Retention

Students with higher *Academic Discipline* ($\hat{\beta} = 0.284$), *Commitment to College* ($\hat{\beta} = 0.127$), and *Social Connection* ($\hat{\beta} = 0.135$) were significantly *more* likely to stay at their college than to transfer or drop out. Meanwhile, students who had higher *Academic Self-Confidence* ($\hat{\beta} = -0.216$) were significantly *less* likely to stay than to transfer or drop out. *Academic Self-Confidence* was the only scale that significantly differentiated students who transferred from students who dropped out. Students with higher *Academic Self-Confidence* ($\hat{\beta} = -0.189$) were significantly *less* likely to transfer than to drop out. Parameter estimates and standard errors for the full model are shown in Table 4 (Appendix B).

Comparison to Results from Allen et al. (2008)

In this section, we compare the results from the current study to the results in Allen et al. (2008), given the similarities between the two studies, although there are several differences worth noting. As for predictors of retention status, the Allen et al. (2008) study⁴ included first-year academic performance, a measure not included in the current study. Furthermore, Allen et al. (2008) used only three of the 10 PSFs in the current study to model second-to-third year retention, whereas this study used all 10 PSFs to model first-to-second year retention. Finally, the outcome of interest in the Allen et al. (2008) study was second-to-third retention as compared to first-to-second retention, which is the focus of the current study.

A separate set of contrasts between retention status outcomes was specified to compare model estimates obtained from the current sample with estimates obtained from an earlier validation sample (Allen et al., 2008). In Allen et al. (2008), contrasts were specified between “stay versus drop out” and “transfer versus drop out;” all categorical variables were dummy-coded; “Male” was specified as the reference group for *Gender*; “White” for *Race*; and “Moderate Income” for *Family Income*.

Although the predictors and the outcome used in the current study and the Allen et al. (2008) study were not the same, the model estimates were similar. The estimates for demographic predictors were in the same direction and achieved the same level of statistical significance in both studies. Table 5 (Appendix B) of the current study shows that males were *more* likely than females to transfer than to drop out ($\hat{\beta} = 0.325$) and Black students were *more* likely than White students to stay than to drop out ($\hat{\beta} = 0.321$).

The family income predictor in the current study was operationalized differently than the socioeconomic status (SES) predictor in the Allen et al. (2008) study, but the results were still similar. Namely, after controlling for all other predictors in the model, students from lower-income families were *less* likely than students from moderate-income families to stay than drop out ($\hat{\beta} = -0.467$), whereas students from high-income households were *more* likely than those from moderate-income families to stay than drop out ($\hat{\beta} = 0.276$).

Three PSFs common to both studies were *Academic Discipline*, *Commitment to College*, and *Social Connection*. Most notably, students with higher *Academic Discipline* were *more* likely to stay than drop out in the current study ($\hat{\beta} = 0.341$), but were *less* likely to stay than drop out in the Allen et al. (2008) study ($\hat{\beta} = -0.179$). An explanation for this discrepancy is that *Academic Discipline* was mediated by first-year academic performance in the Allen et al. (2008) study; this study did not control for first-year academic performance. Indeed, the total effect of *Academic Discipline* was positive and statistically significant in the Allen et al. (2008) study.

Furthermore, *Commitment to College* and *Social Connection* were statistically significant and in the same direction in both studies. Namely, students with higher *Commitment to College* were *more* likely to stay than drop out ($\hat{\beta} = 0.120$), and students with higher *Social Connection* were also *more* likely to stay than drop out ($\hat{\beta} = 0.137$). Full model estimates for the “stay versus drop out” and “transfer versus drop out” contrasts are shown in Table 5 (Appendix B).

Can Psychosocial Factors Identify Students at Risk of Leaving Their Institutions?

We used parameter estimates from the full and reduced models to calculate the estimated probability that each student in the cross validation (holdout) sample stayed at his or her institution from the first-to-second year. To examine whether the estimated probabilities could be used to accurately identify students who transferred or dropped out, we examined thresholds at the 5th, 10th, 15th, 20th, and 25th percentiles.⁵ A student was classified as “low risk” (of transfer/drop out) if the estimated probability of staying was greater than a specified threshold and classified as “at risk” if the estimated probability of staying was less than or equal to the threshold. Following each classification, we recorded the number of times the student was correctly classified as staying (i.e., true positives), incorrectly classified as staying (false positives), correctly classified as not staying (true negatives), and incorrectly classified as not staying (false negatives).

The full and reduced models correctly identified students at risk of transfer/drop out with negative predictive values⁶ ranging from 9% to 16% higher than random chance. Negative predictive values were 0 to 2% higher for the full model than for the reduced model. Detailed results from the classification analysis are shown in Table 6 (Appendix B).

