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Technical Research Report

# Revel for Psychology, 1st edition by Marin and Hock 

Correlation study with University of Nebraska-Lincoln:
Revel for Psychology, 1st edition by Marin and Hock

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## Executive summary

## Overview of Revel

Revel is an interactive learning environment intended to help students prepare for class by reading a little, then doing a little.

Within Revel, there are several different learning products. Each product consists of instructional text interspersed with videos, interactive elements and assessments. Revel for Psychology, 1st edition by Marin and Hock is one of these.

To help learners get more out of their experience, Revel has been designed with a number of learning design principles in mind. Learning design is an approach to designing education products that focuses on learners' experiences.

In particular, Revel is designed to:

- manage cognitive load
- encourage active engagement
- provide continuous formative assessment as learners work through the text


## Intended outcomes

Here's what success looks like for Revel in terms of learners' experiences using the product.

## Outcomes related to access and experience

## 1. Revel users are getting good value for money.

Features like "Listen to Audio" and 360 degree activities let students learn anywhere. To judge whether learners feel like they are getting value for money, we can look at survey results.

## 2. Learners are engaged.

Revel is designed to get students engaged in psychology and help them come to class prepared. For example, as well as reading about the central nervous system, with Revel they could also watch a short video on the major structures of the human brain, or select hotspots on an interactive cerebral cortex to understand its relationship to behavior and personality.

To judge how engaged learners are, we look at the amount of time they spend using Revel and how they rate their own levels of engagement.

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## 3. Learners have a positive learning experience.

Revel presents text and interactive elements together, giving students the option of delving deeper into the topic. Revel for Psychology, 1st edition by Marin and Hock includes a Real World Application feature to illustrate how psychology explains real-world behavior, to help students relate psychology to their everyday lives. Revel is also accessible as a mobile app, so students can practice with flashcards on their phones, listen to chapters read aloud, or turn in assignments from anywhere.

To judge whether learners have a positive experience, we look at survey responses.

## Outcomes related to timeliness/completion

## 4. Learners complete the course.

Completing the course means not dropping out at any stage. Revel's performance dashboard can tell instructors how well their students perform in its embedded quizzes and writing assignments. This way, instructors can get an early warning about students who might need more support to pass the course.

## 5. Learners complete assignments on time.

One of Revel's main aims is to help learners come to class prepared to learn. This means that in an ideal world, learners will complete their Revel assignments before class, rather than after.

## Outcomes related to competence/standard of achievement

## 6. Learners pass the course.

Revel is designed to help students learn the course materials and key skills they need to pass the course. To judge whether it achieves this, we can look at Revel users' course grades.

## 7. Learners achieve competency or expertise in subject matter.

In Revel, students read a little and then do an activity to reinforce the material they just read. Activities can include short experiments, solving problems, or completing tables, for example. These are opportunities for active engagement, which is a step on the way towards competency and expertise in the subject.

To judge whether this is working for learners, we can look at Revel interaction data and course grades.

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## Research aims and research questions

This study examines a group of students using Revel for Psychology, 1st edition by Marin and Hock in their introductory psychology course. We analyze learning behaviors (by looking at surveys and Revel interaction data) and outcomes (by looking at achievement data). We also explore how the instructor and institution integrate Revel into the course.

The research questions we set out to answer are as follows.

## Questions related to access and experience

1. What are students' perceptions and experiences with using Revel for Psychology, 1st edition by Marin and Hock?

## Questions related to timeliness/completion

2. What percentage of students completed the required course components?
3. How many Revel assignments did students complete?

## Questions related to competence/standard of achievement

4. What percentage of learners pass the course?
5. What is the average grade students receive on exams?
6. What is the relationship between students' use of Revel and their exam scores?
7. What is the relationship between the amount of time students spend doing activities in Revel and their Revel assessment scores?

Each of the intended outcomes can be linked to one of these research questions. Appendix D explains how the outcomes and questions match up.

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## Findings

## Main findings

In the context of this study, we can make the following correlational statement about the efficacy of Revel for Psychology, 1st edition by Marin and Hock:

- Each additional ten percentage points students scored on Revel for Psychology, 1st edition by Marin and Hock quizzes were associated with an increase of $1.36( \pm 0.41)$ percentage points on unit exams ${ }^{1}$. These results are based on a regression model controlling for self-reported ACT score, gender, and year in college, and the study was conducted with 316 students in the Fall 2017 and Spring 2018 semesters at the University of Nebraska-Lincoln.

Because we consider students' scores on assignments to be a summary measure of their use of Revel, this finding addresses the research question, What is the relationship between students' use of Revel and their exam scores? It is also associated with Intended Outcome 7, Learners achieve competency or expertise in subject matter. The other correlational statements arising from this study are secondary findings, discussed in the next section.

In the same context, we can also make several descriptive statements about the efficacy of Revel for Psychology, 1st edition by Marin and Hock. These statements are as follows:

## Findings related to access and experience

- When asked how likely they were to recommend Revel to another student on a scale of 0 (not at all likely) to 10 (extremely likely), 41\% of students provided a rating of 9 or 10, with another 43\% of students providing a rating of 7 or 8 .
- Revel's net promoter score, which is an index of customer experience that captures the likelihood a student would recommend Revel to a friend, was 27.
- $72 \%$ of students said they used Revel several times a week or daily.
- $84 \%$ of students said they spent more time using Revel than other books or products.
- $92 \%$ of students said Revel was a more efficient way to study compared to other books or products.

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## Findings related to timeliness/completion

- $100 \%$ of students completed the required aspects of the course - that is, at least three of the four unit exams and the final exam.
- Students successfully completed $93 \%$ of Revel assignments, measuring successful completion as scoring $70 \%$ or higher on the assignments and counting missing assignments as incomplete.


## Findings related to competence/standard of achievement

- $96 \%$ of students passed the course.
- The average grade for the final was $94.6 \%$, and the average unit exam grades were $85.2 \%$ for instructional unit one, $82.0 \%$ for unit two, $82.9 \%$ for unit three, and $79.4 \%$ for unit four.

Because the intended outcomes were specified after we had collected the data, the extent to which we can link the potential findings to the intended outcomes is limited.

This study could not address the research question What is the relationship between the amount of time students spend doing activities in Revel and their Revel assessment scores? because of substantial misfit in the associated statistical model.

## Secondary findings

In order to better understand the main findings, we conducted secondary analyses within the same study to analyze Revel usage patterns. This usage analysis showed that, when controlling for selfreported ACT score, gender, and year in college, students who spent more time reading and interacting with Revel for Psychology, 1st edition, and who answered more questions correctly on the first attempt - both suggestive of a higher quality of engagement with the title - also tended to obtain higher unit exam scores. These secondary findings supplement the main findings and unpack student usage of Revel at a finer grain size. Because they are supplementary to the main findings, the secondary findings should be viewed as suggestive.

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## Discussion

The results of the study suggest that students who got higher quiz scores in Revel tended to do better on exams. Likewise, students who spent more time reading in Revel, and who answered more questions correctly on the first attempt, also tended to do better on exams.

These results line up with our expectation that using Revel helps students to succeed in the course. However, because of the way the study is designed, we can't say for sure whether using Revel is the cause of the students' success.

## Next steps

As part of this study, we try to separate out several different ways that students interact with Revel and see how these relate to exam scores. Spending more time on reading and answering questions correctly on a first attempt - signs of thoughtful engagement with Revel - were associated with higher exam scores.

Future research could study these different ways of interacting with Revel in more depth, or categorize students according to their patterns of use.

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## Introduction

## Background

Manda Williamson, an instructor at the University of Nebraska-Lincoln, has used the title Revel for Psychology, 1st edition since the Fall 2016 semester to teach an introductory psychology course. This study examines how her students learn with Revel for Psychology 1st edition by Marin and Hock, analyzing learning behaviors in Revel and their associations with achievement. Analysis is performed using data from six classes she taught in the fall of 2017 and spring of 2018. This study also explores how the technology is integrated into the course experience.

These six classes were selected for study in part because the instructor had previous experience teaching this topic with Revel. Further, she was entirely responsible for the course design, including the creation of the course exams. These exams were specifically aligned to the instructional content taught in the course, and so in this way scores on the exams capture students' mastery of the psychology concepts and ideas presented in the course.

## Description of Revel for Psychology, 1st edition by Marin and Hock

## Product description

Revel is an interactive learning environment intended to help students prepare for class by reading a little, then doing a little. Each product within Revel consists of instructional text interspersed with videos, interactives, and assessments. The design is aligned with a number of learning science principles, helping learners get more out of their experience.

For example, one learning design principle revolves around managing cognitive load. In any learning experience, there is an inherent limit on the amount of information a learner's mind can process at once, often termed "cognitive load". While some degree of cognitive load is necessary for learning, too much extraneous load can be deleterious (Sweller, Ayers, \& Kalyuga, 2011). When students are presented with distracting visuals or asked to integrate information across multiple pages or screens, the cognitive load may be too much and, subsequently, learning can suffer. Revel products are designed to minimize such extraneous sources of cognitive load by following research-based best practices in the presentation and segmentation of information.

In addition, research has shown that, on average, learning experiences that require learners to actively engage with information and create their own ideas are more effective than experiences that require only passive intake of information (Chi, 2009). Revel titles include numerous opportunities for active engagement through embedded interactives and creation of new ideas through writing exercises. Revel for Psychology, 1st edition by Marin and Hock presents a feature called "YourTurn", where students are invited to engage in short experiments, solve problems, complete tables, etc. throughout each chapter. After a block of material is presented, students will be prompted to actively process the information. Many of these YourTurns are paired with a video to show the reader how to accomplish the task.

This title includes a feature called "Real World Application". These short features illustrate how psychology is used to explain real-world behavior. They highlight pop culture and other applications of psychology in everyday life. Highlighting the everyday relevance of course material is intended to help students appreciate the material's real-world value. Research has shown that recognizing the value of material can increase student motivation and persistence (e.g., Hulleman \& Harackiewicz, 2009).

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Formative assessment that includes timely, informative feedback can also help the learning process. Specifically, formative assessment with feedback helps learners monitor progress toward learning goals, identify and correct their mistakes, and think deeply about the correct information (Nicol \& Macfarlane-Dick, 2006). This Revel title includes key terms, end of session and end of chapter quiz questions that provide immediate feedback, including hints in response to incorrect answers. This formative assessment and immediate feedback can support learning of foundational concepts before class, so that students come to class prepared to build upon those concepts.

## Brief summary of the learner outcomes associated with the product

The learner outcomes associated with this product, organized by learner outcome category, are:

## Access and experience

1. Revel users are getting good value for money. Features such as the "Listen to Audio" functionality and 360 degree activities facilitate learning from any location. Indications that learners feel they are getting value for money come from survey questions.
2. Learners are engaged. Revel is an interactive learning platform designed to engage students in psychology and help them come to class prepared. For example, instead of just reading about the central nervous system, with Revel they can watch a short video on the major structures of the human brain or select hotspots on the cerebral cortex to understand its relationship to behaviour and personality. Learner engagement indicators include time spent within Revel and self-reported level of engagement.
3. Learners have a positive learning experience. Media interactives are integrated directly within the authors' narrative, enabling students to delve further into key concepts easily. Real-world applications illustrate how psychology is used to explain real-world behavior, highlighting applications of psychology in everyday life. Revel is also accessible as a mobile app, and so students can practice with flashcards on their phones, listen to a chapter, or turn in assignments from anywhere. Indicators of learners having a positive experience come from survey responses.

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## Timeliness/ completion

4. Learners complete the course. Course completion means that students have not dropped out at any stage. The performance dashboard contains information about students' usage of the product as well as performance on embedded quizzes and writing assignments. This allows instructors to track students' engagement, progress and performance, enabling them to intervene early with students who may be at risk.
5. Learners complete assignments on time. A central purpose of Revel products is to help learners come to class prepared to learn. To this end, learners will ideally complete Revel assignments before class rather than after.

