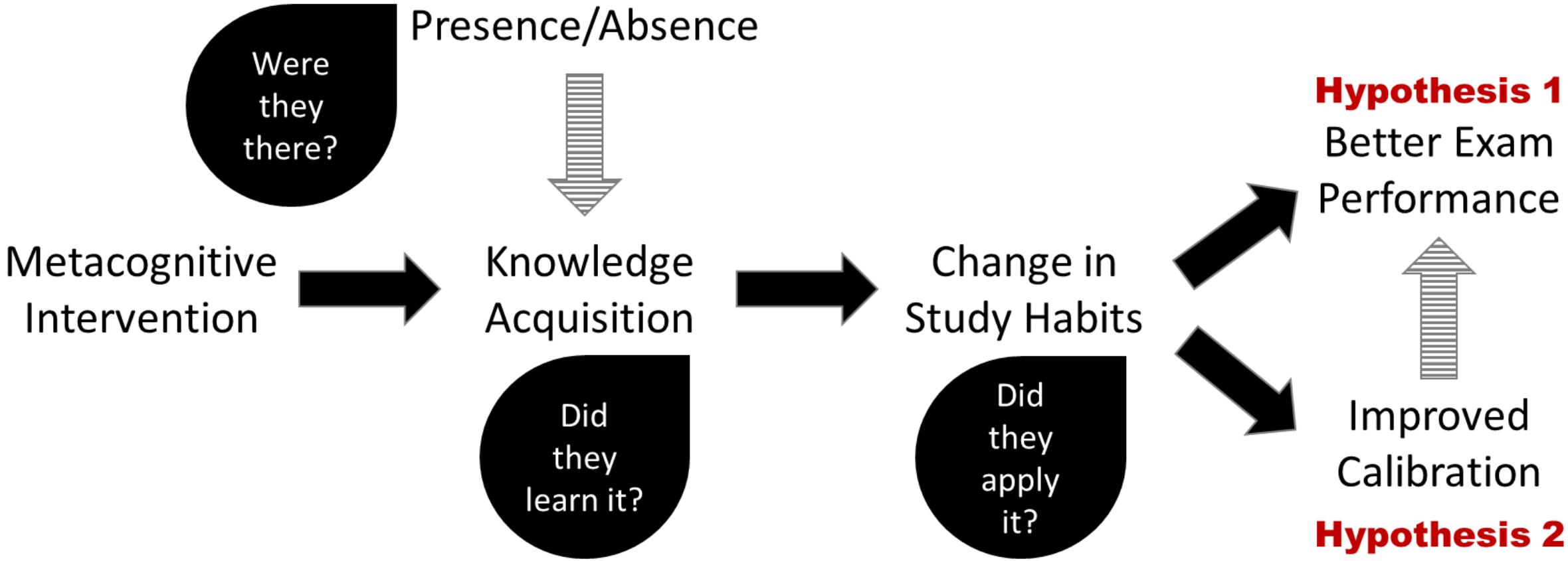
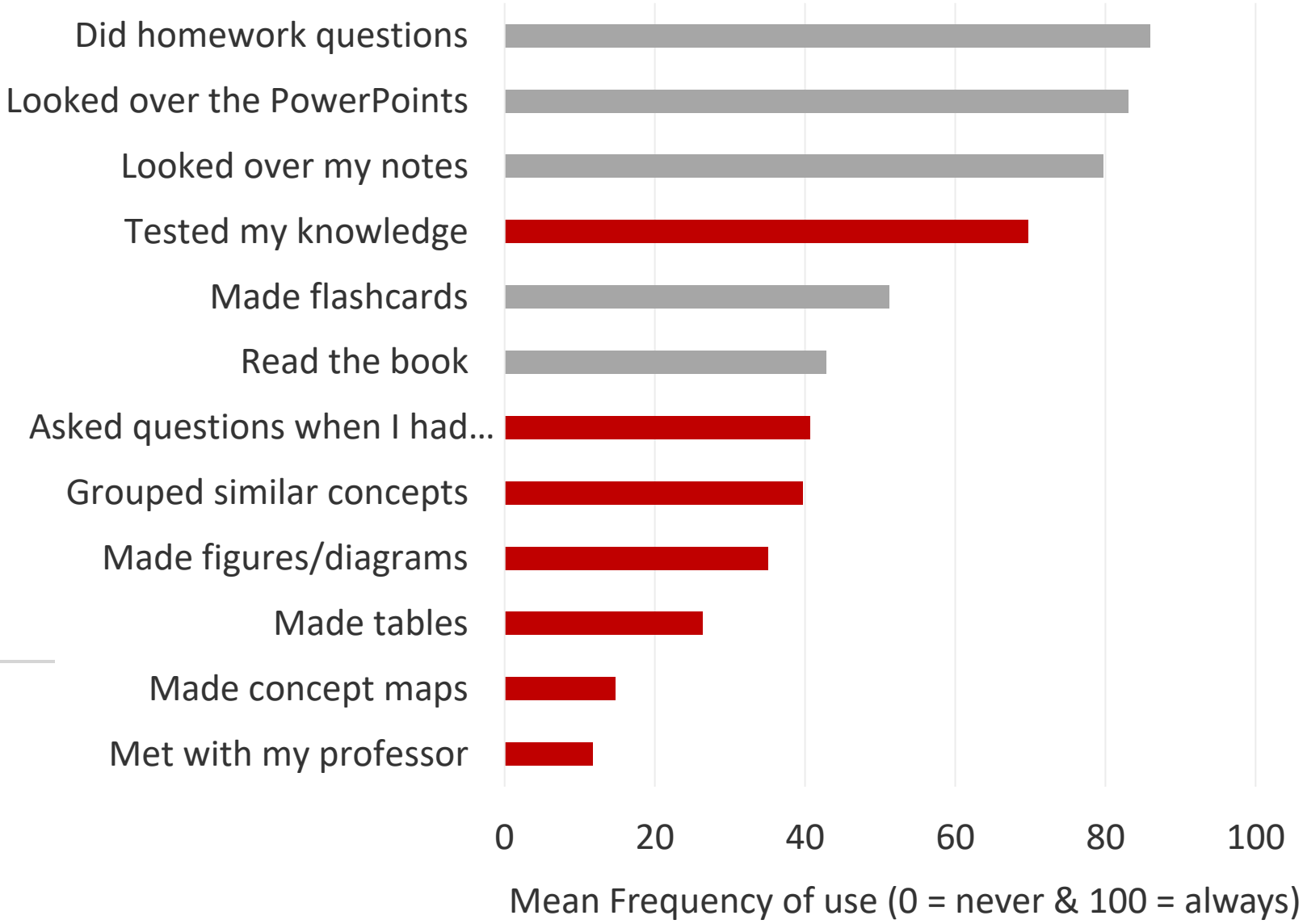
Proposed Research Model