In practice, school administrators and/or guidance counselors may not be familiar with parameter estimates obtained from a logistic regression and may prefer a more straightforward method for identifying students who drop out or transfer. We examined the incremental predictive validity of the most salient PSFs (i.e., *Academic Discipline*, *Commitment to College*, and *Social Connection*) in identifying students who dropped out or transferred.

The probability that a randomly selected student transferred or dropped out was approximately 25%. Using standardized ACT Composite score to identify students as “at risk” of transfer/drop out, the probability of selecting a student who actually transferred or dropped out increased to approximately 33%. Further, using an unweighted composite of standardized *Academic Discipline*, *Commitment to College*, and *Social Connection*, the probability of selecting a student who actually transferred or dropped out increased to approximately 36%. Lastly, when using both standardized ACT Composite score and the three standardized PSF scales, the probability of selecting a student who actually transferred or dropped out increased to approximately 37%.

The results indicate *Academic Discipline*, *Commitment to College*, and *Social Connection* provide increased accuracy in predicting “transfer/drop out” over ACT Composite score. Further, combining ACT Composite score with the three significant PSFs best predicted “transfer/drop out.” Full results are shown in Table 7 (Appendix B) and corroborate similar findings reported in the ACT Engage College User’s Guide (ACT, 2012).

Do the Psychosocial Factors Provide Useful Information for Creating Effective Interventions and Increasing First-To-Second Year College Retention Rates?

Identification of students at risk of leaving their institutions only improves retention if the students experience effective interventions. An advantage of using PSF scores to identify students at risk of leaving an institution is that the PSF scores can also be used to design effective interventions. Further information on interpreting PSF scores and designing appropriate intervention can be found in the ACT Engage College User’s Guide (ACT, 2012).

Students with predicted probabilities of retention in the bottom 5% reported much lower *Academic Discipline*, *Commitment to College*, and *Social Connection* than students with higher predicted probabilities. Interventions that focus on improving these particular psychosocial skills can increase a student’s probability of first-to-second year retention. For example, our study showed that if a student in the 5th percentile increased his or her *Academic Discipline* by one standard deviation, the student’s estimated probability of staying at his or her institution increased from 65% to 71%. If the student increased his or her *Academic Discipline*, *Commitment to College*, or *Social Connection* by one standard deviation, the student’s probability of first-to-second year retention increased from 65% to 76%. Estimated increases for the 5th, 10th, 15th, 20th, and 25th percentiles are shown in Table 8 (in Appendix B).

Conclusion

This study examined the differential effects of 10 PSFs on retention characterized by “stay versus transfer/drop out” and “transfer versus drop out.” Among the 10 PSFs examined, *Academic Discipline*, *Commitment to College*, *Social Connection*, and *Academic Self-Confidence* incrementally predicted first-to-second year retention status beyond standard variables. That is, students with higher *Academic Discipline*, *Commitment to College*, and *Social Connection* were more likely to stay at their institutions than to drop out or transfer, whereas students with higher *Academic Self-Confidence* were less likely to stay than to drop out or transfer. *Academic Self-Confidence* also differentiated students who transferred from students who dropped out: namely, students with higher *Academic Self-Confidence* were less likely to transfer than to drop out. *Academic Self-Confidence* was defined as “The extent to which you believe you can perform well in school” (ACT, 2012); thus, this finding suggests that students may not return to college for the second year because they overestimated their ability to perform well in college.

Among the 10 PSFs examined, the effect of *Academic Self-Confidence* on retention seemed counterintuitive to the expectations that higher self-confidence would result in improved retention (e.g., DeWitz, Woolsey, & Walsh; 2009). As such, the impact of *Academic Self-Confidence* warranted further examination. It is plausible to expect that students with higher academic self-confidence would stay in college rather than transfer or drop out. The effect of *Academic Self-Confidence* on retention status could have been impacted by the effects of other predictors in the model—for instance, HSGPA, ACT Composite score, and *Academic Discipline*. These other predictors were significantly related to retention status and were also highly correlated with *Academic Self-Confidence* (Table 9 in Appendix B). That is, multicollinearity may be one reason for the counterintuitive results. To this point, the simple bivariate relationship between *Academic Self-Confidence* and retention status (stay versus transfer/drop out as shown in Table 3 in Appendix B) was positive, meaning higher *Academic Self-Confidence* scores were associated with a higher probability of a student staying (versus not staying) at his or her institution. However, in the full model that accounted for other predictors, the odds of a student staying at the same institution in the second year were lower for students with higher *Academic Self-Confidence* (Table 4 in Appendix B). When HSGPA, ACT Composite, and *Academic Discipline* variables were excluded from the model, we found that the more academically self-confident students were more likely to stay than transfer or drop out ($\beta = 0.072$, $SE = 0.030$, $p = 0.021$), unlike the prior conclusion derived from Table 4 (Appendix B).

