Path Analysis of Factors Affecting University Student Academic Achievement

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Abstract

Variables shown to be related to academic achievement include academic skills, learning preferences, and procrastination. Instruments for measuring these variables were administered to 157 undergraduate students, and grade point average was determined. The scales of the learning preferences inventory were factor analyzed, and a specific path relationship was hypothesized between these factors and the other variables. The path analysis depicts direct and indirect effects of these on achievement. Results are discussed in terms of implications for research and for the provision of services to low achieving university students.

Numerous variables have been investigated with respect to their relationship with academic achievement. Those which have thus far been examined in university students include academic skills, learning preferences or style, and procrastination (Dunn, 1984; Kirkland & Hollandsworth, 1979; McCown, Petzel, & Rupert, 1987; Rothblum, Solomon, & Murakami, 1986; Solomon & Rothblum, 1984).

Academic skills research has shown various factors to be associated with academic achievement. These include positive attitudes (Miller, Weaver, & Semb, 1974), direct instruction in the application of study skills (Gadzella, 1982), level of study skills (Jones, Slate, Bell, & Saddler, 1991), and self-concept (Gadzella & Williamson, 1984). Other researchers have confirmed that academic skills and academic achievement are positively correlated (Cappella, Wagner, & Kusmierz, 1982; Tollefson, Cox, & Barke, 1979).

Prolific research on styles or preferences for learning has demonstrated the importance of accommodating the learner's preferences in the learning process. Price, Dunn, and Dunn (1982) describe these preferences as consisting of the conditions internal and external to the learner under which learning is likely to be optimized. This research collectively suggests that a significant improvement in academic achievement, student attitudes, and academic behavior is achieved when learning styles or preferences are appropriately accounted for in the learning process. When preferences are unaccounted for, then academic achievement is negatively affected (Napolitano, 1986; Robertson, 1977).

Research on procrastination has been a relatively recent development. Much of the research has been done with college students experiencing academic procrastination. Rothblum and her associates (1986) defined academic procrastination as "the (a) self-reported tendency to nearly always or always put off academic tasks and (b) to nearly always or always experience problematic levels of anxiety associated with

this procrastination" (p. 387). The prevalence of problematic procrastination in college students has been found to range between 15 and 45% (Solomon & Rothblum, 1984). Additionally, it has been found to be negatively correlated with academic achievement and with study skills. Jones and his colleagues (1991) found a negative relationship between procrastination and study habits, while Rothblum and her associates (1986) found that procrastination and grade point average were negatively related. Other investigators, however, have found no relationship between procrastination and academic achievement (Jones, et al., 1991; Solomon & Rothblum, 1984). While previous research has shown that academic achievement is related to academic skills, learning style or preference, and procrastination, the relationships have been found to be modest and inconsistent, and have usually been obtained in isolation from one another. The evidence indicates that each of these variables can be an important contributor to academic achievement. Knowledge is lacking, however, as to possible interrelationships and mediating effects among the variables in their relationships with academic achievement. Moreover, the way in which personal styles or preferences for learning may interact with academic skills and procrastination to affect academic achievement is unclear.

We had two objectives in this study for examining these variables: (1) to confirm the presence of individual relationships between academic achievement, academic skills, learning preferences, and procrastination; and (2) on the basis of these relationships, to hypothesize and verify the direction and extent of mediating effects of these variables on academic achievement by developing a causal model.

Method

Subjects

The subjects of the study were 157 students at a small, private university in Southern California who were enrolled in traditional lecture format undergraduate courses in the spring semester of 1991 and who expressed a willingness to participate in an in-class group assessment session. No student declined to participate. The sample included 109 females and 48 males. Fifty-two subjects were freshmen (mean age 19.86, SD 3.00 years), 27 were sophomores (mean age 20.12, SD 1.03 years), 34 were juniors (mean age 21.16, SD 0.99 years), and 44 were seniors (mean age 24.26, SD 5.54 years). Eight students failed to provide requested demographic information and were consequently omitted in instances where that information was relevant for data analysis purposes.

Measures

Academic skills were measured by the Study Habits Inventory (SHI), a 63-item inventory designed for use with college students (Jones & Slate, 1988). The SHI uses a true-false format wherein students describe the manner in which they typically study. Items indicating inappropriate study habits are reverse scored, so that high scores indicate good study habits. Jones and Slate (1993) reported the results of five validity studies conducted with the SHI. The average criterion-related validity coefficient was +.39 when using semester grades as the criterion. The SHI was found to have a test-retest reliability of +.82 over a two week interval (Jones, Stone, & Slate, 1990).

