Statement of Research Interests – Cristina Zepeda

As a Cognitive Psychologist with a Learning Sciences background, the goal of my research is to make education more equitable by preparing students from various backgrounds to engage in robust learning. To achieve this goal, my work centers around metacognition and motivation. I focus on these two constructs as they are at the core of self-regulated learning; students require both the metacognitive knowledge and skills to effectively learn as well as the motivation to engage in learning. These complementary constructs can be particularly powerful during instances of "failure" or struggle. Students' metacognitive knowledge and skills equip them with ways to improve learning and performance and enable them to recognize when they are not effectively learning. The way students think about their abilities and motives also has a direct impact on their learning trajectories through their persistence and effort. To explore how to foster and measure each construct and understand their relation to each other and self-regulated learning, I use a variety of methods (laboratory studies, classroom interventions and observations) and perspectives (Cognitive, Social, Educational Psychology).

What are the causal relationships between metacognition and motivation and their impact on learning?

To gain a deeper understanding of how and when metacognition and motivation promote one another and robust learning, I have employed different types of in-vivo ***instructional interventions***. Although theories of self-regulated learning suggest that both metacognitive and motivational constructs affect one another and work together to contribute to better learning outcomes, most prior work has used correlational analyses with dispositional measures or has evaluated the effect of interventions on only a couple of motivational and learning outcomes. These approaches limit our understanding of their causal relations. In my work, I aim to address these limitations via interventions and the use of multiple assessments. Not only does this approach provide insight into when and how metacognition and motivation work together, but it also reveals when certain types of supports are particularly critical for student learning.

Can a metacognitive intervention that provides direct instruction and practice with metacognitive skills positively affect different aspects of student motivation and learning? In my prior work, I found several benefits of a metacognitive intervention for two middle school physics classrooms. Using a between-subjects design, we randomized students within each classroom to either an intervention or a control condition. Those in the metacognitive intervention condition received a self-guided metacognitive intervention that provided direct instruction about each metacognitive skill, worked examples for how to apply those skills, and space for them to practice using the skills. The intervention resulted in better conceptual learning of physical science concepts and performance a novel learning task, as well as higher endorsements of several types of motivation (incremental theories of intelligence, mastery-approach goals, self-efficacy, task values) in comparison to a control condition that engaged in more problem-solving practice (Zepeda, Richey, Ronevich, & Nokes-Malach, 2015). This work shows that student metacognitive knowledge and skills can play a critical role in different types of learning and motivational outcomes.

Do we find similar effects with college students, given that adolescence is a period in which they are still acquiring and improving their metacognitive abilities? To test this question, we revamped the middle school intervention at a domain-general level to fit the context of three hybrid Educational Psychology college courses. Unlike the middle school intervention, results showed that there were no differences between the metacognitive condition and a control

condition on several performance and motivational measures (Richey, Davis, & Zepeda, submitted). One explanation for these conflicting results is that students might not have been adequately completing the intervention materials. We are currently examining their fine-grain behavioral data from the course management system to elucidate their completion of the materials and their actual behaviors (e.g., planning, procrastination).

In the future, I want to examine whether different aspects of metacognition and motivation work together to boost student learning or whether boosting one component is sufficient to improve overall outcomes. Some aspects of motivation and metacognition might be particularly intertwined, especially when considering the various cognitive, social, and environmental factors that contribute to students' use of the different components of metacognition and motivation. For example, prompting students to reframe their attributions might have a stronger effect on learning if they are also prompted that they can control and regulate their cognitions at a more general level. Examining these questions will allow us to determine whether different types of supports might be more beneficial for certain students. In some cases, instructional interventions targeting how students view and regulate certain types of motivations might be more critical while in other cases it might be more critical to support how students view and regulate their cognitions.

Can other interventions that implicitly support student use of metacognition benefit student learning?

Using other instructional techniques such as prompting self-explanation, analogical comparison, or retrieval practice provide opportunities for students to engage in metacognition. In a series of classroom experiments, we compared the effect of learning how to spell words with retrieval practice versus rewriting the words (Jones, Wardlow, Pan, Zepeda, Heyman, Dunlosky, & Rickard, 2015). Second and third graders not only learned better with retrieval practice, but the students tended to like and think they learned how to spell more effectively with retrieval practice versus rewriting. In a laboratory study with undergraduates, higher use of self-explanation while learning from worked examples was associated with better transfer performance whereas higher use of analogical comparison was associated with worse learning performance (Richey, Zepeda, & Nokes-Malach, 2015). This work highlights that different instructional processes encourage students to engage in different levels of learning and transfer. I hypothesize that examining the underlying mechanisms promoted by each of these instructional techniques, particularly the underlying metacognitive and motivational mechanisms at play, is central to understanding these different levels of learning and transfer.

In my dissertation work, I am examining the underlying metacognitive and motivational constructs that result in different learning outcomes throughout two semester-long college courses. Using an extension of existing self-regulated learning theories that takes into account the interactions between student motivation, their strategies, and performance that take place over a course (Figure 1). In the extension of the model, I predict that a students' initial motivation (grit) can impact the types of metacognitive study strategies students report using as well as their self-efficacy for each exam, their subsequent exam performance, and their willingness to change strategies and resources for the next exam. As part of this work, I am also examining whether similar patterns occur across different classrooms structures by using data from a typical Cognitive Psychology course and a flipped version of the course that had more cognitive scaffolds. Unlike a typical course, the transformed the course implemented eight short pre-lecture videos and quizzes, allowing for students to engage in constructive learning activities during class time (e.g., retrieval practice, structured inquiry, and collaboration; Nokes-Malach,

Zepeda, Boden, & Bartsow, 2017). Disentangling these patterns can reveal whether students with certain beliefs engage in specific behaviors which can potentially be used as space to provide additional instructional support.