## Competence/ standard of achievement

6. Learners pass the course. Revel is designed to provide an effective way for students to learn the course materials and key skills needed to pass the course.
7. Learners achieve competency or expertise in subject matter. Within Revel, students read a little and then they do an activity to reinforce the material they have just read. Throughout each chapter, students may also engage in activities, such as short experiments, solving problems, or completing tables. Revel contains opportunities for active engagement through embedded interactives and writing exercises. Looking at course grades will provide evidence on how effectively this outcome has been achieved.

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## The present study

This study examines how students learn with the help of digital technology in their introductory psychology course. We analyze learning behaviors (via self-report and via platform data generated by the digital technology) and outcomes (via achievement data). We also explore how the technology is integrated into the course experience, or in other words, the implementation.

The research questions addressed in this study, as organized by the learner outcome categories, are:

## Access and experience

1. What are students' perceptions and experiences with using Revel?

## Timeliness/ completion

2. What percentage of students completed the required course components?
3. How many Revel assignments did students complete?

## Competence/ standard of achievement

4. What percentage of learners pass the course?
5. What is the average grade students receive on exams?
6. What is the relationship between student interactions in Revel and exam scores?
7. What is the relationship between the amount of time students spent on platform activities and assessment scores within Revel?

Each of the learner outcomes may be linked to one of these research questions. Appendix D provides a table indicating the alignment between the research questions and learner outcomes. A summary of the measures used and findings for each pair is also provided.

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## Implementation of product in study

The instructor has taught the introductory psychology course at the University of Nebraska, Lincoln since 2005 and first used Revel in the Fall semester of 2016. The present study focuses on six classes she taught in the Fall 2017 and Spring 2018 semesters using Revel for Psychology, 1st edition. The two semesters each featured one small face-to-face class and one online class. In the spring, the instructor additionally taught two large face-to-face classes. She relied on students completing readings in Revel before class because she used a flipped classroom format, organizing her class time around group activities rather than direct instruction. A syllabus for one of the classes is reprinted in Appendix F.

In each of the six classes, 12 or $13^{2}$ Revel assignments were assigned. The due dates were roughly the same within a semester, as depicted in Figure 1. The assignments were due shortly after the classes covering the associated content, usually a couple of days after, though the instructor did require students to complete the readings before class. Though the assignments had due dates, Revel allows instructors to optionally accept late assignments, and the instructor accepted all late assignments submitted by the students. For the last two assignments in each class, the instructor allowed students to optionally use Psychology First Edition by Hudson and Whisenhunt, a newer Revel title, instead of Marin and Hock for the readings and assessments.


Figure 1: Due date for each Revel assignment by class. The assignments are further grouped by instructional unit.
2. An anomaly regarding the Revel assignments bears mentioning, which is that the small face-to-face class in the Fall looks as though it is missing a third assignment. As encoded in the Revel database, the second assignment for that class included all of the readings and assessments that may be found in the second and third assignments for the other Fall class. In other words, it appears that two assignments were collapsed into one. Based on information regarding daily interaction counts in Revel (discussed later), it is likely that two separate assignments somehow were misrecorded in the database as one assignment.

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The course was divided into five instructional units, and the Revel assignments may be grouped according to these units (color-coded in Figure 1). The first instructional unit provided an overview of psychology and then covered chapters on lifespan development and personality. The second covered the foundations of behavior, consciousness, and sensation and perception. The third covered learning and memory. The fourth covered cognitive processes and motivation. The fifth covered social psychology, therapy, psychological disorders, and health psychology. The first four instructional units each concluded with a unit exam encompassing the content within the unit. At the end of the fifth unit a final exam was administered, in which two-thirds of the questions addressed unit five and one-third addressed units one through four. Each of the exams were created by the instructor.

Figure 2 describes the overlap of content in Revel assignments between the classes (for Marin and Hock only). Within a semester, identical Revel quiz items and learning resources were assigned in each instructional unit. Between semesters, the assignments were still quite similar, with overlap in content ranging from $77 \%$ to $100 \%$. In short, there is a substantial degree of consistency regarding the content of Revel assignments between the six classes.

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Figure 2: Percent of content overlap for assignments between courses by unit (for Marin and Hock only). The small cells represent the percent of content in the row course that was assigned also in the column course.

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The instructor did not modify the default assignment settings for Revel quizzes. As such, questions were worth three points following a chapter section and five points after a chapter. Students were able to make up to three attempts on any given question, with one point less credit earned per repeated attempt. In terms of grades, the instructor framed the Revel assignments as class participation and assigned participation points based on the Revel assignment scores, though not on a one-to-one basis. The participation points awarded (based on Revel quiz performance) are provided in Table 1. These participation points constituted $15.5 \%$ of the total course grade.

Table 1: Class participation points awarded based on Revel quiz performance. The participation points were worth $15.5 \%$ of the total course grade.

| Revel quiz average | Participation points |
| ---: | ---: |
| $80-100 \%$ | 100 |
| $70-79 \%$ | 90 |
| $60-69 \%$ | 80 |
| $50-59 \%$ | 70 |
| $40-49 \%$ | 60 |
| $30-39 \%$ | 50 |
| $0-29 \%$ | 0 |

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## Method

The main purpose of the study is to learn about the relationship between Revel usage and achievement as measured by exam scores and Revel quiz scores. This study examines data from an instructor interview, a student survey, course records, and Revel platform data. Leveraging these data, regression models are employed to learn about the relationships of interest, controlling for prior achievement (self-reported ACT score), gender, and year at university. The evidence provided by such an approach is correlational in nature rather than causal.

## Participants

The six classes had a total of 739 students, though the analytic sample includes only the 316 (43\%) students who consented to participate. Table 2 provides the number of consenting and total students by class. Participation rates were highest for the small face-to-face classes and lowest for the online classes. As described in greater depth later, most participating students were female and in their first academic year. The instructor also reported that most students were caucasion and studying full-time, though data were not collected on these matters directly.

Table 2: Total and consenting numbers of students by class.

| Course section | N consented | N total |
| :--- | ---: | ---: |
| Fall online | 45 | 197 |
| Fall small | 19 | 25 |
| Spring large A | 66 | 122 |
| Spring large B | 108 | 162 |
| Spring online | 56 | 208 |
| Spring small | 22 | 25 |
| Total | $\mathbf{3 1 6}$ | $\mathbf{7 3 9}$ |

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A teaching assistant recruited students to participate in the study by email after the conclusion of either semester, directing students to a web-based survey that included a consent form. The majority of the students did not consent to the study. Because data are unavailable for nonconsenting students, it is unknown how nonconsenting students may differ from the consenting students.

## Data collection

Four sources of information are involved in this study:

- an interview with the instructor
- a survey administered to the students
- the instructor's course records (for exam scores and course grades)
- Revel platform data

The instructor interview was conducted to learn about the instructor's course, how she incorporated Revel, and her experiences and perceptions regarding Revel. This interview informed the account of implementation provided above, as well as the design of the statistical analyses.

The survey was designed by the instructor and included questions about students' ACT scores, grade point average, gender, race, and other questions relevant to a research study of her own. She also added to the survey seven questions provided by Pearson regarding Revel. Five of the Revel questions were closed-response, asking about:

- how students accessed Revel
- how often they used it
- whether they felt it was an efficient way to study
- whether they spent more time using it than other books or products
- whether they would recommend it to others

Two open-response questions sought more information about responses to a couple of the closeended questions. The survey questions about Revel are reprinted in Appendix E. Figure 12 (presented later) summarizes the responses to questions about student background and prior achievement. Figure 16 summarizes responses to questions about Revel (also presented later).

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The instructor merged the survey data with the exam scores and overall grades, and then further merged that dataset with platform data for Marin and Hock provided by Pearson. The platform data summarized student activity on each Revel assignment with quiz score, number of hours spent reading the e-text, number of hours spent working in assessments, and the number of attempts at quiz questions. The number of question attempts was subdivided between correct and incorrect attempts, and also between first and repeat attempts. Revel platform data for Hudson and Whisenhunt were not included in the merging process and so are unavailable for analysis, though the instructor did provide Revel scores associated with that text.

## Measures

Time on task in Revel
Information about student usage of Revel was obtained from the platform database. The platform records information about each student interaction with the Revel e-text and quizzes, including the length of time students hold open pages of the e-text and quiz questions. From this, the time spent on reading and quizzes may be calculated for each student. Figure 3 describes the distribution for the total number of hours spent on reading Revel e-text over the semester. Figure 4 describes the distribution for the total number of hours spent on Revel quizzes.


Figure 3: Students' hours spent reading Revel e-text by instructional unit

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Figure 4: Students' hours spent on Revel quizzes by instructional unit

## Quiz item responses in Revel

The Revel platform records every attempt made on quiz questions. These attempts, up to three per question, may be classified as correct versus incorrect and separately as a first attempt or a repeat attempt (a second or third try at the same question). The motivation for classifying attempts in this way is that it characterizes students' ways of working in Revel. Within each instructional unit, the number of correct first attempts, incorrect first attempts, correct repeat attempts, and incorrect repeat attempts are each summed, and these sums serve as covariates in one of the regression models.

Figure 5 summarizes the numbers of correct first attempts students made on questions in the Revel quizzes, and dotted lines are added to indicate the total number of questions. A small number of students succeed in answering every question correctly on the first attempt, and most students answer the large majority of questions correctly on the first try. Figure 6 depicts similar information regarding the numbers of incorrect first attempts.

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Figure 5: Students' number of correct first attempts at Revel quiz items by instructional unit. The total number of questions for each unit is indicated by the dotted lines.


Figure 6: Students' number of incorrect first attempts at Revel quiz items by instructional unit. The total number of questions for each unit is indicated by the dotted lines.

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Likewise, Figures 7 and 8 provide the numbers of correct repeat and incorrect repeat attempts at questions made by students. More of the repeated attempts were correct than incorrect, which may be expected given that the quiz questions were multiple choice.


Figure 7: Students' number of correct repeat attempts at Revel quiz items by instructional unit. The total number of questions for each unit is indicated by the dotted lines.


Figure 8: Students' number of incorrect repeat attempts at Revel quiz items by instructional unit. The total number of questions for each unit is indicated by the dotted lines.

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## Revel quiz percentage scores

Revel quiz scores will serve as either a covariate or an outcome measure for achievement, depending on the statistical model. The Revel platform records the number of points earned on each assignment, and these scores may be considered summary measures of student interactions on Revel. As mentioned above, students received three or five points per quiz question, losing one per repeated attempt. Student performance within each instructional unit may be summarized by the percentage of total points earned. Figure 9 describes the distributions for these Revel quiz percentage scores. It may be seen that the scores tend to be quite high.


Figure 9: Revel quiz percentage scores by instructional unit.

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## Unit exam scores

Unit exam scores are measures of achievement within the course. The four unit exams were administered at computer labs on campus. Each exam consisted of 75 multiple choice questions drawn at random from a bank of about 350 questions. Although the vast majority of the exam questions were written by the instructor, the instructor included in each item bank about five questions that she previously assigned in Revel, which means a student had about a $72 \%$ probability of seeing at least one item on the exam that was previously presented in a Revel assignment. Students could take each exam twice, in which case the second exam would present a different set of questions. Further, students who earned a Revel score of $80 \%$ or higher across all the assignments were permitted to drop their lowest unit exam score, not including the final. Figure 10 provides the number of unit exams completed by class. In unit four, a small number of students did not complete the exam, perhaps due to the policy allowing the dropping of an exam score.


Figure 10: Numbers of unit exams completed for each class.
Figure 11 depicts the distributions for exam scores across instructional units. The scores are adjusted to range from zero to 100, though sometimes they are somewhat higher due to extra credit. The scores tend to be fairly high, with medians just shy of 90 .