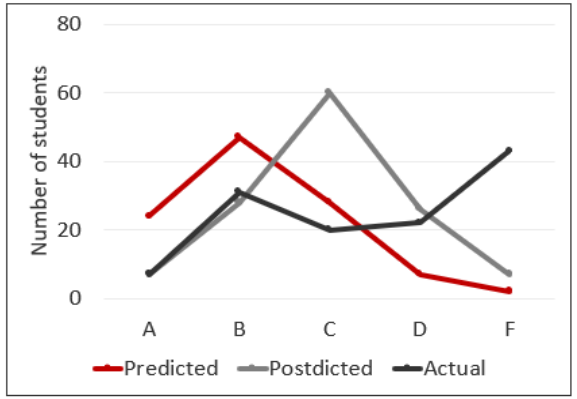
Evidence of need

Commonly used study strategies from 270 students surveyed before intervention. Red bars are metacognitive strategies.



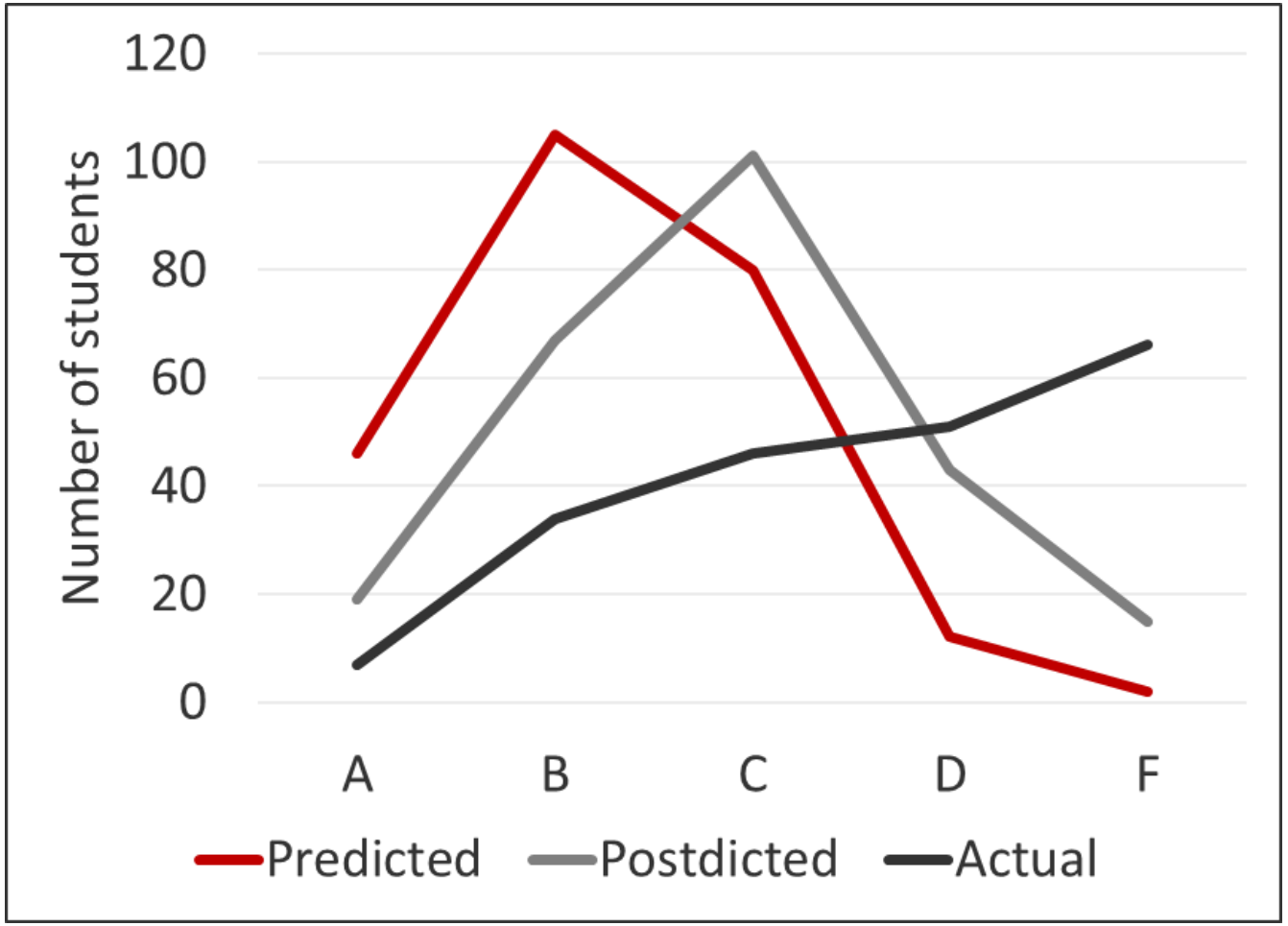
Students who know different kinds of strategies for learning, thinking, and problem solving are more likely to use them

(Pintrich, 2002)



Evidence of need

165 BIOL 131 students' predictions vs. actual grades on Exam 1. BIOL 120 graph was similar.



BIOL 131. Letter grades in rank-order of greatest disparity where under predictions are (-) and over predictions are (+): Bs (+71) > Fs (-64) > As (+39) = Ds (-39) > Cs (34).

