

ABSTRACT

WAGEMAKER, MARINA GRISEL. Metacognition of Academic Speech for International Multilingual Graduate Students. (Under the direction of Dr. Christy Byrd).

Academic speech in the higher education community is an important form of communication and connection for scholars. Metacognition of academic speech for international multilingual graduate students is an understudied area. The purpose of the current study was to understand metacognition during academic speech for international multilingual graduate students through a mixed-method convergent design merging data from survey collection to measure metacognitive awareness and language experience and a qualitative case study of international multilingual and domestic monolingual students' metacognitive regulation use during academic speaking tasks. Results show that international multilingual students and domestic monolingual students did not show a statistically significant difference in their mean scores for self-reporting metacognitive regulation of academic speech, and language experience did not relate to metacognitive regulation self-reports. Graduate students used metacognitive regulation skills like planning, monitoring, and evaluating in different ways during their academic speaking tasks. Students' self-reports of metacognitive regulation did not relate to their verbal recall or observed metacognitive regulation skill use during academic speaking tasks. The results of this study provide theoretical and practical contributions to the metacognitive and linguistics fields furthering the understanding of metacognitive regulation in academic speech for international multilingual graduate students.

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Metacognition of Academic Speech for International Multilingual Graduate Students

by
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DEDICATION

This is dedicated to my dearest son. I love you.

BIOGRAPHY

Marina Wagemaker earned two undergraduate degrees in 2008 from the University of North Carolina Greensboro, a Bachelor's of Science in Elementary Education and a Bachelor's of Arts in Psychology. After graduation she taught one year abroad in San Miguel de Allende, Mexico, and two years abroad in Seoul, South Korea. Upon returning to the United States, she worked for six years in Wake County Public Schools in North Carolina as a second grade teacher and a Spanish teacher to pre-kindergarten- fifth grade students. In 2014 she received a Fulbright Scholarship to work for the ministry of education in Buenos Aires, Argentina that resulted in the first exchange of principals between Argentina and Wake County Public Schools that continued for two years. She received her Master's in Elementary Education from North Carolina State University in 2016. She enrolled in the Educational Psychology PhD program full-time in fall 2017. Through the program she served as a research assistant for a National Science Foundation grant, a Department of Public Instruction grant (Wolfpack WORKS), and was a teaching assistant for several courses. As an engaged scholar, teacher educator, and mother, she views partnerships among researchers and other education stakeholders as essential to assuring intellectually rigorous, culturally sustaining, and humanizing education for all students.

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TABLE OF CONTENTS

LIST OF TABLES.....	viii
LIST OF FIGURES.....	viii
Chapter 1: Introduction	1
Research Questions.....	5
Chapter 2: Literature Review	6
International Multilingual Graduate Students.....	6
International Multilingual Engineering and Computer Science Graduate Students...	7
Academic Speaking Contexts for International Multilingual Students.....	8
Academic Speaking in Graduate Programs Generally.....	8
Academic Speaking for International Multilingual Students in Particular.....	9
Metacognition.....	12
Knowledge of Cognition.....	14
Regulation of Cognition.....	15
Metacognition and Student Outcomes.....	15
Metacognition and Speaking.....	16
Speaking.....	18
Planning.....	18
Monitoring.....	19
Evaluation.....	20
Metacognition and Multilingualism.....	21
Language Experience.....	24
Purpose of Study.....	25
Chapter 3: Methods	31
Overview of Current Study.....	31
Research Questions.....	32
Quantitative.....	32
Qualitative.....	33
Mixed Methods.....	33
Research Question 1 Analysis.....	34
Research Question 2 Analysis.....	35
Research Question 3 Analysis.....	37
Reliability, Validity, Credibility, and Trustworthiness.....	37
Reliability and Validity.....	37
Credibility and Trustworthiness.....	38
Participants.....	40
Quantitative.....	40
Qualitative.....	41
Measures.....	42
Quantitative Measures.....	42
Demographic Survey.....	42
Metacognitive Awareness Inventory (MAI).....	43

Metacognitive Regulation of Academic Speaking in English (MRASE).....	43
Language Experience and Proficiency Questionnaire (LEAP-Q).....	43
Qualitative Measures.....	44
Academic Speaking Task.....	44
Observation Checklist.....	45
Procedures.....	45
Chapter 4: Results	48
Quantitative.....	48
Reliability and Validity Scores.....	48
MAI.....	49
MRASE.....	50
Language Experience.....	52
Qualitative.....	57
International Multilingual Case.....	57
Planning.....	58
Writing Script.....	58
Bullet Points.....	59
Planning in Their Heads.....	60
Monitoring.....	62
Fluency.....	62
Evaluating.....	66
Active.....	67
Silent.....	69
Domestic Monolingual Case.....	70
Planning.....	70
Monitoring.....	71
Evaluating.....	73
Cross- Case.....	74
Planning.....	74
Monitoring.....	75
Evaluating.....	76
Mixed Methods Integration.....	80
Description.....	85
Chapter 5: Discussion	88
Summary of Findings.....	88
Research Question 1.....	88
Research Question 2.....	91
Research Question 3.....	96
Key Findings.....	99
Limitations.....	100
Significance of Findings.....	101
Implications.....	102
Future Research.....	104

Conclusion.....	106
References.....	108
APPENDICES.....	122
Appendix A Demographic Survey.....	123
Appendix B Language Experience and Proficiency Questionnaire (LEAP-Q).....	124
Appendix C Metacognitive Regulation in Academic Speaking in English (MRASE).....	125
Appendix D Metacognitive Awareness Inventory (MAI).....	126
Appendix E Speaking Tasks.....	128
Appendix F Observation Checklists.....	132

LIST OF TABLES

Table 1	Demographics of Participants.....	42
Table 2	Data Collection Timeline.....	47
Table 3	Correlations Between Language Experience, MAI, and MRASE.....	54
Table 4	Confirmatory Factor Analysis.....	55
Table 5	Case Study Themes.....	57
Table 6	Mean Scores from Academic Speaking Task Observation Checklist.....	80
Table 7	Joint Display Merging QUAN + QUAL: Within and Cross-Case Analysis...	82

LIST OF FIGURES

Figure 1	Theoretical Model of Metacognition.....	14
Figure 2	Metacognition in Academic Speech Model.....	17
Figure 3	Mixed Methods Convergent Design.....	39
Figure 4	MAI Mean Score Distribution of International Multilingual and Domestic Monolingual Groups.....	50
Figure 5	MRASE Mean Score Distribution of International Multilingual and Domestic Monolingual Groups.....	52

CHAPTER 1 Introduction

In the United States, higher education is dominated by the English language (Pennycook, 2017). One third of enrolled graduate students in the U.S. are international students with the majority coming from a country where English is not the official language (Institute of International Education [IIE], 2020). Understanding the experiences of these multilingual students in English-dominant academic settings is vital to their success. The majority of studies conducted with international multilingual students in higher education have focused on social and academic experiences (Harrison & Shi, 2016; Laufer & Gorup, 2019; Sato & Hodge, 2009; Zhang, 2016). Throughout these studies language use has appeared as a common theme as being an integral part of international multilingual students' journey throughout higher education. Studies have found that international multilingual students report speaking in academic settings as a challenge. One of these participants described the inability to communicate as "heart-wrenching," like "that person in *The Scream*" (the famous painting by Norwegian Expressionist artist Edvard Munch) while speaking in an academic setting (Xing & Boulder, 2019, p. 843). Researchers have used communication strategies to help explain how international multilingual students cope with these difficult academic speaking settings. Communication strategies are strategies that students use while speaking to make meaning in a creative way or avoid a communication problem. This explains only part of the complex mental processes that are occurring during academic speech leaving out things like how a student plans for speech or evaluates their speaking experiences. Little research has investigated how international multilingual students think about their academic speaking contexts in higher education (Dörnyei & Scott, 1997; Nakatani & Goh, 2007).

To better explain this I will present a hypothetical student named Clara who has enrolled in a Research 1 university in the United States (U.S.) for a graduate program. Clara is coming to the U.S. from China and uses multiple languages in their everyday life that include Chinese and English. They are proficient enough in English to pass the English entry exam into the university, but Clara still feels as though their English in a university context could be improved. Upon arrival Clara goes through a transitional process while they become acculturated. Some of the most important experiences in the acculturation process include adopting (assimilation) or rejecting (separation) the dominant cultural norms, or integrating the dominant culture with one's other cultural practices or identities (Andrade, 2006; Laufer & Gorup, 2019; Li, 2016; Sato & Hodge, 2009; Ye & Edwards, 2015; Zhang, 2016). For students like Clara, acculturation will also include *Linguistic Acculturation* (Zuo & Wang, 2016), when two languages interact; and *Academic Acculturation* (Simpson & Matsuda, 2008), the interplay of academic and non-academic experiences through language.

As Clara begins their classes, they notice how discussion is a large part of classroom participation, they meet with their advisor once a week to discuss research goals, and have lab meetings where they are wanting to express their ideas to their colleagues and also make a good academic impression. To complete these tasks, Clara will need to use communication strategies, which are measurable strategies that speakers use in the moment of a conversation to keep the conversation going or to correct a mistake in the conversation (e.g., rephrasing, repeating, using filler words; Dörnyei & Scott, 1997; Nakatani & Goh, 2007). Strategy use can vary due to cultural learning, individual construction, and peer interaction (Selinker, 1972). While acculturation and communication strategies can explain some of Clara's experiences as they

navigate their graduate program, the current research has not provided enough insight into the full mental processes that multilingual students go through in their speaking experiences, including how they plan for speaking contexts, monitor their strategy use, or evaluate how successful their strategy use went.

For example, Clara often thinks about what they want to say in classroom discussions and how they want to say it by jotting down notes. They also think about if what they are saying during their advisor meeting is what they had rehearsed saying earlier. After Clara gives academic presentations, they spend the rest of the day replaying the things they said wrong and how to fix it. Clara has an international multilingual friend Mai who has similar experiences but prepares differently. Mai plans for what they are going to say in their head instead of writing it down because otherwise it feels like they are reading a script. During their speech they do not notice what they've said wrong until someone tells them. They do not think about their speech while speaking because they would be distracted constantly thinking about what they were saying and unable to get out what they wanted to say. After presentations Mai feels relieved to be finished and does not evaluate how the speaking event went. Their experiences are quite different from their third classmate, Laura, who only speaks English. Laura is able to go with the flow during classroom discussions; what they want to say just comes to them. For presentations they always make sure to have slides to remember key points, but they can fill in the blanks as they go. When evaluating their academic speaking events, they rate themselves on a scale from 1-10 and adjust their academic speaking for the next event.

Acculturation or communication strategies could be used to understand the differences between these students by explaining how the students' cultures and language use interact in

academic spaces and their moment to moment speaking strategies used. These are important approaches to understanding graduate student experiences, however they provide limited insight into how these students are thinking about their academic speech. The way that students think impacts their behaviors (Winnie 2001, Winnie & Azevedo, 2014). This is to say how students think about learning will impact how they approach their learning task and what they do during the learning task. For graduate academic speaking settings this could mean that what students know about their speech could impact how they approach their graduate academic speaking and what they do during and after their speech. More importantly, without this research it has not been established that students are setting academic speaking goals, monitoring their progress, or evaluating their academic speech, and if so in what ways they are doing this.

A field of study that explores how we think about our thinking is metacognition (Brown, 1987; Dinsmore et al., 2008; Flavell, 1979; Schraw, & Moshman, 1995). In an academic context, metacognition includes students thinking about what they know about a learning task and regulating their cognition. Metacognitive skills include planning, monitoring, and evaluating while learning. Using a metacognitive theory to explore how international multilingual students think about their speaking could better illuminate the complex processes that are happening during their academic speaking experiences. While speaking in an academic context, using a metacognitive perspective can provide a deeper insight into how an international multilingual student thinks about their academic speaking experience. These insights can also help those that interact with students in academic speaking contexts, in hopes of improving the academic speaking experience as a whole. In a graduate setting, speaking events could include classroom discussions, conference presentations, teaching a course, meeting with an advisor, etc.

Understanding metacognition in academic speaking settings for international multilingual graduate students is particularly relevant because a main goal during a graduate program is to become an expert in their academic discipline by communicating their knowledge in a way that is appropriate to their field of study. The current study will investigate metacognition in academic speech of international multilingual graduate students.

Research Questions

Quantitative

1. Are there differences between engineering and computer science international multilingual and domestic monolingual graduate students' metacognitive awareness self-report scores?
 - a. To what degree does language experience in speaking English relate to metacognitive awareness for international multilingual graduate students?

Qualitative

2. In what ways do international multilingual and domestic monolingual engineering and computer science graduate students use metacognitive regulation skills (planning, monitoring, and evaluation) during academic speaking tasks?

Mixed Methods

3. How do metacognitive self-report scores relate to the use of metacognitive regulation skills for engineering and computer science international multilingual graduate students?
 - a. In what ways does language background explain this variance?

CHAPTER 2 Literature Review

This review begins by defining international multilingual graduate students with the target population of students being in engineering and computer science programs. A focus is placed on describing a metacognition perspective as a lens to focus on the context of academic speaking. Gaps in the research are highlighted, and justification is proposed for the current study.

International Multilingual Graduate Students

This study will focus on the international multilingual graduate student population. Multilingualism has been defined as someone who uses more than one language in their everyday life (Grosjean, 2010; 2021). There is not an agreed upon descriptive term in the research for students that use a primary language that is different from the instructional language used in the university in which they are enrolled (e.g., a student enrolled in an English-speaking university that uses Chinese as their primary language). Common terms used in research to describe this type of participant include non-native *language* speaker (e.g., non-native *English* speaker), English as a second language student (ESL), English language learner (ELL), international student, and multilingual/bilingual student. The lack of a term to describe multilingual students in higher education is partly due to linguistic resources (e.g., asking what languages one uses in their everyday life) not being tracked or documented throughout higher education in the U.S. as commonly as they are for elementary, middle, or high school (Andrade, 2014).

Given the multiple terms for this population, general statistics for multilingual graduate students are not readily available. necessitating that inferences be drawn from the statistical information that is available for example from international graduate students that are also

multilingual (Andrade, 2014). For the 2018-2019 year there were a total of 19,828,000 students enrolled in higher education, of those 1,095,299 were international students and 791,777 of these international students were enrolled in doctorate-granting universities (IIE, 2020; Okahana, & Zhou, 2019). The majority of international students had a place of origin listed where English is not the native language. Countries in East Asia represented 43% of the place of origin for international students with China being the most represented country (34%). Engineering (21.1%), math and computer science (18.5%), and business management (16.7 %) were some of the top represented fields of study. The statistics that are available suggest that a large portion of graduate students attending English-speaking universities in the U.S. are multilingual coming from a country of origin where English is not the official language.

For this study the population of focus will be international multilingual graduate students, defined as students from outside of the U.S. that are enrolled in a graduate program in a U.S. university who knows more than one language. Available statistics reveal that students enrolled in engineering and computer science programs make up the majority of the international graduate community (IIES, 2020). These combined findings invite researchers looking for the largest representation of international multilingual students to begin their search within these engineering and computer science programs.

International Multilingual Engineering and Computer Science Graduate Students

Students enrolled in engineering and computer science programs make up 40% of the international graduate student population (IIES, 2020). Within engineering programs, 82% of all students are international students (Redden, 2021), and 72% of all students enrolled in computer science programs. This population was chosen for the current study because it represented the

majority of international students. Research has investigated cognition and metacognition in science literacy and science, technology, engineering, mathematics (STEM) education (Dori, Mevarech, & Baker, 2018), but few studies have examined academic speaking for graduate students, including engineering and computer science graduate students (McCord & Matusovich, 2019), despite effective communication being a pillar to higher education success (Klomegah, 2007).

Academic Speaking Contexts for International Multilingual Students

Academic settings are typically contexts in which individuals are gathered for the purpose of learning (e.g., a school, college, or university; Andrade, 2006; Goh, 2012). Speaking has been identified as an essential skill in academic settings such as higher education across programs (Boetje & van Ginkel, 2021; Kerby & Romine, 2009). Speaking is a domain of language that involves multiple people creating a speaking experience, where quick decisions must be made in understanding the speaker and then creating one's response in an ongoing manner. In higher education programs, graduate students engage with each other as a scholarly community through speech, connecting ideas, making meaning, and exchanging ideas. Introductions on the first day of class to presenting a thesis or dissertation at the end of a graduate program all involved speaking in academic settings. The current study is especially concerned with academic speaking in these settings.

Academic Speaking in Graduate Programs Generally

Academic speaking has been defined as “sustained and purposeful conversations about school topics that actively engage learners in collectively constructing knowledge, deepening conceptual understanding, and developing students' sense of the self as an authorial agent.” (p.

410, Meston et al., 2021). A graduate program presents a unique language setting where all students are learning to use and understand language specific to their field as experts with varying degrees of previous experience. Academic language has a formal structure, tends to be less repetitive, and more complex as compared to everyday language (Goh, 2012; Grosjean, 2021). In graduate programs academic language is specific, precise, and sophisticated in nature toward the field of study, requiring what one could describe as ‘acquisition of academic language’. In other words, learning how this field of study speaks in academic settings about academic topics.