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Figure 11: Unit exam scores by instructional unit.

## Student background information

Figure 12 summarizes students' responses to the background questions on the survey. Most of the students were in their first year, and most were female. The average ACT score was 23.2. ACT score is a measure of prior achievement, and as such, it is an important control variable in the statistical models. There is some degree of evidence that self-reported standardized test scores are reasonably accurate; Kuncel, Credé, and Thomas (2005) found a correlation of .82 between actual and self-reported SAT scores in their meta-analysis. The university reports that the average ACT score for first year students was 25.3 in the academic year this study was conducted, somewhat higher than the sample ACT score.

Responses to the question about grade point average seem to be unreliable. Some students appeared to have responded on a 4-point scale, while others seem to have used a 100-point scale. However, it is difficult to make sense of the responses between 25 and 60. Owing to the discordant responses to this question, grade point average will not be included in the statistical analysis, but the other data points will be used as control variables.

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Figure 12: Summaries for student demographics. In each case, the percentage of non-response ("NA") is provided.

In addition, the instructor reported that most of her students were Caucasian and that most were fulltime students, though the survey did not include questions on these topics.

## Analysis method

Some of the research questions may be addressed with descriptive statistics, but the questions pertaining to the relationship between Revel activity and achievement are addressed with statistical models. Several similar hierarchical regression models are fit, the difference between them being only the choices of response variables and covariates. These models account for clustering (by student, instructional unit, and class) and impute missing data (using joint multivariate normal imputation). They also control for prior achievement (self-reported ACT score), gender, and year at university.

The response variable is unit exam score (or in one case Revel quiz score) within an instructional unit, scaled to range from zero to 100 (though exam scores may be somewhat higher owing to extra credit). Let $y_{s b}$ be the score for student $s$ in block $b$, where a block is defined as the crossing of class and instructional unit. Because Revel platform data are not fully available for the fifth instructional unit, data from the last unit are omitted from the analysis. With six classes and four units, there are then 24 blocks. Each student may have up to four observations, one per unit.

The distribution (likelihood) for $y_{s b}$ is

$$
y_{s b} \mid x_{s}, u_{s b} \sim N\left(\alpha_{b}+x_{s}{ }^{\prime} \beta^{(x)}+u_{s b} \beta^{(u)}+\zeta_{s}, \sigma_{y}^{2}\right),
$$

where $x_{s}$ is a vector of a student's demographic covariates (self-reported ACT score, female indicator, freshman indicator) and $u_{s b}$ is a vector of covariates related to a student's Revel activity in a block. Regarding the parameters, $\alpha_{b}$ is a block-specific intercept, $\beta^{(x)}$ and $\beta^{(u)}$ are vectors of regression coefficients, $\zeta_{s}$ is a student-specific effect, and $\sigma_{y}^{2}$ is the residual variance.

The approach taken here in accounting for the clustered nature of the observations is a highly flexible one. The block-specific intercepts $\left(\alpha_{b}\right)$ allow for cluster-level differences in exam scores between the various classes and instructional units, and they further allow for potential interactions between class and instruction unit. In addition, the student-specific effects $\left(\zeta_{s}\right)$ account for the clustering of observations within students. The flexibility afforded by this helps to guard against model misspecification.

The continuous covariates are grand mean-centered. ACT scores and Revel quiz percentage scores (when included as a covariate) are divided by ten, the number of hours in assessment and in learning are divided by five, and the counts of item attempts are divided by twenty. Grand mean-centering allows the model intercept to be more interpretable, which in turn helps in choosing a sensible prior distribution for it. Likewise, rescaling the covariates makes the units more substantial, improving interpretability and assisting in the choice of sensible priors. The indicator variables take values zero and one and are not otherwise altered.

To complete the specification of the model, priors for the parameters are provided. The block-specific intercepts and student-specific effects have hierarchical priors:

$$
\begin{aligned}
\alpha_{b} & \sim N\left(\mu_{\alpha}, \sigma_{\alpha}^{2}\right) \\
\zeta_{s} & \sim N\left(0, \sigma_{\zeta}^{2}\right) .
\end{aligned}
$$

## Pearson

The remaining prior distributions are chosen to be weakly-informative, meaning that they will not be influential for reasonable parameter values. This is of course dependent on the chosen encodings of $y$, $x_{s}$, and $u_{s b}$.

$$
\begin{gathered}
\mu_{\alpha} \sim N\left(50,100^{2}\right) \\
\beta^{(x)} \sim N\left(0,20^{2}\right) \\
\beta^{(u)} \sim N\left(0,20^{2}\right) \\
\sigma_{\alpha} \sim \operatorname{Half}-\operatorname{Normal}\left(0,50^{2}\right) \\
\sigma_{\zeta} \sim \operatorname{Half}-\operatorname{Normal}\left(0,50^{2}\right) \\
\sigma_{y} \sim \operatorname{Uniform}(0, \infty)
\end{gathered}
$$

Joint multivariate normal imputation is used to impute missing values for the control variables. To this end, the instances of the student-level control variables $x_{s}$ may be gathered into a matrix $X$ having one row per student. Then matrix $X$ contains missing values where students opted not to respond to a survey question, and so it is a mixture of known and unknown quantities. A distribution for $X$ is specified,

$$
\mathrm{X} \sim \operatorname{MVN}\left(\mu_{X}, \Sigma_{X}\right),
$$

allowing the model to proceed by imputing the unknown elements of $X$. The assumed multivariate normal distribution for $X$ is somewhat of a mismatch, given that $X$ includes two binary variables, but joint multivariate normal multiple imputation has been found to perform acceptably with binary variables (Lee \& Carlin 2010; Kropko, Goodrich, Gelman, \& Hill 2014). The covariance matrix $\Sigma_{X}$ is more conveniently parameterized as a vector of standard deviations $\sigma_{X}$ and a correlation matrix. Uniform priors are placed on $\mu_{X}, \sigma_{X}$, and the correlation matrix.

## Pearson

## Results

## What are students' perceptions and experiences with using Revel?

The survey included several questions about students' use and impressions of Revel. Responses to these questions are summarized in Figure 13. A total of 316 students responded to the survey. Most of the students reported accessing Revel via computer only, and most said they used Revel several times a week or more. A large majority said Revel was a more efficient way to study compared to other books or products, and likewise, a large majority said they spent more time using Revel than other books or products. Most students responded favorably when asked to rate the likelihood that they would recommend Revel to another student, and $41 \%$ provided a rating of 9 or 10. The net promoter score, which may be calculated from responses to that question, was 27.

## Pearson



Revel for your course this semester?


How often did you access Revel from either the mobile app or computer?


Did you spend more time using Revel, compared to other books or products for other courses?



Figure 13: Summaries for responses to survey questions about Revel. In each case, the percentage of non-response ("NA") is provided. Percentages may not sum to 100 due to rounding. Two open-ended questions, not summarized here, were also asked of students.

## Pearson

## What percentage of students completed the required course components?

The instructor considered students to have completed the required course components if they completed the exams (four unit exams and one final exam), though students were permitted to skip one of the unit exams. 100\% of the students in the sample completed these required course components.

How many Revel assignments did students complete?
There is not a singular definition for whether or not a student has completed a Revel assignment. If a student has more than zero points on an assignment, then it is clear that they have started the assignment. Assignments were started the large majority of the time, as shown in Figure 14. Across all assignments and students in the sample, $96 \%$ of Revel assignments were started. (When students had a choice of Revel textbook to work out of, the use of either text was counted for starting the assignment.)


Figure: 14 Percentage of students starting each Revel assignment. (When students had a choice of Revel textbook to work out of, using either option counted for starting the assignment.)

It is not possible to obtain high scores on the assignments without responding to at least most of the questions, and so it may be inferred that students achieving high scores have completed the assignments to a meaningful extent. Figure 15 provides a summary for the scores on each assignment. Across all assignments and students in the sample, $93 \%$ of scores were $70 \%$ or higher. (When students worked on assignments in both textbooks, the higher score was used in the calculations.)

## Pearson



Figure 15: Scores on Revel assignments, rescaled to range from 0 to 100. (When students worked on assignments in both textbooks, the higher score was used in the calculations.)

What percentage of learners pass the course?
The instructor awarded a passing grade to students who had a course percentage grade of $69.5 \%$ or higher. Given this benchmark, $96 \%$ of students passed the course.

What is the average grade students receive on exams?
The average unit exam grades were $85.2 \%, 82.0 \%, 82.9 \%$, and $79.4 \%$ for instructional units one through four, respectively. The average grade for the final was $94.6 \%$. Some amount of extra credit was available for each of the exams.

## Pearson

## What is the relationship between student interactions in Revel and exam scores?

## Performance model

The "performance" model includes the Revel quiz percentage scores earned within an instructional unit as the covariate of main interest. The purpose of the model is to address the relationship between exam scores and quality of work in Revel quizzes. Further, in order to examine how the relationship between exam scores and Revel quiz scores may be influenced by prior achievement (as measured by self-reported ACT scores), a second model was fit that includes interactions between ACT score and Revel quiz scores.

The models were estimated using Stan (Carpenter et al. 2017), and the Stan code for them is provided in Appendix B. In both cases, four Markov chain Monte Carlo chains were run for 1,000 iterations, discarding the first half of each chain as warm up. While no problems were observed regarding convergence, both models show some degree of misfit. The difficulty seems to be that students often achieve exam scores near the upper boundary, and so the conditional distribution of exam scores deviates somewhat from the assumed normal distribution. Appendix $C$ provides the details regarding these diagnostics.

Table 3 summarizes the fitted models, providing the posterior means and standard deviations, as well as the $95 \%$ posterior intervals (also called credible intervals), for the parameters. These summaries of the posterior are analogous to point estimates, standard errors, and confidence intervals in frequentist analysis. The proportion of explained variance ("R-squared") was calculated as in Gelman and Pardoe (2006).

## Pearson

Table 3: Summary of the "performance" models, multilevel regression models for unit exam scores. The exam scores and Revel quiz percentage scores range from zero to 100, though exam scores may be somewhat higher owing to extra credit. Both models include student-specific effects and blockspecific effects, where blocks are defined as the crossing of instructional unit and class. The continuous covariates have been grand mean-centered and rescaled as indicated in parentheses.

|  | Main effects only |  |  |  | Interaction included |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Mean | SD | 2.5\% | 97.5\% | Mean | SD | 2.5\% | 97.5\% |
| Intercept and coefficients for controls ("Fixed effects") |  |  |  |  |  |  |  |  |
| Intercept | 82.97 | 1.23 | 80.56 | 85.37 | 82.96 | 1.29 | 80.40 | 85.47 |
| ACT score (per 10 points) | 8.24 | 1.17 | 6.01 | 10.47 | 8.31 | 1.14 | 5.99 | 10.62 |
| Female (versus male) | 0.43 | 1.23 | -1.97 | 2.85 | 0.47 | 1.26 | -2.02 | 2.91 |
| Freshman (versus other years) | 0.26 | 1.22 | -2.16 | 2.67 | 0.22 | 1.24 | -2.18 | 2.57 |
| Coefficients for Revel quiz scores ("Fixed effects") |  |  |  |  |  |  |  |  |
| Revel quiz score (per 10 percent) | 1.36 | 0.21 | 0.95 | 1.76 | 1.39 | 0.23 | 0.95 | 1.83 |
| Quiz score interaction with ACT score |  |  |  |  | -0.66 | 0.43 | -1.51 | 0.21 |
| Standard deviations ("Random effects") |  |  |  |  |  |  |  |  |
| Intercept | 1.73 | 0.45 | 0.99 | 2.75 | 1.78 | 0.46 | 0.99 | 2.79 |
| Student | 8.70 | 0.47 | 7.86 | 9.68 | 8.58 | 0.44 | 7.75 | 9.43 |
| Residual | 8.55 | 0.21 | 8.16 | 8.97 | 8.57 | 0.20 | 8.18 | 8.95 |
| R-square |  |  |  |  |  |  |  |  |
| R-square | 0.58 | 0.02 | 0.55 | 0.62 | 0.58 | 0.02 | 0.55 | 0.62 |
| Sample size |  |  |  |  |  |  |  |  |
| $N$ students | 316 |  |  |  | 316 |  |  |  |
| $N$ blocks | 24 |  |  |  | 24 |  |  |  |
| $N$ observations | 1248 |  |  |  | 1248 |  |  |  |

## Pearson

Focusing on the model including only the main effects, results indicate that students who performed better on the Revel assignments tended to perform better on the unit exams, controlling for gender, freshman-status, and, most importantly, self-reported ACT score. Students who scored ten percentage points higher on Revel quizzes earned, on average, 1.36 more points on unit exams. The margin of error for this estimate is $\pm 0.41$ based on a $95 \%$ posterior interval.

