Academic performance in human anatomy and physiology classes: a 2-yr study of academic motivation and grade expectation

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Sturges D, Maurer TW, Allen D, Gatch DB, Shankar P. Academic performance in human anatomy and physiology classes: a 2-yr study of academic motivation and grade expectation. Adv Physiol Educ 40: 26–31, 2016; doi:10.1152/advan.00091.2015.—This project used a nonexperimental design with a convenience sample and studied the relationship between academic motivation, grade expectation, and academic performance in 1,210 students enrolled in undergraduate human anatomy and physiology (HAP) classes over a 2-yr period. A 42-item survey that included 28 items of the adapted academic motivation scale for HAP based on self-determination theory was administered in class during the first 3 wk of each semester. Students with higher grade point averages, who studied for longer hours and reported to be more motivated to succeed, did better academically in these classes. There was a significant relationship between students’ scores on the adapted academic motivation scale and performance. Students were more extrinsically motivated to succeed in HAP courses than intrinsically motivated to succeed, and the analyses revealed that the most significant predictor of final grade was within the extrinsic scale (introjected and external types). Students’ motivations remained stable throughout the course sequence. The data showed a significant relationship between HAP students’ expected grade and their final grade in class. Finally, 65.5% of students overestimated their final grade, with 29% of students overestimating by two to four letter grades.

Academic motivation; health majors; self-determination theory; grade expectation; longitudinal study

SELF-DETERMINATION THEORY (SDT) (15, 16) is an approach to human motivation whose basic tenant is the innate desire of humans to learn intrinsic motivation. SDT is concerned with the relationship between extrinsic forces acting on individuals that can encourage or discourage these intrinsic motives. The key idea of SDT is that as long as the “environment allows one to experience feelings of competence, autonomy and relatedness, the person’s motivation toward a given task will be optimal” (52). SDT has been successfully applied to a diverse array of important life domains, including work, health, and relationships, among others (47). Niemec (40) has argued that SDT is most important in education, since “students’ natural tendencies to learn represent perhaps the greatest resource educators can tap.” While some theories focus on the amount or quantity of motivation, SDT focuses on the quality of motivation and proposes a continuum composed of three types of motivation: intrinsic motivation (IM), extrinsic motivation (EM), and amotivation (AM). Motivations along the continuum differ in the extent in which they are self-determined.

IM represents the most self-determined type of motivation, in which activities are accomplished for the sake of enjoyment, central to a human’s tendencies to learn and develop (20). Vallerand et al. (51) added to the original SDT theory by including three separate subscales of IM: IM to know, IM toward accomplishments, and IM to experience stimulation. IM to know is seen when an individual engages in a behavior for the satisfaction experienced while learning or trying to understand something new. IM toward accomplishments occurs when an individual engages in a behavior for the pleasure experienced while trying to accomplish a task or create something. IM to experience stimulation transpires when an individual engages in a behavior to experience stimulating or exciting sensations.

EM lies in the center of the continuum of self-determination. EM represents actions taken to achieve a goal or reward beyond the activity itself. There are three subscales included in EM. These are listed in order from the most to least self-determined forms of regulation: EM identified, EM introjected, and EM external. EM identified is when an individual truly values a behavior, even though they are not doing it because they like it. EM introjected is when one engages in a behavior to maintain personal expectations or avoid guilt. EM external is when an individual participates in an activity solely as a means to obtain an external reward or avoid punishment.

AM lies at the opposite end of the self-determination continuum from IM. AM refers to the absence of intention or motivation. While there are other conceptualizations of motivation, this study focused on the motivation continuum developed by Deci and Ryan (15, 16).

Studies have shown that academic motivation predicts academic performance in college students and includes course grades (56), course attendance (38), and persistence in the program of study (17). In a review of SDT applied to educational practice, IM and autonomous forms of EM relate positively to important academic outcomes (27, 28, 44). Students whose motivations are more intrinsic do better in school, have lower rates of withdrawal, absenteeism, and dropout, and have lower feelings of anxiety (45, 5) about school with higher levels of academic performance (45). Students with stronger IM and self-regulation report less procrastination, deeper engagement, and higher persistence with learning activities (7, 54). IM has been associated with psychological well-being independent of academic performance (8); higher autonomous self-regulation has been associated with greater effort and persistence (48) and higher perceived competence and enjoy-
This study is a longitudinal project that investigated students’ motivation in human anatomy and physiology (HAP) classes at a 4-yr university. This course is required for continuation into a health major, enrols students across many different majors, is considered to be very difficult by most students (50), and has a high D, F, or withdrawal rate. As such, it provided an excellent opportunity to study differential student motivations and the impact of those differences on student academic behaviors and performance.