We note that *Academic Self-Confidence* is a good proxy for academic preparation (as shown by the significant bivariate correlation with the academic variables in Table 9). However, when more precise indicators of academic readiness for college (ACT Composite score and HSGPA) are taken into account, the positive relationship between *Academic Self-Confidence* and retention is lost—in fact, we observed a reversed relationship. One explanation could be that these students are unskilled and unaware, or overconfident in their academic competencies and their ability to succeed (Kruger & Dunning, 1999). That is, among students with the same academic competencies and *Academic Discipline*, those with higher *Academic Self-Confidence* may be more likely to drop out, in part, because of an artificially inflated self-appraisal and unrealistically high expectations of their performance in college.

Utility of Results

The stability of the parameter estimates was examined through a cross-validation analysis on a holdout sample. Students were classified as “at risk” or “low risk” of drop out/transfer. The 10 PSFs increased identification accuracy of “at risk” students by a small margin over the model without the PSFs and by a large margin over random identification. The results from this analysis suggest that PSFs are useful for identifying students “at risk” of leaving their institutions, beyond the traditionally used academic factors. Hence, the prediction equation developed in this study might be used for identifying “at risk” students for targeted interventions. A simpler approach for identifying “at risk” students involves using overall ACT score in combination with the three most significant PSFs (*Academic Discipline*, *Commitment to College*, and *Social Connection*).

Although all students may benefit from intervention programs, the type of intervention that may be most effective for one student may not be the most effective for another student, depending on each student’s profile of strengths and weaknesses. Based on the current findings, colleges and universities may want to design and develop multiple intervention programs and strategies to improve both academic skills and nonacademic factors (such as *Academic Discipline*, *Commitment to College*, and *Social Connection*, given their unique contribution in predicting college retention). Then, based on a student’s strengths and weaknesses, tailored interventions could be provided, in-line with the notion that a one-size-fits-all solution is not likely going to adequately address an institution’s retention needs. Because the study involved only four-year institutions, we recommend caution when applying the results to two-year colleges. Overall, these findings provide tools and rationales to help inform the development of holistic-based targeted-interventions for improving college retention.

Notes

1. The NSC includes data for more than more than 3,600 colleges and universities, enrolling over 98% of all students in public and private U.S. institutions. More information can be found at www.studentclearinghouse.org.
2. First-to-second year retention is defined as the percentage of students who enrolled as first-time, full-time students who return one year later as either full-time or part-time students at the same institution.
3. A likelihood ratio test was appropriate because the reduced model was nested within the full model and we estimated both models using maximum likelihood.
4. As a cautionary note, we should mention that neither the predictors nor the outcome in the two studies were exactly the same and, therefore, cannot be directly compared.
5. Percentiles are based on students’ estimated probabilities of retention (staying). For example, a threshold at the 5th percentile differentiates the 5% of students with the lowest probability of retention from the 95% of students with the highest probability of retention.
6. Negative predictive values are the proportion of students who were correctly classified as “at risk” out of the total number of students who transferred or dropped out.

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Appendix A

Formula Explaining Contrasts Coding in Multinomial Logistic Regression

This section provide an example for dummy coding the outcome as probabilities in a multinomial logistic regression model. The red numbers were used to emphasize the combination of the contrast coefficients:

$$\Pr(Y_{ij} = \text{drop out} | \beta) = \frac{\exp(0z_{ij2} + 0z_{ij3})}{\exp(0z_{ij2} + 0z_{ij3}) + \exp(1z_{ij2} + 0z_{ij3}) + \exp(0z_{ij2} + 1z_{ij3})} = \frac{1}{1 + \sum_{h=2}^C \exp(z_{ijh})},$$

$$\Pr(Y_{ij} = \text{transfer} | \beta) = \frac{\exp(1z_{ij2} + 0z_{ij3})}{\exp(0z_{ij2} + 0z_{ij3}) + \exp(1z_{ij2} + 0z_{ij3}) + \exp(0z_{ij2} + 1z_{ij3})} = \frac{\exp(z_{ij2})}{1 + \sum_{h=2}^C \exp(z_{ijh})},$$

and

$$\Pr(Y_{ij} = \text{stay} | \beta) = \frac{\exp(0z_{ij2} + 1z_{ij3})}{\exp(0z_{ij2} + 0z_{ij3}) + \exp(1z_{ij2} + 0z_{ij3}) + \exp(0z_{ij2} + 1z_{ij3})} = \frac{\exp(z_{ij3})}{1 + \sum_{h=2}^C \exp(z_{ijh})}.$$

For this study, two custom contrasts were examined, comparing:

1. “stay” (coefficient = 2/3) versus “transfer” (coefficient = -1/3) and “drop out” (coefficient = -1/3), and
2. “transfer” (coefficient = 1/2) versus “drop out” (coefficient = -1/2). The contrast coefficient for “stay” is 0.