Procrastination was measured by the Aitken Procrastination Inventory (API), a 19-item inventory constructed and validated for use with college students (Aitken, 1982). The API has been found to consistently differentiate chronic academic procrastinators from other students and has acceptable psychometric properties (McCown, 1986). Students respond on a 5-point Likert scale to items that describe a tendency to delay completing tasks. One-half of the items are reverse keyed; high scores indicate procrastination tendencies.

Learning preferences were measured by the Productivity Environmental Preference Survey (PEPS). This instrument was designed for use with individuals 18 years of age and older. The PEPS assesses the internal and external conditions under which an adult is most likely to learn, produce, and solve problems. Price and Griggs (1985) report that the PEPS has acceptable psychometric properties. Sixty-eight per cent of the 21 scale reliabilities on the PEPS are equal to or greater than .60, while fifty percent are greater than .75. Numerous validity studies cited in the manual show significant relationships of scale scores to various criteria.

Procedure

At in-class assessment sessions in five separate undergraduate classes, students were asked to complete a battery consisting of the Aitken Procrastination Inventory (API), the Study Habits Inventory (SHI), and the Productivity Environmental Preference Survey (PEPS). The assessment sessions were scheduled within a two-week period during the first month (February) of the semester. At the end of the semester, semester grade reports were collected for each subject from the University Registrar.

Factor Analysis

An iterated principle factor analysis (PFA) was performed on the PEPS learning preferences scores using program 4M in BMDP (Frane, Junnrich, & Sampson, 1989). The program determined the number of common factors to be extracted. The number of iterations was set at 25; the convergence criterion was set at .01. The Varimax procedure was used as a rotation transformation method.

Path Analysis

LISREL (LInear Structural RELationships) path analysis was used to test the fit of the model depicted in Figure 1 (Joreskog & Sorbom, 1989). Specifically, the computer program LISREL 7.15 performed the analysis for maximum likelihood parameter estimates and overall maximized goodness of fit of our model.

Generally the LISREL model assumes that one specify a causal structure among a set of latent dependent and independent variables. There are a set of observed variables that are related to the latent variables. Hence, the latent variables appear as underlying causes of the observed variables. These latent variables can also be treated as intervening variables in a causal chain. The full LISREL model consists of two sub-models: the measurement model and the structural model. The measurement model specifies how the latent variables are measured in terms of the observed variables. The structural model specifies the causal relationships among the latent variables. The full LISREL model can be summarized by the following three matrix equations:

Structural Model: $\eta = \Gamma\xi + B\eta + \zeta$

Measurement Model for y: $y = \Lambda_y \eta + \varepsilon$

Measurement Model for x: $x = \Lambda_x \xi + \delta$

Our model assumes all measurement in y. Hence, all parameter estimates are only for the first two equations.

Results

Means, standard deviations, and Pearson product-moment correlations for API, SHI, GPA, and 20 of the original 21 learning preferences scales are presented in Table 1. One scale, learning alone, was omitted in the analysis of the data.

---Insert Table 1 about here---

Five factors from the 20 learning preferences scale variables were generated. The factors accounted for 85% of the total variance of the scale scores. We reduced the lowest admissible eigenvalue to .95 in order to include the fifth factor whose variance was just under 1. Orthogonal (Varimax) rotational transformations were performed in order to eliminate factor intercorrelations. The variables were then reordered to show juxtaposition of groups to rotated factor loadings. Factor loadings less than .25 were set

to zero. The sorted rotated factor loadings are shown in Table 2, and the corresponding factor score coefficients are shown in Table 3.

---Insert Table 2 about here---

---Insert Table 3 about here---

Factor 1 consisted of seven items: motivation (MOTIVTN), persistence (PERSIST), responsibility (RSPNSBL), peer-oriented learning (PEERLRN), need for structure (STRUCTR), light (LITE), and tactile preference (TACTILE). Motivation, persistence, and responsibility had loadings higher than .65. These variables seemed to be associated with emotional stability or maturity. We labelled this factor Maturity.

Factor 2 was made up of afternoon (PM), late morning (LATE AM), and evening/morning (PM AM). Since all these measures are time of day related, we called this factor Time of Day.

The third factor was comprised of learning several ways (LRNWAYS), peer-oriented learning, and motivation. We named this factor Social Contact since the variables comprising the highest loadings are related to social contact.

Factor 4, Sensory Preferences, consisted of auditory preference (AUDIT), need for structure, visual preference (VISUAL), kinesthetic preference (KINE), authority-oriented (A-FIGRS), and peer-oriented learning, which seemed to be oriented along a sensory preference dimension.