**Goals of the study.** The goals of the present study were as follows:

1. To investigate the relationship between a) motivation, as measured by the adapted academic motivation scale (AMS); b) demographic factors (such as hours studying and GPA); and c) student’s estimation of their final grade on academic performance in class, as measured by individual final course grades of HAP students.

2. To investigate if the motivation of HAP students changes as they progress through the course sequence [Human Anatomy and Physiology I (HAPI) to Human Anatomy and Physiology II (HAPII) courses].

**METHODS**

**Participants.** Students enrolled in 17 sections of HAPI and HAPII between fall 2012 and spring 2014 were invited to participate in the study. Of a target population of 2,400 students, complete survey data were obtained from 1,302 students (response rate: 54%). Final course grades were obtained for 1,363 students enrolled in the 17 sections of the courses, of whom complete survey data were available for 1,210 students. Of the 1,210 participants, 288 (24%) were men and 922 (76%) were women. The ethnic distribution of the sample was 799 White (66%), 321 African-American (27%), 39 Hispanic (3%), 19 Asian (2%), and 32 “other” (3%). In terms of class standing, 144 (12%) were first-year students, 605 (50%) were sophomores, 321 (27%) were juniors, 111 (9%) were seniors, three (<1%) were graduate students, and 26 (2%) were “other.” The majors reported were 481 Prenursing (40%), 333 Exercise Science (28%), 39 Athletic Training (3%), 57 Nutrition (5%), 54 Health Education and Promotion or Community Health (5%), 20 Health and Physical Education (2%), 90 Biology/Premed (7%), and 136 “other” (11%). Seventy percent of the participants were enrolled in HAPI (n = 847), and 30% were enrolled in HAPII (n = 363). Although demographic comparisons between participants and nonparticipants were not possible, the sample in this investigation was similar to that obtained in prior investigations in HAP courses at this institution (2, 34, 50) and is consistent with the course instructors’ anecdotal observations of these HAP courses.

A total of 137 students completed the survey in both HAPI and HAPII. Of the 137 participants, 35 (26%) were men and 102 (74%) were women. The ethnic distribution of the sample was 87 White (64%), 39 African-American (29%), 5 Hispanic (4%), 3 Asian (2%), and 2 “other” (1%). In terms of class standing at the time of taking HAPI, 9 (7%) were first-year students, 90 (66%) were sophomores, 27 (20%) were juniors, 10 (7%) were seniors, and 1 (<1%) was “other.” The majors reported were 60 Prenursing (44%), 40 Exercise Science (29%), 5 Athletic Training (4%), 4 Nutrition (3%), 6 Health Education and Promotion or Community Health (4%), 1 Health and Physical Education (<1%), 10 Biology/Premed (7%), and 10 “other” (7%). Of the 137 surveys, 114 surveys contained enough information for use in the longitudinal analyses due to missing data on 23 surveys.

**Measures.** The measure was a scantron-type survey with 42 items (see APPENDIX A in the Supplemental Material): 1) six demographic questions; 2) eight additional questions of interest to this investigation taken from Maurer et al. (34)’s likelihood of continuing with
their major, GPA, class attendance, class preparation, study time, perceived level of difficulty of the class, overall level of motivation, and anticipated grade in the class); and 3) the 28-item AMS adapted for HAP courses (34). The AMS (51) operationalized SDT and was developed for use in college students. The AMS consists of 28 items with a 7-point Likert scale measuring seven subscales: IM (three subscales), EM (three subscales), and AM in academic contexts. In our previous studies (34, 35), the AMS was adapted from a global higher education scale to a discipline-specific scale and validated in HAP, physics, and nutrition disciplines. The adapted AMS used in this study had reported Cronbach’s α-values of 0.80 or higher for all the subscales (35). Final grades (letter grades A–F) were collected from the course instructors after the end of the semester.