The multinomial logits were multiplied by the contrast coefficients associated with each outcome-type, resulting in the probabilities models shown below:

$$\Pr(Y_{ij} = \text{drop out} | \beta) = \frac{\exp[(-1/3)z_{ij2} + (-1/2)z_{ij3}]}{\exp[(-1/3)z_{ij2} + (-1/2)z_{ij3}] + \exp[(-1/3)z_{ij2} + (1/2)z_{ij3}] + \exp[(2/3)z_{ij2} + (0)z_{ij3}]},$$

$$\Pr(Y_{ij} = \text{transfer} | \beta) = \frac{\exp[(-1/3)z_{ij2} + (-1/2)z_{ij3}]}{\exp[(-1/3)z_{ij2} + (-1/2)z_{ij3}] + \exp[(-1/3)z_{ij2} + (1/2)z_{ij3}] + \exp[(2/3)z_{ij2} + (0)z_{ij3}]},$$

and

$$\Pr(Y_{ij} = \text{stay} | \beta) = \frac{\exp[(2/3)z_{ij2} + (0)z_{ij3}]}{\exp[(-1/3)z_{ij2} + (-1/2)z_{ij3}] + \exp[(-1/3)z_{ij2} + (1/2)z_{ij3}] + \exp[(2/3)z_{ij2} + (0)z_{ij3}]}.$$

Appendix B

Tables of Results

Table 1. Percentage First-to-Second Year College Retention Status by Gender, Family Income, and Race

Group		N	Enrollment status		
			Drop (%)	Transfer (%)	Return (%)
Gender	Female	8,348	10.4	13.4	76.3
	Male	6,063	14.3	12.7	73.0
Income	Low	3,829	15.8	12.2	72.0
	Moderate	7,567	11.0	13.2	75.8
	High	3,015	10.0	13.7	76.4
Race	Asian	470	10.4	9.2	80.4
	Black	1,595	13.3	12.9	73.8
	Hispanic	1,627	15.2	11.6	73.2
	White	10,145	11.0	13.5	75.5
	Other	574	20.0	12.7	67.2
Overall		14,411	12.1	13.1	74.9

Table 2. Means of Standardized PSF Scales by Retention Status

	Drop Out (n = 1,737)	Transfer (n = 1,882)	Stay (n = 10,792)
Academic Discipline	-0.23	-0.14	0.09
Academic Self-Confidence	-0.04	-0.07	0.05
Commitment to College	-0.12	-0.06	0.06
Communication Skills	-0.07	-0.03	0.03
General Determination	-0.06	-0.04	0.06
Goal Striving	-0.03	-0.02	0.04
Social Activity	-0.08	0.04	0.00
Social Connection	-0.15	-0.02	0.04
Steadiness	-0.04	-0.07	0.01
Study Skills	0.01	-0.06	0.04

Table 3. Point-Biserial Correlations Between Standardized PSF Scales and Retention Status Contrasts

	Stay versus Transfer/Drop Out (<i>n</i> = 14,411)	Transfer versus Drop Out (<i>n</i> = 3,619)
Academic Discipline	0.12**	0.04**
Academic Self-Confidence	0.05**	-0.02
Commitment to College	0.07**	0.03
Communication Skills	0.03**	0.02
General Determination	0.05**	0.01
Goal Striving	0.03**	0.01
Social Activity	0.01	0.06**
Social Connection	0.05**	0.06**
Steadiness	0.03**	-0.01
Study Skills	0.03**	-0.03*

Note. ** $p < .01$, * $p < .05$

Table 4. Parameter Estimates and Standard Errors (SE) for Full Model

Predictor	Stay versus Transfer/Drop Out		Transfer versus Drop Out	
	Estimate	SE	Estimate	SE
Intercept	2.231**	(0.101)	0.115	(0.137)
<i>Pre-college Variables</i>				
High School GPA	0.312**	(0.030)	0.175**	(0.049)
ACT Composite score	0.310**	(0.038)	0.056	(0.064)
<i>Gender</i>				
Male (vs Female)	-0.063*	(0.029)	0.164**	(0.049)
<i>Race/Ethnicity</i>				
Asian (versus White)	0.174	(0.146)	0.344	(0.256)
Blacks (versus White)	0.249**	(0.082)	-0.140	(0.137)
Hispanic (versus White)	-0.050	(0.101)	0.141	(0.167)
Other (versus White)	-0.165	(0.104)	-0.495**	(0.169)
<i>Household Income</i>				
Low (versus Middle)	-0.212**	(0.043)	-0.387**	(0.073)
High (versus Middle)	0.183**	(0.048)	0.316**	(0.083)
<i>PSFs</i>				
Academic Discipline	0.284**	(0.041)	0.107	(0.067)
Academic Self-Confidence	-0.216**	(0.036)	-0.189**	(0.061)
Commitment to College	0.127**	(0.030)	-0.012	(0.049)
Communication Skills	-0.046	(0.037)	-0.035	(0.061)
General Determination	-0.055	(0.049)	-0.081	(0.082)
Goal Striving	-0.026	(0.049)	0.144	(0.082)
Social Activity	-0.019	(0.035)	0.061	(0.059)
Social Connection	0.135**	(0.037)	0.004	(0.062)
Steadiness	0.012	(0.031)	0.012	(0.052)
Study Skills	0.004	(0.035)	-0.086	(0.058)
Institutional variation	0.144*	(0.062)	0.134	(0.071)