The final factor was comprised of formal design (DESIGN), light, tactile preference (TACTILE), food intake (INTAKE), ambient sound level (DB LVL), and mobility (MOBIL). These measures reflected environmental conditions, so we labelled this factor Environment.

Scores for the 20 learning preferences scales were substituted with the scores of the five rotated learning style factors. Table 4 shows the correlation matrix of the five

factors with API, SHI, and GPA. The intercorrelations of the five rotated factors are expectedly close to zero.

---Insert Table 4 about here---

Based upon the intercorrelations apparent in Tables 1 and 4, we hypothesized the path model shown in Figure 1. The model depicts an interrelationship among seven endogenous factors, . The first five factors are the learning preferences factors associated with the factor analysis performed on the PEPS scales. Factors η_1 through η_5 account for the five learning preferences factor score measures respectively, Y1 through Y_5. A sixth endogenous factor, Study Style (η_6), loads both SHI (Y_6) and API (Y_7). The seventh endogenous factor, Academic Achievement (η_7) is determined by GPA (Y_8).

The path parameters between measures and factors are depicted by the lambda coefficients (λy). These parameters are elements of a full matrix, Λ_y The error variances associated with each measurement term are epsilon 1 through epsilon ($\varepsilon_1 - \varepsilon_8$). Error variance-covariance is represented by a symmetric matrix with elements theta epsilon ($\theta\varepsilon$). Due to the orthogonality of y_1-y_5, we expected little error covariance across these measures. Since all the variance of each factor score measure (y_1-y_5) is due to the factor contribution, then by definition there is no error variance per measure. This fact is helpful since error perturbation must be fixed in a model where a factor has only one indicator, as does $\eta_1 - \eta_5$ and η_7. Additionally, all error covariance was fixed in the model. Error disturbance (residuals) on the endogenous variables is represented by the zeta (ζ) parameters, . Psi (ψ) is the variance-covariance symmetric matrix associated with endogenous latent variable error. Only the diagonal entries of psi in our model were freed.

The beta's (β) are elements of the square parameter matrix B, defined with zero entries on its main diagonal. The beta parameters show direction and strength of effect

between endogenous factors. Our initial model depicts six free beta parameters (Figure 1). The direct effect of Maturity on Study Style is β_{61}; Social Contact directly on Academic Achievement is β_{73}; Study Style's direct effect on Academic Achievement is β_{76}. The other three learning preferences factors are shown with direct paths to Study Style.

In order to verify that we were presenting the best model for the data, we compared other models by varying the direction of the paths from Maturity and Social Contact. Figure 2 presents five competing alternate models containing the same number of free beta parameters each, where Figure 2(a) is our original model. The model in Figure 2(e) is the same as Figure 2(a) except that effects from the other learning style factors are directed toward Academic Achievement instead of Study Style. Figure 2(f) is the baseline model with effects from η_2, η_4, and η_5 removed. There is a significant reduction in fit with these effects deleted. However, whether they impact $\eta 6$ or $\eta 7$ directly appears insignificant. Goodness of fit parameters for all models are compared in Table 5. The models shown in Figures 2(a) and 2(e) represent the best fit based on goodness of fit, $\chi 2$ estimates, $\chi 2$/df ratios, and probability.

---Insert Table 5 about here---

These results suggest that the best model is explained by a singular indirect effect between Maturity and Academic Achievement through Study Style. Another direct path exists between the Social Contact factor and Academic Achievement. Also, Study Style influences Academic Achievement directly. Finally, the results suggest that the other three learning style factors do not contribute significantly to Study Style or Academic Achievement.

The parameter estimates for both measurement and structural models are combined and included in Figure 1. The goodness of fit estimators for the final model (Figure 1) are shown in Table 5, where $\chi 2 = 19.48$ with 20 df ($p=.491$). The goodness

of fit index was .970; the adjusted goodness of fit index was .946. These results suggest that since the $\chi 2$ statistic was not significant at the .05 level, the model provides a viable representation of the data.

Discussion

The correlation coefficients shown in Table 4 confirm previously established relationships between study habits and academic achievement, study habits and procrastination, and procrastination and academic achievement. Two learning preferences factors, Maturity and Social Contact, show positive relationships with academic achievement and study habits, and a negative relationship with procrastination.