People tend to be blissfully unaware of their incompetence

(Dunning et al., 2003)

Hypothesis 1: Metacognitive interventions can improve students' performance.

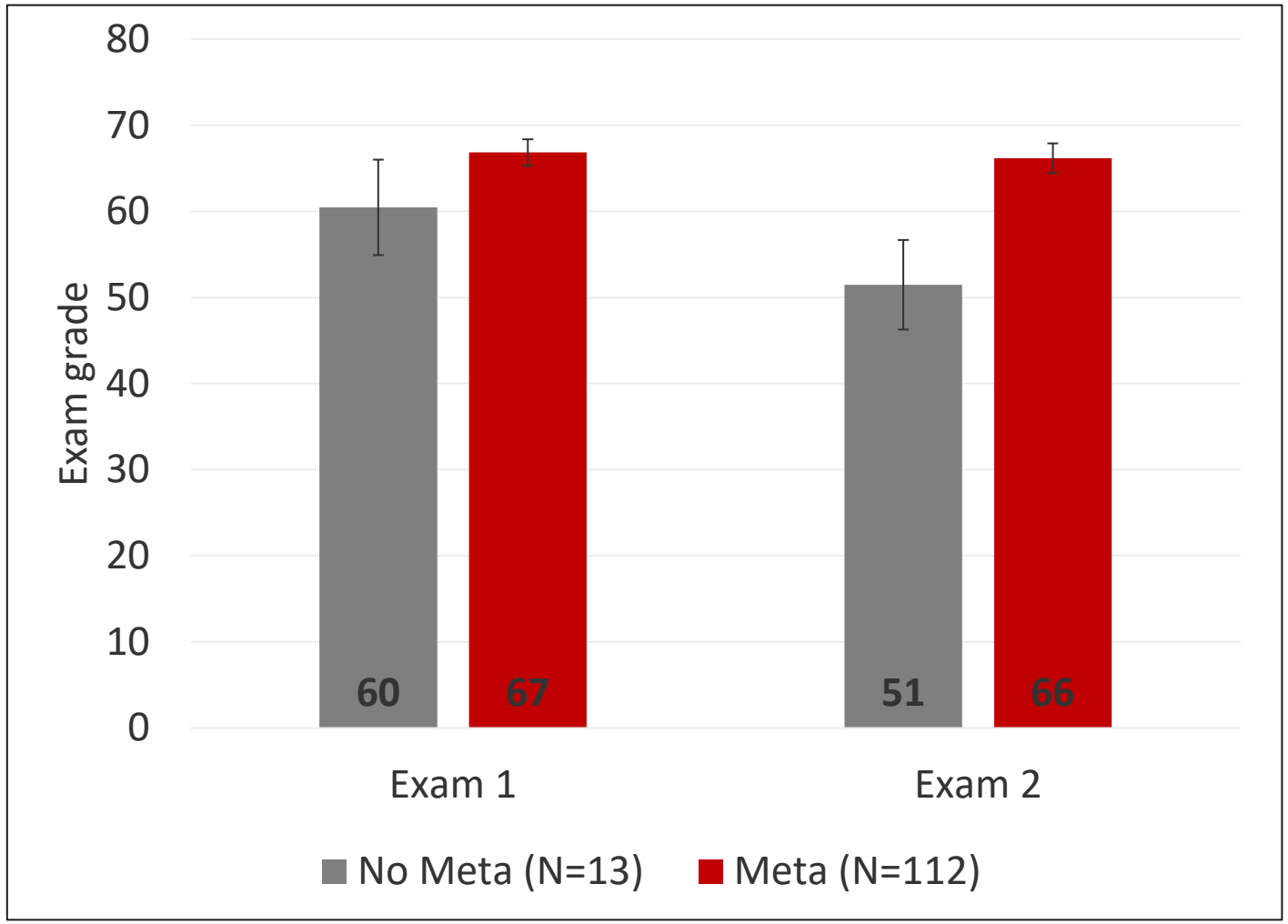
- Were they there? The exam 2 grades, following the intervention, will be better for individuals present (Meta) vs. those absent (No Meta).
- Did they learn it? The exam 2 grades, following the intervention, will be better for individuals who learned more from the intervention (i.e, had better post-lecture quiz) vs. those who did not.
- Did they apply it? The exam 2 grades, following the intervention, will be better for individuals who changed their study habits (via self-report) vs. those who did not.

Hypothesis 2: Metacognitive interventions can improve students' calibration.

- Were they there? Calibration for exam 2 following the intervention, will be better for individuals present (Meta) vs. those absent (No Meta).
- Did they learn it? Calibration for exam 2 following the intervention, will be better for individuals who learned more from the intervention (i.e, had better post-lecture quiz) vs. those who did not.
- Did they apply it? Calibration for exam 2 following the intervention, will be better for individuals who changed their study habits (via self-report) vs. those who did not.

Hypothesis 1. Metacognitive interventions can improve students' performance: Were they there?