Note. ** $p < .01$, * $p < .05$

Table 5. Parameter Estimates and Standard Errors (SE) for Model with Dummy Contrasts Between Outcomes for Comparison with Allen et al. (2008)

Predictor	Stay versus Drop Out		Transfer versus Drop Out	
	Estimate	SE	Estimate	SE
Intercept	2.193**	(0.111)	0.082	(0.155)
<i>Pre-college Variables</i>				
High School GPA	0.397**	(0.041)	0.174**	(0.049)
ACT Composite score	0.340**	(0.053)	0.055	(0.064)
<i>Gender</i>				
Male (vs Female)	0.036	(0.081)	0.325**	(0.099)
<i>Race/Ethnicity</i>				
Asian (versus White)	0.481	(0.263)	0.198	(0.317)
Blacks (versus White)	0.321**	(0.123)	-0.279	(0.155)
Hispanic (versus White)	0.159	(0.165)	0.010	(0.201)
Other (versus White)	-0.289	(0.150)	-0.663**	(0.199)
<i>Household Income</i>				
Low (versus Middle)	-0.467**	(0.085)	-0.446**	(0.106)
High (versus Middle)	0.276*	(0.109)	0.244	(0.126)
<i>PSFs</i>				
<i>Academic Discipline</i>	0.341**	(0.056)	0.111	(0.067)
<i>Academic Self-Confidence</i>	-0.312**	(0.051)	-0.189**	(0.061)
<i>Commitment to College</i>	0.120**	(0.042)	-0.013	(0.049)
<i>Communication Skills</i>	-0.063	(0.051)	-0.033	(0.061)
<i>General Determination</i>	-0.097	(0.068)	-0.084	(0.082)
<i>Goal Striving</i>	0.045	(0.068)	0.143	(0.082)
<i>Social Activity</i>	0.012	(0.048)	0.062	(0.059)
<i>Social Connection</i>	0.137**	(0.051)	-0.000	(0.062)
<i>Steadiness</i>	0.020	(0.043)	0.010	(0.051)
<i>Study Skills</i>	-0.038	(0.049)	-0.083	(0.058)
Institutional variation	0.114*	(0.052)	0.203	(0.110)

Note. ** $p < .01$, * $p < .05$

Table 6. Identification of Students at Risk of Leaving Their Institutions at Various Thresholds

Model	Percentile	Threshold	Correct	Incorrect	Accuracy
Full	5	0.74	103	137	0.43
	10	0.79	192	288	0.40
	15	0.81	277	446	0.38
	20	0.83	364	593	0.38
	25	0.85	432	775	0.36
Reduced	5	0.76	99	144	0.41
	10	0.80	189	293	0.39
	15	0.83	261	447	0.37
	20	0.84	355	606	0.37
	25	0.85	426	774	0.36
Random	5	0.05	65	179	0.27
	10	0.10	128	343	0.27
	15	0.15	192	548	0.26
	20	0.20	261	720	0.27
	25	0.25	327	883	0.27

Note. Correct = correctly identified as “at risk” (true negatives); Incorrect = incorrectly identified as “at risk” (false negatives); Accuracy = identification accuracy (negative predictive value)

Table 7. Percent of 4-Year Students Accurately Identified as At-Risk

Selection Method	Drop Out (%)	Transfer (%)	Overall (%)
Random selection	12.05	13.05	25.10
ACT Composite Score only*	19.20	13.95	33.15
ACT Engage only*	18.51	17.27	35.78
ACT Composite Score + ACT Engage	20.99	16.16	37.15

Note. ACT Engage stands for the PSFs. *Students scoring in the bottom 5% of these populations were flagged

Table 8. Average ACT Engage estimates by Percentile and Estimated Probabilities Based on ACT Engage Improvements

Percentile	ACT Engage estimates			Probability of retention				
	AD	CC	SC	Baseline	AD +1SD	CC +1SD	SC +1SD	Overall
5	-1.39	-0.99	-0.75	0.65	0.71	0.68	0.68	0.76
10	-1.05	-0.73	-0.61	0.70	0.76	0.73	0.73	0.80
15	-0.92	-0.60	-0.53	0.73	0.78	0.75	0.76	0.82
20	-0.75	-0.49	-0.43	0.75	0.80	0.77	0.77	0.84
25	-0.65	-0.43	-0.38	0.76	0.81	0.78	0.78	0.85

Note. AD = *Academic Discipline*; CC = *Commitment to College*; SC = *Social Connection*; +1SD = estimated probability of retention if the student increases his or her ACT Engage score by one standard deviation; Overall = estimated probability of retention if the student increases all three AD, CC, and SC scores by one standard deviation.