The results of the path analysis explicate the nature of the relationships among these variables. A latent factor emerged that was comprised of Academic Skills (SHI) and Procrastination (API) which we identified as Study Style. This factor can be viewed as consisting of the habitual or stylistic patterns which students employ in completing academic tasks. It reflects the extent to which they make use of good study habits and do not delay the completion of academic tasks. Maturity and Social Contact were two other factors found to be significant indices in determining academic achievement. Maturity represents personal qualities of students, which include motivation, persistence, and responsibility. Social Contact reflects the extent to which students are motivated to study and learn with others, in groups, or in ways to facilitate interaction with fellow students.

Maturity exerts its effect on academic achievement by means of the stylistic ways in which students approach academic tasks. Those students who are more responsible, persistent, and motivated also possess better study habits and procrastinate less, which results in higher academic achievement. Those students who are less mature have

poorer study habits and procrastinate more, which results in lower academic achievement.

Social Contact affects academic achievement directly. Those students who tend to study in groups, who make use of fellow students in approaching academic tasks, and are flexible in the ways in which they study with others enjoy higher academic achievement. This effect is realized irrespective of Study Style. The remaining three learning preferences factors, Time of Day, Sensory Preferences, and Environment, had no effect on academic achievement. These factors were simply not related to academic achievement for our sample.

Students' study style directly affects their level of academic achievement. Those students who possess good study habits and procrastinate less do better academically. Our findings indicate that these two variables are related to one another in a way that reflects a stylistic approach to studying which affects academic achievement directly. The two combine to form a style for studying that must be accounted for if academic achievement is to be completely explained.

Our findings have direct implications for providing interventions for students who are experiencing difficulties in academic achievement. Most current interventions concentrate on academic skills instruction and do not consider other factors such as the cognitive and behavioral components of procrastination. We believe that, for interventions to be maximally effective, both academic skills and procrastination must be addressed. Moreover, our results suggest that students should be encouraged to be flexible in the ways in which they attempt to learn material and that they interact with other students in the process of studying and learning.

Our study identifies some new factors that need to be taken into account when considering academic achievement at the university level. However, our sample consisted of mostly Caucasian undergraduate students at a small, private university. Additionally, the

instruments we used for student assessment conceptualized the variables of interest in specific ways. Whether the findings generalize beyond this population and the instruments we used remains to be determined by further empirical research.

References

Aitken, M. E. (1982). A personality profile of the college student procrastinator (Doctoral dissertation, University of Pittsburgh, 1982). Dissertation Abstracts International, 43, 722-723A.

Cappella, B. J., Wagner, M., & Kusmierz, J. A. (1982). Relation of study habits to academic performance. Psychological Reports, 50, 593-594.

Dunn, R. (1984). Learning style: State of the science. Theory into Practice, 23, 10-19.

Dunn, R., Dunn, K., & Price, G. (1985). Learning style manual (3rd ed.). Lawrence, KS: Price Systems.

Frane, J., Junnrich, R., & Sampson, P. (1988). Factor analysis. In W. J. Dixon (Ed.), BMDP Statistical Software Manual (Vol. 1). Los Angeles: University of California Press.

Gadzella, B. M. (1982). Computer-assisted instruction on study skills. Journal of Experimental Education, 50, 122-126.

Gadzella, B. M., & Williamson, J. D. (1984). Study skills, self-concept, and academic achievement. Psychological Reports, 54, 923-929.

Jones, C., & Slate, J. (1988). Note-taking, studying, and test-taking: A survival manual for college students. Unpublished manuscript, Arkansas State University, Jonesboro.

Jones, C., & Slate, J. (1993). Technical manual for the Study Habits Inventory. Unpublished manuscript, Arkansas State University, Jonesboro.

Jones, C., Slate, J., Bell, S., & Saddler, C. (1991). Helping high school students improve their academic skills: A necessary role for teachers. The High School Journal, 74, 198-202.

Jones, C., Stone, T., & Slate, J. (1990). A role for educational psychologists in higher education: Improving study skills and instructional effectiveness. Paper presented at the Mid-South Educational Research Association Conference, New Orleans.

Joreskog, K. G., & Sorbom, D. (1989). LISREL 7: A guide to the program and applications. Chicago: SPSS, Inc.

Kirkland, K., & Hollandsworth, J. C. (1979). Test anxiety, study skills and academic achievement. Journal of College Student Personnel, 20, 431-436.

McCown, W. (1986). An empirical study of the behaviors of chronic procrastinators. Social and Behavioral Sciences Documents, 16, 2745.

McCown, W., Petzel, T., & Rupert, P. (1987). An experimental study of some hypothesized behaviors and personality variables of college student procrastinators. Personality and Individual Differences, 6, 781-786.