Procedures. This project used a nonexperimental design with a convenience sample. During the third week of class, students in 17 sections of HAPI and HAPII were invited to participate in a brief in-class survey. Students were given 15 min to complete the survey on a scantron form and asked to include their first and last name and university identification number. To protect student anonymity, all completed scantron forms were scanned by research team members who were not the course instructors. Only T.W. Maurer, who was not a course instructor, had access to the data set. The project was approved by the university’s Institutional Review Board, and passive consent was obtained before survey completion and used to further protect student anonymity. No participation incentives were offered.

Plan of analysis. To address goal 1 of the study, a correlational matrix was computed with the final grade, the seven AMS scales, which course students were taking (HAPI or HAPII), their likelihood of continuing with their major, their self-reported GPA, their self-reported class attendance, their class preparation, their study time, their perceived level of difficulty of the class, their overall level of motivation, and their anticipated grade in the class. Next, a forward-entry regression was run using the independent variables that emerge as significantly correlated with final grade (one at a time, P < 0.05 to retain) and all seven AMS scales (force entered in one block).

Final grade overestimation was calculated as the difference between the actual final grade and estimated final grade. Next, another correlational matrix was computed identical to the matrix computed above except that final grade overestimation was used in place of estimated final grade. A forward-entry regression was then run using the independent variables that emerged as significantly correlated with final grade (one at a time, P < 0.05 to retain) and all seven AMS scales as the dependent variables computed.

RESULTS

To address goal 1, a forward-entry regression was run using the five independent variables that emerged as significantly correlated with final grade and all seven AMS scales [final adjusted R² = 0.33, F (12, 1,197) = 51.51, P < 0.001; Table 1].

For final grade overestimation, of the 1,210 students in the sample, 1 student (<1%) underestimated their final grade by two letter grades, 54 students (5%) underestimated their final grade by one letter grade, 367 students (30%) correctly estimated their final grade, 442 students (36.5%) overestimated their final grade by one letter grade, 206 students (17%) overestimated their final grade by two letter grades, 98 students (8%) overestimated their final grade by three letter grades, and 42 students (4%) overestimated their final grade by four letter grades. No students anticipated earning an F in the course or withdrawing from the course; only two students anticipated earning a D in the course. A total of 225 students (19%) earned less than a C in the course for their actual final grade, nearly all of whom estimated a final grade of C or better.

A forward-entry regression was run using three independent variables that emerged as significantly correlated with final Grade overestimation [final adjusted R² = 0.18, F (3, 1,209) = 88.70, P < 0.001; Table 2].

To address goal 2, a repeated-measures multivariate ANOVA test with time as the independent variable and the seven AMS subscales as the dependent variables was computed. A significant multivariate main effect emerged [Wilks’ λ = 0.88, F (7, 107) = 2.18, P < 0.05, partial η² = 0.13]. Followup univariate tests revealed significant differences over time only for IM to experience stimulation (F (1, 113) = 6.00, P < 0.05, partial η² = 0.05), suggesting that students’ motivations remained stable throughout the course sequence.

DISCUSSION

HAP courses are required of all health majors and are considered “difficult” by both faculty members and students (37, 50). Our institution has seen a significant increase in the number of students in the Nursing, Exercise Science, and Nutrition majors, which meant a rising enrollment in HAP classes. Considering the crucial role of health professions in the health care delivery and given the importance of this class in the health curriculum, examining students’ motivations is imperative to predicting students’ performance in these courses. This is especially true given the high D, F, or withdrawal rates, which, in turn, impact students’ progression into health majors.