Results from the model with interactions indicated substantial uncertainty regarding the interaction terms. For this reason, the main effects-only model is preferred for interpretation, though the posteriors for the common parameters are quite similar. Figure 16 summarizes the relationship between quiz, ACT, and exam scores for the two models. It omits depicting the uncertainty for the sake of simplicity and is presented mainly as a way to describe the use of the interaction term. For the main effects-only model, the lines shift upwards or downwards depending on self-reported ACT score while remaining parallel. For the model with interactions, the slopes of the lines vary depending on ACT score, though only slightly.


Figure 16: Model-predicted unit exam scores based on Revel quiz percentage scores and self-reported ACT scores, setting all other covariates to zero. Separate lines are shown for the mean and $\pm 1$ standard deviation for ACT scores. There was a high degree of uncertainty in the interaction term, so this aspect should not be over-interpreted.

## Pearson

Two sensitivity analysis are conducted for the main effects only model. The first such analysis involves fitting a similar model but with a Student's $t$ distribution for the likelihood, which is more robust to outliers. The coefficients were similar between fitted models with the normal likelihood and Student's $t$ likelihood. The second sensitivity analysis involves fitting a fixed effects model, which will be robust against the normal distribution assumption of the student-specific effects and the assumption of no correlation between the covariates and student-specific effects. The coefficients differed in the fixed effects model, though this may not be too surprising as coefficients in the fixed effects model have a somewhat different interpretation. Details for both sensitivity analyses are presented in Appendix C.

## Usage model

The "usage" model includes as covariates the number of hours reading e-text and the counts of each type of Revel question attempt. It was fit in the same way as the performance models. Table 4 summarizes the fitted model.

Students who spent more time on reading or gave a greater number of correct responses to Revel quiz questions on the first try tended to score higher on the unit exams, controlling for gender, freshmanstatus, and self-reported ACT score. Students who spent five more hours on reading earned, on average, $2.19( \pm 1.10)$ more points on unit exams. Students who answered twenty more questions correctly on the first attempt earned,on average, $1.82( \pm 1.12)$ more points on unit exams. Incorrect second or third tries at questions were associated with lower unit exam scores. Students who answered an additional twenty more quiz questions incorrectly after the first attempt earned, on average, 6.21 ( $\pm 3.86$ ) less percentage points on unit exams. There was much more uncertainty, indicated by wide posterior intervals, for the other coefficients of main interest in the usage model, so much so that there is poor evidence even for the direction of the relationships.

## Pearson

Table 4: Summary of the "usage" model, a multilevel regression model for unit exam scores. The exam scores range from zero to 100, or somewhat more owing to extra credit. The model includes student-specific effects and block-specific effects, where blocks are defined as the crossing of instructional unit and class. The continuous covariates have been grand mean-centered and rescaled as indicated in parentheses.

|  | Mean | SD | 2.5\% | 97.5\% |
| :---: | :---: | :---: | :---: | :---: |
| Intercept and coefficients for controls ("Fixed effects") |  |  |  |  |
| Intercept | 83.26 | 1.10 | 81.14 | 85.49 |
| ACT score (per 10 points) | 7.40 | 1.02 | 5.33 | 9.32 |
| Female (versus male) | 0.23 | 1.09 | -1.92 | 2.28 |
| Freshman (versus other years) | 0.01 | 1.07 | -2.03 | 2.07 |
| Coefficients for Revel activity ("Fixed effects") |  |  |  |  |
| Hours reading (per 5) | 2.19 | 0.56 | 1.07 | 3.29 |
| Correct first responses (per 20) | 1.82 | 0.57 | 0.77 | 2.96 |
| Incorrect first responses (per 20) | -2.92 | 2.24 | -7.25 | 1.59 |
| Correct repeat responses (per 20) | 0.38 | 2.55 | -4.85 | 5.33 |
| Incorrect repeat responses (per 20) | -6.21 | 1.97 | -10.19 | -2.42 |
| Standard deviations ("Random effects") |  |  |  |  |
| Intercept | 1.79 | 0.50 | 0.92 | 2.84 |
| Student | 7.47 | 0.43 | 6.65 | 8.35 |
| Residual | 8.63 | 0.21 | 8.24 | 9.05 |
| R-square |  |  |  |  |
| R -square | 0.58 | 0.02 | 0.53 | 0.61 |
| Sample size |  |  |  |  |
| $N$ students | 316 |  |  |  |
| $N$ blocks | 24 |  |  |  |
| N observations | 1248 |  |  |  |

## Pearson

Two sensitivity analyses are conducted for the usage model, paralleling those conducted for the performance model, and the results were similar. The alternative model with a Student's $t$ likelihood and the reported model had similar coefficients, though coefficients in the fixed effects model differed. Details for both sensitivity analyses are presented in Appendix C.

## What is the relationship between platform activities and assessment scores within Revel?

Similar to the preceding models, a model having Revel quiz scores as the outcome measure was fit with Stan, using four chains of 1,000 iterations and discarding the first half of each. No problems were observed regarding convergence, but other diagnostics show evidence of substantial misfit. More detail is provided in Appendix C. Owing to the misfit, results for this model are not reported.

## Pearson

## Discussion

The main purpose of this study is to learn about the relationship between Revel usage and achievement as measured by exam scores and Revel quiz scores. To this end, data from a student survey, course records, and Revel platform data were employed in regression models. These models controlled for several confounders, including prior achievement (self-reported ACT score), gender, and year at university.

## Limitations of the study

Since the study design is correlational, results from this study should not be interpreted causally. In a regression analysis like those presented in this study, the hope is that an effect may be estimated net the influence of the relevant confounders. However, the limited set of control variables in this study cannot realistically be expected to adequately adjust for a robust range of potential confounders.

There are also some limitations regarding a couple of the variables used. Student ACT scores serve as an important control variable in the models, and these were self-reported. This leaves some room for error in the reported ACT scores. Also, this study utilized instructor-created exams as the outcome of main interest. While the instructor naturally aligned the exams to the course content, an ideal study would make use of psychometrically validated instruments instead.

Lastly, the participation rate in the study was fairly low at $43 \%$. Students consented to participate by responding to an electronic survey sent out after the end of the semester, and it may be that students who responded to that survey differed systematically from those that did not. Because data are unavailable for non-participating students, it is unknown to what extent the participating students resemble the full target sample.

## Generalizability of the findings

This study could be viewed as a description of what happened for an instructor and her students, essentially a case study. The available data are well-suited to this interpretation, excepting of course the aforementioned limitations. The results presented here may be considered reasonable descriptions of what happened for this instructor and her students (again, excepting the aforementioned limitations).

However, we normally wish to generalize beyond this singular context to infer what the results would be in a different context or would be for the population of Revel for Psychology, 1st edition users broadly. Taking this view, the participating instructor and students in this study constitute something of a convenience sample. Being a non-probability sample, the participants in this study may differ from users in another context, and likewise they may differ from the greater population.

Given the non-probability sample, results from this study may be informative for another context (another instructor and set of students) to the extent that the new setting is similar to the circumstances of the present study in relevant ways. Which similarities are relevant is uncertain, but student background characteristics, teacher experience and style, course structure, implementation of Revel, exam design, and the Marin and Hock content itself are probable candidates. Therefore, we may expect to see similar results in another context if these factors are similar.

## Conclusion

Results from the regression models are compatible with the expectation that engagement with Revel is associated with students achieving higher unit exam scores. Results for the performance model suggest that students obtaining higher scores in the Revel assignments tended to have higher exam scores. Results for the usage model suggest that students who spent more time reading in Revel and who answered more questions correctly on the first attempt, both suggestive of higher quality of engagement, also tended to obtain higher unit exam scores. Unfortunately, the data cannot support causal claims regarding these associations, and so these findings are merely suggestive.

Students appeared to be engaged with Revel and regarded it favorably. Most students reported using Revel several times a week or more, and most said that they used Revel more than other books or products. They also tended to score highly on the quizzes in Revel, implying a reasonable effort on their part. Most students said that Revel was a more efficient way to study in comparison to other books and products.

## Pearson

## Implications of findings for product implementation and further research

The usage model was an attempt to distinguish several aspects of student interactions with Revel and how these relate to exam scores. Signs of thoughtful engagement with Revel (spending more time on reading and answering questions correctly on a first attempt) was associated with higher exam scores. Future research could study the components of engagement with Revel in greater depth or categorize students as following several different patterns of use. In addition, this study should be replicated within a variety of other institutional and course settings, so that we can determine if this result generalizes. Finally, a study employing an experimental or quasi-experimental design would provide more robust support for the impact of Revel Psychology use on these learner outcomes.

## Pearson

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## Pearson

## Appendix A. Data cleaning process statistical tables

Table 5 provides the counts of students and observations available for the statistical models as data exclusion rules are applied. This study excludes students who did not consent to participate and excludes observations where the unit exams were not completed (each student may have up to four observations). No observations were excluded due to missing covariates as the model imputed these.

Table 5: Counts of students and observations as filters are applied.

| Data | N students | N obs |
| :--- | :---: | :---: |
| Sample if all students consented and completed all unit exams | 739 | 2956 |
| Sample after excluding non-consenting students | 316 | 1264 |
| Sample after further excluding missing exams | 316 | 1248 |

## Pearson

## Appendix B. Stan code

The Stan code for the models is provided below.

```
functions {
    matrix fill_in_missing (matrix input_matrix, int[,] is_missing, vector fill) {
        matrix[rows(input_matrix), cols(input_matrix)] output_matrix = input_matrix;
        int k = 0;
        for (i in 1:rows(input_matrix)) for (j in 1:cols(input_matrix))
            if (is_missing[i,j] == 1) {
                k +=-1;
                output_matrix[i,j] = fill[k];
            }
        return output_matrix;
    }
}
data {
    int<lower=1> N; // N observations
    int<lower=1> S; // N students
    int<lower=1> B; // N blocks
    int<lower=1,upper=S> ss[N]; // Student for n
    int<lower=1,upper=B> bb[N]; // Test for n
    vector[N] y; // Response vector
    int<lower=1> J; // N covariates (no intercept)
    matrix[N,J] U; // Covariates
    int<lower=1> K; // N covariates (no intercept)
    matrix[S,K] X; // Covariates
    int<lower=0, upper=1> X_missing[S,K]; // Which in X are missing?
    int<lower=0> n_cli; // N cross-level interactions
    int<lower=1> cli[n_cli,2]; // Cross-level interactions (X then U)
    real<lower=0> prior_mean_mu_alpha;
    real<lower=0> prior_sd_mu_alpha;
    real<lower=0> prior_sd_sig}m\textrm{gm}_alpha
    vector[K] prior_mean_bèta_x;
    vector<lower=0>[K] prior_sd_beta_x;
    vector[J+n_cli] prior_meān_\overline{beta_\overline{u};}
    vector<lower=0>[J+n_c\overline{li] prior_sd_beta_u;}
    real<lower=0> prior_sd_sigma_zeta;
}
transformed data {
    int n_missing = 0;
    for (\overline{s}}\mathrm{ in 1:S) for (k in 1:K)
        n_missing = n_missing + X_missing[s,k];
}
parameters {
    vector[B] alpha_raw; // Intercepts / block means
    real mu_alpha;
    real<lower=0> sigma_alpha;
```