Miller, L. K., Weaver, F. H., & Semb, G. (1974). A procedure for maintaining student progress in a personalized university course. Journal of Applied Behavior Analysis, 7, 87-91.

Napolitano, R. (1986). An experimental investigation of the relationships among achievement, attitude scores, and traditionally, marginally, and under-prepared college students enrolled in an introductory psychology course when they are matched and mismatched with their learning style preference for the element of structure. (Doctoral dissertation, St. John's University, 1986). Dissertation Abstracts International, 47, 435A.

Price, G. E., Dunn, R., & Dunn, K. (1982). Productivity Environmental Preference Survey Manual. Lawrence, KS: Price Systems.

Price, G. E., & Griggs, S. H. (1985). Counseling college students through their individual learning styles. Ann Arbor: University of Michigan, ERIC Counseling and Personnel Services Clearinghouse.

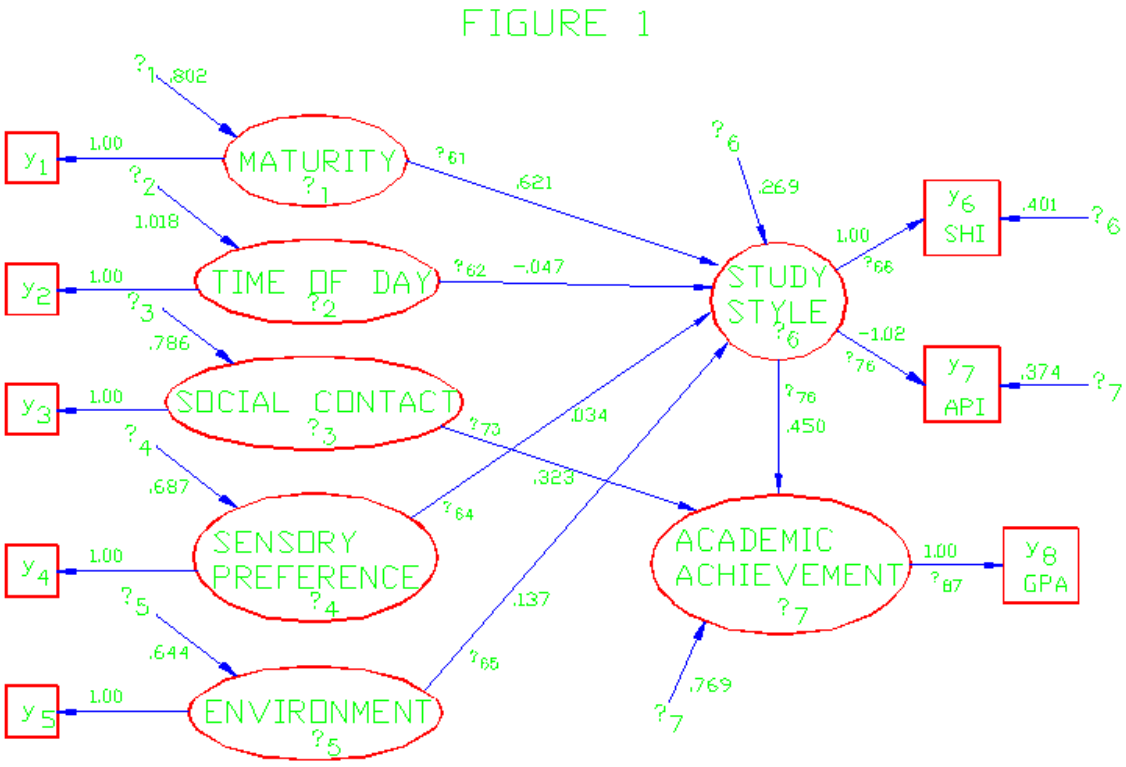
Robertson, P. F. (1977). The implications of student learning styles for prescribing reading skill development strategies for community college students. (Doctoral dissertation, Florida Atlantic University, 1977). Dissertation Abstracts International, 38, 3919A.

Rothblum, E. D., Solomon, L. J., & Murakami, J. (1986). Affective, cognitive, and behavioral differences between high and low procrastinators. Journal of Counseling Psychology, 33, 387-394.

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. Journal of Counseling Psychology, 31, 504-510.

Tollefson, N., Cox, E., & Barke, C. (1979). Study behavior and academic achievement. Paper presented at the Association for the Study of Higher Education Conference, Washington, DC.

Figure 1



Measurement and structural model depicting observed measures (y1-y8), measurement error (e6 & e7), factors (in ellipses), factor error (z1-z7), and effects between factors.