Academic speaking events specific to graduate programs can include seminars or classroom discussions, department or conference presentations, teaching a course, meeting with an advisor, job talks, interviews, etc. (Andrade et al., 2015; Haukås et al., 2018). Thinking back to the example in the introduction, Clara engages with peers, an advisor, and other professors. In each exchange they must understand what their colleagues are saying and simultaneously formulate a response repeatedly throughout each conversation. This is salient in academic speaking settings as students can receive immediate feedback to their speaking task (Zuo & Wang, 2016). Some examples of this are when an advisor or mentor engages with a student during a meeting and comments on how the student speaks, a student is speaking in a class discussion, or after a student gives a presentation. Speaking in academic settings requires careful construction to produce meaningful, precise, and purposeful dialogue.

Academic Speaking for International Multilingual Students in Particular

International multilingual students have unique challenges with academic speaking in academic settings. They have learned English in varying contexts, and once in their graduate

program are using their learned English in new ways while also continuing to learn the expert academic language of their field. There is a minimum baseline of proficiency that is expected in graduate programs, yet this baseline does not align with needed language skills to be successful in the program. Grosjean (2021) differentiates language use versus language proficiency by illustrating multiple contexts and how the combination of language use and language proficiency can vary in differing contexts for each individual. Both multilingual and monolingual graduate students from the same program are expected to use English in a similar manner resulting in equivalent language use, yet each student's English-speaking proficiency of academic language will vary. For our three sample students Clara, Mia, and Laura, each student was expected to use English in a similar way in their graduate program (e.g., during classroom discussions or academic presentation), yet their proficiency in academic English varied with Laura identifying as a native speaker and Clara and Mia having differing English proficiency scores on their English screening measures.

Furthermore, professionals at the academic institute often assume that students will have successful English skills in all four modalities of language (speaking, writing, reading, and listening), when they may not (Andrade et al., 2015). International multilingual students have reported that upon arrival to their programs they believe their English skills will result in successful English use; however, once they begin interacting with the higher education community, they realize there are academic English language experiences they were not prepared for (Xing & Boulder, 2019). This disconnect may be due to how English proficiency is screened for admission into higher education (Andrade, 2014). For access to higher education in the U.S. there is often a screening process for English proficiency (e.g., Test of English as a Foreign

Language [TOEFL] and International English Language Testing System [IELTS]; Xing & Bolden, 2019). The university admission process varies in whether they use one or multiple methods to determine English skills. Only 17% of U.S. universities require completing a language test post admission, and rarely are speaking samples required (Andrade, 2014). These indicators are used for the admission process; however they are not intended to be used to understand a student's rich linguistic background. Even though English proficiency is measured using assessments, achieving proficient results on these measures does not always correspond to successful English use in higher education academic settings (Bifuh-Ambe, 2011). This is particularly relevant for graduate level students as additional academic responsibilities like teaching assistantships and conference presentations may be required; with a main goal in graduate programs being to engage as an expert in your field (Zhang, 2016).

This disconnect between assumed skill and actual ability to successfully use English in academic settings can have a negative impact on the academic experience. For example, international multilingual students report experiencing anxiety when speaking in academic settings (Khoshlessan & Das, 2019; MacIntyre & Gardner, 1994). Some students are adjusting to new communication patterns (e.g., a student not being comfortable challenging a professor's statement), have a fear of negative judgment from their audience, or are unable to convey their thoughts due to limited proficiency. Research also highlights the impact this disconnect has on how other academic community members perceive international multilingual students. Peers judge international multilingual students as not actively participating in discussions (Lin et al., 2019), which can negatively impact their classroom and research experiences. Additionally, professors' beliefs about international multilingual students impact the type of feedback they

provide to these students (Mori, 2000). One illustration of this is when professors may attribute lack in speaking proficiency to lack of academic knowledge and base feedback off this assumption. Each of these studies reveal the importance of academic speaking in U.S graduate higher education and how this impacts the academic journey for multilingual graduate students.

International multilingual graduate students who are newly applying English in a higher education setting face academic and social transitions like that of automatized English speakers but with the added challenges of having to navigate these transitions using a language that is not their primary language. Despite these challenges, international multilingual graduate students show a higher completion rate than that of their domestic peers (Council of Graduate Schools, 2020). This suggests that these students are doing well in challenging circumstances.

Understanding how students approach speaking tasks, adjust the strategies they are using to produce academic speech, and judge their speech production would be essential in assessing and improving academic speech. The field of metacognition focuses on how individuals think about their cognitive processes and provides a lens to focus on how the speaker is thinking about their academic speech. Applying a metacognitive framework to speech can help to explain the difficulties and successes that are occurring in academic speech for international multilingual graduate students. This is important because how students think about learning environments can impact their behaviors and their performance (Winnie, 2001; Winnie & Azevedo, 2014).

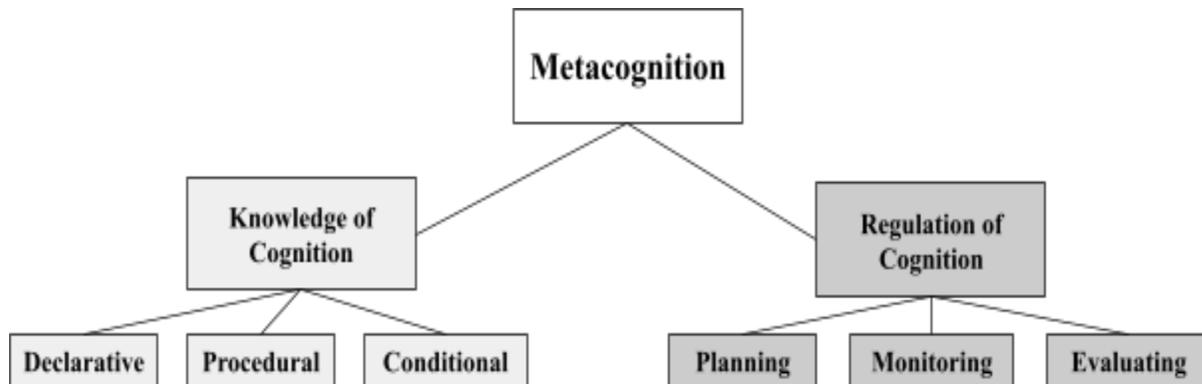
Metacognition

In this section metacognition will be defined, a metacognitive model will be presented, the subcomponents of metacognition will be described, and how metacognition attributes to learning will be explained. Metacognition is a term used to encompass the processes and

components of being aware and regulating one's own cognition (Brown, 1987; Flavell, 1979).

Metacognition is part of our higher order thinking process; this facilitates the remarkable efficiency of human learning. Metacognition is becoming aware of your thoughts and the ability to regulate them. It is in this progression of thinking about one's own cognition that the cognitive process becomes an object of attention and can therefore be manipulated.

A metacognitive model presented by Brown (1987; Baker & Brown 1984) distinguishes two components of metacognition. In this model metacognition consists of metacognitive knowledge and metacognitive regulation. See Figure 1 for the theoretical model of metacognition. First, metacognitive knowledge is what we understand about our cognition; and has been categorized into three types: *declarative* (knowing about things), *procedural* (knowing how to do things) and *conditional* (when and how to apply knowledge to things; Schraw & Moshman, 1995). Second, regulation of cognition is the control of one's thinking through several subprocesses. Three main skills include planning, monitoring, and evaluating. *Planning* involves thinking about the appropriate strategies and resources to use before a task, *monitoring* involves thinking about one's own comprehension and task performance during a task, and *evaluating* involves assessing how effective cognitive processes went. Each dimension will now be described in more detail.

Figure 1*Theoretical Model of Metacognition*

Note. Created using the metacognitive definition from Baker and Brown 1984; Brown, 1987; Flavell, 1979.

Knowledge of Cognition

Knowledge of cognition in the metacognitive process is what one knows about their cognition. This component has been categorized into three types: declarative, procedural, and conditional. Declarative knowledge is what one knows about themselves as a learner. This could be factual knowledge or knowledge on one's abilities or skills. Procedural knowledge is one's understanding of the process of a learning task or how to engage and complete a learning task (e.g., a doctoral candidate knowing how to describe their research to an audience). Conditional knowledge is one's understanding of when and why to apply certain skills or knowledge specific to the context of the learning task. For example, a doctoral candidate knowing when it is appropriate to share about their research and in what way (e.g., an elevator pitch versus a job talk).

Regulation of Cognition

An individual's knowledge of what they know differs from the second component of metacognition, regulation of cognition (Schraw & Dennison, 1994). Even though an individual may be highly aware of what they know, what to do in a learning task, and when and why to apply related knowledge, this metacognitive awareness may not transfer into action while they are completing the learning task if the individual is not regulating their cognition as well (Schraw, 2000). Thus, regulation of cognition is the monitoring and control of cognition. Cognitive processes are the actions that accomplish a learning task, while the regulation of this cognition is the individual agent initiating, changing, or terminating cognitive acts to engage in and complete a learning task (Nelson & Narrens, 1984). Strategies that are used for metacognitive regulation include planning, monitoring, and evaluating (Brown, 1987; Schraw, 2000; Winnie & Azevedo, 2014). Planning involves thinking about the appropriate strategies and resources to use before a task, monitoring involves thinking about one's own comprehension and task performance during a task, and evaluating involves assessing how effective cognitive processes went. In graduate settings this could include planning for a classroom presentation including creating outlines and rehearsing, monitoring how well one is doing during the classroom presentation, and then evaluating how well the classroom presentation went and applying what was learned to the next classroom presentation.

Metacognition and Student Outcomes

Learners using effective metacognitive skills identify what they know and do not know that is relevant to the task and are able to monitor and evaluate their performance and strategy use during their learning process working towards a goal (Perry et al., 2018; Tobias & Everson,

2000). Overall, findings suggest that metacognition supports learning (Craig, 2020; Dent & Koenka, 2016; Neisser et al., 1996; Ohtani & Hisasaka, 2018; van der Stel & Veenman, 2010, 2014; Veenman & Spaans, 2005), in higher education especially (Everson & Tobias, 1998; Zamery et al., 2016). One longitudinal study conducted over three years found that graduate students attributed metacognitive skills as part of their successful journey in completing their programs (Yang & Bai, 2019). However, more research on metacognition in graduate programs is needed. In particular, identifying different tasks required for the completion of a graduate program is an important step in disentangling and understanding the role of metacognition in graduate settings. Oral language in particular plays an important role in students' success during their academic experiences. How a person expresses themselves or understands what is happening takes place largely through speaking and understanding spoken language (Andrade, 2006).

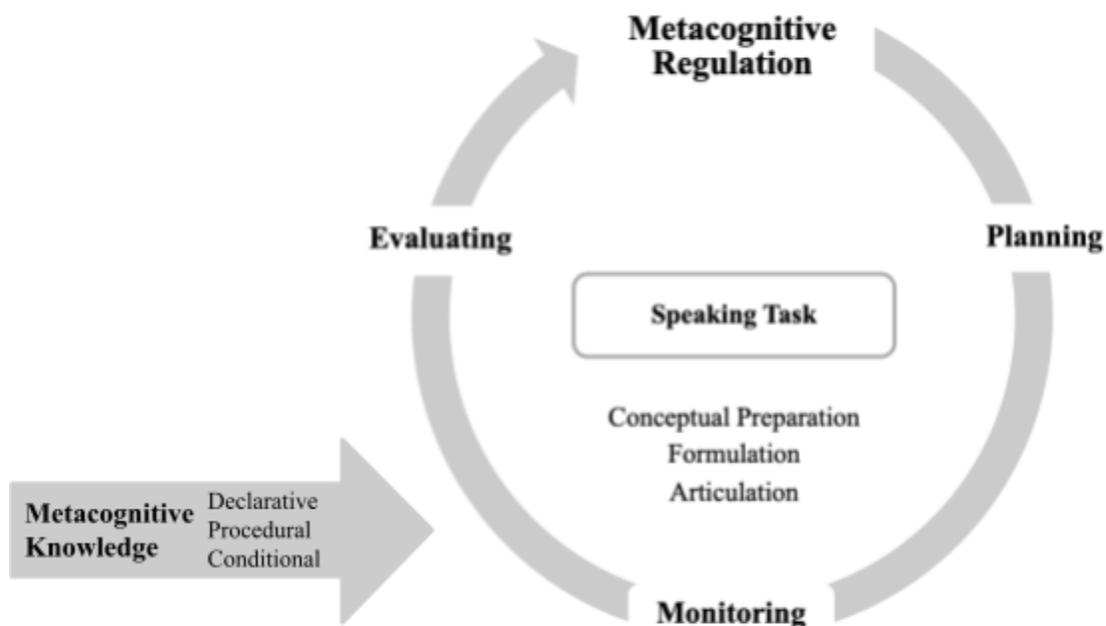
Metacognition and Speaking

A metacognitive framework has been applied to listening (Goh, 2000, 2008; Vandergrift et al., 2006), reading (Temelman-Yogev et al. 2020; Tobias & Everson, 2000), and writing (Hacker, 2018) in previous research, however, using a metacognitive framework for academic speech remains understudied. A metacognition in academic speech model is presented in Figure 2 combining Baker and Brown's (1984; Brown 1987) model of metacognitive and Levelt's (1990) model of speech. There are few studies to draw upon that use a metacognitive framework to explain academic speech. The metacognition in academic speech model introduced here is an attempt to present how metacognitive theory could explain academic speech combining what we know from the linguistic and metacognitive field. A student thinks about themselves as a

speaker, understands how to engage in the speaking task, and knows when and why to apply certain skills to complete the speaking task. Before academic speech, students interact with speaking tasks by pulling from their linguistic resources to think about what to say and how to say it. During academic speech a speaker is creating sound waves for the listener while simultaneously continuing the speech cycle of thinking about what to say and how to say it. Metacognitive regulation involves planning for speaking tasks by setting goals and thinking of strategies to use, monitoring speech by assessing how the speech process is going to further inform the regulation process, and evaluating speech by making a judgment on one's speech performance. This process is cyclical, recurring throughout the speech process, and could potentially be influenced by a variety of factors.

Figure 2

Metacognition in Academic Speech Model



Note. Baker & Brown 1984; Brown, 1987; Flavell, 1979; Levelt, 1990

Speaking

First, producing fluent and accurate speech involves the learner combining knowledge about language and discourse with speaking skills (pronunciation, speech function, interaction, management, discourse organization; Goh, 2012). There are three stages that occur during speech (Levelt, 1993): conceptual preparation (thinking about what to say), formulation (how to say it), and articulation (saying it aloud). These steps are depicted within the circle in Figure 2. In conceptual preparation, the speaker thinks about what they are going to say before or while they say it. A speaker thinks about what they may know or relevant ideas about the topic. Formulation occurs when these ideas are mapped onto specific words in the speaker's mental lexicon and strung together (Garman, 1990). This is challenging as speakers are making grammatical choices, translating direct words, utterances, or phrases, and using judgements about how the discourse is unfolding to decide the best word choice. In the articulation stage, a speaker will activate and control their vocal tract, larynx, and lungs to create sound waves for the listener. This process is closely linked to memory and information processing as these movements are automatized in competent speakers and little effort or thought is used when moving these muscles to create these sounds.

Planning

Academic speaking tasks can differ in a variety of ways such as time allotted to complete the task, objectives for the speaking task, and interlocutors involved in the speaking task. For example, planning for speech during classroom discussions may involve quick formulations of responses, where a student processes the discussion questions and responses from other students while pulling from their existing knowledge on the topic and taking into account socially

acceptable speech acts (e.g., when to start talking, for how long, etc.). In contrast, a presentation permits more time to plan speech and involves less interaction during the main presentation with a dedicated section to interact with others (e.g., question and answer portion). A student planning for a presentation will understand the purpose of the presentation, outline key points to present, identify information that they already know, seek out information they need to know, and formulate strategies to effectively deliver their message. In meetings with advisors, topics covered might build on previous meeting objectives. Planning could involve students or advisors generating goals for the meeting by creating agendas to address main talking points. These talking points can be rehearsed in advance, however there will likely be moments where student and advisor must quickly formulate responses similar to a classroom discussion based off of the interlocutor's response.

Monitoring

Monitoring speech for academic speaking tasks like classroom discussions, presentations, and during advisor meetings would be somewhat of a similar process. The student would monitor their speech process during the task discerning what is working well towards the objective or goal of the speaking task, and what is not working well. Students would then use this information to inform cognitive control processes on what strategies to execute or adjust to best meet the speaking goal. This process may be somewhat limited in attention capacity during speech because of the amount of effort needed in producing speech, thinking about what to say, how to say it, saying it, and attending to interlocutors. Monitoring speech during a classroom discussion might look like a student thinking about a response to a peer, then upon delivery noticing that their response was not as clear as their original thought, nor did it achieve the goal

of arguing their point. The student then could use this information to inform their cognitive control process of formulating a more effective talking point during their next turn to speak, or to stop talking for the remainder of the discussion. During a presentation a student may recognize in the moment that they forgot what to say next. The student can use this information to decide if they will skip to the next section they remember or use filler sentences until they remember what they had rehearsed. For student-advisor meetings a student might be keenly aware that the advisor is likely basing their response on their judgment of what the student is saying. Students might monitor their speech by recognizing that they answered one of the advisor's questions well by using a strategy they had practiced in a professional development. The student could use this information to inform their cognitive control process to use this strategy again for the next question.

