Higher levels of intrinsic motivation are related to higher levels of class performance for male but not female students

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How We Teach

MOTIVATION is the desire or drive to accomplish a specific action or behavior (21). This desire or drive takes many forms, including intrinsic motivation, extrinsic motivation, or no motivation (amotivation, defined as the absence of intrinsic or extrinsic motivation) (21, 30, 31). Intrinsic motivation, which reflects the highest degree of self-determination (22), includes actions and behaviors that are accomplished for the purpose of self-fulfillment. Specifically, these actions and behaviors are carried out voluntarily for personal fulfillment and may or may not produce material rewards (30, 32). In contrast, extrinsically motivated actions and behaviors are accomplished as a means to an end rather than an end in itself, for example, when a students’ behavior is not self-determined but reflects actions that are regulated by external rewards and constraints. Students who are grade oriented are extrinsically motivated, whereas students who embrace their work and take a genuine interest in it are intrinsically motivated.

Intrinsic motivation, which relies markedly on the tenets of the Self-Determination Theory (4, 6, 9), has the most positive impact on school performance ranging from elementary schools (5, 8, 10, 16, 32) to medical schools (36). The success of intrinsic motivation is attributed to meeting three basic psychological needs, which markedly impact a students’ level of self-fulfillment. These three basic psychological needs include 1) our need for autonomy (initiating and regulating our own behaviors), 2) our need for competence (confidence in our success in achieving the goal), and 3) our need for relatedness (creating meaningful connections with faculty members and peers) (5, 6, 8, 12, 25, 35, 36).

Unfortunately, teachers often underrate the importance of their influence (7) and fail to appreciate the significance of motivating their students while overrating the importance of their content. However, students forget much of the content that they memorize (34). Thus, attempts to teach students all that they will need to know is futile. Rather, it is important that students develop an interest and love for lifelong learning (12). Motivating students is critical because unless students are motivated, our efforts to instill a desire for lifelong learning are limited (7). Once students are motivated, there are countless resources available to learn more about a subject. Achieving this goal requires an understanding of student motivations (28). Accordingly, since intrinsic motivation has the most positive impact on school performance (5, 36), we tested the hypothesis that higher levels of intrinsic motivation would be related to higher levels of class performance for our undergraduate exercise physiology class (during the summers of 2011 and 2012) of 46 students (20 female students and 26 male students).

Furthermore, we have recently documented sex differences (women vs. men) on the influence of regular attendance on examination performance (1) and learning style preference (28, 33). However, it is unknown if female and male students are motivated differently. Sex differences in motivation could be rooted in evolutionary biology and/or overwhelming social differences. It is clear that there is an emotional debate regarding questions about innate or social differences between men and women (11); however, despite the passions and political correctness encountered by addressing these questions, these are important issues that must be addressed by the academic community if we are to provide quality education for everyone. Accordingly, we also tested the hypothesis that sex (women vs. men) influences the relationship between the levels of intrinsic motivation and class performance.
How We Teach

METHODS

Design. All procedures were reviewed and approved by the Institutional Review Board, and informed consent was obtained from all students before beginning the study. This experiment was implemented during the Exercise Physiology class at East Carolina University in Greenville, NC (EXSS 3805), during the summers of 2011 and 2012. Classes consisted of 46 students (20 female students and 26 male students). The course, offered through the Department of Kinesiology, must be completed in the third or fourth year in order for Kinesiology majors to meet the graduation requirements in 1) Health Fitness Specialist (13 students; 9 men and 4 women) (BS), 2) Physical Education (7 students; 7 men and 0 women) (BS), 3) Sport Studies (6 students; 3 men and 3 women) (BS), or 4) Exercise Physiology (7 students; 3 men and 4 women) (BS). Students from other basic science departments could also enroll (3 students; 1 man and 2 women). Finally, students from the Department of Health Education and Promotion are required to complete this course (10 students; 3 men and 7 women). The class was lecture based and presented with Microsoft PowerPoint slides provided ahead of the lecture (via a Blackboard account) by the instructor of record. Students could also supplement the lecture content by reading and consulting their recommended textbook. Many slides used in class were directly from the textbook but were supplemented by slides designed by the instructor. The same instructor taught both summer sessions and has taught this textbook but were supplemented by slides designed by the instructor. The same instructor taught both summer sessions and has taught this textbook but were supplemented by slides designed by the instructor. The experiment was designed not to interfere with the normal conduct of the course. The intrinsic motivation inventory (IMI) was administered at the end of the semester. The IMI is a multidimensional measurement device that assesses students’ motivation for a particular task. The IMI has been used in several experiments related to intrinsic motivation and self-regulation (3, 4, 17, 19, 20, 22–24). Furthermore, McAuley et al. (13) examined the validity of the IMI and found strong support for its validity. Similarly, Tsigilis and Theodosiou (29) found a Greek version of the scale to be reliable.