Table 9. Correlation between the Academic and Nonacademic (Psychosocial Factors) Variables in the Model

	1	2	3	4	5	6	7	8	9	10	11	12
1. High School GPA	1.00											
2. ACT Composite	0.38**	1.00										
3. Academic Discipline	0.39**	0.00	1.00									
4. <i>Academic Self-Confidence</i>	0.30**	0.43**	0.38**	1.00								
5. Commitment to College	0.14**	0.01	0.44**	0.31**	1.00							
6. Communication Skills	0.10**	-0.01	0.38**	0.20**	0.36**	1.00						
7. General Determination	0.20**	-0.08**	0.70**	0.35**	0.50**	0.56**	1.00					
8. Goal Striving	0.12**	-0.07**	0.59**	0.47**	0.51**	0.50**	0.77**	1.00				
9. Social Activity	-0.01	-0.03*	0.15**	0.25**	0.28**	0.33**	0.27**	0.43**	1.00			
10. Social Connection	0.05**	0.00	0.27**	0.19**	0.35**	0.53**	0.38**	0.47**	0.61**	1.00		
11. Steadiness	0.10**	0.03**	0.37**	0.35**	0.27**	0.42**	0.39**	0.44**	0.28**	0.24**	1.00	
12. Study Skills	0.10**	-0.06**	0.49**	0.30**	0.30**	0.52**	0.58**	0.58**	0.21**	0.33**	0.36**	1.00

Note. N = 9,364 students. ** $p < .01$, * $p < .05$

Appendix C
Charts Illustrating Retention Rates At Deciles
for Each Psychosocial Factor