Evaluation

Evaluation during academic speaking tasks could involve judging how well one did in achieving their speaking goal, effective strategies used, and considering things that would be done differently when completing a similar task in the future. For classroom discussions a student might evaluate their speech noting that they did not speak as much as they would have liked and could have added some valuable information to the discussion. The student may decide that during the next class they will engage in speech at least twice during the discussion. During a presentation a student will likely evaluate their performance at the end of the presentation judging how well they did in comparison to their rehearsal of the speaking task, and how well the audience responded. The student may also note where they had difficulty in the presentation and rehearse those sections if they are giving the presentation again. A student may also note that

they did not know what to do when they forgot a section and decide that they need to come up with a strategy to address this for future presentations. During a student and advisor meeting a student might evaluate their speech by how well they were able to accomplish their different meeting goals. Previously the student may have noticed that they were not asking enough follow-up questions to understand feedback from their advisor, and for their current meeting the student tried asking several follow up questions. The student noticed the follow up questions worked well and planned to use this again for future meetings.

Questions remain as to how metacognition impacts academic speaking for graduate students, and what these processes look like for different students. The ability to convey ideas and engage with the ideas of others is a large part of higher education. Speaking allows students to express themselves and connect with others in an academically demanding environment. In academic settings students can encounter limits in time to produce speech and cognitive load because of limited cognitive capacity leading to inaccurate or incomplete production of speech; this may be particularly salient for multilingual students that are speaking in a language that they feel less proficient in, in comparison to the other languages they speak.

Metacognition and Multilingualism

Metacognition for multilingual students may be unique compared to monolingual students because of the added linguistic resources multilingual individuals can draw from for speaking tasks. First, multilingual individuals have higher cognitive loads when speaking, especially when speaking in a newly learned language. This increase can be due to grammar and vocabulary knowledge specific to the new language when an individual is first learning, but also because individuals will use skills and rules from their first language to assist them in their

understanding and production of their additional language (Puig-Mayenco, 2020). A person may know how they want to respond in a conversation when speaking in a new language, but they may need time to formulate their response in the newly learned language thinking through the appropriate grammatical structures or the right words to use that might be conflicting with their other language's grammatical structure and vocabulary (Levelt, 1993). Simultaneously they must pay attention to what the other person is saying and formulating their response again. This could result in the inability to keep the conversation going.

Second, multilingual students will need to adapt their speaking in an academic setting compared to non-academic settings, and this may require a different use of metacognition compared to monolingual students. Cohen and Olshtain (1993) highlights ways multiple languages played a role in speech performance. The authors were interested in how multilingual speakers shifted the language in which they thought during speaking tasks, and how verbal reports might measure this. Participants used different languages in their thought process depending on their own proficiency level and the differing context of the speaking tasks. When the context of the speaking task changed (in topic or language) so did the pattern of which language they used to think about their task. The authors explained that academic speaking tasks were going to be far more demanding than those that their everyday speaking tasks yielded (e.g., discussing favorite music choice, travel). This suggests that the participants with less English proficiency used more complex systems to produce their answers.

Another study looked to explore multilingual adults' metacognitive practices using English as a second language in their everyday life through diary entries and semi-structured interviews (Wenden, 1986). Researchers found that certain events triggered strategy use,

encountering unfamiliar items to the language, a gap in one's language repertoire, and when trying to inhibit feelings like anxiety or fear. These findings suggest that context matters when it comes to strategy use; this could mean that international multilingual students enrolled in a graduate program are triggered to use different metacognitive skills depending on the academic speaking context.

Returning to the graduate students in the earlier example, we see that Clara uses metacognition in their academic speech. They plan by jotting down notes, monitoring their speech in advisor meetings by comparing what they are saying to what they rehearsed, and evaluate their speech by noting what they did wrong and replaying it until they find a solution. In contrast, Mai plans for speech in their head, does not engage in monitoring, and rarely evaluates their speech for effectiveness. Finally, Laura, who speaks English as their first language, uses planning to create visuals as a reminder of the main points to use during their speech, they engage in some monitoring during speech but mainly go with the flow, after their speech they compare their performance to past speaking events and apply what they learned to future speaking events. Communication strategies could help to explain the cognitive processes used for monitoring, in other words what they are using to keep the conversation or presentation going in the moment, but this does not encompass the students' planning, evaluation, or complete monitoring skills used for speech (Dörnyei & Scott, 1997; Nakatani & Goh, 2007). Using metacognitive theory as a lens into these experiences could provide a more complete picture of this complex process.

Language Experience

Current research is beginning to explore whether metacognition is dependent on language proficiency or shared across languages. Research has been conducted in the field of reading (Temelman-Yogev et al., 2020) yielding mixed results, and so far, no known research has been conducted with speech. Understanding how multilingualism and metacognition relate would be beneficial especially for students in graduate programs where language proficiency impacts the academic experience, like that of international multilingual students. Language experience is an important factor that may impact the use of metacognition and could use further exploration in their relation to metacognition in speech.

Language experience includes a participant's language exposure, immersion, acquisition process, proficiency, and use (Grosjean, 2021; Kaushanskaya et al., 2020). Understanding the varying degrees of linguistic background for multilingual graduate students is important to collect because of the lack of information we have in general on higher education students' linguistic experiences. While few studies have focused specifically on graduate students' metacognition, researchers have explored experts versus novice learners. Findings showed an increase in metacognitive skillfulness with acquisition of expertise (Veenman & Elshout, 1999). The complexity of the problem determined where on the novice to expert continuum the participant resided. Using these findings one could hypothesize that graduate students completing a task related to their field of study in a language they were proficient in would differ in their metacognitive knowledge and regulation skills when compared to novice participants in their field or those that felt less proficient in the academic language used in completing the same task. Having a deeper understanding of a field of study (e.g., graduate versus undergraduates) or

more experience in the academic language (i.e., higher proficiency in academic English versus lower proficiency) helps in creating an automated process of accessing and expressing knowledge, and knowing when and how to effectively apply cognitive skills depending on the task. Understanding this process for graduate students is important to their success in completing graduate programs. Data about students' language experience can shed light on previous academic English-speaking experiences, numbers of languages in participants' linguistic resources, ages of acquisition, and proficiency levels in languages to help understand if this relates to metacognition.

Languages of multilinguals coexist and constantly interact within one's language system (Grosjean, 2021). Languages can be acquired simultaneously (at the same time) or sequentially (at different times) and vary in use and proficiency dependent on context. Those that acquire multiple languages from birth, simultaneously, go through a different language acquisition process as compared to those that learn languages at different times, sequentially. Learning multiple languages sequentially involves more conscious processing to take place (Mihalicek & Wilson, 2011). An individual may know how to speak, read, write, and listen in one language but be unable to do these things proficiently in additional languages. This would occur before the additional language becomes automatized. This suggests that when and how people learn languages can influence their cognitive regulation processes (Blumenfeld & Marian, 2013).

Purpose of the Study

The purpose of this study is to explore metacognition of international multilingual graduate students in their academic speaking. Speaking is an important form of communication in the academic community that can impact students' success in their academic journey.

Metacognition in academic speaking for international multilingual graduate students is an understudied area. To begin exploring this area it's important to understand students' metacognition and how this compares to other groups, including domestic monolingual graduate students. Preliminary data is needed from large groups to make comparisons between international multilingual and domestic monolingual graduate students. Language is used to conceptualize and express what we experience and know. Individuals that know and use more than one language have multiple languages in which to accomplish this process. International multilingual graduate students in English speaking programs, especially those that may be less proficient in English than that of their dominant language, are likely operating with a higher cognitive load during academic speaking tasks than that of their domestic monolingual peers. Using a metacognitive framework to better understand metacognition of academic speech for international multilingual graduate students will provide insight into the higher order functions that this population is engaging in during academic speech. Metacognition and speech are both complex processes that are impacted by a range of variables, language experience is one factor to explore that could provide insight into these complex processes.

A metacognitive theoretical lens will be used to explain the academic speech process. This is informed by a pragmatist worldview where there are both singular and multiple realities and importance is placed on the practicality of addressing the research problem (Creswell & Guetterman, 2019). The multiple realities are understood through the integration of multiple research methods. Using mixed methods provides a deeper understanding of the research problem. As a middle-aged Mexican-American woman that immigrated to the U.S. from Mexico at a young age, I deeply value multilingualism and biculturalism. I believe these are positive

characteristics of one's identity that impact how one engages in academic speaking settings. Additionally, everyone deserves the opportunity to learn and maintain multiple languages throughout their educational journey including higher education. A case study was used to best understand how students are using metacognitive regulation skills during academic speech and to collect multiple forms of data that would best reflect students' metacognitive skills within each case. I have an 'insider' advantage with my participants, as we are all enrolled in graduate programs within the same university. Participants held a similar understanding of the research process, even though our programs differed. This helped with participants' awareness of the purpose of conducting research and engaging with the tasks. Multiple forms of data were used to understand the complexities of metacognitive regulation during academic speech, examining each participant's individual experience within a case, and comparing across cases to explore both the individual's reality while also using a metacognitive framework as a lens to describe these metacognitive skills.

The first goal of this study includes identifying engineering and computer science graduate students' metacognitive awareness of their academic speaking process and general learning processes. A focus is placed on multilingualism as a factor that may impact metacognitive awareness. International multilingual students' scores will be compared to their domestic monolingual peers to determine whether there are statistical differences; and language background and experience will be collected for multilingual students to explore the relationship between language and metacognition. The second goal of this study is to capture metacognitive regulation during academic speaking. Participants completed academic speaking tasks that were coded for planning, monitoring, and evaluating, and themes within these categorizations will be

identified. The final goal of this study is to integrate the quantitative and qualitative data to encompass the complex nature of metacognition during academic speech and how international multilingual students' metacognition compares to that of their domestic peers. A joint display will be used to illustrate metacognitive awareness and metacognitive regulation for academic speech and how these two measurements were similar or different, as well as comparing international multilingual students to their domestic monolingual peers. The description explains similarities and differences between how students think they are engaging in metacognition versus how they are actually engaging in metacognition during academic speaking tasks. The implications of this study can help to better understand metacognition during academic speech for a linguistically diverse population.

A mixed methods convergent design was used to describe international multilingual graduate students' metacognition for academic speech. Three research questions will guide this study including a quantitative, qualitative, and a mixed methods question that addresses the integration of the qualitative and quantitative data.

1. Are there differences between engineering and computer science international multilingual and domestic monolingual graduate students' metacognitive awareness self-report scores? (Quantitative)
 - a. To what degree does language experience in speaking English relate to metacognitive awareness for international multilingual graduate students?
2. In what ways do international multilingual and domestic monolingual engineering and computer science graduate students use metacognitive regulation skills (planning, monitoring, and evaluation) during academic speaking tasks? (Qualitative)

3. How do metacognitive self-report scores relate to the use of metacognitive regulation skills for engineering and computer science international multilingual graduate students?
 - a. In what ways does language background explain this variance? (Mixed Methods)

I hypothesize that international multilingual graduate students will have differing metacognitive self-reports from that of their domestic monolingual peers, and that these differences relate to their language experience in academic English speaking. International multilingual graduate students have multiple languages to draw from, and they may experience high cognitive load during speech as compared to domestic monolingual students. Nevertheless, this group of students have similar outcomes in their graduate programs as their domestic monolingual peers (Council of Graduate Students, 2020). Metacognition may help to explain these differences when looking towards students' planning, monitoring, and evaluation of their academic speaking in English.

A convergent design collects both quantitative and qualitative data to understand the research problem (Creswell & Guetterman, 2019). Both data forms are merged in analysis to look for convergence, divergence, contradictions, or relationships (Creswell & Guetterman, 2019, p. 74). Quantitative data will be collected using a survey, with descriptive statistics and t-tests used to compare international multilingual and domestic monolingual students' metacognitive awareness. Correlations will be used to explore how language experience and metacognitive awareness relate for international multilingual graduate students. Qualitative data will be collected using a collective case study including international multilingual and domestic monolingual graduate students. Students completed two academic speaking tasks. Observation of tasks, verbal recall, and semi-structured interviews focusing on students' metacognitive

regulation of speaking during the task will be analyzed using within case analysis and cross-case analysis. Integration of quantitative and qualitative data using a joint display and description will provide an in-depth understanding of metacognition in academic speech for international multilingual graduate students.

This study is significant to the field of educational psychology in several ways. The context and population of interest have been understudied in the field of metacognition (Azevedo, 2020). International multilingual graduate students make up a large portion of the higher education field and understanding how these students think about their academic speaking context can help with their success in the program. This study will also provide a methodological contribution specific to metacognition in academic speaking as few measurement systems have been created to understand metacognition specific to academic speech in graduate programs. This is a starting point to investigate metacognition of academic speech for multilingual students enrolled in English speaking universities in the U.S. The metacognitive field lacks research in understanding the relationship between language background and metacognition. Providing evidence to describe this relationship will help to build upon our existing knowledge in the metacognitive field to better define metacognition in academic speaking contexts for linguistically diverse students. These findings can help students and colleagues that work with students to improve their academic speaking experiences that are often challenging and stressful (Andrade, 2016).

CHAPTER 3 Methods

Overview of Current Study

A mixed-methods convergent design was used to investigate metacognition of academic speech for international multilingual graduate students (Creswell & Clark, 2018). This design was chosen to best capture the complex nature of metacognition. For the quantitative portion, participants' metacognitive awareness of general learning and studying, metacognitive regulation awareness of speaking in an academic setting in English, and language background were collected through an online survey. Metacognition focuses on the mind of the individual and must be conveyed by explaining one's own thinking or showing how they are regulating their thinking including self-reports, interviews, observations, think-alouds and verbal reports (Dinsmore, 2008). Combining measurements to capture metacognitive processes have not been used as often as singular measurements, yet combining measurements are needed. As Dinsmore (2008, p. 406) suggests, "It may be that neither quantitative nor qualitative approaches alone will suffice to illuminate the nature of monitoring and regulation, but that some combination is required." Using self-reports in combination with measurements that capture metacognitive regulation during actual speech is the best approach to begin understanding metacognition in academic speech.

Data analysis will show if there are differences in multilingual and monolingual participants' metacognitive scores, and how language background correlates to metacognitive scores for multilingual speakers. For the qualitative portion a case study including observation of academic speaking, verbal recall, and semi-structured interviews was used to further explore metacognitive regulation. Type and frequency of metacognitive regulation was measured using

an observation checklist, and a thematic analysis of the metacognitive regulation process was conducted comparing within and across cases.

Research Questions

A mixed method convergent design uses quantitative and qualitative data to best investigate the research problem (Creswell & Guetterman, 2019). For this design, guiding questions include a quantitative, qualitative, and a mixed method integration question.

Quantitative

- 1. Are there differences between engineering and computer science international multilingual and domestic monolingual graduate students' metacognitive awareness self-report scores?**

H1: There is a statistically significant difference between international multilingual and domestic monolingual graduate students' metacognitive awareness scores.

H0: There is no statistically significant difference between international multilingual and domestic monolingual graduate students' metacognitive awareness scores.

- a. To what degree does language experience in speaking English relate to metacognitive awareness for international multilingual graduate students?**

H1: There is a statistically significant relationship between language experience in English and metacognitive awareness of academic speech.

H0: There is not a statistically significant relationship between language experience in English and metacognitive awareness of academic speech.

Qualitative

2. **In what ways do international multilingual and domestic monolingual engineering and computer science graduate students use metacognitive regulation skills (planning, monitoring, and evaluation) during academic speaking tasks?**

Mixed Methods

3. **How do metacognitive self-report scores relate to the use of metacognitive regulation skills for engineering and computer science international multilingual graduate students?**
 - a. **In what ways does language background explain this variance?**

Research question one will be answered using quantitative data to establish if international multilingual graduate students' metacognitive awareness differs from their domestic monolingual peers. Language experience is measured using questions from the LEAP-Q to further explore how varying language experience relates to metacognition scores. Descriptive statistics and correlations will be conducted using demographic data to describe the participants in the sample, and t-tests will be used to examine multilingual and monolingual groups. Metacognition survey scores only provide a glimpse into the complex processes involved in metacognition. Research question two will be answered by using qualitative case study data to investigate metacognition during academic speaking tasks. Semi-structured interviews, verbal-recall, and observation of metacognitive regulation skills will be used to measure metacognition. Within and cross-case analysis include a description of each case and comparison across cases focusing on similarities and differences in planning, monitoring, and evaluation of metacognitive regulation. This will reveal in what ways graduate students were using

metacognition in academic speaking settings, specifically focusing on metacognitive regulation skills (planning, monitoring, and evaluation). Research question three will be answered by integrating the quantitative survey data with the qualitative case study data to provide an explanation of metacognition of academic speaking for international multilingual graduate students reporting on metacognitive awareness and regulation for academic speech and comparing this to domestic monolingual peers. These data shed light into the complex metacognitive practices used by multilingual graduate students and help with promoting successful academic speech. See Figure 3 for research design.