Exam 2 grades, following the intervention, will be better for individuals present ("Meta") vs. those absent ("No Meta").



BIOL 120. Figure depicts exam means for each group and standard error.

Exam 2 grade comparison: Exam 2 scores are significantly higher for the Meta group ($p<0.01$, $t=2.6863$, $df=123$).

- No Meta = 51%
- Meta = 66%

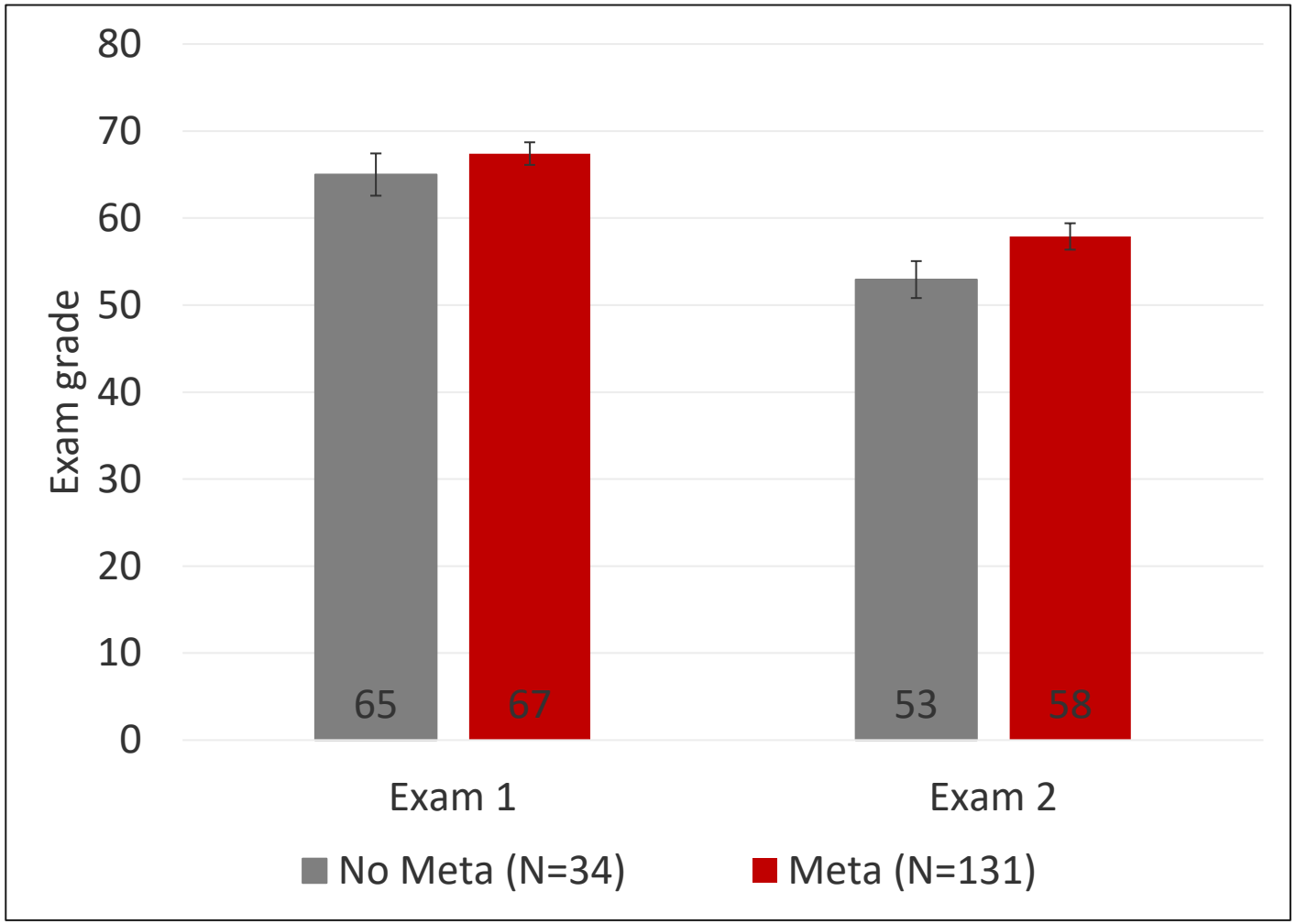
Difference between exam 1 and exam 2 comparison: Both groups' grades went down exam 2, but the meta groups' grades went down significantly less ($p<0.01$, $t=2.6633$, $df=123$).

- No meta = decreased 9 points
- Meta = decreased 1 point
- Better controls for student "type"

Analysis completed only with students took exam 1 and exam 2 as scheduled.

Hypothesis 1. Metacognitive interventions can improve students' performance: Were they there?

Exam 2 grades, following the intervention, will be better for individuals present ("Meta") vs. those absent ("No Meta").



BIOL 131. Figure depicts exam means for each group and standard error.

Exam 2 grade comparison: Showed a similar trend, but Exam 2 scores are not significantly different.