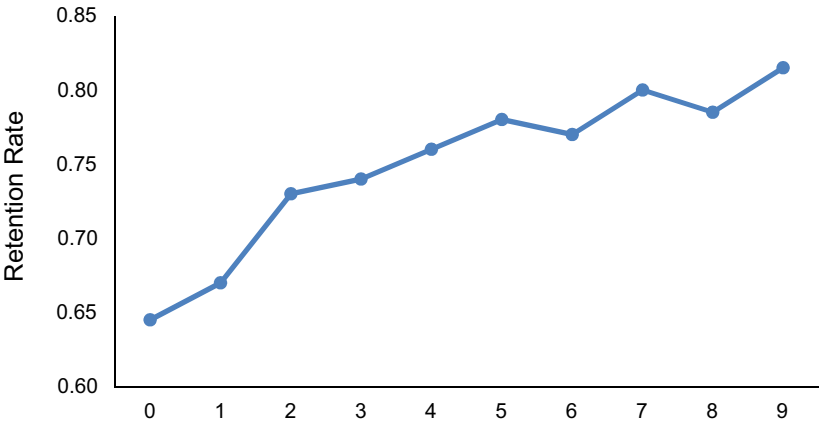


Figure 1. Average retention at each decile of *Academic Discipline*

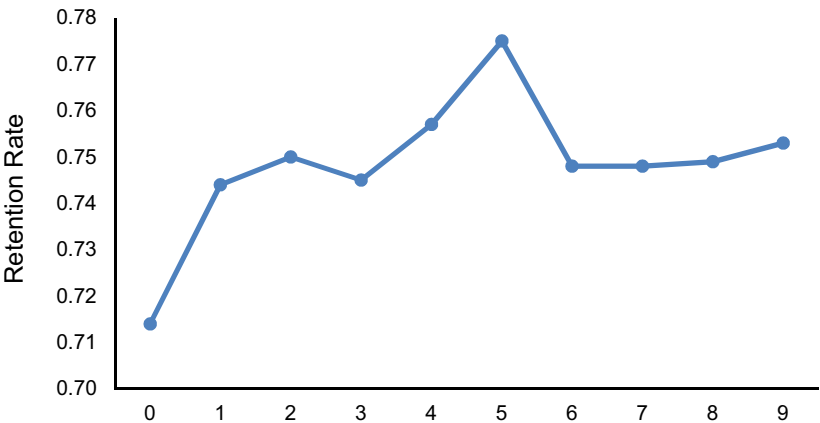


Figure 2. Average retention at each decile of *Social Activity*

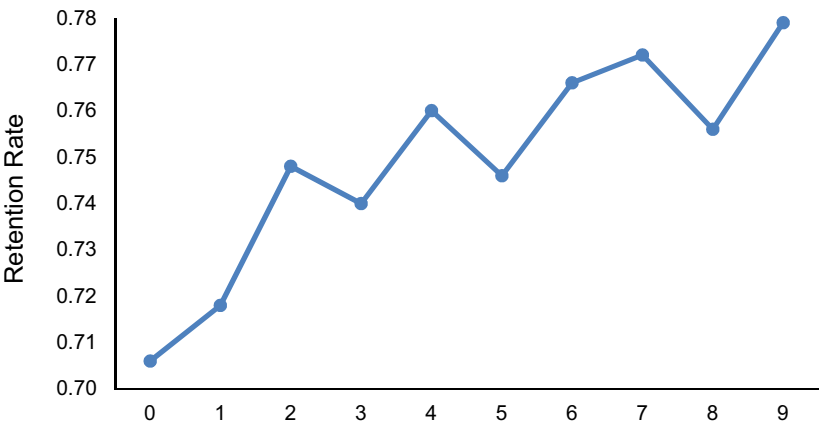


Figure 3. Average retention at each decile of *Academic Self-Confidence*

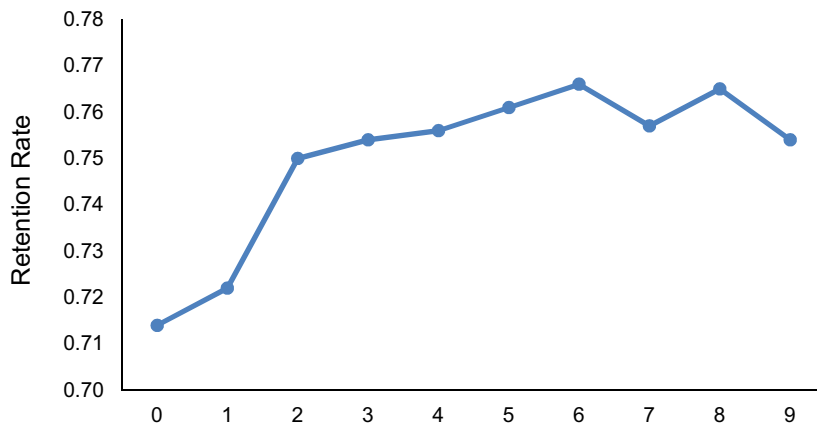


Figure 4. Average retention at each decile of *Communication Skills*

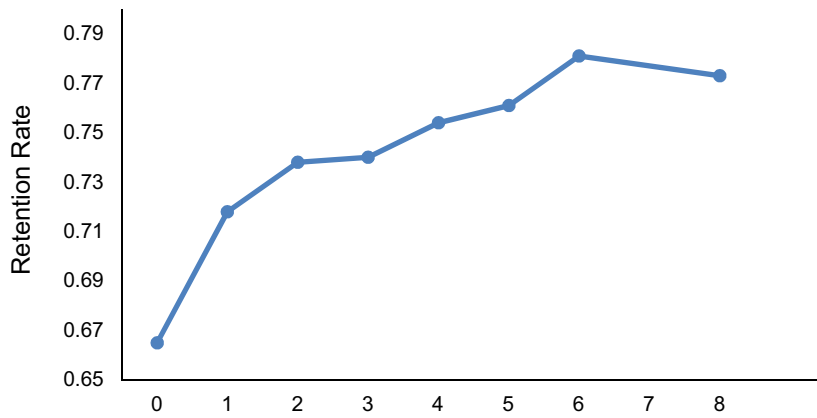


Figure 5. Average retention at each decile of *Commitment to College*