Research Question 1 Analysis

Research question one will be analyzed using metacognitive mean scores from the quantitative survey. Metacognitive mean scores included the average of students' MAI scores (measuring metacognitive awareness of general learning and studying) and MRASE scores (measuring metacognitive regulation in academic speaking in English). T-tests were used to determine if mean scores are statistically different between the international multilingual and domestic monolingual student groups. Multiple t-tests were run to look at planning, monitoring, and evaluation mean scores from the MAI and MRASE to identify differences in these subcategories of metacognitive regulation. Language experience was measured using questions from the LEAP-Q. Age of acquisition of English, proficiency rating of English (1-10), and number of languages known were used to correlate with MAI and MRASE mean scores to understand if language experience related to metacognitive mean scores. Demographic data were correlated with metacognitive mean scores to identify any relationships between demographic data and MAI and MRASE scores. Previous research has shown that university students report

using metacognitive strategies in their academic environments (Shi, 2018). With this finding it is anticipated that students will report using metacognitive regulation during academic speech. Few studies have focused on language experience and metacognition, however one study found that some aspects of monitoring were related to language proficiency (Temelman-Yogev et. al, 2020). Participants that had a higher proficiency in the target language were able to more accurately predict how well they would do on a comprehension quiz. This finding suggests that there could be a relationship found between language background and metacognitive regulation of academic speech.

Research Question 2 Analysis

Research question two will be analyzed using a case study that includes within and cross-case analysis. Case study methodology is implemented to understand a phenomenon that occurs within a bounded context (Merriam, 1998; Stake, 1995). The bounds for this case study included students from a public R1 university enrolled in a graduate engineering or computer science program during the academic year of 2021-2022. The two bounded cases include 10 international multilingual students and 7 monolingual domestic students with a total of 17 participants. These cases were selected to understand metacognitive regulation processes used during academic speaking and in what ways multilingualism plays a role in that process.

The two cases included international multilingual students and domestic monolingual students. Each participant completed two academic speaking tasks and a semi-structured interview. A thematic analysis was used to analyze the academic speaking tasks and semi-structured interviews (Creswell & Poth, 2018). Review of the transcription and video centered within each case (international multilingual case and the domestic monolingual case),

and also compared across cases focusing on how each case planned, monitored, and evaluated for each task. First and Second round coding was used (Miles et al., 2014). The first cycle of coding included line by line analysis of transcripts and recorded video with initial descriptions as codes. The first cycle of coding included three categories, planning, monitoring, and evaluating. Sentences and phrases were highlighted that were related to each category. A description was written of how the participant was using each skill within the highlighted episode. For example, this phrase was coded as evaluating, “It depends like either that Professor is the one that you read a lot you just admire or you would like to have some you know collaborative work in the future, or you would like to be the part of his or her lab.” A description was written to describe how the participant was using evaluation, *‘reference to context mattering, or audience for how they evaluate their speech’*. A review of descriptions was conducted to identify patterns. The second cycle of coding included reviewing transcriptions and videos to affirm initial patterns and relate these back to the research question. Memoing was completed throughout the analysis process to capture research reflexivity. Video recordings of the academic speaking tasks were reviewed to complete the observation checklist. The observation checklist was created using the MRASE. There were 15 items for each academic task, including five for planning, five for monitoring, and five for evaluation. A score for 1 was given if the item was observed and a score of 0 was given if the item was not observed. Observations were tied into explanations of themes and used as supportive evidence. For coding, metacognition during academic speech was defined as the process of being aware and regulating one’s own cognition during academic speech. *Planning* was defined as the approach towards a speaking task where one sets goals for the speaking task and thinks of strategies that one will use. *Monitoring* was defined as monitoring one's audience,

fluency, logic of thoughts and using these to inform regulating cognitive processes for speech. This included managing high cognitive load and in the moment problem solving during speech. *Evaluation* was defined as an analysis of one's speaking performance and the effectiveness of strategy use throughout speaking.

Research Question 3 Analysis

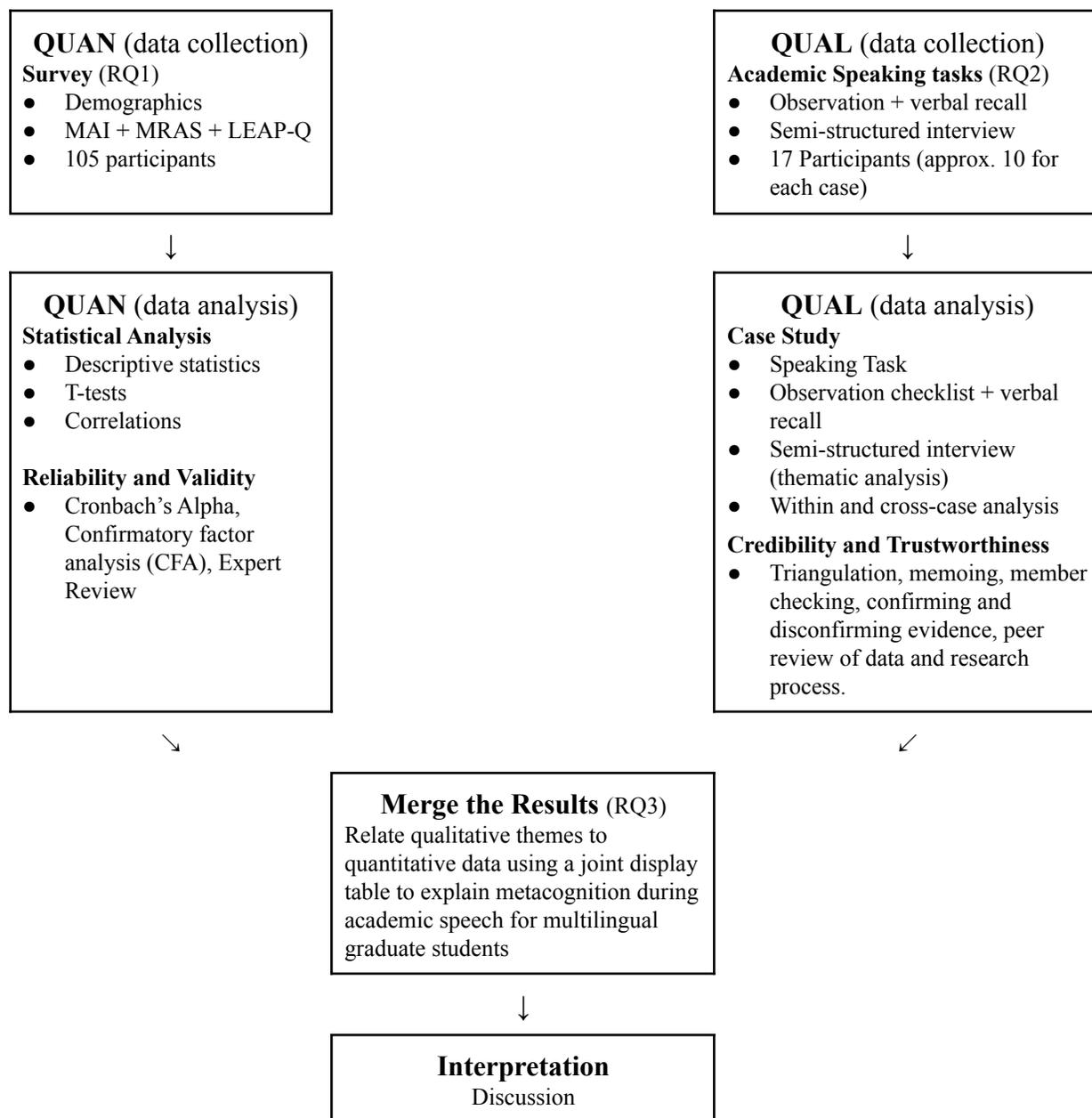
Research question three will be analyzed by integrating the quantitative and qualitative data. A description and a joint display will convey speaking task observation checklist scores, MAI scores, MRASE scores, and thematic data. The description provides an explanation for how international multilingual graduate students and domestic monolingual graduate students are similar or distinct in their self-reports versus their actual use of how they plan, monitor, and evaluate during academic speaking tasks. The observation checklist from the qualitative portion was used to calculate an academic speaking task score for each participant in the case study. The mean of this score was correlated with the participants' MAI, and MRASE scores. The mean scores of planning, monitoring, and evaluation were also used in the description. Using both the quantitative and the qualitative data in the joint display and description provide a more complete picture of how international multilingual and domestic monolingual students' self-reports and actual use are similar or distinct in their metacognitive regulation of academic speaking tasks.

Reliability, Validity, Credibility, and Trustworthiness

Reliability and Validity. Establishing reliability demonstrates consistency in research findings. For the quantitative portion of this study measuring internal consistency includes establishing that survey items measure the same concept and determining how survey items correlate with each other. This was accomplished by measuring Cronbach's alpha for survey

results (Creswell & Gutterman, 2019). For the MAI Cronbach's alpha = .95, and MRASE = .90. Validity in quantitative studies addresses the accuracy of research findings. This helps to determine how well instruments are measuring what they intend to measure (Creswell & Clark, 2018). Correlations were run between the MAI and MRASE, construct validity was addressed through expert review, and a confirmatory factor analysis was used for content validity.

Credibility and Trustworthiness. For the qualitative portion of the study, corroborating evidence through triangulation of multiple sources of data and memoing throughout data collection and analysis were used (Creswell & Poth, 2018). During the analysis process, member checking, peer review of the data, and disconfirming evidence was used (Creswell & Poth, 2018). Throughout the analysis process peers within the relevant fields of metacognition and multilingualism were asked to review the data analysis, participants were contacted to review the accuracy of the reporting of data collected from their speaking tasks, and conflicting data towards conclusions drawn from data analysis were included in findings.

Figure 3*Mixed Methods Convergent Design*

Note. Adapted from “Designing and conducting mixed methods research”, 3rd ed., by J.W.

Creswell and V.P. Clark, 2018, p. 75.

Participants

Quantitative

Participants included graduate students enrolled in an engineering or computer science program at a public Research I university located in the Southeastern part of the U.S. Participant emails were randomly selected and provided through the Survey and Research Offices of the university. Of the 1000 participants that received an invitation email, 127 participants consented to participate, and 105 participants completed the survey in Qualtrics. A total of 62 doctoral students and 43 master's students participated. Almost all the students were full-time students with 3% reporting being part-time. The majority of students were enrolled in an engineering program (79%), and 26% were in computer science programs. Most students were in their first year of their program (53%), there were 15% in their second year, 13% in their third year, 10% in their fourth year, and 9% in their fifth or sixth year. There were more men (66%) than women (34%), and 2% identified as non-binary. The ages of the participants ranged from 22-40 with the average age being 27. Ethnicity was self-reported with 54% identifying as Asian, 33% as White, 6% as Middle Eastern, 3% Hispanic/Latina/o/x, 2% as Black, 1% as African, and 1% did not report. International multilingual students represented 70% of the data and domestic monolingual students represented 30% of the data. Multilingual students identified their first language as Chinese, Hindi, Tamil, Bengali, Spanish, Arabic, Russian, Turkish, Urdu, Telugu, Azerbaijani, Farsi, Portuguese, Korean, Marathi, or Konkani. Countries of origin included China, India, Bangladesh, Ecuador, El Salvador, Egypt, Saudi Arabia, Pakistan, Turkey, Taiwan, Azerbaijan, Iran, Brazil, Korea, Russia, Bahamas, Kenya, Italy, and Indonesia. See Table 1 for demographics of participants in the quantitative portion of the study.

Qualitative

Participants that completed the survey and indicated interest in participating in a follow-up interview were contacted to schedule the completion of the academic speaking tasks. Purposeful sampling was used to select participants for each case in an attempt to have 10 multilingual and 10 monolingual participants (Creswell, 2012). Of the 11 multilingual participants contacted, 10 participants responded and completed the academic speaking tasks. Of the 19 monolingual participants that were contacted, seven participants responded and completed the speaking tasks. There were a total of 17 participants, with 13 being doctoral students and 4 being masters students. One student was a part time student and 16 were full time students. The majority of students were in engineering programs (88%) and 12% were in computer science. The year in their program varied with 35% in their first year, 12% in their second year, 29% in their third year, 18% in their fourth year, and 6% in their sixth year. There were 10 men and 7 women in this study. The ages of the participants ranged from 23-33 with the mean age being 27. Ethnicity was collected through self-report and 47% of participants identified as White, 24% Middle Eastern, 24% Asian, and 5% African. See Table 1 for demographics of participants in the qualitative portion of the study.

Table 1*Demographics of Participants*

	Quantitative		Qualitative	
	<i>n</i>	%	<i>n</i>	%
Graduate Level				
Doctor	62	59.05	13	76.47
Master	43	40.95	4	23.53
Full-time	102	97.14	16	94.12
Part-time	3	2.86	1	5.88
Graduate Program				
Engineering	79	75.24	15	88.24
Computer Science	26	24.76	2	11.76
Graduate Year				
First Year	53	51.96	6	35.29
Second Year	15	14.71	2	11.76
Third Year	13	12.75	5	29.41
Fourth Year +	21	20.58	4	23.53

Note. Total participation included 105 graduate students in the quantitative and 17 graduate students in the qualitative portion of the study.

Measures*Quantitative Measures*

Demographic Survey. The demographic survey included eight questions. The first question asked if the participant is an international or domestic graduate student. The second question asked if the participant is multilingual or monolingual. There are three questions about

the participant's graduate program (program, year started, and full-time versus part-time).

Gender, age, and self-identified ethnicity are included. See Appendix A for demographic survey.

Metacognitive Awareness Inventory (MAI). The Metacognitive Awareness Inventory (MAI; Schraw & Dennison, 1994) is a self-report questionnaire measuring metacognitive knowledge (declarative, procedural, and conditional), and metacognitive regulation (planning, monitoring, debugging, information management, and evaluations) during learning tasks. This is a validated survey used across many studies. Cronbach's $\alpha = .95$. In the original form there are 52 items that are measured as true or false on a 0-100 scale. A five-point Likert scale ranging from always to never was used instead of a sliding 0-100 scale (Nietfeld, 2003). See Appendix D for MAI questions.

Metacognitive Regulation of Academic Speaking in English (MRASE). The researcher created the Metacognitive Regulation of Academic Speaking in English (MRASE) questionnaire using the metacognitive regulation portion of the MAI. The planning, monitoring, and evaluation questions were adapted from the MAI and discussed with experts. Questions were selected on relevance to academic speaking in graduate settings and re-worded to be understood by participants as questions related to academic speaking in their current graduate programs. This resulted in a total of 15 questions with five questions for each category of planning, monitoring, and evaluating. A five-point Likert scale ranging from always to never was used. Cronbach's $\alpha = .90$. See Appendix C for MRASE questions.

Language Experience and Proficiency Questionnaire (LEAP-Q). The language experience and proficiency questionnaire (LEAP-Q; Marian et al., 2007) is a self-report measure that collects data measuring language dominance, language exposure, and language preferences

using a mix of Likert scale, fill in the blank, and multiple-choice questions (Kushanskaya et al., 2018). This is a validated survey for ages 14-80, and available in 20 different languages.

Cronbach's alpha = .88 for second language items. The survey is available in a Qualtrics format and was added as a section for the multilingual participants to complete. Questions from the original LEAP-Q survey were removed that asked about proficiency in reading. This was done to keep the total survey time for multilinguals under 20 minutes. See Appendix B for the questions included in this study from the LEAP-Q survey.

Qualitative Measures

Academic Speaking Task. Two academic speaking tasks were completed in a recorded Zoom session with the researcher and the participant. Recordings were transcribed with identifying information removed. The purpose of conducting these tasks was to understand how students plan, monitor, and evaluate during academic speech. See Appendix E for the speaking task script. The first speaking task involved the participant providing a formal introduction at a professional development event; and the second task involved that participant sharing about an academic resource related to their field (e.g., journal article, podcast, book, etc.). These speaking tasks were created using common speaking activities graduate students engage in (Andrade, 2014). Participants were given instructions verbally, and instructions with guiding questions were given in a google doc. Immediately after each task was completed the researcher asked the participant if they had any thoughts they wanted to share about the speaking task (with follow up questions) to capture their evaluating skills. They were also asked to elaborate on how they planned for the task to capture their planning skills. Then the researcher played back the participants' speaking task. The participant was instructed to verbally recall their monitoring

skills. Both the researcher and the participant indicated when to pause the speaking task to engage in the verbal recall (Huang, 2014). At each pause, the participant shared what they were thinking at the moment the speaking task was paused (e.g. Were they planning to say what they wanted to say, What strategies were they using and why?). The verbal recall portion of the speaking task is modeled after the video-stimulated verbal recall (Huang, 2014).