- No Meta = 53%
- Meta = 58%

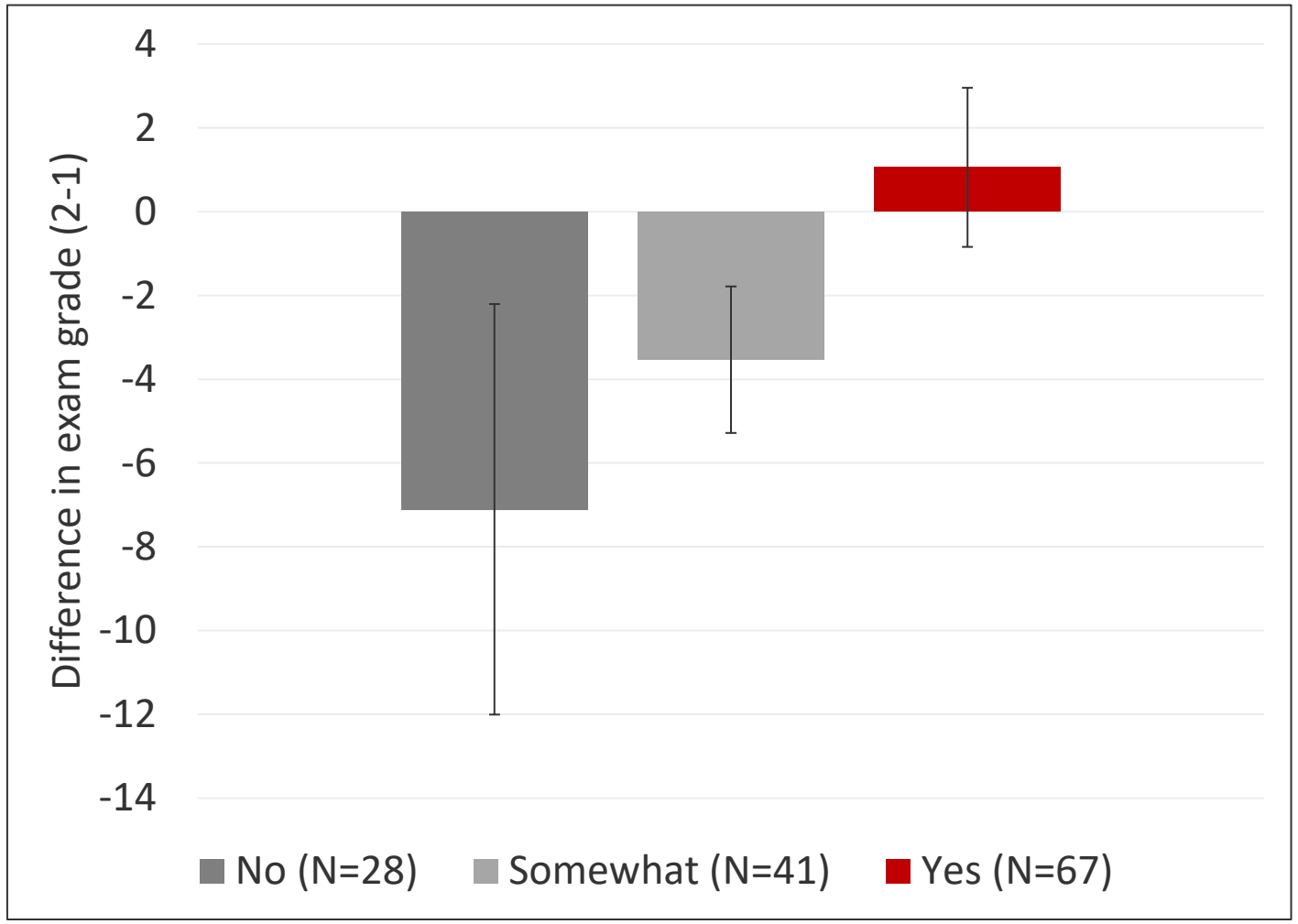
Difference between exam 1 and exam 2 comparison: Again, similar trend but the change from exam 1 to exam 2 is not significant.

- No meta = decreased 12 points
- Meta = decreased 9 points
- Better controls for student "type"

Analysis completed only with students took exam 1 and exam 2 as scheduled.

Hypothesis 1. Metacognitive interventions can improve students' performance: Did they apply it?

Exam 2 grades, following the intervention, will be better for individuals who changed their study habits ("Yes") vs. those who did somewhat ("Somewhat") or did not ("No"), via self-report.



BIOL 120. Figure depicts change in exam scores (from Exam 1 to Exam 2) among the three groups with standard error.