## Pearson

```
    vector[K] beta_x; // Coefficients
    vector[J+n_cli] beta_u; // Coefficients
    vector[S] zeta_raw; // Student effects
    real<lower=0> S'igma_zeta;
    real<lower=0> sigma_y; // Level 1 residual SD
    vector[n_missing] x_unknown; // Imputed elements of X
    vector[K] mu_X; // Means for X
    vector<lower=0>[K] sigma_X; // SDs for X
    corr_matrix[K] Omega_X; // Correlation matrix for X
}
transformed parameters {
    vector[S] zeta = zeta_raw * sigma_zeta;
    vector[B] alpha = alp\overline{ha_raw * sigm}a_alpha + mu_alpha;
}
model {
    matrix[S,K] X_filled = fill_in_missing(X, X_missing, x_unknown);
    vector[K] X_fīlled_vec[S];
    matrix[K,K] Sigma_\overline{X = quad_form_diag(Omega_X, sigma_X);}
    matrix[N,J+n_cli] U_expand;
    for (s in 1:S)
        X filled vec[s] = X filled[s]';
    X_fīlled_véc ~ multi_\overline{normal(mu_X, Sigma_X);}
    U expand[,1:J] = U;
    if (n_cli > 0) for (i in 1:n_cli)
        U_expand[,J+i] = X_filled[ss,cli[i,1]] .* U[,cli[i,2]];
    alpha_raw ~ normal(0, 1);
    mu_alpha ~ normal(prior_mean_mu_alpha, prior_sd_mu_alpha);
    sig}ma_alpha ~ normal(0, prior__s\overline{d_sigma_alpha);
    beta_x ~ normal(prior_mean_beta_x, prior_sd_beta_x);
    beta_u ~ normal(prior_mean_beta_u, prior_sd_beta_u);
    zeta raw ~ normal(0, 1);
    sigma_zeta ~ normal(0, prior_sd_sigma_zeta);
    y ~ normal(alpha[bb] + X_filled[ss,]*beta_x + U_expand*beta_u + zeta[ss], sigma_y);
}
generated quantities {
    vector[N] Y_rep;
    vector[N] Y_hat;
    vector[N] resid;
    real r2;
    {
    matrix[S,K] X_filled = fill_in_missing(X, X_missing, x_unknown);
    matrix[N,J+n_cli] U_expand;
    U_expand[,1:\overline{J}] = U;
    if (n_cli > 0) for (i in 1:n_cli)
        U_expand[,J+i] = X_filled[\overline{ss,cli[i,1]] .* U[,cli[i,2]];}
```

```
Y_hat = alpha[bb] + X_filled[ss,]*beta_x + U_expand*beta_u + zeta[ss];
resid = y - y_hat;
r2 = variance(y_hat) / (variance(y_hat) + sigma_y^2);
for (n in 1:N)
    y_rep[n] = y_hat[n] + normal_rng(0, sigma_y);
```

    \}
    \}

## Pearson

## Appendix C. Diagnostics

## Performance model

In preparation for model fitting, scatter plots of unit exam scores against the continuous explanatory variables are used to explore the relationships, particularly in regards to whether they are approximately linear. These plots include both a linear fit line and a loess fit line to aid in making judgments about the functional form. For binary variables, box plots are shown instead. Figure 17 indicates the relationship between unit exam scores and the control variables. Figure 18 indicates the relationship between unit exam scores and Revel quiz performance. It may be seen that where most of the observations lie (on the upper end of quiz scores), the loess curve is approximately linear, and the curvature is most pronounced in the region where the observations are sparse (the lower end of quiz scores). This occurrence motivated the use of splines in the model.


Figure 17: Unit exam scores plotted against the control variables across instructional units. A linear regression line and loess curve are overlaid on each panel.

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Figure 18: Unit exam scores plotted against quiz percentage scores across instructional units. A linear regression line and loess curve are overlaid on each panel.

## Convergence and fit diagnostics for main effects-only model

Figure 19 shows that the Stan chains converged and that the process returned a reasonable effective number of posterior samples (or in other words, the number of posterior draws adjusted downward due to autocorrelation). Convergence is customarily inferred when the scale reduction factor for all parameters is less than 1.1. There is no benchmark for what the effective number of posterior sample should be.

## Pearson



Figure 19: Diagnostics for the performance model for unit exam scores (Model 1). The scale reduction factor should be less than 1.1 for all parameters to infer that the MCMC chains have converged. The effective number of posterior samples is the number of MCMC draws after warmup adjusted for autocorrelation.

Figure 20 is posterior predictive model check for the model. The gist of posterior predictive model checking is that at every MCMC iteration a replicate dataset may be simulated based on the current draws for the parameters. If the model fits the data well, then the replicated datasets will resemble the observed data. Here a simple check is performed: a kernel density plot for the observed unit exam scores is displayed alongside kernel densities for the replicates. The replicates appear to follow normal distributions. The observed unit exam scores have a higher mode than any of the replicates and the distribution shows negative skew, owing to students earning test scores near the upper boundary.

## Pearson



Figure 20: Kernal density plot of the overserved unit exam scores along with 500 posterior predictive replicates from Model 1.

Figure 21 provides a check for homoskedasticity of the residuals. An assumption of normal models is that the residuals should be normal and have constant variance. The figure indicates that the residuals have smaller variance where the model predicts for higher unit exam scores.

## Pearson



Figure 21: Plot of residuals against the model predicted unit exam score for Model 1. Each point is the posterior median for a residual. The gray horizontal lines indicate $\pm 1$ standard deviation for the residuals.

Two sensitivity analyses are conducted for the model. First, a more robust likelihood function is used in a model similar to that presented in the report body. For this purpose, the likelihood part of the model is Student's $t$ distributed:

$$
y_{s b} \mid x_{s}, u_{s b} \sim \text { Student } t\left(v, \alpha_{b}+x_{s}^{\prime} \beta^{(x)}+u_{s b} \beta^{\prime} \beta^{(u)}+\zeta_{s}, \sigma_{y}^{2}\right) .
$$

Here $v$ is the degrees of freedom parameter for the Student's $t$ distribution. The prior for $v$ is

$$
\mathrm{v} \sim \operatorname{gamma}(2,0.1) .
$$

## Pearson

The parameter posteriors for this robust model are provided in Table 6. There is little difference in the posterior means or standard deviations for the coefficients compared to those in Table 3, which represents results from the model with a normal likelihood. Given the similarity, this sensitivity analysis does not cast doubt on the model presented in the report body.

Table 6: Posterior means and standard deviations, along with effective numbers of samples and scale reduction statistics, for the performance model adjusted to use a Student's $t$ distribution for the likelihood.

| parameter | mean | sd | $\mathbf{2 . 5 \%}$ | $\mathbf{9 7 . 5 \%}$ | n_eff | Rhat |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| Intercept | 83.03 | 1.25 | 80.62 | 85.44 | 495 | 1.01 |
| ACT | 8.15 | 1.16 | 5.84 | 10.40 | 474 | 1.01 |
| Female | 0.62 | 1.25 | -1.81 | 3.16 | 415 | 1.01 |
| Freshman | 0.24 | 1.24 | -2.19 | 2.55 | 465 | 1.00 |
| Revel quiz score | 1.33 | 0.22 | 0.90 | 1.76 | 1358 | 1.00 |
| Intercept SD | 1.69 | 0.45 | 0.96 | 2.71 | 719 | 1.01 |
| Student SD | 8.69 | 0.45 | 7.86 | 9.59 | 678 | 1.00 |
| Residual SD | 7.91 | 0.33 | 7.27 | 8.51 | 1093 | 1.00 |
| Nu | 16.55 | 8.16 | 7.23 | 36.79 | 1267 | 1.00 |

## Pearson

The second sensitivity analysis involves fitting a fixed effects model instead. Bell, Jones and Fairbrother (2018) discuss the merits of this approach in relation to other modeling strategies for clustered data. Let $y_{s b}^{*}$ and $u_{s b}^{*}$ be (respectively) $y_{s b}$ and $u_{s b}$ group mean centered at the student level. The student-level covariates (ACT score, gender, year at university) are omitted. Then the fixed effects model is as follows.

$$
\begin{aligned}
y_{s b}^{*} \mid u_{s b}^{*} & \sim N\left(\alpha_{b}+u_{s b}^{*}{ }^{\prime} \beta^{(u)}, \sigma_{y}^{2}\right) \\
\alpha_{b} & \sim N\left(0, \sigma_{\alpha}^{2}\right) \\
\beta^{(u)} & \sim N\left(0,20^{2}\right) \\
\sigma_{\alpha} \sim \operatorname{Half} & -\operatorname{Normal}\left(0,50^{2}\right) \\
\sigma_{y} & \sim \operatorname{Uniform}(0, \infty)
\end{aligned}
$$

This type of model isolates the within-student effect of quiz scores, as the centering eliminates the between-student effect. An advantage of this approach is that some assumptions regarding the student-specific effects (that they are normal, distributed and uncorrelated with the covariates) are not required. Table 7 provides a summary of the fitted model. With the fixed effects model, the relationship between quiz scores and exam scores appears weaker, though the evidence still points to a positive relationship. It is likely that fitting a single line rather than the splines partially accounts for the weaker relationship.

Table 7: Posterior means and standard deviations, along with effective numbers of samples and scale reduction statistics, for the fixed effects model.

| parameter | mean | sd | $\mathbf{2 . 5 \%}$ | $\mathbf{9 7 . 5 \%}$ | n_eff | Rhat |
| :--- | :---: | ---: | :---: | :---: | :---: | :---: |
| Quiz score | 0.90 | 0.24 | 0.43 | 1.38 | 3288 | 1.00 |
| Intercept SD | 1.62 | 0.39 | 0.96 | 2.48 | 659 | 1.01 |
| Residual SD | 7.39 | 0.15 | 7.10 | 7.68 | 2833 | 1.00 |

## Pearson

Convergence and fit diagnostics for model with interaction terms


Figure 22:Diagnostics for the performance model for unit exam scores (Model 1). The scale reduction factor should be less than 1.1 for all parameters to infer that the MCMC chains have converged. The effective number of posterior samples is the number of MCMC draws after warmup adjusted for autocorrelation.

## Pearson



Figure 23: Kernal density plot of the overserved unit exam scores along with 500 posterior predictive replicates from Model 1.

## Pearson



Figure 24: Plot of residuals against the model predicted unit exam score for Model 1. Each point is the posterior median for a residual. The gray horizontal lines indicate $\pm 1$ standard deviation for the residuals.

## Usage model

Figure 17 in the previous subsection indicates the relationship between unit exam scores and the control variables. Figure 27 below indicates the relationship between unit exam scores and counts of actions in Revel quizzes.

## Pearson



Figure 25: Unit exam scores plotted against the counts of several types of attempts at Revel quiz items across units. A linear regression line and loess curve are overlaid on each panel.

## Pearson

Figure 26 shows that the Stan model converged and that it returned a reasonable number of effective posterior samples. Figures 27 and 28 provide some checks on the model assumptions, which show results similar to those for the performance model.


Figure 26: Diagnostics for the usage model for unit exam scores (Model 2). The scale reduction factor should be less than 1.1 for all parameters to infer that the MCMC chains have converged. The effective number of posterior samples is the number of MCMC draws after warmup adjusted for autocorrelation.

