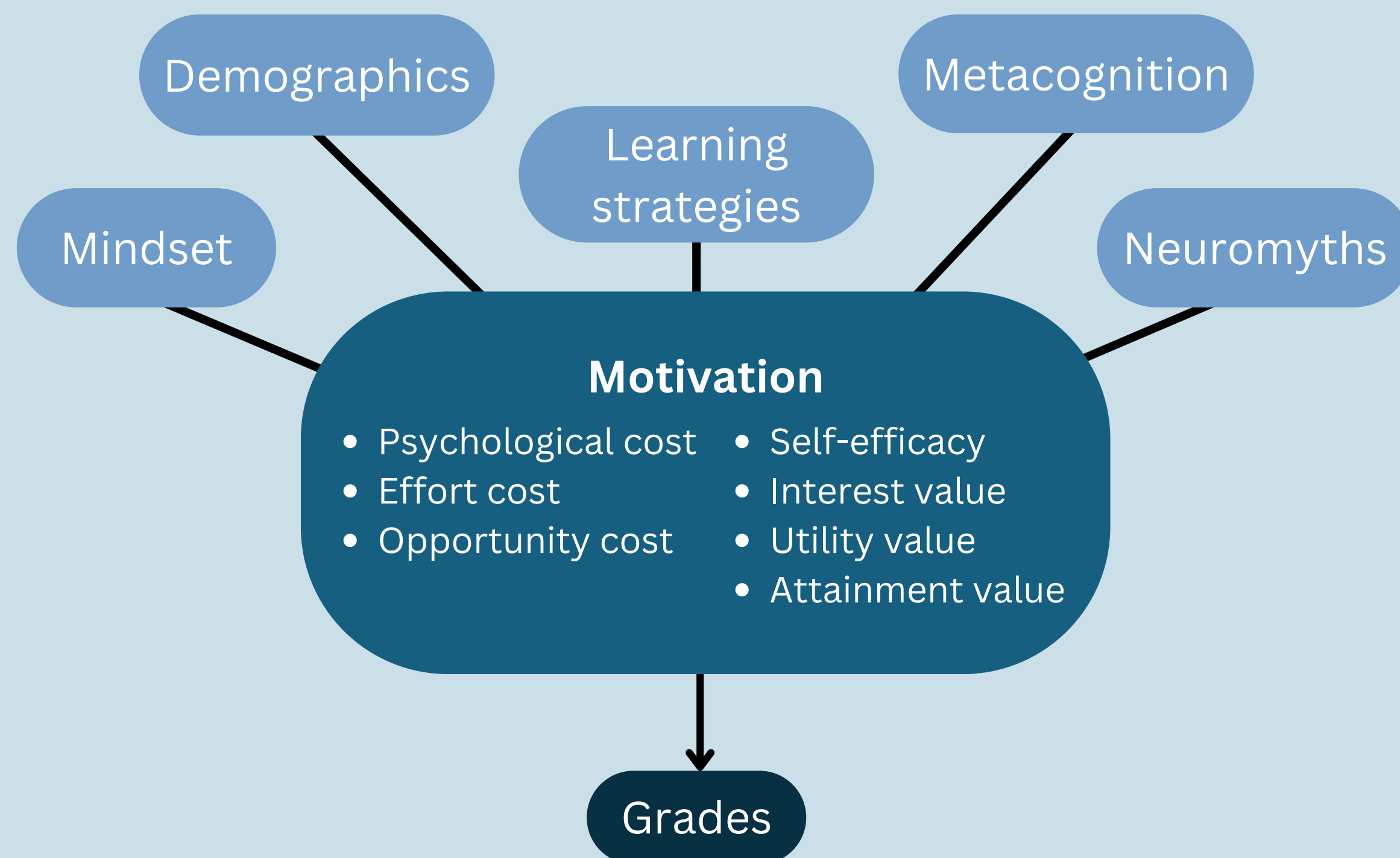




Introduction

- According to expectancy-value theory, motivation can be described in terms of the cost and value of a task.
- Other factors that contribute to learning can interact with motivation to influence academic performance.



Research questions

1. How does motivation change throughout the semester?
2. Can we predict student's grades based on motivation and its interactions with other factors?

Methods

Participants

- ~300 undergraduates in PSYC100, Fall 2023
- SciLearn program

Surveys

- Questionnaires about motivation, study habits, metacognitive awareness, etc.
- Two timepoints: week 5 (pre) & week 13 (post)

Machine Learning Model

- Linear Regression model
- Features selected according to correlation with grades and model performance