Observation Checklist. An observation checklist totaling 15 observation items was used to note metacognitive regulation skill use of the participant by an observer (see Appendix F). This observation checklist was created using the MRASE questionnaire. Other metacognitive observation checklists related to problem solving were referenced to create the observation checklist as well (McCord & Matusovich, 2019, Veenman & Spaans, 2005; Whitebread et al., 2009). The researcher discussed the final checklist with experts resulting in five items for each category of metacognitive regulation (planning, monitoring, and evaluation). The researcher and another coder individually coded five participants' interviews (this included the completion of two speaking tasks, verbal recall, and semi-structured interview questions). The inter-rater reliability was calculated using Cohen's Kappa, resulting in .95 showing high reliability.

Procedures

Interest emails that included information about the study and a link to an online survey were sent to 1000 students enrolled in engineering and computer science programs. The emails were randomly selected and provided from the university survey and research office. Interested participants were directed to consent documents within Qualtrics. A qualifying question was included to self-identify as a graduate student. Qualifying participants proceeded to demographic and metacognitive questions (MAI; MRASE). International multilingual graduate students also

completed language experience measurement questions (from the LEAP-Q). All participants were asked if they would like to be contacted for a follow-up interview and then thanked for their participation. The total time for participating in this survey portion of the study was approximately 15 minutes. Each participant was entered to win one of four \$50 gift cards for completing the survey.

Participants interested in a follow-up interview were contacted through email with information about the qualitative portion of the study. Qualifying participants included students that completed the survey and met the needed criteria for the bounds indicated for the case study (i.e., international multilingual and domestic monolingual graduate students). Responding participants were scheduled for a 60-minute Zoom meeting with the researcher. Verbal consent was collected at the beginning of the meeting followed by the completion of both speaking tasks that included participant's verbal recall and semi-structured interview questions. After completion of the follow-up interview participants received a \$25 Amazon gift card to their email address. See Table 2 for a timeline of data collection procedures.

Table 2*Data Collection Timeline*

	Data Measures	Participants	Time frame
Quantitative (descriptive statistics, correlations, and t-tests)	Online Survey	Survey sent: 1000 Completed: 105	January 2022- March 2022
	Demographics		
	Metacognitive Awareness Inventory (MAI)		
	Metacognitive Regulation of Academic Speaking in English (MRASE)		
	Language Experience and Proficiency Questionnaire (LEAP-Q) *only for international multilingual students		
Qualitative (within and cross-case study analysis)	Academic Speaking Tasks	Invitation: 30 Completed: 17	January 2022- March 2022
	Two academic speaking tasks		
	Observation checklist		
	Verbal recall		
	Semi-structured Interview questions		

Note. Participants indicated through their online surveys if they would like to be contacted to participate in the qualitative portion. Gift cards for the quantitative portion were selected and sent at the close of the survey in March. Gift cards for the qualitative portion were sent immediately after the interview was complete.

CHAPTER 4 Results

Quantitative

Are there differences between engineering and computer science international multilingual and monolingual domestic graduate students' metacognitive awareness self-report scores?

- a. To what degree does language experience in speaking English relate to metacognitive awareness for international multilingual graduate students?**

The Qualtrics survey was used as the main source of data for analysis. Questions were compiled using the Metacognitive Awareness Inventory (MAI, 52 items), Metacognitive Regulation of Academic Speaking in English (MRASE, 15 items). Analysis was conducted using STATA version 17 (n=105). To answer this research question an independent t-test was used to compare international multilingual students' MAI and MRASE mean scores with that of domestic monolingual students. A t-test is a statistical analysis that shows if the means of two groups are different in a statistically significant way.

Reliability and Validity Scores

For this study the MRASE (domain specific measure of metacognition in speaking; $\alpha = .90$) was an adaptation of the MAI (domain general measure of learning and studying; $\alpha = .95$, Schraw & Dennison, 1994;) there was a moderate positive correlation (.41) indicating that they are measuring different domains and these areas are also not unrelated. Construct validity for the MRASE was addressed through expert review throughout the question development process. The content validity was addressed by conducting a confirmatory factor analysis testing one factor model where 15 items measure the construct of Metacognitive Regulation in Academic Speaking

of English ($\chi^2 = 185.70, p < .000$; CFI .839; RMSEA = .101; SRMS = .077). A three-factor model was also measured examining the items specific to each component of metacognitive regulation with five items measuring planning, five items measuring monitoring, and five items measuring evaluation ($\chi^2 = 159.53, p < .000$; CFI .878; RMSEA = .090; SRMS = .072) suggesting a better fit. Examination of modification indices for opportunities to improve the model fit indicated that suggested changes were not large, and theoretically consistent. Factor loadings for each item are listed in Table 4.

MAI

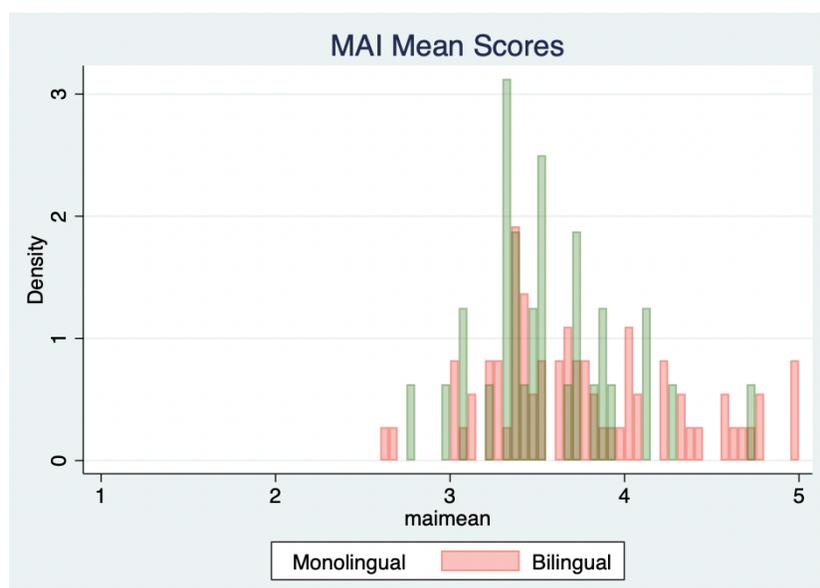
An independent t-test was run to determine if there were differences in the mean scores calculated from the MAI between two groups of students. The sample size included 105 engineering and computer science graduate students consisting of 73 international multilingual students and 32 domestic monolingual students. The results showed that there was not a statistically significant difference between international multilingual students' mean score ($3.76 \pm .06$) and that of their domestic monolingual peers ($3.56 \pm .07$), $t(103) = -1.760, p = .081$. This confirms the null hypothesis.

A second round of independent t-tests were run to understand if the mean scores calculated from the MAI specific to metacognitive regulation differed in a statistically significant way (planning, monitoring, and evaluating). The results showed that there was a statistically significant difference in the mean scores of the planning questions. International multilingual mean scores ($3.69 \pm .07$) and domestic monolingual ($3.35 \pm .10$), $t(103) = -2.649, p = .009$. The effect size for this difference was calculated using Cohen's d , with a medium effect size found $d = .561$ standard deviations between the two means. No statistical significance was found in the

difference for monitoring mean scores of international multilingual students ($3.81 \pm .06$) and domestic monolingual students ($3.68 \pm .06$), $t(103) = -1.174$ $p = .243$. No statistical significance was found in the difference between evaluation means for international multilingual evaluation scores ($3.63 \pm .08$) and domestic monolingual ($3.36 \pm .10$), $t(103) = -1.178$ $p = .077$. A histogram shows that both the international multilingual and domestic monolingual groups' MAI mean scores are varied in their distribution, with most students scoring within the 3-4 mean score range. See Figure 4 for a histogram of international multilingual and domestic monolingual mean scores on the MAI.

Figure 4

MAI Mean Score Distribution of International Multilingual and Domestic Monolingual Groups



Note. Histogram image was created using STATA version 17.

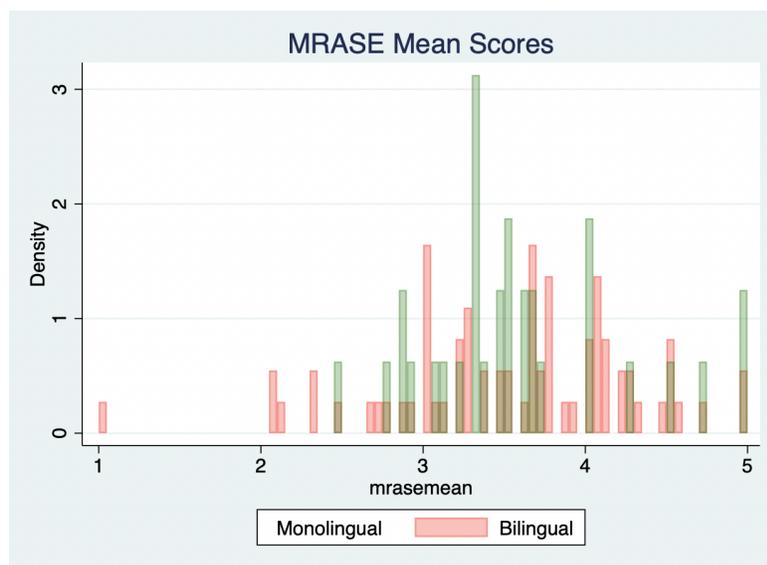
MRASE

An independent t-test was run to determine if there were differences in the mean scores calculated from the MRASE between the international multilingual students and domestic

monolingual students. No statistical significance was found in the difference between international multilingual mean scores ($3.55 \pm .08$) and domestic monolingual mean scores ($3.58 \pm .10$), $t(103) = .22$ $p = .826$, confirming the null hypothesis. A second round of t-tests were conducted to determine if there were differences in planning, monitoring, and evaluation mean scores. No statistical significance was found in the difference of planning mean scores for international multilingual students ($3.44 \pm .09$) and domestic monolingual students ($3.53 \pm .13$), $t(103) = .52$ $p = .599$. No statistical significance was found in the difference of monitoring mean scores for international multilingual students ($3.60 \pm .09$) and domestic monolingual students ($3.63 \pm .12$), $t(103) = .19$ $p = .847$. No statistical significance was found in the difference of evaluating mean scores for international multilingual students ($3.60 \pm .09$) and domestic monolingual students ($3.59 \pm .11$), $t(103) = -.13$ $p = .892$. A histogram shows that both the international multilingual and domestic monolingual groups' MRASE mean scores are varied in their distribution, with most students scoring within the 3-4 mean score range. See Figure 5 for a histogram of international multilingual and domestic monolingual mean scores on the MRASE.

Figure 5

MRASE Mean Score Distribution of International Multilingual and Domestic Monolingual Groups



Note. Histogram image was created using STATA version 17.

Language Experience

Language experience was collected from 72 international multilingual students through the LEAP-Q. Variables chosen for language experience included age of acquisition for the English language, proficiency rating of English on a scale from 1-10, and how many languages the participant listed knowing. Pearson's correlation was run to assess the relationship between MAI mean scores and language experience, and MRASE mean scores and language experience.

There were 28 participants that knew two languages, 26 participants knew three languages, 12 participants knew four languages, and seven participants knew five languages. There was a moderate positive correlation between the number of languages a participant knew and the MAI mean score, $r(70) = .187$, $p < .05$. Further investigation showed that the p value

was only statistically significant for the correlation of the number of languages participants knew and the planning mean scores $r(70) = .247$, $p < .01$. A t-test was run for international multilingual participants with participants that knew two languages as one group ($3.61 \pm .08$) and participants that knew three or more languages as another group ($3.84 \pm .08$). There was not a statistical difference in group means for the MAI total score $t(71) = -1.07$ $p = .091$. There was a statistical difference for MAI planning mean scores for participants knowing two languages ($3.48 \pm .09$) and knowing three or more languages ($3.81 \pm .09$), $t(71) = -2.30$ $p = .024$. With a medium effect size of $d = .55$.

There were no statistically significant relationships between age of English acquisition or rating of English proficiency and MAI or MRASE mean scores. The null hypothesis was confirmed. See Table 3 for correlations between language experience, and MAI and MRASE mean scores.

Table 3*Correlations Between Language Experience, MAI, and MRASE*

		Variables				
		1	2	3	4	5
Language Experience						
	Age of acquisition	1.00				
	Proficiency	*-.31	1.00			
	# of languages	*-.28	*.41	1.00		
Metacognition						
	MAI	-.07	.09	*.18	1.00	
	MRASE	.11	-.10	-.05	*.40	1.00

Note. Age of acquisition= age of acquisition of the English language. Proficiency= English proficiency rating on a scale from 1-10. # of languages= The number of languages the participant knows. n=105. *= $p < .05$.

Table 4*Confirmatory Factor Analysis*

	Item	Construct			
		Metacognition (1 factor)		Plan, Monitor, Evaluate (3 factors)	
		Coefficient	Standard error	Coefficient	Standard error
Planning					
	I think about what I need to say before I begin speaking about an academic topic in English	.528	.075	.554	.075
	I set specific goals before I begin speaking about an academic topic in English.	.690	.057	.739	.053
	I ask myself questions about the speaking task before I begin speaking about an academic topic in English.	.621	.066	.678	.061
	I think of several ways to approach a speaking task and choose the best one when speaking about an academic topic in English.	.668	.059	.653	.064
	I organize my time to best accomplish my speaking goals when speaking about an academic topic in English.	.680	.058	.707	.057
Monitoring					
	I consciously focus my attention on important information when speaking about an academic topic in English.	.530	.075	.512	.075

Table 4 (continued)

I ask myself if the speaking task is related to what I already know when speaking about an academic topic in English.	.590	.069	.551	.074
I visualize or follow an organizational structure in my mind to help me organize my speaking while speaking about an academic topic in English.	.654	.062	.633	.064
I think through changing strategies when I fail to say what I wanted to say when speaking about an academic topic in English.	.601	.068	.592	.067
I find myself mentally pausing when speaking about an academic topic in English to check the comprehensibility of what I'm saying to the listener.	.703	.055	.694	.054
<hr/>				
Evaluating				
I know how well I did once I finished speaking about an academic topic in English.	.455	.082	.484	.083
I ask myself if there was an easier way to do things after I finish speaking about an academic topic in English.	.526	.076	.578	.074
I ask myself how well I accomplish my goals once I'm finished speaking about an academic topic in English.	.629	.065	.578	.074
I ask myself after I've spoken about an academic topic in English if I expressed everything I wanted to while speaking.	.659	.061	.722	.057
I ask myself if I best conveyed my thoughts after finishing speaking about an academic topic in English.	.622	.065	.650	.066

Note. All $ps < .001$.

Qualitative

In what ways do engineering and computer science graduate students use metacognitive regulation skills (planning, monitoring, and evaluation) during academic speaking tasks?

For this case study the bounds included engineering and computer science graduate students enrolled in their program for the 2021-2022 academic school year in a R1 university in the U.S. The first case included international multilingual students and the comparison case included domestic monolingual students. The focus of this investigation was understanding the metacognitive regulation skills, including planning, monitoring, and evaluating, during academic speaking tasks using within case and cross-case analysis. A metacognitive lens for thematic analysis was used. See Table 5 for a summary of qualitative findings.

Table 5

Case Study Themes

	Multilingual	Monolingual	Cross-case
Planning	Script Bullet points In their mind	Organizational structure	Plan time Physical behaviors Clarifying questions
Monitoring	Fluency	Blank screens	Tailoring speech
Evaluation	Additional Languages: Active or Silent	Extensive detail	Content in relation to audience comprehension Emotion.

International Multilingual Case

Review of transcriptions, recorded speaking tasks, and an observation checklist revealed themes for the ways that international multilingual engineering and computer graduate science

students used metacognitive regulation skills (planning, monitoring, and evaluation). Findings are organized by discussion of the main ways students used each subcategory of metacognitive regulation during the academic speaking tasks. See Table 6 for international multilingual graduate students' observation checklist data. All of the participants used metacognitive regulation skills to complete these speaking tasks including planning, monitoring, and evaluation. Overall, each participant varied in comparison to other students within this case in the ways that they used metacognitive regulation skills.

Planning. Planning was defined as the approach towards a speaking task where one sets goals for the speaking task and thinks of strategies that one will use. Participants set goals for their speaking tasks that were related to meeting the demands of the task, speech being relevant, clear, and concise for the audience, or self-improvement in speech. There were three types of approaches to planning, writing a script of what to say, writing bullet points, or planning in their head.

Writing a Script. The first approach to planning was writing a script. This was characterized as the participants writing out what they wanted to say in the speaking task in complete sentences as a script. This took the longest planning time in comparison to the other planning methods (5-6 minutes). Only one participant took this approach, but other participants referred to planning this way in the past (i.e., in the beginning of their programs) in their semi-structured interviews. The participant that planned by writing a script had a goal of being clear and concise with their audience. This participant described their approach,

I thought about it when doing it (*the academic speaking task*), the way that I would with a paragraph...I wrote in full sentences for that reason. Even though,

like I treated it as notes so I wouldn't necessarily completely look at it, or read straight up from it. I did write a full sentence because that's the way that I would, if it was a college application. If I was to read it just by putting like just by points in my head it doesn't make sense. Like in English it doesn't make sense to me to do that I wouldn't be able to afterwards say it, the way that I did it.