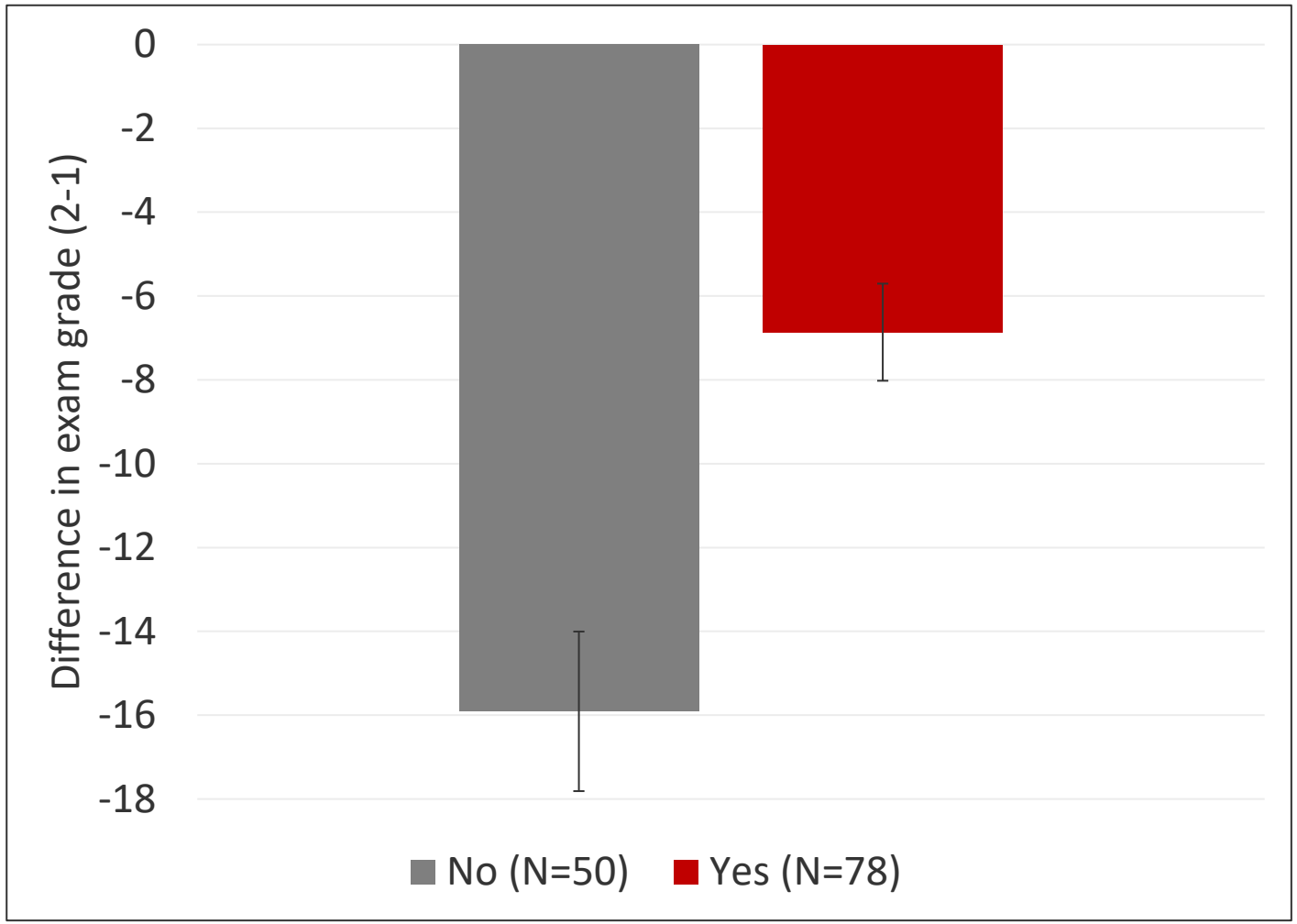
There was a significant effect of changed study habits on the difference between exam 1 and exam 2 grades across the groups($F=3.89655$, $p<0.02$).

Students reporting "Yes" regarding changed study habits did significantly better than those reporting "No" ($Q=4.09$, $p<0.05$).

Analysis completed with students took exam 1 and exam 2 as scheduled via Blackboard. IT issues this week in lecture hall.

Hypothesis 1. Metacognitive interventions can improve students' performance: Did they apply it?

The exam 2 grades, following the intervention, will be better for individuals who changed their study habits ("Yes") vs. those who did not ("No"), via self-report.



BIOL 131. Figure depicts change in exam scores (from Exam 1 to Exam 2) among two groups with standard error.

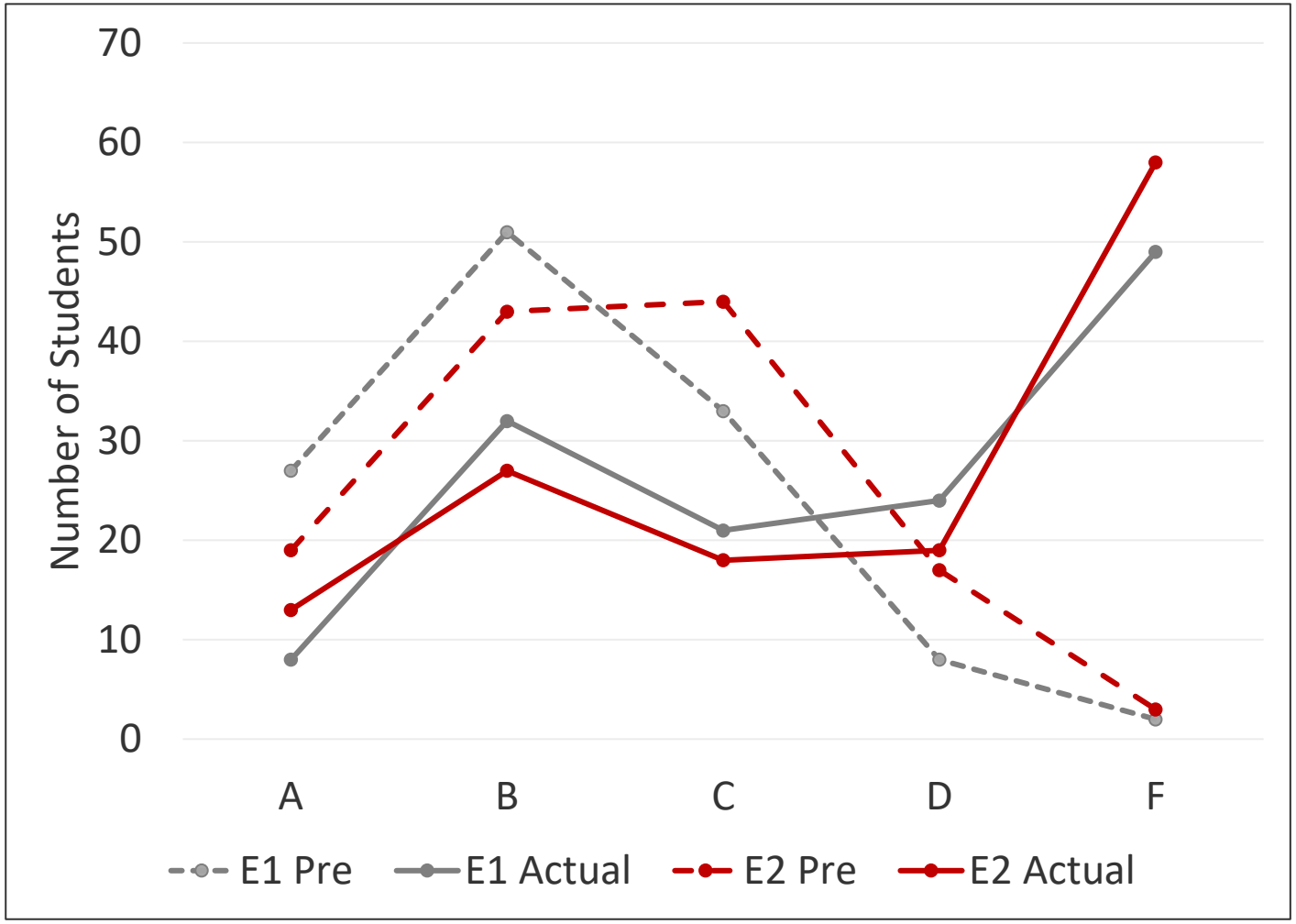
There was insufficient sample size for the "somewhat" group to be included (N=3) so an ANOVA was not possible.

