Academic Effort and Time Spent in Physical Activity: A Longitudinal Study

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Introduction

Purpose: To investigate the relationship between time spent in physical activity and effort put into academics over a given week.

Questions:
- University students have many demands on their time. How do they divide their time?
- Can time spent in physical activity impact academic effort?
- If time spent in physical activity impacts academic effort, does the level of exercise vary over time?

This research has important, real-world applications for university students; it answers the question of how to effectively manage your time between academics and physical activity. While previous research has investigated the overall relationship between academics and physical activity, our methods allow us to extend previous research by looking at this relationship on a weekly basis. This approach lends itself well to the application stated above. We will be using multi-level modelling to investigate the general trend between the two variables. We will then look to account for any variance using several moderator variables.

Previous Research

- Physical activity has broad effects on our present and future lives. (Kramer, Erickson & Colcombe, 2006)
- Time management affects many things, including evaluation of performance, increasing work and life satisfaction and decreasing role overload. This is mainly due to increased perceived control over time. (Montani, Shadish, Dipboye, & Phillips, 1990)
- Physical activity has many effects on our goals, such as increasing efficacy in managing goals, increasing persistence in achieving goals and promoting a positive view of the pursuit of current goals. (Jung & Brawley, 2010)

These effects are discussed by Macan et al. (1990), time management can reduce stress, increasing optimal cognitive functioning and performance. Furthermore, it decreases stress and role overload, typical barriers to academic success for stressed university students.

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Gaps in existing research:
- Main focus on school children, need to extend research to university students.
- Currently focused on academic achievement rather than effort, motivation or efficiency.

- Studies mainly conducted at a single time point or cross-sectional, longitudinal data would provide a more comprehensive picture.
- Longitudinal studies focus on steady changes over time rather than time intervals.

Hypothesis: We proposed that there would be a slight, positive relationship between physical activity and academic effort. However, our main hypothesis was that there would be a significant amount of variance in this relationship and that it could be at least partially accounted for by our predictor variables of trait exercise, gender and grade.

Method

The data used was from the second phase of Tremblay et al.’s 2010 study of drinking habits.

Participants: 415 first-year students from the University of Western Ontario, recruited via email.

Procedure: Participants completed 26 online weekly questionnaires and were compensated $5 per questionnaire.

Measures:
- Level 1: Exercise: participants recorded the time spent in specific sport or fitness activities on each day of the week. These times were summed for the entire week to generate a single exercise time for each week per participant.
- Academic Effort: Participants were asked to what extent they agreed with the statement “I worked hard on my studies” from “very strongly disagree” to “very strongly agree” on a 10-point Likert scale each week.

- Level 2:
  - Trait exercise: the exercise values from level 1 were averaged over the 26 weeks as an indicator of the overall exercise level of each participant.
  - Grade: each participant’s average grade for their first year of university was used.

Design: A longitudinal design was used in order to look at the effects of exercise on academic effort while controlling for individual differences. This design also allows us to investigate potential moderator variables of this relationship.

Analysis: Multi-level modelling
- Level 1: analyze overall within-person relationship between exercise and academic effort
  - o The first model will be used to assess the proportion of variance. This model will be unconditional and have no predictors.
- Level 2: analyze the difference between people. Account of the variability found in level 1 using 3 moderate variables: trait exercise, gender, and grade.

Exercise and academic effort were also modelled over time to look at the overall trends and to investigate differences during critical time periods (e.g. final exams). Mean for each timepoint were calculated across individuals for each week.

Results

The data were gathered from 415 students, with a mean exercise level of 2.00 hours per week (SD = 3.1) and a mean academic effort of 6.19 (SD = 1.5). Mean academic effort was plotted by week in figure 1. Mean exercise was plotted by week in figure 2.

The multi-level modelling data is presented in table 1. A sample of students’ slopes can be seen in figure 3. Overall, the model had an intra-class correlation coefficient of 0.276. Level 1 data were based on weekly measures of academic effort and exercise level. These data were within person, such that each person had 26 data points, one for each week of the study.