Results

Model	Features									Mean Absolute Error			
	Brain Quiz	Mindset	MCAI KC	Opportunity Cost	Effort Cost	Combined Cost	Expectancy	Atomic 1	Atomic 2	Run 1	Run 2	Run 3	Cross-validation
1	✓	✓	✓	✓	✓		✓	✓		0.0946	0.0632	0.0659	0.0834
2	✓	✓	✓	✓	✓		✓		✓	0.0949	0.0625	0.0649	0.0831
3	✓	✓		✓	✓		✓		✓	0.0950	0.0639	0.0656	0.0832
4	✓	✓	✓			✓	✓		✓	0.0948	0.0627	0.0646	0.0830
5	✓	✓				✓	✓		✓	0.0951	0.0637	0.0654	0.0831
6	✓					✓	✓			0.0973	0.0674	0.0686	0.0843
7	✓	✓	✓						✓	0.0924	0.0679	0.0708	0.0852
Correlation with grades	0.27	0.14	0.1	-0.28	-0.32	-0.31	0.23	0.16	0.2				

Figure 1: Features and mean absolute errors of each linear regression model & correlations between features and grades

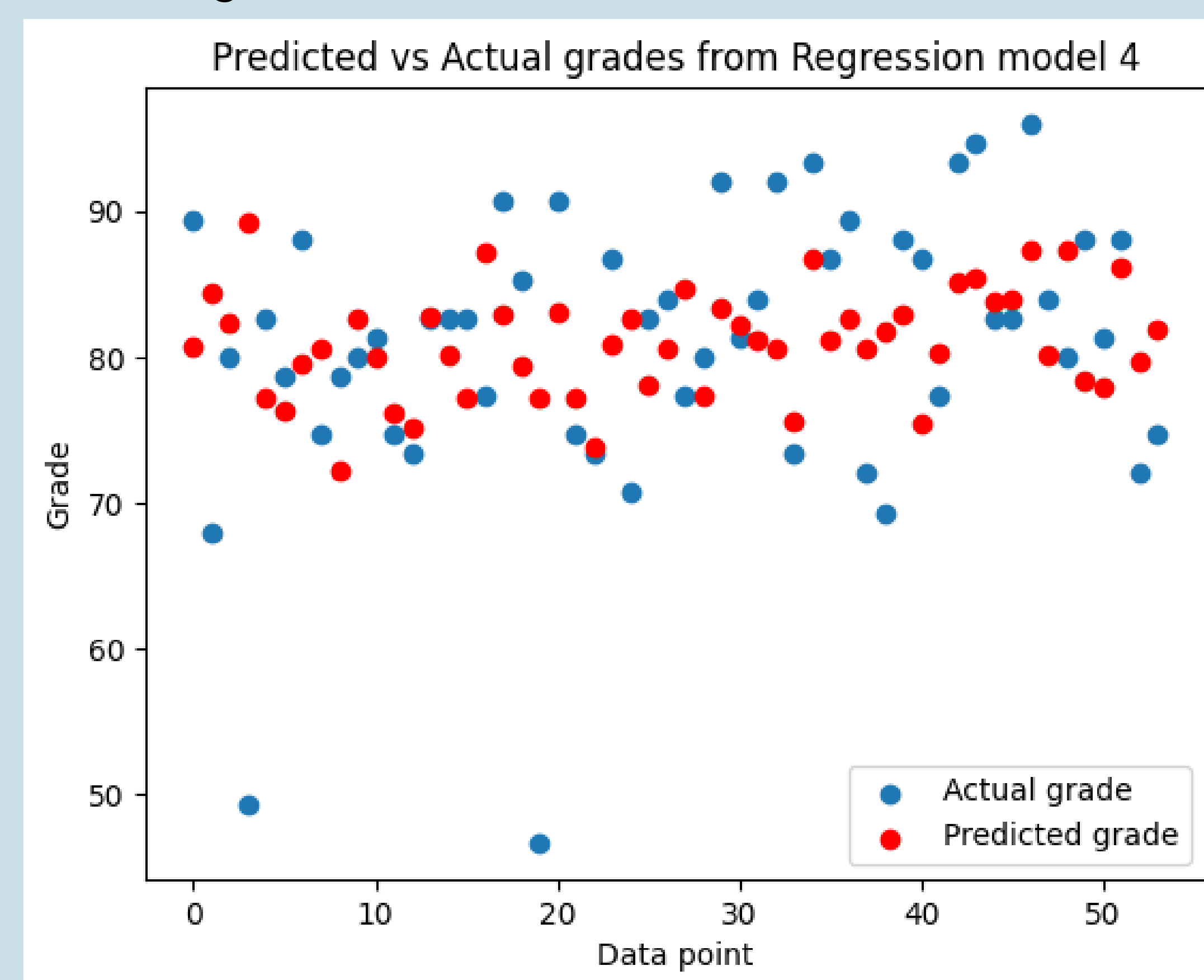


Figure 2: Comparison of the predicted grades from the testing set for model 4 on run 2 and actual student grades