Students reporting "Yes" regarding changed study habits did significantly better than those reporting "No" ($t = 2.1693$, $df = 160$, $p<0.015$).

Analysis completed with students took exam 1 and exam 2 as scheduled via Blackboard. IT issues this week in lecture hall.

Hypothesis 2. Metacognitive interventions can improve students' calibration.

No evidence that being present for the intervention, nor using the new study strategies had an any impact on calibration in BIOL 120 or BIOL 131 ("Pre" = predicted grade & "Actual" = grade)



BIOL 120. Figure depicts grade distribution between predicted letter grade (dashed) and actual grade (solid) on exam 1 (E1) and exam 2 (E2).

From exam 1 to exam 2 predictions shifted from mostly Bs to mostly Cs.

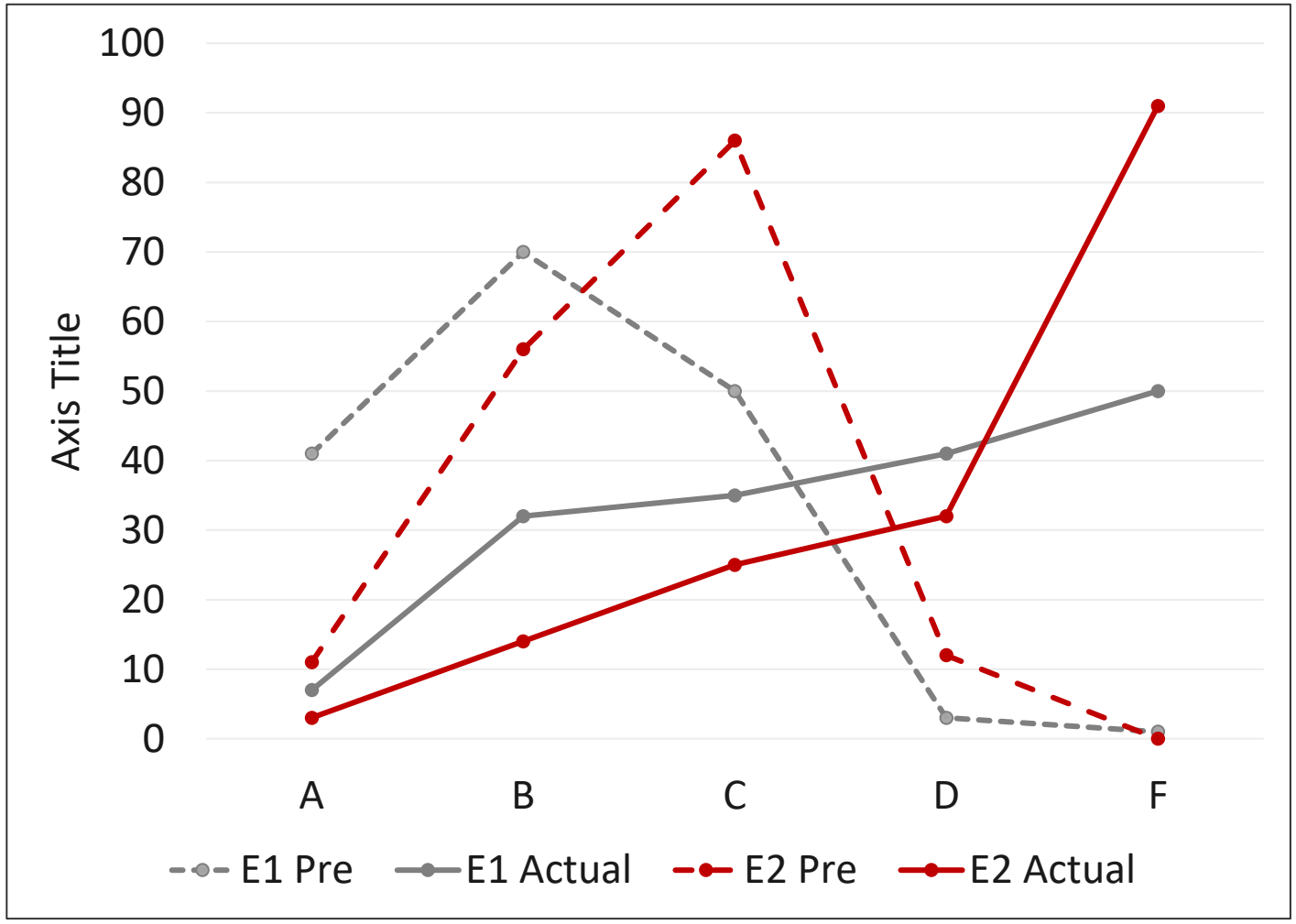
On both exams the greatest disparity was in predicted failing grades.

Only 3 students predicted a failing grade on exam 2.