## Pearson



Figure 27: Kernal density plot of the overserved unit exam scores along with 500 posterior predictive replicates from Model 2.

## Pearson



Figure 28: Plot of residuals against the model predicted unit exam score for Model 2. Each point is the posterior median for a residual. The gray horizontal lines indicate $\pm 1$ standard deviation for the residuals.

The same sensitivity analyses of the performance model are conducted on the usage model. First, a similar model with a Student's $t$ likelihood is fit to determine if results differ much if a more robust likelihood function is used. The parameter posteriors for the robust model are provided in Table 8. There is little difference in the posterior means or standard deviations for the coefficients compared to those in Table 4, which represents results from the model with a normal likelihood. Given the similarity, this sensitivity analysis does not cast doubt on the model presented in the report body.

## Pearson

Table 8: Posterior means and standard deviations, along with effective numbers of samples and scale reduction statistics, for the usage model adjusted to use a Student's $t$ distribution for the likelihood.

| parameter | mean | sd | $\mathbf{2 . 5 \%}$ | $\mathbf{9 7 . 5 \%}$ | n_eff | Rhat |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Intercept | 83.45 | 1.15 | 81.22 | 85.59 | 727 | 1.01 |
| ACT | 7.45 | 1.03 | 5.42 | 9.45 | 688 | 1.01 |
| Female | 0.35 | 1.09 | -1.86 | 2.50 | 796 | 1.00 |
| Freshman | -0.06 | 1.06 | -2.11 | 1.98 | 772 | 1.00 |
| Reading | 2.16 | 0.56 | 1.07 | 3.27 | 1539 | 1.00 |
| Correct first | 1.74 | 0.55 | 0.69 | 2.89 | 1110 | 1.00 |
| Incorrect first | -2.79 | 2.32 | -7.50 | 1.71 | 1245 | 1.00 |
| Correct repeat | 0.20 | 2.63 | -4.88 | 5.35 | 1333 | 1.00 |
| Incorrect repeat | -6.55 | 1.93 | -10.25 | -2.75 | 1839 | 1.00 |
| Intercept SD | 1.73 | 0.49 | 0.89 | 2.86 | 709 | 1.01 |
| Student SD | 7.47 | 0.44 | 6.66 | 8.37 | 645 | 1.01 |
| Residual SD | 7.91 | 0.33 | 7.27 | 8.52 | 1129 | 1.00 |
| Nu | 14.99 | 7.56 | 6.86 | 34.11 | 1043 | 1.00 |

## Pearson

Next, a fixed effects model, as described above for the performance model, is fit as well. The coefficients tend to be smaller for the fixed effects model than for the model presented in the report body, with the exception of the coefficient for number of correct repeat attempts. With the fixed effects model, there is favorable evidence for a positive relationship between hours spent reading and exam scores, and weaker evidence for a positive relationship between correct first attempts and exam scores. The large posterior standard deviations for counts of incorrect first, correct repeat, incorrect repeat attempts are likely a result of there being little within-student variation for these variables; the withinstudent standard deviations for them are 5.1, 4.1, and 3.2, respectively.

Table 9: Posterior means and standard deviations, along with effective numbers of samples and scale reduction statistics, for the fixed effects model.

| parameter | mean | sd | $\mathbf{2 . 5 \%}$ | $\mathbf{9 7 . 5 \%}$ | n_eff $^{\text {Rhat }}$ |  |
| :--- | :---: | ---: | :---: | :---: | :---: | :---: |
| Reading | 1.62 | 0.59 | 0.46 | 2.73 | 2154 | 1.00 |
| Correct first | 0.97 | 0.57 | -0.09 | 2.10 | 947 | 1.01 |
| Incorrect first | -2.54 | 2.36 | -7.08 | 1.92 | 1483 | 1.00 |
| Correct repeat | 1.69 | 2.64 | -3.58 | 6.76 | 1575 | 1.00 |
| Incorrect repeat | -1.17 | 1.83 | -4.66 | 2.54 | 2330 | 1.00 |
| Intercept SD | 1.63 | 0.40 | 0.95 | 2.49 | 430 | 1.00 |
| Residual SD | 7.37 | 0.15 | 7.07 | 7.67 | 2625 | 1.00 |

## Revel quiz score model

The final model is the model where the outcome measure is Revel quiz score. Figure 29 shows that the Stan model converged and that it returned a reasonable number of effective posterior samples.

## Pearson



Figure 29: Diagnostics for the model for Revel quiz scores (Model 3). The scale reduction factor should be less than 1.1 for all parameters to infer that the MCMC chains have converged. The effective number of posterior samples is the number of MCMC draws after warmup adjusted for autocorrelation.

Figure 20 provides the same posterior predictive model check as for the other models. Here, the observed quiz scores differ sharply from the replicates. The issue appears to be that the observed quiz scores tend to be very near the upper boundary and have a long left tail, which differ greatly from approximately normally-distributed replicates.

## Pearson



Figure 30: Kernal density plot of the overserved Revel quiz scores along with 500 posterior predictive replicates from Model 3.

Figure 31 depicts the residuals in relation to model predictions for quiz scores. The assumption of homoskedasticity is clearly violated, as the residuals have lower variance where the predicted scores are high. The residuals also appear to have strong negative skew.

## Pearson



Figure 31: Plot of residuals against the model predicted Revel quiz scores for Model 3. Each point is the posterior median for a residual. The gray horizontal lines indicate $\pm 1$ standard deviation for the residuals.

## Pearson

## Appendix D. Alignment between learner outcomes and research questions

Table 10 provides the alignment between learner outcomes and research questions. These are further linked to the measures and findings associated with each.

Table 10: Alignment between learner outcomes and research questions.

| Learner outcome <br> category | Learner outcome | Research <br> question | Measures | Findings |
| :--- | :--- | :--- | :--- | :--- |
| experience and | Revel users are <br> getting good value <br> for money | What are students' <br> perceptions and <br> experiences with <br> using Revel? | Survey questions <br> on willingness to <br> recommend | When asked how <br> likely they were to <br> recommend Revel <br> to another student <br> on a scale of 0 (not <br> at all likely) to 10 <br> (extremely likely), <br> $41 \%$ of students <br> provided a rating of <br> 9 or 10, with <br> another 43\% of <br> students providing <br> a rating of 7 or 8. |
|  |  |  |  |  |
|  |  |  |  | Revel's net promoter |
| score, which is an |  |  |  |  |
| index of customer |  |  |  |  |
| experience that |  |  |  |  |
| captures the |  |  |  |  |
| likelihood a student |  |  |  |  |
| would recommend |  |  |  |  |
| Revel to a friend, |  |  |  |  |
| was 27. |  |  |  |  |

## Pearson

$\left.\begin{array}{|l|l|l|l|l|}\hline & & & & \text { books or products. } \\ \text { Access and } \\ \text { experience }\end{array} \quad \begin{array}{l}\text { Learners have a } \\ \text { positive learning } \\ \text { experience }\end{array} \quad \begin{array}{l}\text { What are students' } \\ \text { perceptions and } \\ \text { experiences with } \\ \text { using Revel? }\end{array} \quad \begin{array}{l}\text { Survey question on } \\ \text { perceptions of } \\ \text { Revel efficiency }\end{array}, \begin{array}{l}\text { 92\% of students } \\ \text { said Revel was a } \\ \text { more efficient way } \\ \text { to study compared } \\ \text { to other books or } \\ \text { products. }\end{array}\right]$

## Pearson

$\left.\begin{array}{|l|l|l|l|}\hline & & \begin{array}{l}\text { Revel and exam } \\ \text { scores? }\end{array} & \begin{array}{l}\text { Psychology 1st } \\ \text { edition by Marin } \\ \text { and Hock quizzes } \\ \text { were associated } \\ \text { with an increase of } \\ 1.36 \text { ( } \pm 0.41)\end{array} \\ \text { percentage point } \\ \text { on unit exams. } \\ \text { These results are } \\ \text { based on a } \\ \text { regression model } \\ \text { controlling for self- } \\ \text { reported ACT } \\ \text { score, gender, and } \\ \text { year in college, and } \\ \text { the study was } \\ \text { conducted with 316 } \\ \text { students in the Fall } \\ 2017 \text { and Spring } \\ 2018 \text { semesters at } \\ \text { the University of } \\ \text { Nebraska, Lincoln. }\end{array}\right]$

## Pearson

## Appendix E. Student survey

## Revel Questions

Q1. How likely are you to recommend Revel to another student?

| Not at all <br> Likely |  |  |  |  |  |  |  |  |  | Extremely <br> Likely |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Please tell us the main reasons for your rating

Q2. Which of the following did you use to access Revel for your course this semester? (please select the best option)

| ○ | Computer |
| :---: | :--- |
| ○ | Mobile App (phone/tablet) |
| ○ | Mobile App \& Computer |
| ○ | Neither Mobile <br> App nor Computer |

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Q3. How often did you access Revel from either the mobile app or computer? (please select the best option)

| $O$ | Daily |
| :---: | :--- |
| $\bigcirc$ | Several times a week |
| $\bigcirc$ | Once a week |
| $\bigcirc$ | Every couple of weeks |
| $\bigcirc$ | Once a month |
| $\bigcirc$ | Once or twice this term |
| $\bigcirc$ | Never |

Q4.

|  | Yes | No |
| :--- | :--- | :---: |
| Did you feel Revel was a more efficient way to study <br> compared to other books or products for other courses? | $\bigcirc$ | $\bigcirc$ |
| Did you spend more time using Revel, compared to other <br> books or products for other courses? | O | O |

Q5. How can Revel be better or more helpful? $\qquad$

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## Appendix F. Course syllabus

PSYC 181 Sect 900-903: On line Introduction to PsychologyFall, 2016

## SYLLABUS

In this syllabus area, you will find the following information separated by these headings:

1. Background Information: This section details the name of the course, the name of your instructor, the purpose of your TAs and how to contact each of us.
2. Textbook Information
3. Course Goals and Objectives: This section details what we all will work together to accomplish. My hope for you is that when you successfully complete the course, you'll be comfortable enough with the topics explored in Psychology that you'll easily transition to higher level courses within this discipline and in other social sciences and research method courses.
4. Course requirements: this section summarizes the different methods of evaluation and the total number of points offered in the course.
5. ACE requirements.

Note: Our Weekly Schedule is Located in your "Weekly Schedule" Link within Blackboard

## Pearson

## Section 1: Background Information

Instructor: Dr. Manda Williamson

Phone: (c) $x x x-x x x-x x x x$
email: xxxxxx@unl.edu

Office: xxx Burnett Hours: MWF 10:30-12:15pm

Psychology Department Office: 238 Burnett;
Study lounge/Tutoring Center for YOU!!! Burnett 125
Teaching assistants:
There are a boatload of teaching assistants who have specifically requested to work with our on line section. They want to be sure you all succeed and have devoted up to 9 hours of their week to help you! Please take advantage of the expertise they offer, not only in Intro to Psych, but in how to study effectively and test effectively.

Your TAs are available in our study center, located in 125 Burnett Hall. The schedule for hours of operation for the study center is posted below. The TA's can provide you with a discussion on general concepts and to help clarify terms or review missed responses on quizzes or exams. If you feel you need additional support in studying for this course you can request tutoring services from TA's where they can assist you in reviewing each chapter. Don't forget to utilize the TA's as a study resource. TA's can answer questions for you over blackboard in your "Group" link that is close to the bottom left side of blackboard. I will be able to show you better in the course orientation that will be posted by next Thursday in your UNIT ONE>WEEK 1 Folder.