Table 1. Predictors of final course grade

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours of study</td>
<td>4.10</td>
<td>0.82</td>
<td>0.05</td>
<td>0.01</td>
<td>0.08</td>
<td>3.39</td>
<td>0.001</td>
</tr>
<tr>
<td>Motivation</td>
<td>3.51</td>
<td>0.59</td>
<td>0.13</td>
<td>0.04</td>
<td>0.08</td>
<td>3.06</td>
<td>0.002</td>
</tr>
<tr>
<td>Grade point average</td>
<td>4.64</td>
<td>0.59</td>
<td>0.54</td>
<td>0.03</td>
<td>0.47</td>
<td>18.78</td>
<td>0.001</td>
</tr>
<tr>
<td>Expected grade</td>
<td>2.79</td>
<td>0.70</td>
<td>0.24</td>
<td>0.05</td>
<td>0.12</td>
<td>4.84</td>
<td>0.001</td>
</tr>
<tr>
<td>HAPI or HAPII</td>
<td>1.10</td>
<td>0.31</td>
<td>0.34</td>
<td>0.06</td>
<td>0.14</td>
<td>5.74</td>
<td>0.001</td>
</tr>
<tr>
<td>IM to know</td>
<td>22.70</td>
<td>4.38</td>
<td>0.02</td>
<td>0.01</td>
<td>0.07</td>
<td>1.43</td>
<td>NS</td>
</tr>
<tr>
<td>IM toward accomplishments</td>
<td>20.90</td>
<td>5.11</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
<td>0.98</td>
<td>NS</td>
</tr>
<tr>
<td>IM to experience stimulation</td>
<td>19.16</td>
<td>5.34</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.02</td>
<td>-0.48</td>
<td>NS</td>
</tr>
<tr>
<td>EM identified</td>
<td>23.60</td>
<td>3.81</td>
<td>-0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>-0.00</td>
<td>NS</td>
</tr>
<tr>
<td>EM introjected</td>
<td>21.45</td>
<td>5.36</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.13</td>
<td>-3.01</td>
<td>0.003</td>
</tr>
<tr>
<td>EM external</td>
<td>22.07</td>
<td>5.21</td>
<td>0.02</td>
<td>0.01</td>
<td>0.07</td>
<td>2.24</td>
<td>0.025</td>
</tr>
<tr>
<td>Amotivation</td>
<td>5.73</td>
<td>3.45</td>
<td>0.01</td>
<td>0.01</td>
<td>0.04</td>
<td>1.46</td>
<td>NS</td>
</tr>
</tbody>
</table>

n = 1,210 students. HAP, Human Anatomy and Physiology course; IM, intrinsic motivation; EM, extrinsic motivation; NS, not significant.
Faculty place more emphasis on student motivation and attitudes toward learning as central to learning than students themselves. Furthermore, students are increasingly taking a consumerist approach to higher education, suggesting a shift from IM to EM (32). Our project becomes particularly unique in this context, as it examined motivation in a sample of students representing multiple health majors over a 2-yr period and responded to the call to provide more information on causality between motivation and achievement (46, 31). Other long-term studies on motivation were only 1 yr long (3, 22, 43) and examined first-year students in United Kingdom (3), disadvantaged first-year students in South Africa (43), and high school students (22). Baker (3) examined the relationship of academic motivation types to total GPA and controlled for academic achievement as measured by entry qualifications upon entering the university; Petersen et al. (43) only used several questions from the AMS and measured the average end grade in his population, and Guay et al. (22) used a relative autonomy scale, not the AMS.

The results obtained indicated that there was a significant relationship between students’ GPA, how many hours studying they reported, their overall self-reported motivation, and their academic performance. Students with higher GPAs, who studied for longer hours and reported to be more motivated to succeed, did better academically in this class.

There was also a significant relationship between students’ scores on the adapted AMS and performance. Students were more extrinsically motivated to succeed in HAP courses than intrinsically motivated to succeed, and the analyses revealed that the most significant predictor of final grade was within the extrinsic scale (EM introjected and EM external), which supports previous research indicating a shift to EM (10, 18, 29). What is particularly troubling is the fact that these two sub-scales are the least self-determined types of EM, indicating a strong preference for rewards or avoidance of punishment and guilt as main drivers to succeed. There is some evidence that motivation can differ across disciplines or majors, and what leads to success in one field may not necessarily do so in another. Disciplinary differences in self-regulated learning were noted among college students taking courses in the humanities, social sciences, and natural science courses (23, 53). However, the findings of this study support previous findings conducted by this research team in undergraduate students of physics, HAP, and nutrition. notably, that HAP students, along with physics students, exhibit primarily EM, whereas nutrition students exhibit primarily IM. (34, 35)