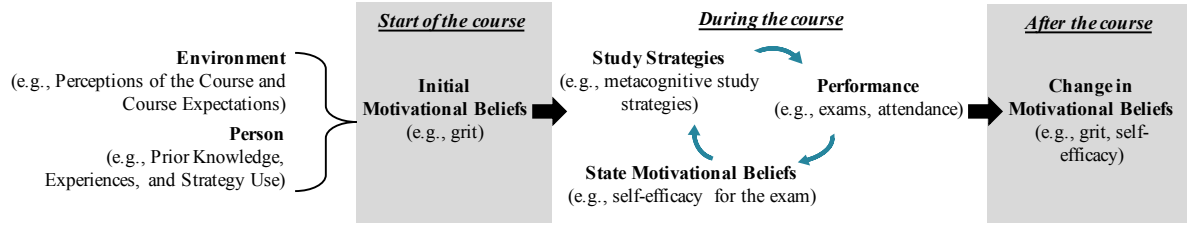

Figure 1. Self-regulated learning over the course of a semester.

How are students' metacognition and motivation naturally supported in the classroom?

Another area of my research examines how metacognition and motivation are supported via discourse. Do teachers support aspects of metacognition and motivation through their talk and are those supports related to student learning? As a member of a large research team, I took the lead role in supervising several undergraduates in transcribing observational data from 40 middle school math classrooms. We then coded for the metacognitive and achievement goal talk that was present in teacher talk. To code for metacognitive talk, I developed and applied a metacognitive support framework which contains two dimensions: the metacognitive component consisting of the type of metacognitive knowledge and skill, and the delivery component consisting of the different manners and frames teachers used to provide support to their students (Zepeda, Hlutkowsky, Partika, & Nokes-Malach, under review, invited resubmission). Findings from this study revealed classrooms with higher learning growth on a conceptual assessment had more teacher talk supporting metacognition. When examining the specific types of metacognitive support, the classrooms with higher growth had more talk supporting personal metacognitive knowledge (e.g., being able to determine what you do and do not know). Personal knowledge also appears to be important for college students, as students who continually reported that they monitor what they do and do not know while studying for an exam received higher average exam grades (Zepeda & Nokes-Malach, 2017).

To code for achievement goal talk, we adapted Ames' (1992) TARGET protocol to examine whether teachers naturally supported mastery and performance goals in their talk when talking around task expectations, recognizing students, and evaluating students (Boden, Zepeda, & Nokes-Malach, in prep). We observed that teachers in the high-growth classrooms supported more mastery talk and less performance talk compared to the low-growth classrooms.

Building upon this work, I plan to examine whether there is a causal link between the relations we observed in teacher and whether these links differ based on the content, time, and the interaction-level. Can metacognitive or motivational prompts from one activity affect learning on a future learning task? Do low-performing students benefit from some types of supports more than high-performing students? In which ways do peers support metacognition and motivation in their interactions?

Investigating the measures of metacognitive, cognitive, and motivational constructs

I have also examined and used a variety of metacognitive and motivational measures (Likert-scale items, open-ended questions, behavioral data from the course management system, classroom observations) to obtain a more complete picture of how these constructs function. Across the different studies, there tends to be a disconnect between metacognitive Likert-scale questionnaires and other metacognitive measures (e.g., metacognitive judgements, open-ended

questions) (Zepeda et al., 2015; Zepeda & Nokes-Malach, 2017; Zepeda & Nokes-Malach, submitted). In related work, we found a disconnect between self-explanation and analogical comparison self-reports and verbal protocols (Zepeda, & Nokes-Malach, 2015). In a different investigation that examined the effect of self-explanation and analogical manipulations, we also found a disconnect between self-report measures and condition assignment (Richey, Zepeda, & Nokes-Malach, 2015). These findings raise questions about the validity of some self-report measures and highlight the need to have multiple converging measures to understand a phenomenon.

Going forward, I plan to continue using multiple measures and to examine potential mechanisms for when and why some metacognitive measures align and some do not. Perhaps students that value the learning experience or want to master the material are more likely to have convergence across different metacognitive measures than those who do not possess those motivations.

Interdisciplinary Perspective

Across these projects and my experiences at the University of Pittsburgh I have been fortunate to exchange ideas and collaborate with scholars and students from a variety of perspectives. At the Learning Research and Development Center, I learned how to integrate different psychological and educational theories to pursue grounded research in understanding the science of learning. At the Pittsburgh Science and Learning Center (formally LearnLab), I constructed innovative approaches to creating practical applications of the science of learning through collaborations with teachers. At the Discipline-based Science Education Research Center, I familiarized myself with the practices and questions faculty members from Psychology, Physics, Biology, and Chemistry face in terms of how to create more productive pathways for student learning. I value and carry these diverse perspectives with me as I search for ways to create a more enjoyable and beneficial learning experience for students.