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HOURS OF OPERATION: NOTE EVENING HOURS ON WEDNESDAYS; WEEKEND HOURS ON SUNDAY

| MONDAY | TUESDAY | WEDNESDAY | THRUSDAY | FRIDAY | SUNDAY |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 8AM- | 10AM-6PM | 8AM-12PM; | 10AM: 1PM; | 10AM-1PM; | 1PM-5PM |
| 11:30AM; |  | 1PM-6PM; | 1:30PM-6PM | 2PM-5PM |  |
| 6PM |  | 7PM-9PM |  |  |  |

## Pearson

## 2. Textbook Information

REVEL for Psychology -- Access Card: A slip of paper with the info you need to purchase REVEL (this is your textbook and is an e-text) is in the bookstore. Once you purchase the access number (on the slip of paper in the bookstore), you will set up your account in REVEL. Once you're in the on line REVEL environment, you will be asked if you'd like to also purchase an OPTIONAL looseleaf hard copy of the text as well
(I believe it's less than \$20). I have a hard copy and I use it sometimes to orient myself to the material...because I am old and still like to "hold" a book.

Amy J. Marin, Phoenix College<br>Roger R. Hock, Mendocino College

ISBN-10: 0205920012
ISBN-13: 9780205920013
Publisher: Pearson
Copyright: 2016

## 3. Course Goals and Objectives

Description of Course
This course provides an overview of most of the major areas in the field of psychology. The overall goal of this course is to depict how scientific questions within these areas have been formulated, researched, and challenged. Topics will include the steps involved in conducting scientific research, the biological bases of behavior, sensation \& perception, learning, memory, thinking, language, motivation and emotion, stress and health, psychological disorders and social influences on behavior.

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## Course Objectives

By the end of this course you should be able to -define psychology and explain what makes it a science -identify and understand seven underlying themes of psychology -appreciate the history and development of psychology as a science -describe and use the method of critical thinking to evaluate claims -describe at least three methods of psychological research and the strengths and weaknesses of each -recognize and explain key theories and research findings related to the biological bases of behavior, sensation and perception, consciousness, learning, memory, language, thought, motivation and emotion
-recognize and explain the application of psychological research in the areas of personality development, stress and health, psychological disorders and behavior in social settings

## 4. Course requirements:

## Sources of Evaluation

## A. Exams

Our exams are exclusively on-line. Therefore, because you have many days over which to complete your exams, there will be NO MAKE-UPS! Missed, unexcused exams count as a zero.

There will be five (5) exams total: 4 regular unit exams and 1 final exam Each unit test (exams 1-4) will be worth 75 points. The final exam is worth 125 points. All exam will consist entirely of multiple choice questions. Unit exams will cover two to three (or so) chapters, depending on the unit. The final exam will be held during the final exam week and is cumulative. The final will consist of multiple-choice questions only. It will also be completed online. The final exam may only be taken once.

## Instructions for Taking On Line Exams:

Each of your 5 exams (including final's week exam) will be completed in "Digital Learning Commons" (DLC) via computer. Locations to take the exam are in the Digital Learning Commons at Library. See the information located in the Exams link to the left in your navigation panel > Proctored Exams
Procedures. You will need to follow the instructions noted in that Proctored Exams Procedures link before the exam is made available for you to take. See Page ONE for your specific instructions.

These are timed exams, so work at a relatively quick pace (don't spend more than a minute on each question or you won't finish). You will have 75 minutes to answer 75 multiple choice questions. Your individual exam will be created randomly from a pool of about 350 questions; therefore, each exam will test the same content, but will have different orderings and selections of questions. You may take the exams from Units 1-4 TWICE...so please be sure you are ready. (A good rule of thumb is to be certain you have completed and studied your study guide and scored at least an $80 \%$ on your practice quiz and you know where in your book or notes you need to look to find the answers to questions you missed). The final exam can only be taken once.

You will receive a score (out of 75 ) as soon as you complete the exam. You will also receive performance feedback, but you will not receive that information until the test deadline has expired. Hours of operation for the DLC testing location are listed in the Proctored Exams Procedures link: (get there at least 1 hour and 20 minutes before closing so that you have the full amount of time to complete the exam)
B. Research component (120 points)

To help students learn about psychological research you will be required to engage in some research activities during the semester. You may sign up to participate in studies being run in the UNL Department of Psychology and/or read about similar research that has been conducted in the department in the past. It is anticipated that most students will do a combination of research participation and article reports to meet the research component but you may earn all the points with participation or with reports. One way to learn about psychology is to take part in research. In doing so, you help researchers from the department gather new information about human behavior. You also learn about the research process from the "inside"; studies conducted within our department always have a "debriefing" component so you can learn about the study's purposes and goals. All research projects are reviewed by the University's Institutional Review Board to ensure that your rights are safeguarded. However, if you feel that you have been mistreated as a research participant, please let me know. There is no requirement that you participate in research. You may choose to do only article reports without any penalty.

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If you want to participate in research, follow these guidelines:

- Sign up for research. Information about signing up for research will be presented in during the first week of the semester. Sign-up occurs via a website. When you sign up for an appointment on the web, you will receive a reminder e-mail. However, you should be sure that you note all of the pertinent information (date, time, place, and name/number of investigator) in your calendar when you sign up. You must keep track of your own appointments. You will also need this information if you have to cancel participation.
- Make sure to attend the session. I will receive a list of students who failed to show for research appointments. If you cannot attend a research appointment, you must contact the study director (name and number will be listed on the web page) or the research coordinator BEFORE the scheduled session. When you call to cancel, leave your name, student ID, and the name/day/time of the study you were signed up for. Missing appointments is a very serious matter.
- Fill out and keep the blue research receipts you receive from the researcher until you have received your course grade in case there are any questions about your research participation. Some online studies do not provide blue research receipts so be sure to note the name of the study, researcher's name, and date and time of your participation.
- Spread out research participation across the semester. The number of available studies varies across the semester. Do not try to do all 12 credits after Spring Break as it is unlikely there will be sufficient slots. Also be aware that the subject pool usually closes a week before the end of the semester so plan to complete your research participation by the end of the $14^{\text {th }}$ week. The last day is $12 / 07$.
- You may do no more than 6 credits of online research. Some of the studies you will find on SONA are online studies and some require you to go to a research laboratory. Per departmental policy, no more than half of your research credits may be from online studies. These are clearly indicated when you sign up. Doing both online and laboratory studies provides you with a broad array of experience.
- Do not sign up for the same study twice -- you will not receive credit the second time you participate!
- Credit. Each research credit requires $1 / 2$ hour of your time. Many studies will be worth multiple credits. You will receive 10 points for every credit out of the 120 points needed for the research component.

For specific information on participating in research studies, please look at "RESEARCH REQUIREMENT INFO" at the left.

If you want to read about research, follow these guidelines.

- Read articles. There will be journal articles (scientific reports of research) posted in your "Research Requirement Info" tab located on the left side of the blackboard screen. Announcements will be made on Blackboard when these are available. These are studies that were conducted by UNL faculty and are similar to studies in which you might participate. A variety of articles and topics are available. Reading the articles allows you to see research from the perspective of a psychologist because you are reading the same articles that psychologists use to communicate their work to each other. Choose any article and read it. There will be parts that are difficult to understand but try to get the main points as discussed in recitation early in the semester. Each article is accompanied by a series of questions. Follow the instructions with the questions and prepare a brief report on what you read. Turn the report using the assignment link. This assignment link will be in your "Research Requirement Info" area as well. Please also keep a copy of your paper for yourself. Be sure that each report represents your own work, even if you discuss the articles with a classmate. The last day to turn in reports to meet the research component is $12 / 07$
- Grading and Credit. Each article report will be graded on a pass/fail basis. The report must clearly indicate that you have read the article yourself, that you have a reasonable understanding of it and the writing is sufficiently clear to communicate the information. Your recitation instructor will return the reports with a pass/fail grade. Only passing reports will count towards the research component. Failed reports can be redone and resubmitted as long as the final deadline has not passed. Each passing article report counts as four research credits or 40 points out of the 120 needed for the research component. (there are 3 papers in total that you can read)


## C. REVEL Participation

You all have a copy of the electronic text. Within that website appear "end of section" and "end of chapter quizzes". These are designed to fulfill TWO PURPOSES:

1. They will expose you to the kinds of questions you will see on your exam.
2. They are offered as a means to earn points relatively easy: you may take each quiz three times to master the material and you'll earn points for the successful completion of the quizzes. For those of you who really struggle with nerves and with trying to determine how best to prepare for exams, these quizzes offer you the means through which to achieve and to build your confidence.

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Additionally, if you average an $80 \%$ or above, you will be able to drop your lowest UNIT TEST score (out of units 1-4) and replace it with your highest unit test score (from units 1-4). YOU CANNOT DROP YOUR FINAL EXAM.

NOTE: When you complete reading and quizzes within REVEL, you will notice that many of the sections have point totals associated with them. In all, there are 1100 TOTAL POSSIBLE REVEL PARTICIPATION POINTS that you can earn. These make up the participation point requirements that are part of your overall course grade. There are 100 participation points that you can easily earn by completing your REVEL assignments on time. To earn the maximum points (100), you must average an $80 \%$ or higher on your REVEL assignments. That means that if you have earned at least 884 points in REVEL, you will earn 100 participation points. Below is a table detailing a hypothetical point total earned by a student in REVEL and his/her corresponding participation grade.

| REVEL POINT TOTAL | REVEL AVERAGE | PARTICPATION POINTS EARNED |
| :--- | :--- | :--- |
| $880-1100$ | $80 \%-100 \%$ | 100 |
| $770-879$ | $70 \%-79 \%$ | 90 |
| $660-769$ | $60 \%-69 \%$ | 80 |
| $550-659$ | $50 \%-59 \%$ | 70 |
| $440-549$ | $40 \%-49 \%$ | 60 |
| $330-430$ | $30 \%-39 \%$ | 50 |
| Less than 330 | $0-29 \%$ | 0 |

## Pearson

## D. Small Group Activities

In order to reinforce your engagement with the material in a timely fashion, after some of the narrated lectures within your lesson folders, extra credit opportunities will be proved. These assignments are challenge assignments that will enable you to more deeply apply and master concepts we cover during the week. To assist your completion, you will notice that you have been assigned to a small group discussion. Together, you and your 4 colleagues can work together to provide a written essay response to the challenge. Attempts will earn between 3 and 4 points, provided they are written with sound grammar and correct spelling. If your group is correct, you all will earn 5 extra credit points.

## Grading Scale

| Percent | Grade | Percent | Grade |
| :--- | :--- | :--- | :--- |
| $97.0+$ | A+ | $77-79$ | C+ |
| $90-96$ | A | $70-76$ | C |
| $87-89$ | B+ | $67-69$ | D+ |
| $80-86$ | B | $61-66$ | D |

## PERFORMANCE SUMMARY

|  | Possible Points | Earned <br> Points |
| :--- | :--- | :--- |
| Exam \#1 | Exam \#2 | 75 |
| Exam \#3 | 75 |  |
| Exam \#4 | 75 |  |
| REVEL Participation | $100(15.5 \%$ of course grade) |  |
| Final Exam (unit 5 material, cumulative | 125 |  |
| portion) |  |  |
| Research Component (12 research credits <br> or 6 articles or a combination) | 120 |  |

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## Materials on Blackboard:

Blackboard will be used for posting grades and PowerPoint lecture slides and narrated lessons. Please note that the slides on Blackboard will be incomplete. You will need to watch the narrated presentations that accompany the slides to fill in the details.

## Academic Dishonesty

Any student caught cheating (or knowingly helping another student to cheat) will receive a course grade of F and will be reported to The Office of Judicial Affairs for disciplinary action. If you do not know what exactly constitutes cheating, see me as soon as possible. You should also consult the university policy on Academic Integrity (see student handbook).