The participant later describes how they feel as though the way they speak is not reflective of the knowledge they have within their field. This participant uses the script as a rehearsal method, practicing the task to ensure that they are expressing the information they want and in the way that they want. The participant is in their first year of their doctoral program and shares how their academic proficiency in English is still growing. Using a script is likely a way the participant copes with the cognitive load of their other languages interfering with their academic English speaking. The participant mentioned the grammatical structure of other languages taking over when speaking English in academic settings and struggling to think of the right academic word. The participant anticipates these issues and uses a script to help with a successful execution of the academic speaking task.

Bullet Points. The second type of approach to planning included planning using bullet points. Four participants used this method, and the time for planning varied for this group (48 seconds- 4 minutes). This was characterized by students writing out words or phrases marked by bullet points that reflected key points to cover during their academic speaking tasks. Participants used bullet points to organize their speaking task.

Participants' goals included making their speech relevant to the audience and wanting to

improve their academic English speech by selecting the correct academic vocabulary to use and to sound fluent in their speech through completing these tasks.

One participant shared their bullet point approach to planning, “My main thought, I was thinking I just needed to have something written down in case I got sidetracked and forgot, here’s what I was talking about.” This was echoed by other participants, “I am making sure that I’m following a logical order.” Key words or phrases were chosen by something that would trigger a memory or episode they could expand on during the speaking task, “I wrote the main things that trigger my memory, like ‘collapsing building’ that one always makes me remember more, and ‘fixing construction’ is something I’m passionate about yeah that’s it.” Participants trusted that they would be able to expand on these bullet points ‘on the fly’ during their academic speaking task, “I wanted to put high level points of what I wanted to speak and kind of while I’m speaking then elaborate just a little bit more each one of those given just quite a little bit more details.” Bullet points helped these participants focus on key ideas but did not provide an opportunity for practice or guidance on how to expand on each point as the scripted approach did. These participants felt capable of expanding on each point in the moment during the academic task.

Planning in Their Mind. The third type of approach to planning was to plan for the speaking task in their mind, and this was used by five participants. This was characterized as the participant organizing their thoughts and thinking about the task in their head. The participants that used this approach typically took less time in their planning as compared to those that did not. Participants’ goals included wanting to

introduce themselves or speak in a classroom setting in a concise manner while sounding knowledgeable in their field of study, and concise. One participant described what they were thinking through while planning in their mind for the first task of introducing themselves to someone important to the field,

I think I was mostly setting the scene for myself, like imagining that I'm walking into a room and there's like a professional or someone around. Or maybe this is like after this during a conference or after a symposium or something. I was mostly just creating the mood so that I could speak more you know formally or more professionally. I had just spoken to you (*researcher*) in kind of an informal way, and so I was trying to switch my mental state, so that I would say something more formal.

This was echoed by other participants that also planned in their head with one participant sharing “It clicked in my mind that the person I’m going to introduce myself to is a technical expert in my domain, so there are a lot of things that can be unspoken communication if I just touch upon certain keywords.” The participants planning in their minds had information readily available to complete the task and used their mental space to, as one participant shared, “put the pieces of the puzzle together” connecting what they wanted to say to their audience. Most of the participants that planned in their mind felt comfortable enough with the mechanics of grammar and vocabulary selection to focus on context.

International multilingual graduate students used different approaches to planning for academic speaking tasks where they set goals and thought through strategies to achieve these speaking goals. The approaches included writing a script, using bullet points, or planning in their

mind. During the semi-structured interviews some participants shared how their planning process changed over time indicating that participants may move through these approaches like stages. One participant explained how they developed over time their ability to speak about their specific research,

The first couple of times I did that was just rote memory, like I memorized the entire speech and just went there and blurted it out. But then over time. The main motivation for why I'm doing these experiments sort of became ingrained. I can speak about that ad hoc to anyone at any level...If it needs an involved discussion, then I can go into details. But if it just requires a brushing over, then I can speak in general terms. This definitely comes from experience and repeated rehearsal, so you know discussions of the same topic.

Writing scripts, using bullet points, and planning in one's mind were three different approaches to planning for international multilingual students. As the last participant suggested, these three approaches may also reveal stages of international multilingual development of comfort in academic speaking in English.

Monitoring. Monitoring was defined as monitoring one's audience, fluency, logic of thoughts and using these to inform regulating cognitive processes for speech. This included managing high cognitive load and in the moment problem solving during speech. All participants engaged in monitoring, however they varied in their extent of monitoring. Fluency was an important theme that was found to influence the extent that students engaged in monitoring.

Fluency. Fluency in speech is the ability to speak with ease and accuracy (Goh, 2012). All participants referenced thinking about fluency in their monitoring process and the importance

of fluency in academic speech. One group of participants engaged in monitoring to a lesser extent to gain fluency. This group included three participants. This consisted of the participant indicating that they were aware of whether they were saying what they had planned to say or when they made a mistake, but they rarely used this information to inform their speech. During the verbal recall they were prompted to share what they were thinking in the moment or what they were doing at that moment to complete the task. These participants struggled to identify what strategies they were using and referred to their speech process as ‘automatic’ or ‘natural.’ For example, one participant shared, “Actually I’m not thinking so much about it. I just before saying it, I wrote it so that’s what I actually want to say. Then I just start saying that and it naturally came out of me.”

These participants shared that they were focusing on the fluency of their speech and blocking attempts to focus on their grammar or vocabulary. One participant described trying to block the “mini-google translator” that pops up in their head, “it catches me prior to saying the words, so I switch myself in the moment but by switching myself in the moment because I’m already nervous I kind of just jumble all my words.” This suggests that these participants could engage in monitoring to a higher extent, but for the sake of improving their fluency they ‘turned off’ their monitoring feedback loop in order to let their thoughts flow through their speech. One participant explained their monitoring, “I have this feedback...I’m not a native speaker so I go back and see if the structure of the sentence was good, or was right. And this causes a lot of problems. I’m trying to ignore this, and try to just focus on the fluency, try to be fluent and not think.” In an effort to sound fluent these participants are monitoring their speech to a lesser extent than they potentially could. Another participant describes, “I’m actually not following the

time I am just talking and talking.” These participants were making decisions on how to use their limited working memory space most effectively.

A participant described how they work on different aspects of academic English through different language domains. This participant worked on their grammar and vocabulary in academic English through their academic English writing and used academic speech to work on their fluency. They based their decision on how these two domains will be evaluated by the audience,

Grammatical mistakes will be evaluated in terms of writing I think and speaking it is not so much. While I'm talking with a native speaker then I have to be as fluent as possible. The native speaker will not be worried about the grammar. If I am not fluent then he or she will have to wait to understand my words.

This provides evidence that international multilingual students are using different domains of language like speaking and writing in different ways to improve their academic English.

Compared to the previous group, this group engaged in monitoring to a higher extent to gain fluency. They differed from the first group in that they used more monitoring throughout and they were more careful in their speech. This was characterized by the participants being aware of their speech and using the information to inform the adjustment, continuation, or stopping of their speech. They were able to ‘turn on’ their monitoring feedback loop and apply it to their speech. For some, this process was continuous with several moving parts. One participant described their thoughts during speech as, “monitoring myself.” They checked if they

said the names of the university and program correctly, once those were judged as satisfactory they moved to create a smooth transition by using the right words to go to the next topic. They described that while they were speaking visual information clouds in their mind would appear that were filled with previous experiences, phrases, and feelings. They pulled relevant information from these “kind of virtual entities” and formulated speech during their speech. Simultaneously they were adding details to make the speaking task simulation real. This included calling the researcher Dr. A and using phrases like “I’ve heard a lot about your lab.” These improves were added in the moment as this participant was observed taking five seconds to plan, and shared they wanted to engage in the task spontaneously to mimic how they might encounter this in real life. This participant engaged in monitoring to support their fluency, in contrast to those that consciously blocked monitoring to let their speech flow. For this participant in order to speak in a way that was knowledgeable, clear, and concise they needed to monitor while they were speaking by checking that the words were appropriate, and slowing their speech to give them time to monitor this. This participant described their monitoring as unique to their academic English language, “I become like a soldier trying to meet the goals. I’m trying to train myself, when you speak, be careful.”

Being careful in speech was another important aspect of fluency for the high frequency level of monitoring participants. To sound fluent in academic English speaking, these participants slowed their speech while monitoring. One participant described,

I’m modulating my words. I tend to speak slowly because I need to measure my words and avoid making mistakes and exposing a lack of understanding. I slow down when I’m speaking to my peers or superiors. I’m trying to put the next word

in front of what I'm saying and sort of auto-correcting that sentence internally, and then I'm running through multiple options. Because I want to be clear in my thoughts.

This process was echoed by another participant, "I try to slow down so the quality of what I'm saying is consistent. I'm not that good at it, I still definitely just go off at lightspeed and realize okay this isn't working and I have to like slow down and come back. This is something I've seen professors and scholarly people do and I like it. I like that they speak slowly and carefully choose their words." These participants slowed their speech to allow for monitoring to take place. Their thoughts were focused on the quality and conciseness of the meaning they were conveying to the audience.

International multilingual graduate students use monitoring during their speech. The extent in which they were able to engage in monitoring was influenced by how each participant approached achieving fluency. Some participants let their speech flow to achieve fluency and engaged in monitoring to a lesser extent, while others engaged in monitoring to a higher extent. Fluency in academic English speech was an overarching theme for how international multilingual students monitored their speech for academic speaking tasks.

Evaluating. Evaluation was defined as an analysis of one's speaking performance and the effectiveness of strategy use throughout speaking. All participants evaluated their speech for both speaking tasks. An important theme that emerged was the use of additional languages in the evaluation process. Participants used their additional languages in different ways during their evaluation. The findings suggest that participants thought about their different languages as separate. Additional languages were either active or silent with academic English as a part of the

evaluation process for multilingual participants. For participants that felt less proficient in academic speaking in English, additional languages were reported as active separate entities working alongside academic English. As the participant's proficiency grew, the additional languages were reported as separate entities but fell silent.

Active. One participant shared their evaluation process as a meeting with different languages in their mind. Here the participant introduced each language as a persona,

My voice changes, when I speak in a certain language compared to another. When I speak *L1* I am, I seem like I'm, my voice is very angry sometimes I scare my own self. When I speak *L2* I sound normal like much more docile. When I speak English, I'm from ~~U.S. state name~~ so whatever sound that comes from that there you go, you have that. When I speak academic English I sound like it's much more confident and a slower thing. It has a whole, I haven't figured out that, like I don't know that persona yet because I'm still talking to it if that makes sense. I'm shaping her to come across if that makes sense.

This participant separates each language, including a separate persona for everyday English and a persona for academic English. The participant later explains how their languages interact for their evaluation process in academic speaking. The participant shared that the way they evaluated their academic speaking task for the study was similar to how they evaluate in their actual academic setting using their weekly meetings with their principal investigator (PI) as an example,

I have a meeting every Friday with my PI. I use that as an exercise like it's my final test every single week to be able to know how much academic English I'm

actually able to speak. You want your PI to think well of you. Every morning at 8:45 I throw on this persona that has learned all this academic English and I go through the meeting. After the meeting is done that persona and myself kind of go to a corner and talk, okay that's what we did wrong, that's what was going on, that's where you use wrong, and so on and so forth. Then we take those notes and use them for the next meeting.

The participant clarifies that in their evaluation process it is the everyday English persona debriefing with the academic English persona. They continued to explain the development of the interaction of their languages in the evaluation process. They described the interacting personas as 'fighting' in the initial development phase of a language.

When I was first learning English, I would speak to that English persona in Italian because it was the Italian that was fighting. To give you a parallel example, right now it's my English against my academic English that's fighting kind of thing. While when I was initially learning English, it was my Italian that was fighting with English. So when I was like turning to my corner I would answer to that whatever in Italian like we will have that conversation Italian. Right now, we will have that conversation in English if that makes sense.

This participant was able to describe in detail how additional languages guide the development of their academic English, with the most relevant additional language taking center stage in the evaluation process (in this case everyday English evaluating academic English). Discussion between these two languages would take place in their mind

identifying what needed improvement in academic English, and future steps for improvement were identified and applied to subsequent speaking events.

Silent. For other participants their additional languages were still described as separate but became silent over time in the academic speaking evaluation process. This participant described focusing mainly on the accuracy of what they said (e.g., did they have the correct sentence structure or word) in their evaluation process. They continued by explaining how the prominence of their additional language changed over time, “For a long time it was (*the evaluation process*) in Arabic but now the processing is faster. So sometimes I don't even realize that I evaluated in Arabic at first, but it just came to my mind in English. But if I focus it was in Arabic, but the translation process is now faster so.” Additionally, another participant described that their other languages did not affect their speaking, “I think yeah I think it's sort of negligible.” They later explained that this is because the concepts in academia are complex and they “don't have the capacity to exercise that much critical thought” in their other languages. In this case the participant has separated their academic English to the specific context of academic settings, where they feel their proficiency in other languages is not to a level where they are able to engage in an evaluation process of their academic speaking using their other languages.

International multilingual graduate students used metacognitive regulation during their academic speaking tasks. Metacognitive regulation strategies included planning, monitoring, and evaluating. These participants approach the task in three different ways, by writing a script, using bullet points, or planning in their mind. Their approach related to how they effectively wanted to meet their goal. For monitoring, fluency played a key

role in the extent that participants engaged in monitoring. Participants blocked monitoring processes that inhibited their fluency, while others engaged in monitoring to a higher extent to improve their fluency in speech. The role of multiple languages was highlighted in the evaluation process. All participants viewed academic English as a separate language from their other languages with some participants actively engaging their other languages to inform their evaluation process of academic English, and others describing their other languages as silent in this process. Overall, international multilingual graduates use metacognitive regulation strategies in different ways during their academic speech.

Domestic Monolingual Case

Planning. Participants engaged in planning for each speaking task. Approaches included scripted speeches, bullet points, or planning in their minds. Each participant shared that within their approach they were using an organizational structure. Some participants used names or labels for their organizational structure, and others described its formation. The structures were similar across participants. One participant that planned in their head for task one and used bullet points for task two described their organizational structure for their speeches.

I use Cornell notes, I think that's the right one, or outline notes and you have the main topic and then it's inverted of the sub areas you want to talk about so that's how I take notes. And that's how I think of this. I was like lit review okay, what do I remember that's related to lit review. And then I think about the subtopics running through my head and quantification I was like Okay, the biggest thing I pulled out of when I learned about this topic was this idea.

Another participant that planned in their mind for both tasks provided a metaphor to describe their organizational structure,

Usually musical pieces have an opening, rising action, crescendo to a high point, and then they try to gradually drop off, decrescendo. So I kind of do like a little pyramid in my head. Other than that, it's just a rough construct and outlines that I've experienced through my life that I apply to presentations. But there's not a lot of what I would deem to be active in cognizant thought into the presentation, especially in something that I'm comfortable with.

Domestic monolingual students are structuring their speech in similar ways. They described using this structure across multiple academic speaking settings. This could be related to having previous academic experiences in the U.S., where academic speech (e.g., having an introduction, main idea, and conclusion) may be taught in a similar way throughout academic levels. Participants did not directly report this conclusion but did mention having used a similar structure throughout time.

Monitoring. Students use monitoring to inform their ongoing speech. Domestic monolingual students were able to verbally recall their monitoring skills, and needed prompts to do so. They reported not knowing how to explain what was going on in their speech. In this example the participant was asked what strategies they used and how they decided on those strategies to continue talking in their task.

I hadn't thought quite about what words to use there, I think I knew that what I was, I had a thought about like how it wasn't the plan, but I ended up there. And I put together that string of words I don't even know if it made sense, as I was

saying them, but I think they did. I say the words and then I realized that they don't make sense. Like I came up with the word stumbled and then I was like is it into onto. I don't know um, um how do I pick the words I have no idea. I don't know how I picked the words.

This shows the participant is aware of their speech, but not able to explain how their control system is working to deliver their academic speaking (e.g., deciding which strategy to use and its effectiveness). Another participant explains, "It's honestly it just kind of comes very naturally speaking presenting off the cuff for me. I don't know how to explain it being very natural." Participants shared that they do not often see visuals in their mind while trying to speak; they explain their minds are like "a blank screen." One participant shared what this is like during their academic speaking,

There's pros and cons of presenting the way I did. Some people think of it as like, okay, they draw the line out first and then they try to follow it. I have what I consider like a blank open space in front of me and I grab stuff from my brain and just like put it forward put it, put it forward. And so, with enough practice it's just like charging into uncharted waters instead of looking at a map first. The same thing that happened there, that was a cool demonstration of some of the faults that can come from, that is, it's like the difference between using a GPS and a map from 1980.