The IMI assesses students’ interest and enjoyment, perceived competence, and perceived choice while performing a given activity. The interest and enjoyment subscale is considered the self-reported measure of intrinsic motivation. The perceived choice and perceived competence subscales are theorized to be positive predictors of both self-reported and behavioral measures of intrinsic motivation. Additional information as well as access to the IMI can be obtained online at http://www.selfdeterminationtheory.org/questionnaires/10-questionnaires/50.

In addition, class attendance was recorded anonymously in each class; although regular attendance was encouraged, it was not required and did not factor into the final grades. The final course grade was based on four 1-h examinations and a 2-h cumulative final examination. Examinations consisted of multiple-choice questions derived from the lecture material. Each of the four examinations and the final exam were weighted equally. Final grades were determined by dividing the total points accrued for the five exams by the total possible points. Letter grades were determined as follows: A = 100–85%, B = 84.99–75%, C = 74.99–65%, D = 64.99–55%, and F = 54.99% or lower.

Analysis. Descriptive statistics and means ± SE are presented. In addition, linear regression analyses were used to test if the slopes for course grade versus each of the three subscales of the IMI when female and male students were combined were different from zero (Figs. 1A, 2A, and 3A).

The slope comparison between men and women for course grade versus each of the three subscales of the IMI was also evaluated (Figs. 1B, 2B, and 3B). Effect size (Cohen’s d) calculations were also performed to determine the effect of the three subscales of the IMI variables on course grade (Figs. 1A, 2A, and 3A).

RESULTS

Daily attendance for female and male students combined averaged 70 ± 3%. There were no differences in daily attendance between female and male students (female students: 67 ± 4%; male students: 73 ± 4%). Examination scores for female and male students combined averaged 74 ± 2%. There were no differences in examination scores between female and male students (female students: 72 ± 3%; male students: 75 ± 3%). The class average for the present courses was typical of previous class averages, based on instructor records (data not shown).

Figure 1A shows the significant (P = 0.0213) increase in course grade with increase in survey score for the interest and enjoyment subscale of the IMI.

Fig. 1. A: there was a significant increase in course grade with increase in survey score on the interest and enjoyment subscale of the intrinsic motivation inventory (IMI) when female and male students were combined. B: furthermore, each increase in survey score was associated with a greater increase in course grade for male (6.1%) compared with female (0.3%) students. C: sex differences (women vs. men) on the interest and enjoyment subscale of the IMI. *P < 0.05 female vs. male students.
enjoyment subscale of the IMI when female and male students were combined. Specifically, each increase in survey score for the interest and enjoyment subscale of the IMI was associated with an average increase of 3.9% (the slope) in course grade. The calculated effect size (18) was 0.7–0.8, suggesting a large effect of this IMI variable on course grade. In addition, each increase in survey score for the interest and enjoyment subscale of the IMI was associated with a significantly ($P = 0.018$) greater increase in course grade for male (6.1%) compared with female (0.3%) students (Fig. 1B). The effect size calculation for the effect of sex on this IMI variable was 0.58, supporting a moderate to strong effect of sex on this variable. These findings are supported by the results shown in Fig. 1C. Specifically, male students reported significantly higher scores on the interest and enjoyment subscale of the IMI intrinsic than female students ($4.9 \pm 0.3$ vs. $4.5 \pm 0.2$).

Similarly, Fig. 2A shows the significant ($P < 0.00001$) increase in course grade with increase in survey score for the perceived competence subscale of the IMI when female and male students were combined. Specifically, each increase in survey score for the perceived competence subscale of the IMI was associated with an average increase of 6.3% (the slope) in course grade. The calculated effect size was 1.9, suggesting a large effect of this IMI variable on course grade. However, each increase in survey score for the perceived competence subscale of the IMI was associated with a larger but nonsignificant ($P = 0.17$) increase in course grade for male (7.5%) compared with female (4.7%) students (Fig. 2B). The calculated effect size for the perceived competence variable was 0.38, suggesting a moderate effect of sex on this IMI variable. Similarly, male students reported significantly higher scores on the perceived competence subscale of the IMI intrinsic than female students ($4.8 \pm 0.3$ vs. $4.0 \pm 0.3$; Fig. 2C).

As shown in Fig. 3A, there was no change ($P = 0.9846$) in course grade with increase in survey score for the perceived choice subscale of the IMI when female and male students were combined. Specifically, each increase in survey score for the perceived choice subscale of the IMI was associated with a greater increase in course grade for male (7.5%) compared with female (4.7%) students (Fig. 2B). The calculated effect size for the perceived choice variable was 0.38, suggesting a moderate effect of sex on this IMI variable. Similarly, male students reported significantly higher scores on the perceived competence subscale of the IMI intrinsic than female students ($4.8 \pm 0.3$ vs. $4.0 \pm 0.3$; Fig. 2C).