The findings from this study showed a significant relationship between HAP students’ expected grade and their final grade in class. Many students (65.5%) overestimated their final grade, with 29% overestimating by two or four letter grades. There is some evidence that students who do not accurately estimate their grades may be more likely to suffer disillusionment after the receipt of grades, more likely to misunderstand the content of the course, and less likely to base their evaluation of quality of instructor on quality of instruction (55). It also depresses the effort students exert on final exams, papers, and projects, which, in turn, can make the gap between actual versus expected grade even larger (4, 11, 30). Over 70% of students who expected to receive at least a C in nonmajor courses when they worked hard—even when they failed to show to they had learned the minimum amount of information required by the instructor (1). The survey for this study was administered during the first 3 wk of the semester, but previous projects conducted by these researchers in HAP classes still showed a large overestimation, even as close as 1 wk before the final exams being completed.

Although the analyses revealed significant differences over time for IM to experience stimulation, the data suggested that students’ motivations remained stable throughout the course sequence. This was contrary to previous research that indicated a change in motivation as students progress through their courses (6, 23) but seemed to further underscore the consumerist approach to education, as discussed previously.

The data suggest two main strategies for HAP and other course instructors. Since instructors may have relatively high levels of control over factors that could affect EM, especially at the external regulation level, there is potential benefit in adjusting course policies to include an attendance policy, homework assignments, online and in-class quizzes, and other low-stake activities that carry additional rewards. At the same time, instructors should give priority to strategies that support IM, since IM results in better academic outcomes. Research in educational settings has shown that students are more likely to experience autonomous types of motivation (including IM and well-internalized forms of EM) when they perceive support for autonomy, competence, and relatedness in their academic pursuits, and autonomous motivation is associated with student interest, creativity, effort, persistence, and performance (for reviews, see Refs. 15 and 40). In the education domain, instructors can provide support for their students’ basic psychological needs when completing learning activities by offering choice and meaningful rationales, acknowledging students’ feelings, and minimizing pressure and control (40). Indeed, both correlational (39) and experimental (13) studies have shown that autonomous motivation is facilitated by provision of need support (14). The next step of these researchers will include developing and implementing training in need support to facilitate meeting students’ psychological needs of autonomy and competence, both influential in promoting IM. In relation to the grade expectation, we recommend that instructors share the findings with their students in the beginning of the semester. Clear statements and policies about test curving and effort versus outcome can be included in the syllabus to further address students’ expectations. Additionally, instructors could consider adding a preclass assessment as a proxy indicator of performance and stress the importance of reflection and reassessment after each major assignment in class.

Limitations. This research highlights an important relationship between academic motivation as measured by the AMS and academic performance, which is similar to previous work conducted by this research team (34, 35). There are several limitations to this study. Self-reported GPA during survey collection was used, and although self-reported GPA has been

**Table 2. Predictors of grade overestimation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
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</thead>
<tbody>
<tr>
<td>HAPI or HAPII</td>
<td>0.34</td>
<td>0.07</td>
<td>0.14</td>
<td>5.18</td>
<td>0.001</td>
</tr>
<tr>
<td>Hours of study</td>
<td>0.05</td>
<td>0.01</td>
<td>0.09</td>
<td>3.52</td>
<td>0.001</td>
</tr>
<tr>
<td>Grade point average</td>
<td>0.42</td>
<td>0.03</td>
<td>0.37</td>
<td>14.22</td>
<td>0.001</td>
</tr>
</tbody>
</table>

n = 1,210 students.
found to be strongly associated with objective GPA (e.g., \( r = 0.89 \)) (42), it may include some error due to memory constraints or inflated estimates (21). Additionally, the self-reported GPA item required students to locate their GPA within a range rather than providing an exact GPA, so some accuracy and variability had to be sacrificed. Similarly, students’ final course grade was reduced from a percentage of points earned and variability had to be sacrificed. This may not be generalizable to private institutions or larger or smaller institutions across the country. Finally, although we had a total of 1,210 students in our sample, we were only able to follow up with 114 students from HAPI to HAPII. This primarily happened because surveys were administered in classes taught by four different instructors over the 2-yr period. As instructors left or decided to opt out of the study, it limited our ability to link students across the class sequence.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS


REFERENCES