## Accommodation for individuals with disabilities

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

## Section 5: ACE Requirements

## ACE Information: Learning Outcome

PSYC 181 has been approved for Learning Outcome \#6 ("Use knowledge, theories, methods, and historical perspectives to the social sciences to understand and evaluate human behavior.") Reinforcements

This class will reinforce Critical thinking, primarily by focusing on the use of evidence and hypothesis testing in science. Since everyone is familiar with human behavior, we tend to think of ourselves as "experts." This approach is based on anecdotes, but science proceeds by systematically collecting and analyzing data. We need to understand how we acquire and analyze our information and become proficient at distinguishing between hypotheses and evidence.

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## Opportunities for Learning the Outcome

- Psychology 181 consists of 26 lectures and 15 weekly recitation sections designed to address the knowledge, methods and history of the discipline of psychology. For example, in the years before the emergence of psychology as a science, mental illness was thought to be the result of demonic possession. Now, because of scientific research, we know that mental illnesses are due to chemical and anatomical disorders of the brain, and that these disorders are more likely to occur in individuals possessing certain genes, or in individuals who are subjected to highlystressful environmental conditions.
- There are five unit exams of 75 questions each and a cumulative final exam of about 50 questions. All the questions are multiple choice. A large majority of the questions are designed to measure your comprehension of the knowledge, methods, and history of psychology at high cognitive levels. That is, many questions require you to use information to reach a conclusion about the phenomenon or to evaluate the reasonableness of a claim. Relatively few questions are concerned with vocabulary or basic information alone.


## How your achievement of the outcome will be assessed

## Exams

Descriptive statistics will be kept on each of the examination questions that pertain to the knowledge, methods and history of psychology. Please note that since exams are multiple-choice, this mode of summarizing the data constitute a $100 \%$ sample of all student work. These statistics will be provided to the Psychology Department's Undergraduate Issues Committee (UIC), which will analyze and archive them so that changes in students' achievement of the SLO 6 elements can be evaluated over time. The methods to be used by the UIC have not been worked out as yet; however, their findings will be reported to instructors so that they can revise their teaching methods to improve student performance.

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## Weekly Schedule

Before skipping down and looking at the actual schedule, be advised:
The lessons, as they are listed in Blackboard, each have their own folders. The folders have SUGGESTED due dates listed under them and you can see them before you click on them to open them. I want to clarify what that word "Suggested" means though:
"Suggested" means you can work AS FAR AHEAD of these dates as you'd like. "Suggested" does NOT MEAN YOU CAN COMPLETE ASSIGNMENTS AFTER THE DATE!!! I made a rather detailed schedule for you to follow with two goals in mind for you:
a. To enable you to spend the least amount of time per day on the class as possible, and
b. to ensure that you spent that time wisely, from a biological standpoint: that is, one that will give your brain the maximum chance of learning as much of the material as possible without experiencing overload.
2. If you choose to complete the lessons AFTER the suggested dates listed in Blackboard, then you will be BEHIND-in that you will need to spend one day working on Psychology far longer than I would prefer. If you do fall behind, the amount of time it will take you to catch up will cause your other classes to suffer, and you likely will not learn this material efficiently enough to perform well on exams. Additionally, there are reading quiz dates that are NOT flexible. That means you must keep up with the material in a timely fashion to complete your reading quizzes before the due date passes. So-work ahead or use this suggested schedule to properly pace yourself and DO NOT FALL BEHIND.
3. The QUIZ dates in REVEL refer to THE LAST POSSIBLE DAY YOU CAN COMPLETE QUIZZES TO STILL RECEIVE CREDIT FOR THEM. These dates are later than the lesson due dates. For example, in blackboard (please get into this section in Blackboard right now to see what I mean OR JUST LOOK AT THE SCHEDULE LISTED BELOW!), I ask that you complete section 1.2a and 1.2c during week 2, by Monday, August, 29. The due date for this section and for this quiz as it's listed in REVEL (look at Revel NOW!) is Sept 6. That means you can choose to read early and take the quiz ANY time during the dates of (and including) August $29^{\text {th }}$ and Sept 6. At the end of most chapters there is also a Chapter Quiz that will display questions you are likely to encounter on your Unit Exams...so please keep up with the deadlines.

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| WEEK | DATE | DATE | DATE | QUIZ DEADLINE | UNIT EXAM OPENS |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 8/22 | 8/24 | 8/26 |  |  |
| LESSONS |  |  | $\begin{aligned} & \hline 1.1 \mathrm{~A}, \\ & 1.2 \mathrm{~A} \end{aligned}$ |  |  |
| 2 | 8/29 | 8/31 | 9/2 |  |  |
| LESSONS | 1.2A | 1.1B | 1.3A |  |  |
|  | 1.2C | 1.1C | 1.3 B |  |  |
|  |  | 1.2B |  |  |  |
|  |  | 1.3A |  |  |  |
| 3 | 9/5 | 9/7 | 9/9 |  |  |
| LESSONS | NO CLASS | 9.1A | 9.3C | CHAPTER 1 QUIZ IS DUE |  |
|  | 9/6 (Tuesday) | 9.1C | 9.3 B | ON TUES, 9/6; CHAPTER |  |
|  | 1.3B | 9.3 B | 9.4C | 9 QUIZ IS DUE ON SUN, |  |
|  | 1.4 | 9.3C | 9.4B | 9/11 |  |
|  |  |  | GROUP REFLECTION PAPER DUE |  |  |
|  |  |  | TODAY, 5PM |  |  |
| 4 | 9/12 | 9/14 | 9/16 |  |  |
| LESSONS | 10.1A | 10.2C | 10.3A | CHAPTER 10 Quiz Due | 9/20: UNIT ONE |
|  | 10.2A |  | 10.3B | on 9/18 | EXAM OPEN: |
|  |  |  | 10.4A | END OF UNIT ONE |  |
|  |  |  | GROUP REFLECTION PAPER DUE |  |  |
|  |  |  | TODAY, 5PM | Specific Dates the exam is |  |
|  |  |  |  | open on campus in |  |
|  |  |  |  | DLC:Tues-Thurs (20-22); |  |
|  |  |  |  | Sun-Tues (25-27) |  |
| 5 | 9/19 | 9/21 | 9/23 |  |  |
| LESSONS | 2.2A | 2.2B | 2.3B | CHAPTER 2 Quiz Due on | . |
|  |  | 2.3A | 2.3C | 9/25 |  |
|  |  | 2.3 B | 2.3D |  |  |
|  |  |  |  | EXAM ONE |  |
|  |  |  |  | CLOSES the 27th |  |
| 6 | 9/26 | 9/28 | 9/30 |  |  |
| LESSONS | 4.1A | 3.1A | 3.1A | CHAPTER 4 QUIZ DUE |  |
|  |  | 3.1B | 3.1B | ON 10/2 |  |
|  | 4.2B |  |  |  |  |
|  | 4.2D |  |  |  |  |
|  | 4.3B |  |  |  |  |
|  | 4.7 |  |  |  |  |
|  | Note: Exam 1 |  |  |  |  |
|  | Closes <br> tomorrow <br> (tues) |  |  |  |  |
| 7 | 10/3 | 10/5 | 10/7 |  |  |
| LESSONS | 3.2A | 3.3B | MONA LISA CHALLENGE | CHAPTER 3 QUIZ DUE | 10/7: UNIT TWO |
|  | 3.2B | 3.3 C | ASSIGNMENT DUE TODAY | ON 10/9 | EXAM OPEN |
|  |  | 3.4 |  | END OF UNIT TWO |  |
|  |  |  |  | Exam 2 is open at DLC from Fri 10/7-Fri 10/14 |  |
| 8 | 10/10 | 10/12 | 10/14 |  |  |
| LESSONS | 5.1A | 5.2B | FREE DAY |  |  |
|  | 5.2A | 5.2C | Note: Exam two closes today |  |  |

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| 9 | $10 / 17$ | $10 / 19$ | $10 / 21$ |  |
| :--- | :--- | :--- | :--- | :--- |
| LESSONS | FALL BREAK | 5.3 A | 5.3 B | CHAPTER 5 QUIZ DUE |
|  |  | 5.3 B | 5.3 D | ON $10 / 23$ |


| 10 | 10/24 | 10/26 | 10/28 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| LESSONS | 6.1A | 6.1C | 6.3A | CHAPTER 6 QUIZ DUE | 10/28: UNIT THREE <br> EXAM OPEN |
|  | 6.1B | 6.2A | 6.3 B | ON 10/30 |  |
|  | 6.1C | 6.1D |  | END OF UNIT 3 |  |
|  | 6.4 B |  |  |  |  |
|  |  |  |  | Exam is open at DLC from |  |
|  |  |  |  | Fri (10/28)-Fri (11/4) |  |
| 11 | 10/31 | 11/2 | 11/4 |  |  |
| LESSONS | 7.3A | 7.3C | 7.3D | CHAPTER 7 QUIZ DUE |  |
|  | 8.4A |  | Exam Three Closes Today | ON 11/6 |  |
| 12 | 11/7 | 11/9 | 11/11 |  |  |
| LESSONS | 8.1A | 8.3A | 8.4A | CHAPTER 8 QUIZ DUE | UNIT FOUR EXAM |
|  | 8.1B | 8.3B | 8.4B | ON 11/13 | OPEN 11/13 |
|  | 8.1C | 8.3C | 8.4C | END OF UNIT FOUR |  |
|  |  |  |  | Exam is open at DLC from Sun (11/13)-Fri (11/18) and again from Sun (11/20)-Mon (11/21) |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 13 | 11/14 | 11/16 | 11/18 |  |  |
| LESSONS | 7.1C | 11.1A | FREE DAY | CHAPTER 11 QUIZ DUE ON 11/20 |  |
|  | 7.3D | $\begin{aligned} & 11.1 \mathrm{~B} \\ & 11.1 \mathrm{C} \end{aligned}$ |  |  |  |
|  |  |  |  |  |  |
| 14 | 11/21 | 11/23 | 11/25 |  |  |
| LESSONS | PLEASE | TAKE | THIS | WEEK TO CATCH UP ON YOUR STUDIES |  |
|  | Exam 4 Closes |  |  |  |  |
|  | Today |  |  |  |  |
| 15 | 11/28 | 11/30 | 12/2 |  |  |
| LESSONS | 15.1A | 13.4C | FREE DAY | CHAPTER 14 QUIZ DUE |  |
|  | 14.1A | 14.3 B | CLINICAL CASE STUDY WRITE-UPDUE TODAY | ON 12/4 |  |
|  | 14.1B | 14.3C |  |  |  |
|  | 14.1C | 14.3A |  |  |  |
|  | 14.1D | 14.2C |  |  |  |
|  | 14.1E |  |  |  |  |
|  | 14.4D |  |  |  |  |

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| LESSONS | 15.1A | 15.2A | LAST DAY TO COMPLETE SONA | CHAPTER 15 QUIZ DUE |
| :---: | :---: | :---: | :---: | :---: |
|  | 15.1B | 15.2B | REQUIREMENTS; | ON 12/11 |
|  | 15.3A |  | RESEARCH SUMMARIES/CRITIQUES |  |
|  | 15.3B |  | DUE |  |
|  | 15.3C |  |  |  |
|  | 15.3D |  |  |  |
|  | 15.4C |  |  |  |
|  | Final Exam |  |  |  |
|  | Opens |  |  |  |
|  | Tomorrow |  |  |  |
|  | (Tues) |  |  |  |
| 17 |  |  |  |  |
|  | PLEASE | TAKE | YOUR | FINAL BY FRIDAY, 12/16 |
|  |  |  |  | DLC Exam is open from |
|  |  |  |  | Final Exam is open |
|  |  |  |  | fromFri 12/9-Sun 12/11; |
|  |  |  |  | Tues 12/13-Fri 12/16 |


[^0]:    1. For example: on average, students score $88 \%$ on Revel quizzes, and this result suggests that a hypothetical student with equivalent characteristics who scored $98 \%$ on quizzes might be expected to score 1.36 percentage points higher on a unit exam. (These examples are for illustrative purposes only and are not subject to independent audit.)