- Level 2 data attempted to account for the variance found in level 1. Level 2 predictors comprised of trait exercise, gender and average grade. These data were between people, such that the slopes of people with different scores were compared to account for the variation found in level 1. In level 2, participants were divided by gender to further investigate the effects of gender on the relationship between exercise and academic effort. In level 2, all 2 predictors are incorporated. A visual representation of the complete model can be seen in figure 4. The participants had an average grade of 74.13% (SD = 1.2) and of 415 participants, 244 were female.

Discussion

The overall model presented in table 1 can be seen clearly in figure 4. Trait exercise and grade were strong predictors of the effort intercept, while gender was the only predictor that had any effects on the slopes. This means that individuals who exercise more and get higher grades also exercise more. This can be explained using two underlying mechanisms: time management and goal orientation.

As discussed by Macan et al. (1990), time management can reduce stress, increasing optimal cognitive functioning and performance. Furthermore, it decreases stress and role overload, typical barriers to academic success for stressed university students.

Jung and Brawley (2010) demonstrated that frequent exercisers have greater efficacy in managing goals, greater persistence in achieving goals and a more positive view of the pursuit of their goals. This was referring to life goals as well as exercise goals. It is clear that these individuals are more highly motivated and better equipped to achieve their goals in the gym or in the classroom.

Lastly, Donnelly and Lamarrone (2011) demonstrated that exercise can be beneficial to academics, even when the time is taken from academic time. This means that it may be worthwhile to spend more time exercising, even if it is the expense of time spent on academics. This is because when you return to your studies, cognitive stimulation may lead to more efficient and effective work. This is the reason that we choose to study academic effort rather than time. If exercise enhances the quality of the academic work completed, the time is well spent.

Furthermore, the weekly relationship between exercise and academic effort is moderated by gender. Our analysis in 5h demonstrates that trait exercise has a stronger positive effect on the effort intercept for women. Further studies are needed to determine whether this relationship is strong enough to represent a real-world difference.

Conclusion

In conclusion, it is highly beneficial for university students to increase their time in physical exercise. It may enhance time management skills and motivational factors. Additionally, cognitive functioning will enhance the quality of academic work such that the loss is not detrimental.

Table 1: Model summaries of longitudinal data

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconditional (intra-class correlation)</td>
<td>Exercise predicting effort (slopes fixed)</td>
<td>Exercise predicting slopes (slopes random)</td>
</tr>
<tr>
<td>Unconditional (intra-class correlation)</td>
<td>Exercise predicting intercepts and slopes</td>
<td>Trait Exercise predicting intercepts and slopes</td>
</tr>
<tr>
<td>Unconditional (intra-class correlation)</td>
<td>Gender predicting intercepts and slopes</td>
<td>Grade predicting intercepts and slopes</td>
</tr>
<tr>
<td>Unconditional (intra-class correlation)</td>
<td>Add Grade predicting intercepts and slopes</td>
<td></td>
</tr>
</tbody>
</table>

Regression coefficients (fixed effects)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait exercise intercept (τu)</td>
<td>4.155 (0.072)**</td>
</tr>
<tr>
<td>Trait exercise slope (τv)</td>
<td>-0.013 (0.009)</td>
</tr>
<tr>
<td>Gender intercept (τg)</td>
<td>0.014 (0.014)</td>
</tr>
<tr>
<td>Gender slope (τh)</td>
<td>-0.001 (0.005)</td>
</tr>
<tr>
<td>Grade intercept (τc)</td>
<td>-0.065 (0.027)</td>
</tr>
<tr>
<td>Grade slope (τd)</td>
<td>-0.044 (0.069)**</td>
</tr>
</tbody>
</table>

Variance components (random effects)

<table>
<thead>
<tr>
<th>Component</th>
<th>Coefficient (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual (ρu)</td>
<td>4.999 (0.077)**</td>
</tr>
<tr>
<td>Intercept (τu)</td>
<td>1.908 (1.511)**</td>
</tr>
<tr>
<td>Slope (τv)</td>
<td>0.018 (0.055)**</td>
</tr>
<tr>
<td>Covariance (τuv)</td>
<td>-0.011 (0.020)</td>
</tr>
</tbody>
</table>

Model summary

Deviance statistic | 39912.946 |
Number of estimated parameters | 6 |

Parameter estimates standard errors are listed in parentheses.

***p<0.001, **p<0.01, *p<0.05