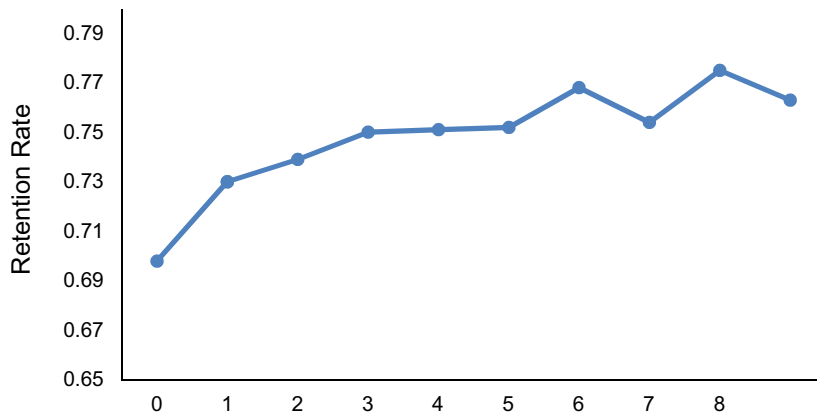


Figure 6. Average retention at each decile of *General Determination*

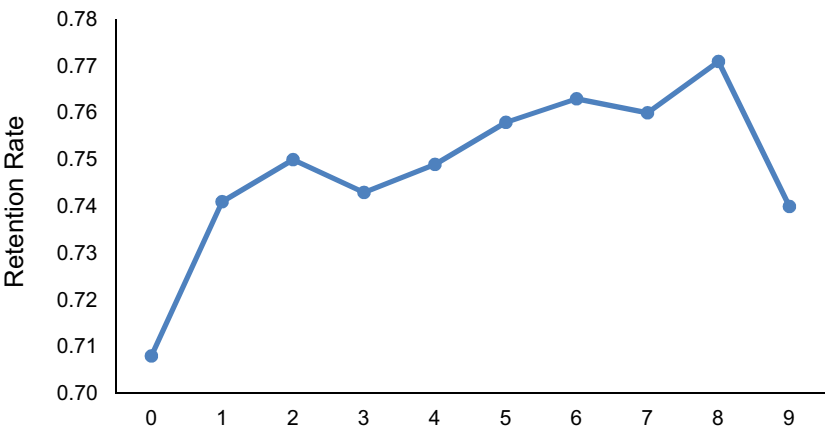


Figure 7. Average retention at each decile of *Goal Striving*

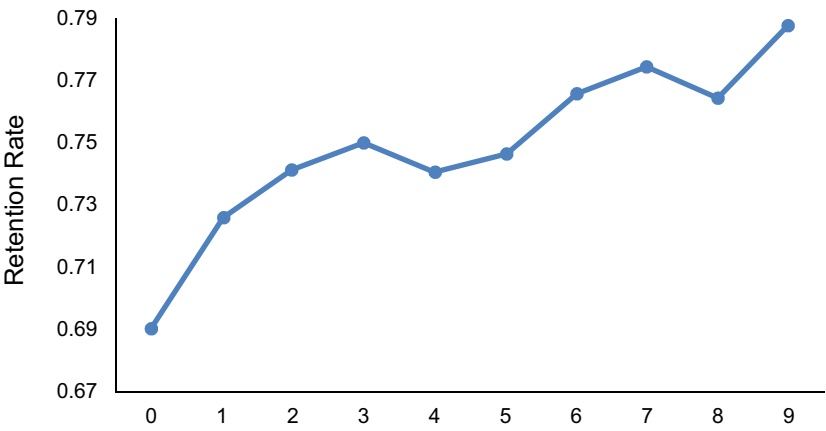


Figure 8. Average retention at each decile of *Social Connection*

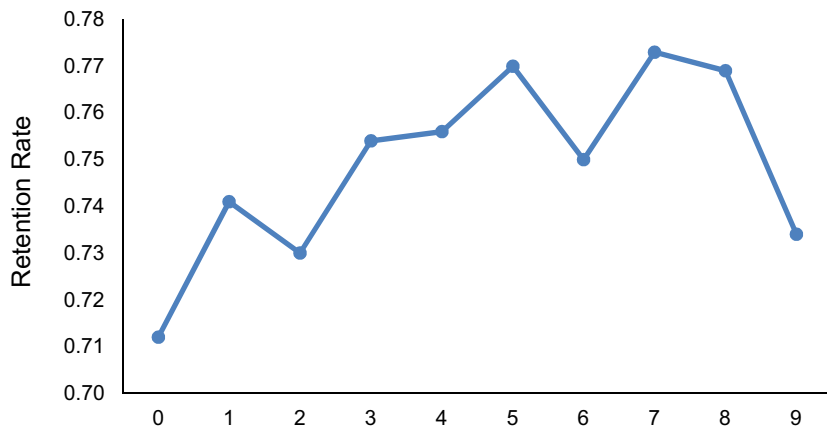


Figure 9. Average retention at each decile of *Study Skills*

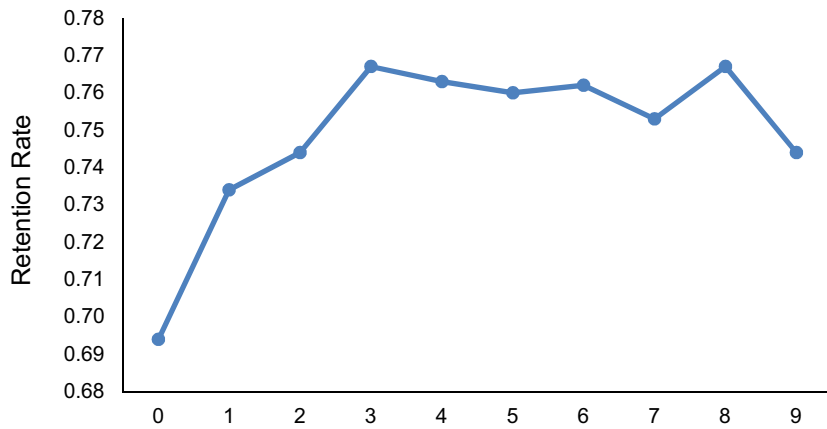


Figure 10. Average retention at each decile of *Steadiness*



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