This indicates that participants are aware that they are not engaging control systems while speaking they "charge" through it. As one participant shared, "I have very little traffic control from this to this (*points to head and then points to mouth*)." Domestic

monolingual students were able to report on their monitoring to some degree, but tended to need prompting to be able to share.

Evaluation. Evaluation involved an analysis of speech performance and strategy effectiveness. Domestic monolingual students tended to provide extended detail in the items that they were evaluating, as compared to the prompting needed to monitor. This was also to a greater extent as compared to the international multilingual students. Participants identified what went well and what they wanted to improve in their speech related to the strategies that they used. Something unique to this group was the extent at which they provided reason for why something went well or did not go well in their speech. One participant shared that they had spoken too broadly about the topic and to create a greater connection with the audience they would have used more specific examples. This participant was concerned about feedback from the audience and elaborated on the complex process. They provided a detailed explanation of why this occurred,

I presented a review article which in and of itself, I think handicaps me at this point because we are not specifically presenting technical exact results. So I'm already starting off a little bit at a disadvantage for what I believe the task content is for this task. I did try to break it down into the relevant sections, there are certain specifics that were left out, because it is such a broad topic and I didn't pick a specific one, for example where you can name specific materials, which then brings the audience into it a little bit closer, but I just think I was a little bit too broad here and specificity probably would have helped out.

These participants tended to know how well they did immediately after their speaking task, indicating that they were aware of their speech while speaking and storing moments from their speech for their evaluation process.

Cross-Case analysis

This sample of engineering and computer science graduate students varied in how they used metacognitive regulation strategies including planning, monitoring, and evaluation. See Table 6 for mean scores from the observation checklist for international multilingual and domestic monolingual graduate students.

Planning. The average time spent planning for the international multilingual group was 1 minute and 42 seconds with plan times varying from 1 second to 6 minutes. The average time spent planning for the domestic monolingual group was 2 minutes and 5 seconds with plan time varying 6 seconds to 6 minutes. This indicates that on average domestic monolingual graduate students planned longer than international monolingual students. Both groups also exhibited physical behaviors while planning. The purpose of this case study was to understand how students are using metacognitive regulation during academic speech. There was not an anticipation that there would be physical indicators of metacognitive regulation skills, however it was visible when both groups of students were in the process of planning. This included touches to the face, changing directions in eye gaze, biting the lip, and shifting the body. There was consistently a major body shift when the participant was finished planning and ready to begin the task. These behaviors were consistent across both groups. Participants from both groups clarified task demands while planning by asking questions. Questions occurred immediately after instructions were given or in the middle of planning. The kinds of questions asked included

checking on the time limit, who the audience might be, and what type of content to include in their speech. International multilingual students would typically engage in one or two clarifying questions, while domestic monolingual students would engage in an ongoing conversation about clarifying the tasks.

Monitoring. Monitoring varied across both groups. International multilingual students engaged in monitoring to a varying extent, influenced by how they were achieving fluency. Domestic monolinguals seemed to be using automated processes in their speech and needed prompting to tap into their control processes. For this section, participants that did engage in monitoring across cases were studied. These participants referenced applying previous feedback to their speech and monitoring the application of this feedback. This feedback came from professors, advisors, family members, or from themselves. One participant that engaged in monitoring described how they were monitoring the logical flow of their professional introduction, applying previous feedback to their speech, and using that to inform their next steps in their speech,

I don't normally name drop, that's kind of a weird thing to do, but my advisor mentioned that I should even though I don't feel any great urge to. I consciously worked that in and that provided some credibility to my own presence. Here I realized, I had to start making more connections, to introduce the research that may be associated with my name, and give them as many key words associated with my name, so later when I'm not around they can say, oh okay they were the one who...

The participants that engaged in monitoring and shared that they had been in their graduate program for a few years tailored their speech as a part of their monitoring processes to meet specific areas that they wanted to work on. They ‘set up’ their speech in a way that provided intervention in anticipation of making an error they typically make. One participant explained this process,

There have been moments in the past where I lost my way explaining something technical to somebody. I lose track of where I am and then I deviate. So in order to, if I'm not able to come back to the point where I began, I should be able to complete a coherent good discussion wherever I am even if I'm deviated from the main topic. So I've started placing words and phrases in sentences in a way that allows me to go in multiple ways and still have a full discussion. That again ties into that auto-correct, you know, putting words as they come out of my mouth and rehearsing it in the brain and then seeing okay, this is fine and then I go on with it yeah something like that.

Students that engaged in monitoring applied feedback from a variety of sources and actively included interventions for themselves to promote effective and comprehensive speech while speaking. This showed how previous feedback on speech is important in the metacognitive regulation process.

Evaluation. Participants from both groups focused on a variety of categories when they evaluated their speech including quality of the content in relation to audience comprehension and affect. Participants would use comparisons, like previous academic experience, to highlight their point. For example, several participants had coincidentally just participated in a career fair. For

the participants that attended the career fair, they compared their speech performance on task 1 (professional introduction) to how they networked in their career fair. One of these participants explained, “I would give myself a seven out of ten because I included all the information I usually do, except I would’ve tailored it more towards the interest of the position, like when I was networking my knowledge in coding was not relevant for some positions.” Other participants compared their second speaking task to their first speaking task, “I was comparing how I did in the first task. Because it naturally came to my mind, don't do the mistakes that you did just before. I think in comparison it went well, I was more, I think confident. I maybe had less mistakes in terms of delivering my ideas.” The evaluation process included comparing their performance to a previous experience to gain a measure of whether they did better or worse. Both international multilingual and domestic monolingual students indicated that in real life settings they tend to pay closer attention to professional introductions (task 1) than they do classroom discussion (task 2). They expressed classroom discussions not being as important as far as performance, whereas with professional introductions it was important to make a good impression. It seemed that the way that participants evaluated task 1 was similar to how they evaluated task 2, although this could have been related to the speaking tasks being part of a research project. Participants knew that the researcher was interested in how they were thinking about their speech, and so they shared their thoughts after each task.

Evaluation that focused on content included analysis of their speaking content in relation to the potential comprehensibility of the audience. Participants’ evaluations included mentions of wanting to add more details in general or to a specific point, conveying the speech in a more eloquent way, or remembering a specific moment where they missed a technical term or repeated

an idea. One participant described their evaluation process identifying what they did well, what they wanted to do differently, and how this would impact their audience,

The main idea was conveyed, but I think I got lost with just like too much background and talking about certain statistics and I think I bridged it well at the end. But an audience that doesn't fully know every little statistic for everything I talked about there needed to have a little bit more clarification.

Having a specific audience in mind was important to all participants to be able to tailor their speech for effective audience comprehension. Participants would imagine an audience or pretend they were simultaneously the speaker and the audience for their evaluation. In this example the participant analyzes their speech as if they had listened to their speech as an audience member using their own interpretation of their speech as a marker of how well the audience would understand, "I should have added a little bit more details to it. So I would say, like if I was hearing someone saying the speech I did, I would still have questions for them."

Participants also focused on emotion during their evaluation process. They would share about how they were feeling after giving the speech, or emotions that were elicited by particular moments during their speech task. One participant shared their emotional battle during their evaluation. "I'm punishing myself, why you don't remember exactly, why you don't remember exactly like you kept it so general. Then I forgive myself okay like due to the time you had for planning it's okay you tried to survive that's also part, but I feel like that yeah." Here the participant is simultaneously focusing on the quality of the content they delivered in their speech and the emotion this elicits in their evaluation process. Another participant immediately after finishing their second task and without prompting stated, " I think I doubled the conductivity

looking back on it.” Remembering a point where they knew they had made a mistake. They go on to say that the feelings remained from that moment in their speech that is how they knew it was a moment to evaluate and correct for future speech, “It felt like that SpongeBob meme where everything's on fire, books, filing cabinets that was going on, there was a lot of colorful language in my head.” These emotions served as a marker for both international multilingual and domestic monolingual participants to remember the moment they wanted to evaluate and to revisit that moment.

This case study revealed the ways that international multilingual and domestic monolingual students use metacognitive regulation in academic speaking. Within and across cases, students used metacognitive regulation during their academic speaking tasks in a variety of ways. See Table 5 for a summary of themes from this case study. Domestic monolingual students on average planned longer than international multilingual students, all students engaged in physical behaviors while planning, and students used clarifying questions to plan and understand the speaking task. Monitoring varied across participants, and those that did engage in monitoring applied feedback from previous speech experiences as a focus for their monitoring. For some this was used to tailor their speech to meet a known area of improvement in their speech. Participants focused on content in relation to the audience comprehensibility during evaluation using emotional markers to pinpoint important moments in their speech process. Findings from this case study provided a first step into understanding metacognitive regulation use in graduate academic speaking.

Table 6*Mean Scores from Academic Speaking Task Observation Checklist*

	International Multilingual				Domestic Monolingual			
	Plan time Task1 Task2	Plan	Monitor	Evaluate	Plan time	Plan	Monitor	Evaluate
Group Mean	102	2.6	3	3.65	125	3	3.2	3.9
M1	1 113	4.5	4	3.5	E1 259 360	4	4	5
M2	64 2	3.5	3	4.5	E1 106 152	2.5	1.5	3.5
M3	1 2	3.5	4.5	4.5	E3 6 75	3	3.5	2
M4	253 174	2	2.5	2	E4 58 87	2	4.5	4
M5	0 64	2.5	3	4.5	E5 68 92	3.5	3.5	5
M6	48 123	1.5	2	3	E6 120 30	3	3	3
M7	133 51	2.5	3	4	E7 230 110	3	2.5	5
M8	16 50	2	4	3.5				
M9	359 309	2.5	2.5	3.5				
M10	11 165	1.5	1.5	3.5				

Note. Observation checklist items are listed in Appendix F. Plan time is in seconds. Planning = 5 items, monitoring= 5 items, evaluation= 5 items. There were two tasks in total and mean scores were taken using both tasks.

Mixed Methods Integration

How do metacognitive self-report scores relate to the use of metacognitive regulation skills for engineering and computer science international multilingual graduate students?

- a.** In what ways does language background explain this variance?

Integration of quantitative and qualitative data is integral to a mixed methods design (Creswell & Clark, 2018). A joint display was created to present the merge of quantitative with qualitative results to understand metacognition in academic speech. See Table 7 for the joint display of metacognition of academic speech for international multilingual students in academic speech.

Table 7*Joint Display Merging QUAN + QUAL: Within and Cross-Case Analysis*

		International Multilingual Students			Domestic Monolingual Students			
		MAI	MRASE	ST	Group Mean	MAI	MRASE	ST
Group Mean		3.76	3.55	3.07	Group Mean	3.56	3.58	3.38
	<i>M1</i>	4.61	4.53	4.00	<i>E1</i>	3.36	3.46	4.33
	<i>M2</i>	2.76	4.13	3.6	<i>E2</i>	3.34	3.40	2.50
	<i>M3</i>	3.53	2.06	4.16	<i>E3</i>	3.50	3.20	2.83
	<i>M4</i>	3.55	3.60	2.16	<i>E4</i>	3.86	2.86	3.50
	<i>M5</i>	3.98	4.73	3.33	<i>E5</i>	3.90	3.66	4.00
	<i>M6</i>	3.51	4.00	2.16	<i>E6</i>	3.48	3.13	3.00
	<i>M7</i>	4.30	2.33	3.16	<i>E7</i>	3.53	3.60	3.50
	<i>M8</i>	3.75	3.80	3.16				
	<i>M9</i>	3.96	4.00	2.83				
	<i>M10</i>	3.64	4.06	2.16				
Themes	Planning	Script Bullet points In their mind		“To plan I was trying to answer every one of the four questions in my mind with one or two sentences. Then after planning those one or	Organizational structure	“I always try to follow a structure what is it that I want to talk about. What are the key points		

Table 7 (continued)

		two sentences, when I speak to you I can expand on those one or two sentences. That's what I was mainly doing while planning.”		and then connecting key points. Okay, this is how I bridge to the next topic, this is our next topic.”
Monitoring	Fluency	“I am trying to be as fluent as possible, but to be as fluent as possible, I cannot comment to myself on the grammatical mistakes because I cannot make those two things happen at the same time. “	Blank screen	“I can't remember at that point, because I do truly just look forward when i'm presenting.”
Evaluation	Additional Languages: Active or Silent	“It's a bit awkward kind of mixing between English and L1. So I keep them separate.”	Extensive detail	“There are some words that I wish that I'd had thought to bring up prior to starting. I was trying to say, stakeholders and taxpayers, but that didn't come to mind right away. Also a couple of pauses so maybe if I had planned ahead of time how I wanted to transition through each of those bullet

Table 7 (continued)

			points that I was following along.” would’ve helped.
Cross-case	Planning	Plan time varied, physical behaviors marked participants' planning, and participants asked clarifying question	“Let me take a look at the task. Can it be like a seminar? Let me make sure I get the title.”
	Monitoring	Consisted of applying previous feedback and tailored speech in anticipation of unique needs.	“I had one Professor who shared the importance of sharing enough detail for the audience to understand but not overwhelm them. So I paused there because my brain is trying to figure out how much can I get away with, giving how much information.”
	Evaluation	Included quality of the content to audience and affect	“In my mind audiences are really important, if not the most important consideration it's like what do I know about my audience, and what they know, and what they know about me, and what they know about what I'm talking about”

Note. MAI- Metacognitive Awareness Inventory (52 items); MRASE- Metacognitive Regulation of Academic Speaking in English (15 items); ST- Speaking Task Observation Checklist (15 items; same items from MRASE).

Description

International multilingual and domestic monolingual engineering and computer science students did not differ in a statistically significant way in their self-reports on metacognition. This included general learning and studying contexts and in their academic speech. The case study explored how students used metacognitive regulation in academic speaking tasks, and findings show that students within and across cases used metacognitive regulation skills in a variety of ways. There were both similarities and differences found in how international multilingual and domestic monolingual students planned, monitored, and evaluated their academic speech. Participants varied in their approach to and time spent in planning. For multilinguals and monolinguals academic speaking in English was viewed as something separate and unique for each participant. Additional languages helped to inform the evaluation process for some multilinguals; fluency influenced the extent that multilinguals engaged in monitoring. Monolinguals created organizational structures in the planning phase, completed the task in what they referred to as a ‘blank state’, and provided detailed evaluation.

The joint display shows the scores across all measures of metacognitive regulation for the case study participants. These measures included two self-reports of metacognitive regulation skill use, one for general learning and studying (MAI), and the other for academic speaking in English (MRASE). These measures capture how students think they use metacognitive regulation. The speaking task observation checklist (ST on the joint display) was an adaptation of MRASE in a checklist format to compare how students self-reported their metacognitive regulation specific to academic speech and how they actually used metacognitive regulation in their academic speech. There was not a significant correlation between the MRASE and the

observation checklist, $r(15) = -.165, p = .525$ or the MAI and the observation checklist $r(15) = .136, p = .600$. This indicates that metacognitive regulation self-reports and actual use in academic speaking did not relate for this sample. Observation checklist and MRASE mean scores were separated for each case and no significant correlation was found for domestic monolingual students $r(5) = .362, p = .424$, and no significant correlation was found for international multilingual students $r(8) = -.208, p = .564$. Looking at each data point, monolinguals tended to have closer MRASE mean scores and observation mean scores as compared to multilinguals, however as the statistical analysis shows these relationships were not statistically significant so these results could be due to chance.

International multilingual and domestic monolingual students were using metacognitive regulation during their academic speech. Students were self-reporting metacognitive use in their general learning and studying and academic speaking in English and it did not relate to their actual metacognitive regulation use in academic speech in a statistically significant way. Language experience did not relate to self-reporting data, but appeared to impact the extent to which international multilingual students engaged in monitoring, and for some, additional languages appeared while evaluating. Self-reporting data was significantly different in planning for general learning and studying with international multilingual students reporting using planning more often than domestic monolingual students. The qualitative data suggests that international multilingual students are anticipating the extent that they will engage in monitoring their academic speech, and aligning their planning with this, however general and learning tasks were not used in this study so it is unclear how these groups' self reports would relate to those kinds of tasks.

Metacognitive regulation was observable for these speaking tasks using a checklist, and findings suggest behavioral cues may indicate ‘in-the moment’ metacognitive regulation. Overall, students were using metacognitive regulation in different ways during their academic speaking tasks. Skill use was cyclical in academic speech with planning, monitoring, and evaluation playing off of each other, but it was difficult to find what predicted these cycles. Some participants planned for 5 seconds and were highly engaged in monitoring and evaluating. Other students somewhat engaged in planning, did not engage in monitoring, and provided detailed evaluation processes. Patterns were found within each skill (planning, monitoring, and evaluation) across and within groups, however the differing combinations of all three skills (e.g., low planning, high monitoring, high evaluation) were not consistent within or across groups. This suggests that language experience was a factor that came into play during metacognitive regulation use for academic speaking, but other factors that were beyond the scope of this study seemed to influence metacognitive regulation during academic speech as well (e.g., motivation and expertise in the speaking task).