As shown in Fig. 3A, there was no change ($P = 0.9846$) in course grade with increase in survey score for the perceived choice subscale of the IMI when female and male students were combined. Specifically, each increase in survey score for the perceived choice subscale of the IMI was associated with a greater increase in course grade for male (7.5%) compared with female (4.7%) students (Fig. 2B). The calculated effect size for the perceived competence variable was 0.38, suggesting a moderate effect of sex on this IMI variable. Similarly, male students reported significantly higher scores on the perceived competence subscale of the IMI intrinsic than female students ($4.8 \pm 0.3$ vs. $4.0 \pm 0.3$; Fig. 2C).

Fig. 3. A: there was a small and nonsignificant decrease in course grade with increase in survey score on the perceived choice subscale of the IMI when female and male students were combined. B: in addition, each increase in survey score was associated with an increase in course grade for male students (2.4%) but a decrease in course grade for female students (−2.9%). C: sex differences (women vs. men) on the perceived choice subscale of the IMI. *$P < 0.05$, female vs. male students.

Fig. 2. A: there was a significant increase in course grade with increase in survey score on the perceived competence subscale of the IMI when female and male students were combined. B: in addition, each increase in survey score was associated with a greater increase in course grade for male (7.5%) compared with female (4.7%) students. C: sex differences (women vs. men) on the perceived competence subscale of the IMI. *$P < 0.05$, female vs. male students.
are supported by the results shown in Fig. 3C. Specifically, male students reported significantly higher scores on the perceived choice subscale of the IMI intrinsic than female students (3.1 ± 0.3 vs. 2.4 ± 0.3).

**DISCUSSION**

In this study, we tested the hypothesis that higher levels of intrinsic motivation are related to higher levels of class performance. Furthermore, we tested the hypothesis that sex (women vs. men) influences the relationship between intrinsic motivation and class performance. To address these hypotheses, we administered the IMI to assess our students’ interest and enjoyment, perceived choice, and perceived competence at the completion of our undergraduate exercise physiology summer courses. The interest and enjoyment subscale is the self-reported measure of intrinsic motivation, whereas the perceived choice and perceived competence concepts are positive predictors of intrinsic motivation.

Our results documented a significant increase in course grade with increase in survey score for the interest and enjoyment subscale of the IMI when female and male students were combined, supporting the first hypothesis. Specifically, each increase in survey score for the interest and enjoyment subscale of the IMI was associated with a significant increase of 3.9% (the slope) in course grade. However, each increase in survey score for the interest and enjoyment subscale was associated with a significantly greater increase in course grade for male (6.1%) compared with female (0.3%) students, supporting the second hypothesis. These results are consistent with reports (5, 36) documenting that the level of intrinsic motivation has a positive impact on school performance.

The success of intrinsic motivation is attributed to meeting three basic psychological needs (autonomy, competence, and relatedness), which markedly impact a students’ level of self-fulfillment (5, 6, 8, 25, 35, 36). Teachers have an opportunity relatedness), which markedly impact a students’ level of self-fulfillment (5, 6, 8, 25, 35, 36). Teachers have an opportunity to positively impact a student’s level of intrinsic motivation by being aware of these basic psychological needs as well as strategies and behaviors that positively impact the level of intrinsic motivation. Thus, a short description of the needs as well as ways to positively address these needs follows.

The concept of autonomy describes the situation when the teacher considers the perspectives of the student and, thus, provides relevant information and opportunities for choice (15). In the process, the teacher encourages the student to accept more responsibility for their own behavior. This process involves minimizing the use of pressure so that the students will be motivated to initiate their own actions. This approach leaves students feeling more understood and more involved in an educational partnership. When this happens, the students’ behaviors become volitional and reflectively self-endorsed, and the students willingly devote time and energy to their studies (15). The success of autonomy is predicated on the teacher providing choices about how to behave, the information necessary to make wise choices, meaningful rationales for suggested behaviors, acknowledgment of feelings about behavioral options, and encouragement to choose and to persist (3, 19).

Perceived competence refers to the student feeling able to meet the challenges of their schoolwork (15). Students will maximally engage and personally value activities they can actually understand and master. Importantly, students’ competence can be enhanced by the teacher introducing learning activities that are optimally challenging, thereby allowing students to challenge and to expand their academic capabilities (15). To accomplish this goal, the teacher must provide students with the appropriate tools and feedback to promote success and feelings of efficacy. Feedback should downplay evaluation and emphasizes students’ effectiveness, thus providing relevant information on how to master the tasks (15).