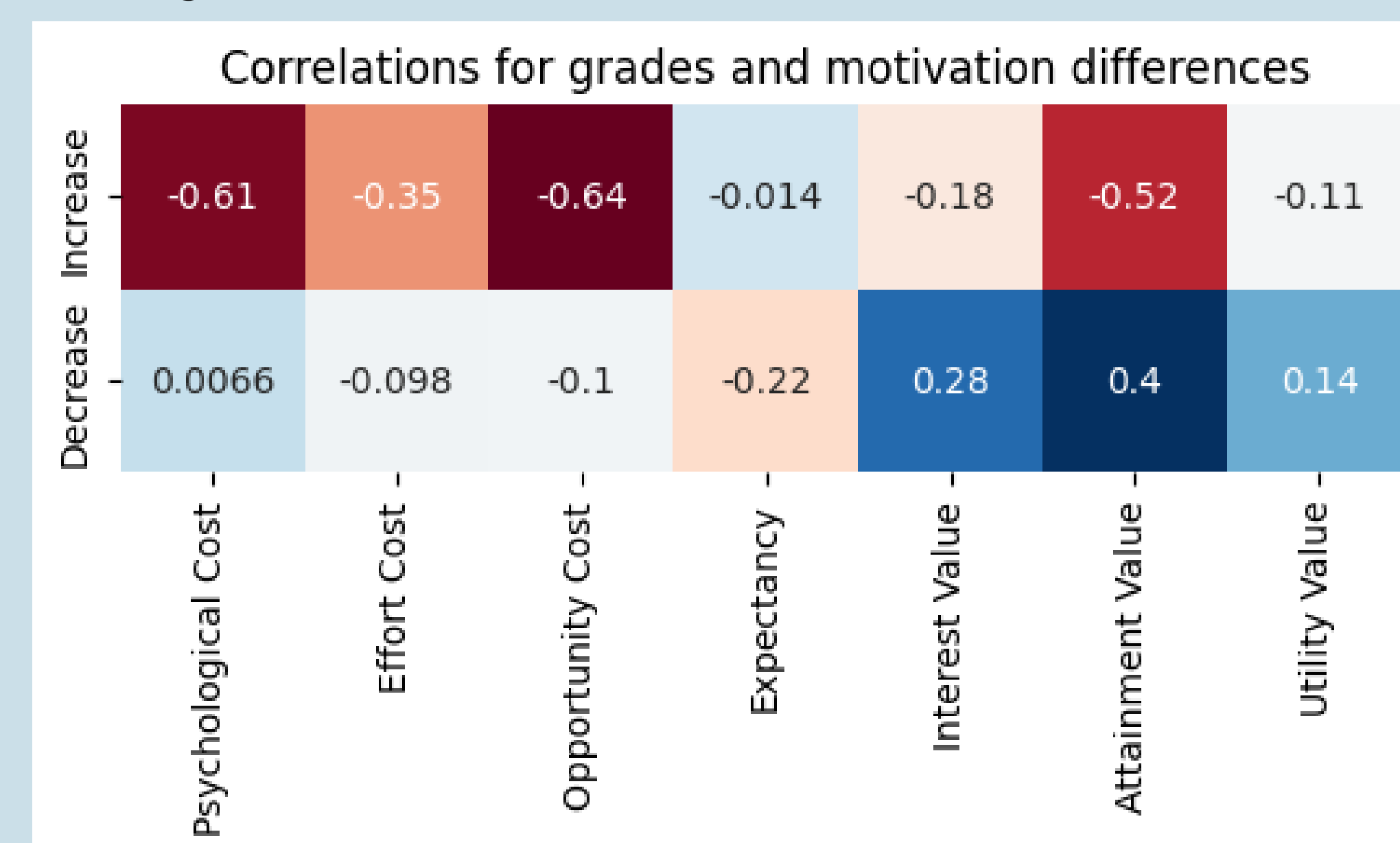


Figure 3: Correlations between grades and amount of change in motivation constructs for students who increased and decreased over time

Discussion

Machine Learning Model

- Model 4 had the best overall performance
 - Includes brain quiz, mindset, knowledge of metacognition, average opportunity and effort cost, expectancy, number of atomic habits (from micro-tasking, teaching others, and retrieval practice)
- Predicts grades up to ~8% error on average.
 - Performs best in B+ to A range

Limitations

- Overrepresentation of high grades
- Small sample size + missing data

Motivation differences

- As the amount of costs increases over time, grades decrease
- Grades are lower for students whose expectancy decreases
- Large increases and large decreases in interest, attainment, and utility value correlate with lower grades

Conclusions

- Motivation can change throughout a term, and this amount of changes relates to grades
- Students' view on the cost of success can influence grades

Future Work

- Comparison with MATH students
- Testing different models, such as polynomial regression
- Developing strategies to prevent increase in costs and decrease in expectancy when learning

References

Lee, S. Y., Friedman, S., Christiaans, E., & Robinson, K. A. (2022). Valuable but costly? University students' expectancy-value-cost profiles in introductory chemistry courses, *Contemporary Educational Psychology*, 69, <https://doi.org/10.1016/j.cedpsych.2022.102056>.

Katiyar, N., Yazdani, A., Barrington, J., Smith, K., Bourassa, V., Sweatman, H., Slapcoff, M. (20??). Transforming Learning Data into a Machine Learning Model to Help STEM students Transition to University.