Analysis completed with students took exam 1 and exam 2 as scheduled via Blackboard. IT issues this week in lecture hall.

Hypothesis 2. Metacognitive interventions can improve students' calibration.

No evidence that being present for the intervention, nor using the new study strategies had an any impact on calibration in BIOL 120 or BIOL 131 ("Pre" = predicted grade & "Actual" = grade)



BIOL 131. Figure depicts grade distribution between predicted letter grade (dashed) and actual grade (solid) on exam 1 (E1) and exam 2 (E2).

Similarly, from exam 1 to exam 2 (E2 in red), predictions shifted from mostly Bs to mostly Cs.

On both exams the greatest disparity was in predicted failing grades.

No one predicted a failing grade on exam 2.

Analysis completed with students took exam 1 and exam 2 as scheduled via Blackboard. IT issues this week in lecture hall.

Examples of Student Feedback

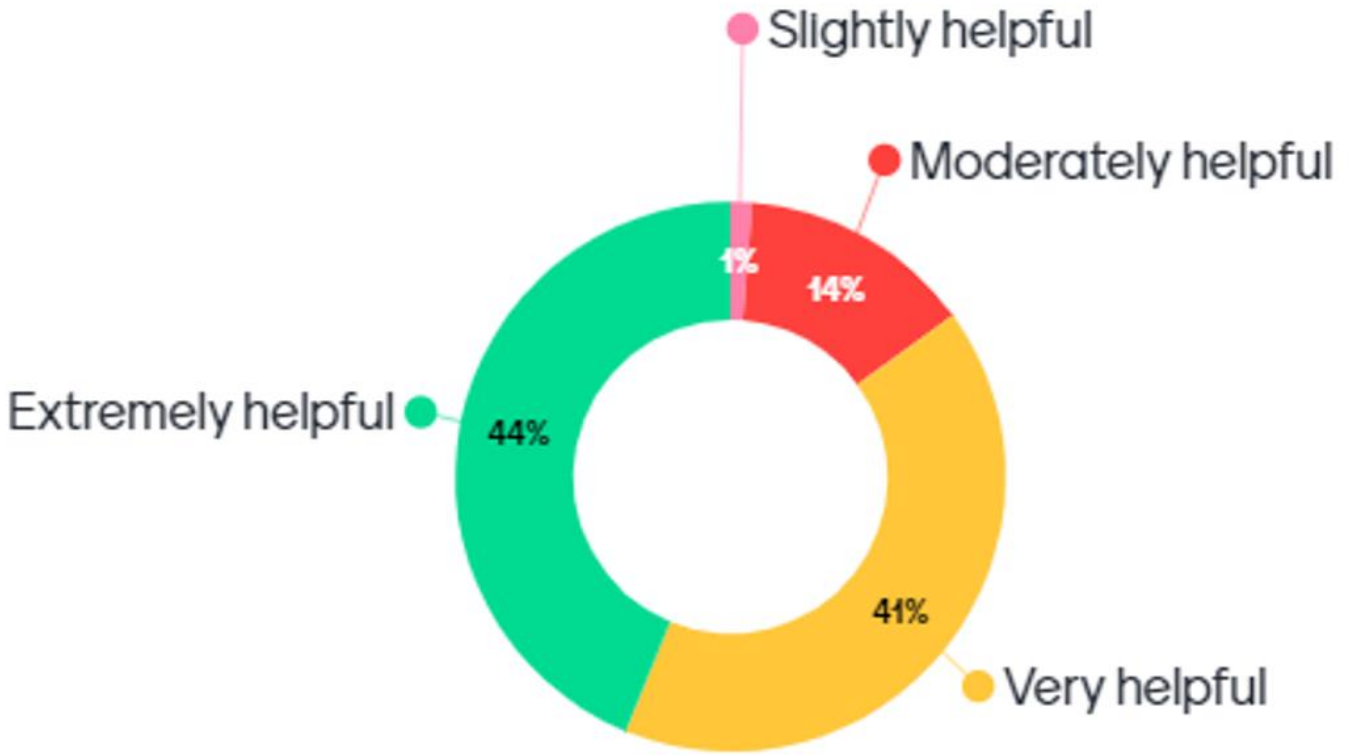
Good afternoon Dr. McDaniel, first and foremost I did not say this after class on Tuesday but thank you. Thank you so much for the studying tips, I personally really needed that for this class, and not just this class but my other classes as well. I really appreciate how you took a whole day of lecture for teaching us a very valuable skill, so from my dearest sincere, thank you.

Doctor Mountjoy,

I meant to talk to you after class on Monday but it slipped my mind. I wanted to say thank you for taking the time to present to us Metacognition, it truly could not have come at a better time for me. The previous night I was seriously debating dropping out of the Honors College and your presentation was very helpful to me. I hope that

When asked if the intervention was helpful

85% said it was very or extremely helpful



Preliminary Conclusions & Considerations

We found some preliminary evidence that the intervention did significantly improve student performance.

Sample sizes for those absent and those not applying any new study strategies are low, but still showed significance.

Confirmation bias: Students have a positive bias towards reporting a change or increase in study habitats.

Future Directions (Spring 22)

We will repeat the same procedure in S22 working with a research student to organize and analyze the data further.

We will include analysis using the metacognition quiz grades to determine if “learning it” increased performance or calibration.

We will explore the longevity of any effects using exam 3 and exam 4 performance and calibration.

Use stratified random sampling to assign study groups. Create a treatment group with metacognitive study activities and a control group with “typical” study-time. Control for GPA, First-Gen, Pell-Eligible, etc. Measure performance across the semester. Conduct qualitative and quantitate interviews with students.

Ideal Controlled Study

Would Require External Funding