Finally, although not measured directly in this study, satisfaction of the need for relatedness facilitates the process of intrinsic motivation. In the classroom, relatedness is associated with a student feeling that the teacher genuinely likes, respects, and values him or her (15). Students who report such relatedness are more likely to accept the challenges involved in learning. In contrast, students who feel disconnected or rejected by teachers are more likely to respond only to external contingencies and controls (15).

Thus, it is empowering to know that teachers, through the structure of their course, nature of their assignments, interactions with their students, and behavior and teaching style, have much to do with their students’ motivational level, that is, everyday teaching practices have a major impact on student motivations (2), i.e., providing choice, deemphasizing grades, providing frequent positive feedback, and providing opportunities for students’ success by assigning tasks that are neither too easy nor too difficult. The level of difficulty should be slightly above the students’ current ability level. A task that is too easy promotes boredom. A task that is too difficult may appear unattainable and may create anxiety. Furthermore, helping students find personal meaning and value in the material while creating an open and positive atmosphere and helping students feel valued are critical. Finally, everyone has a fundamental need to feel connected or related to other people. Students who feel valued have a higher degree of intrinsic motivation and academic confidence (3, 4, 6). The teacher must genuinely demonstrate warmth and openness and encourage student participation in an enthusiastic, friendly, and helpful manner.

The results from this study also documented that sex (women vs. men) influences the relationship between intrinsic motivation and class performance. This is not surprising since sex differences in how women and men learn and behave in educational settings exist (1, 28, 33). Furthermore, the brains of men and women appear to develop differently (11). Female students reportedly have higher intrinsic motivation than male students for learning English (14) and music (26). In contrast, female students also reportedly have lower intrinsic motivation than male students for physical education classes (27). Despite the passions encountered by posing these issues, addressing these concerns have potentially powerful implications for both classroom practice and educational reform policies and must be tackled by the academic community if we are to improve educational quality.

In this context, in the small cohort of students included in this study, male exercise physiology students had a stronger relationship between intrinsic motivation and class performance than female students (Figs. 1B and 3B). Furthermore, male students had a positive relationship with all three subscales of the IMI and class performance. In contrast, female students had a positive relationship only with the perceived
competence subscale and class performance. Accordingly, teachers must be aware of and sensitive to potential sex (women vs. men) differences in motivation. However, future studies are required to obtain data before recommendations can be made regarding specific changes in teaching strategies to increase intrinsic motivation for students. Globally, then, one significant value of the present findings, that learning performance is significantly related to intrinsic motivation in a gender dependent manner, is to stimulate educators to devise novel teaching approaches to enhance student education and to promote lifelong learning given the awareness gained from the present study.

**Limitations.** It is important to note that results from this study were obtained from female and male students from only one environment, with only one instructor, and at only one university. Accordingly, it is not necessarily appropriate to draw conclusions that are applicable to all women and men learning in different environments, for example, public versus private institutions. In addition, we do not know (at this point) the specific variables that accounts for the results. We also have yet to identify the specific changes in teaching strategy that might increase intrinsic motivation for the female students. We are also unaware of, and must consider in future investigations, the teaching behaviors that may have influenced the lower intrinsic motivation scores for female students. It would have also been interesting to administer the IMI at the beginning of the course and then again at the end to determine whether the course increased or decreased intrinsic motivation. Thus, it is exciting that although novel insights have been made, critical questions remain, and important insights into the reasons for these results remain to be identified and gained by future studies.

**Summary.** We administered the IMI to assess our students’ intrinsic motivation at the completion of our undergraduate exercise physiology summer courses. The results documented a significant increase in course grade with an increase in intrinsic motivation for male students only. In fact, the relationship between intrinsic motivation and class performance was greater for male compared with female students. For example, the results shown in Fig. 1B indicate that for female students, course grade was not at all related to intrinsic motivation. It is particularly interesting that the female subjects were as successful in the course as the male subjects (there were no differences in average course grades between male and female students), despite the fact that their intrinsic motivation scores were lower on all three subscales. These results prompt the following question: What was it about the learning environment that led to lower self-reports for female students on an intrinsic motivation survey at the end of the course? Furthermore, do the results suggest that although intrinsic motivation can be helpful for achievement, it is not necessary for achievement (at least in female students)? These results have potentially important implications for both classroom practice and to guide educational reform policies.

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**DISCLOSURES**

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

**AUTHOR CONTRIBUTIONS**

Author contributions: R.N.C., H.L.L., and S.E.D. conception and design of research; R.N.C. and J.H.C. performed experiments; R.N.C., H.L.L., A.J.B., J.H.C., and S.E.D. analyzed data; R.N.C., H.L.L., and S.E.D. interpreted results of experiments; R.N.C. and S.E.D. drafted manuscript; R.N.C., H.L.L., and S.E.D. edited and revised manuscript; R.N.C., H.L.L., A.J.B., J.H.C., and S.E.D. approved final version of manuscript; H.L.L., J.H.B., and S.E.D. prepared figures.

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