CHAPTER 5 Discussion

The purpose of this study was to understand metacognition during academic speech for international multilingual students. There were three guiding questions for this study 1) Are there differences between engineering and computer science international multilingual and domestic monolingual graduate students' metacognitive awareness self-report scores? 2) In what ways do international multilingual and domestic monolingual engineering and computer science graduate students use metacognitive regulation skills (planning, monitoring, and evaluation) during academic speaking tasks? and 3) How do metacognitive self-report scores relate to the use of metacognitive regulation skills for engineering and computer science international multilingual graduate students? Findings for each research question will be discussed below.

Summary of Findings

Research Question 1

For research question one, data were used to determine if there was a difference between international multilingual graduate students and domestic monolingual graduate students' metacognitive scores. Overall, there were no statistically significant differences in their mean scores for the MAI and the MRASE. Looking more closely at each measure revealed that the only statistically different score was for the mean score in planning in the MAI. This key finding suggests that international multilingual students' self-report score specific to planning in their general learning and studying is different from that of their domestic monolingual peers and this difference is not due to chance. The mean score in planning for international multilingual graduate students was higher than for domestic monolingual students. Compared to monolingual students, multilingual students may engage in more planning because international multilingual

students are in learning settings where the instructional language is in a language other than their primary language, and for many international students it is also in a new context (Andrade, 2014). Planning helps a student understand the demands of the tasks and deciding how to engage in the learning task (Winnie, 2001). This could explain the difference between group means scores in planning. It was surprising that a similar difference was not found for self-reporting mean planning scores for the MRASE, that measured metacognitive regulation specific to academic speaking. Research has shown that opportunities to plan for speaking tasks decrease cognitive load and have shown positive effects in fluency and complexity of speech (Foster & Skehan 1996; Ortega, 1999). This suggests that similar benefits from planning for general learning tasks would be the case for academic speaking as well. Additionally, some international multilingual students experience anxiety with speech which might lead some to self-report planning more to help with speech anxiety (Khoshlessan & Das, 2019; MacIntyre & Gardner, 1994). Either way the general trends for self-reporting in both the MAI and MRASE were varied as the histograms in Figure 4 and 5 display indicating that students in general differ in their self-reports for metacognitive regulation in both general learning and academic speaking.

Research question one had a sub-question relating to the degree that language experience relates to metacognitive awareness. There was no statistically significant relationship found between language experience and MAI or MRASE mean scores. Looking more closely there was a moderate positive correlation between the number of languages a participant knew and their MAI planning mean scores. This suggests that the more languages a participant knew the higher the planning self-report mean score was for general learning and studying. Previous research looked to explain how other languages inform speech production in general second language

speaking tasks and found that the more languages their participants knew the more complex the process was in speech production (Cohen & Olshtain, 1993). This supports the idea that international multilingual students may use their multiple languages in their general learning planning process to translate the task, create a plan, and then complete the learning task. Other variables for language experience did not correlate with metacognitive survey scores. The age of English language acquisition and proficiency rating in English did not relate to MAI or MRASE self-report mean scores, which is in contrast to other findings that have linked language experience to metacognition through performance ratings. One study suggests that proficiency in language is related to monitoring in the form of calibration or absolute monitoring (Temelman-Yogev, et al., 2020). They found that a participant's language proficiency in the reading task related to how well they could accurately predict their performance. This study found a relationship between planning for general learning and studying and how many languages a participant spoke; however, the ratings were not self-reported, as in the current study. Other variables for language experience may be correlated if future studies include a performance measurement of speaking and speaker's judgment of task.

A major finding from research question one is that international multilingual students and domestic monolingual students did not differ in a statistically significant way in their self-report scores on metacognitive awareness in general learning and studying measured by the MAI. These groups also did not differ in their self-reports of metacognitive regulation in academic speaking in English measured by the MRASE. Furthermore, language experience did not relate to metacognitive mean scores. These findings suggest that language experience does not relate to overall metacognitive self-reports. The data also shows that there is a difference in how

international multilingual and domestic monolingual students plan in general learning and studying; and for multilingual students the more languages they speak, the higher they self-report planning.

The validity of the MRASE was important to explore for this study. Future studies are still needed to validate this measure using larger population sizes and continued expert advice. Preliminary findings suggest that this is a reliable measure. The confirmatory factor analysis also suggests that a three-factor model is better to measure metacognitive regulation including separate items for planning, monitoring, and evaluation, as opposed to a one-factor model with 15 items that measure metacognitive regulation. The statistical tests that show a significant difference in planning scores between the international multilingual group and domestic monolingual group also support that metacognitive regulation has distinct components. This confirms what is found in the research that metacognition is complex and better measured by its components (Schraw & Dennison, 1994).

Research Question 2

For research question two a case study was used to reveal the ways that international multilingual and domestic monolingual students used metacognitive regulation during academic speech. All students used metacognitive regulation during academic speech, and engaged in planning, monitoring, and evaluation in a variety of ways within and across cases.

Findings from this study showed that international multilingual students approached their speaking tasks in distinct ways that seemed to be related to their English language proficiency with longer planning times for those that expressed feeling less proficient in English. In the Cohen and Olshtain (1993) study the participants that were less proficient in the second language

learning task language used multiple languages to plan for the task (e.g., L1 to translate the task into L2, L2 to plan in their mind, L3 to translate the L2 response back into the target language). This could help to explain how English language proficiency in academic speaking played a role in plan time. Participants used either a script, bullet points, or planning in their mind to organize their task. These different methods were linked to managing their cognitive load. Students were anticipating the extent that they would be able to engage in monitoring their speech related to their English proficiency and used their planning to address their potential monitoring engagement. The extent that participants monitored was influenced by how the participant decided to achieve fluency. Ultimately all participants wanted to sound like a knowledgeable scholar to their field and wanted their voice to be heard and understood by the scientific community. Those that engaged in monitoring to a lesser extent were overwhelmed by English accuracy feedback, and to be able to allow speech to flow freely, had to block all feedback by ‘turning off’ their monitoring. On the other hand, those that engaged to a higher extent in monitoring skills seemed to have less overwhelming internal feedback and were able to manage this feedback loop to produce fluent speech. For those that engaged in monitoring, a common method used to manage the consistent feedback was to slow their speech. The group of students with less proficiency viewed ‘letting their speech flow’ as a fluency goal for the speaking tasks, they did not want the audience to have to wait as they figured out grammatical structures and assumed the audience could autocorrect these errors while listening and still get the main point across. The other group of more proficient English speakers knew their speed of speech was good enough to capture the audience's attention and consciously slowed their speech to ensure

each word choice, phrase, and sentence was carefully and effectively chosen. The perceived feedback and cognitive load played a role in what students chose to do for monitoring.

Participants viewed their academic English as a separate language due to its complexity. During the evaluation process participants either actively used their other languages to inform their evaluation of academic English or their other languages fell silent. This may be influenced by English being the dominant language in higher education academic research in general, not just in the participants' graduate program (Pennycook, 2017). In other words, it can be difficult to incorporate other languages in English dominant education settings where content is complex and other languages may not be needed to interact and succeed in the academic world. International multilingual students used metacognitive regulation skills including planning, monitoring, and evaluation. They varied in their approach to speaking tasks, engagement with monitoring, and use of additional language in evaluation.

Domestic monolingual students planned academic speaking tasks by following a similar organizational structure. This structure included key points with an opening and closing. This showed that students were organizing their academic speech in similar ways. Domestic monolingual students tended to need prompting for their monitoring. They indicated that when they were speaking their minds were like a blank screen, applying their plan to accomplish their speech with few breaks to think about what they were saying. In the evaluation process this group of students provided extensive detail in their evaluation process. They would identify parts of their speech that went well, things they noticed and wanted to improve, the effectiveness of their strategies, and provide explanations for why these occurred. The difference in the extent that participants monitored and evaluated for these groups could be due to the automation of

monitoring processes while speaking. A task can be completed with little thought process and effortlessly when it is automatized (e.g., saying your name, driving a car, etc.; Ormrod et al., 2016). The use of metacognitive regulation skills decreases once a learning task becomes automatic. In this case, domestic monolingual students may have automatized their professional introduction and classroom discussion about their field of study. Metacognitive regulation skills can be used with an automatized skill or task, this would take place when the skill is used in a different way (e.g., sounding out your name backwards, driving on a different side of the road, etc.). It may be that when domestic monolingual students engage in academic speaking tasks in a new way they may be able to report on their monitoring skills. For example, if they had to tailor their professional introduction to meet the needs of a group they had not rehearsed an introduction for, or if a classroom discussion required that they related their field of study to a new topic. For these tasks it seemed that certain monitoring processes were more rehearsed and happened quickly and not as apparent for verbal recall.

For the cross-case analysis, average plan time was similar between cases with domestic monolingual students, on average, planning longer than international multilingual students. Students engaged in planning behaviors that were visible to an observer. This was a helpful marker for plan time and for when the participant was ready to begin the task. Metacognitive regulation during speech is difficult to measure because most metacognitive measurements require the participant to share their thinking, and this usually involves speaking about it. It is difficult to speak about one's thought process during academic speech because the participant is already engaged in speaking. These behaviors served as additional evidence that participants were planning and included looking off into the distance after first hearing the instructions of the

task, writing during planning and then touching one's face, and when the participants were ready to begin speaking they would verbally state it and shift their body by sitting up straight, leaning closer, or to an opposite side. Some research has looked into oral presentation and gestures indicating that people do make movements that are linked to their thought process (Harrison, 2021). This was not an anticipated finding, but something worth exploring in the future for identifying metacognitive regulation during academic speaking.

Monitoring included applying feedback from previous speaking experiences and tailoring their speech to ease anticipated common errors. Evaluations focused on the quality of speech content. This was usually related back to the comprehensibility of their speech to the audience. Participants indicated the audience being an important part of their metacognitive regulation process. Participants imagined the audience during their planning stages and used this to analyze their speech and the effectiveness of strategies for evaluation.

All participants from this sample used planning, monitoring, and evaluation during their speech; this is an important point to clarify as it is not established in the research that graduate students engage in metacognitive regulation during academic speech. Some studies have shown that graduate students report using metacognition in academic settings (not directly related to speech), but no studies have collected metacognitive regulation use during academic speaking tasks for graduate students (Shi, 2018). A key take-away is that engineering and computer science graduate students are using planning, monitoring, and evaluation during academic speech, and the ways that they use metacognitive regulation varies.

One hypothesized variable for impacting the variance for graduate students was language experience. For the international multilingual case there were unique ways in which language

experience impacted their metacognitive regulation including the extent in which students could engage in monitoring, and that some students used additional languages as part of their evaluation process. Domestic monolingual students planned their academic speech using a similar organizational structure, provided detailed evaluation processes, and needed prompts to engage in monitoring. Overall, cases were varied in a similar way across groups with students using each skill to a lesser or higher extent as compared to other skills and to other students.

Research Question 3

On average international multilingual and domestic monolingual graduate students enrolled in engineering and computer science programs at an English speaking R1 university in the U.S. report using metacognition sometimes to most of the time. This included metacognition in both their general learning and studying, and in their academic speaking. There was no statistical difference in overall mean scores for either group. There was a difference found in planning mean scores for metacognitive regulation use in general learning, and a significant correlation between the number of languages participants knew and their planning in general learning and studying. The mean scores were slightly higher for international multilingual students, indicating they spend more time planning in learning and studying contexts. The case study in contrast, revealed that domestic monolingual students on average spent more time planning for their speaking task. The data showed that while both international multilingual and domestic monolingual students asked clarifying questions during their planning for speaking tasks, domestic monolingual students engage in a more conversational style of questioning. International multilingual students would typically ask one to two questions and once the researcher replied they would continue with their planning, in contrast domestic monolinguals

would continue the exchange with additional comments or questions. This likely led to a longer plan time for domestic monolingual students. It would be beneficial to compare plan times in naturally occurring academic speaking settings to explore if participants engage with someone around them to clarify speaking tasks in real life or was it the nature of this simulation that triggered the conversation (i.e., participants knowing this was a research study and wanting to complete the task appropriately).

In general, the mean scores of the MAI, MRASE, and speaking task observation sheet were not related. Looking at each data point it seemed as though the domestic monolingual groups' self-reports on academic speaking were more closely matched to their observed behavior; whereas the international multilingual group tended to self-report higher metacognitive regulation behavior, than was observed in their academic speaking tasks. This was not a significant relationship. These speaking tasks were simulations, however the participants reported using similar metacognitive processes in the task as they did in their actual academic settings indicating that findings in actual academic settings would potentially align. Self-reports in the field of metacognition have been shown to provide a general overview of metacognitive regulation skills, but there is not strong evidence to support that self-reports relate to actual behaviors (Craig et al., 2020). International multilingual graduate students are underrepresented in research in the metacognitive field (Azevedo, 2020), however it seems that the literature supports the findings for international multilingual students in this study in that their self-reports did not accurately represent their actual metacognitive regulation use in academic speaking tasks.

Results from this study can be used to further clarify the definition of metacognition and expand the field of metacognition by introducing a measurement system of metacognitive

regulation of academic speech for graduate students that is based off of previous reliable and valid measures. Previous literature in metacognition highlights the importance of measurement and the need for unification in the definition of metacognition, and as a result improvement in the validity and reliability of measurement systems of metacognition are needed (Azevedo, 2020; Dinsmore et al., 2008; Schraw & Impara, 2010). Issues with metacognitive measurement are partly due to the blurred and multiple definitions of metacognition. Although this term ‘Metacognition’ was introduced in the 1970’s (Brown; 1987; Flavell, 1979), the idea of observing one’s mind, self-reflecting, and regulating one’s thoughts to improve memory dates back centuries (Dunlosky & Metcalfe, 2009). The field of metacognition has continued to grow and diversify since the 1970’s leaving behind different definitions and subcategories of metacognition varying with researchers’ backgrounds and interests. Some of these terms include, “metacognitive beliefs, metacognitive awareness, metacognitive experiences, metacognitive knowledge, feeling of knowing, judgment of learning, theory of mind, metamemory, metacognitive skills, executive skills, higher-order skills, metacomponents, comprehension monitoring, learning strategies, heuristic strategies, and self-regulation” (Veenman et al., 2006, p. 4). This lack of coherence necessitates that researchers in this field be clear in their terminology choice and definitions throughout their research process (Dinsmore, 2008). For this study, the definition of metacognition was made clear to inform the type of measurement used. The aim of this study was to begin understanding multilingual students’ metacognition in academic speaking. Results from this study are a starting point for research in this area, as it is an understudied field. Findings from this study, that included no statistical difference in mean MRASE scores for international multilingual students and domestic monolingual students,

should be interpreted carefully as multiple factors could be at play. Metacognitive awareness and skills are intertwined with other factors like motivation, self-efficacy, and learning context (Winnie & Azevedo, 2014). Collecting data from graduate students in a different program may lend different results. For example, graduate students in the college of education that rely heavily on communication to exchange ideas in practice may self-report differently as compared to students in an engineering or computer science program where communication may not be viewed as important as other skills. For example, during an earlier pilot study I conducted exploring metacognition of speech one participant shared that a common saying in the field of computer science during a job search is that “coding can get you a job, but communication will get you promoted.” They explained that communication is important to success in the program, but you could get by without being skilled in it. Rarely have studies used both qualitative and quantitative data to explore metacognition (Azevedo, 2020; Dinsmore, 2008). Capturing both forms of data for this study provided a bigger picture of metacognitive regulation during academic speech for international multilingual students, revealing what this looked like for participants involved in this study, and invites researchers to continue to explore this field for differing samples across programs.

Key Findings

This study showed that for engineering and computer science graduate students enrolled in a R1 university, academic speaking in English is unique in the vocabulary use, context, and thought processes needed to engage in academic speaking in English. An important finding is that students are using metacognitive regulation in their academic speech, and it is observable. Metacognition is a complex process and disentangling what factors impact this process and how

they impact the process is needed. This study was an attempt to understand if language experience was a factor that impacted metacognition and specifically metacognitive regulation in academic speech for multilingual students. Statistical evidence suggests that language experience is not a factor that impacts metacognition, however these were self-reports that measure what students think their metacognitive processes look like, not how they are actually using them. A case study showed that international multilingual and domestic monolingual students are using metacognitive regulation strategies during academic speech in varied ways. Language played a role in international multilingual students' evaluation and monitoring processes. For some students their additional languages played an active role in evaluating academic speech. Fluency guided to what degree students engaged in monitoring. Overall, students varied in their metacognitive self-reports and metacognitive regulation with self-reports and actual use of metacognitive regulation skills showing no relationship. Qualitative data suggests that factors like expertise, motivation and value of task, and emotions are also important factors in metacognitive regulation for academic speech to consider.

Limitation

For the quantitative portion of this mixed methods study, language experience and metacognition were represented numerically, limiting the findings to the imposed constraints of a number representing the concept of these variables. Metacognition and language are both complex and multifaceted concepts that are difficult to consolidate to a numerical value. To address this, both quantitative and qualitative measures were included to explore these research questions. Metacognition measures included the MAI, MRASE, observation of academic speaking tasks, verbal reports, and semi-structured interviews. It would be beneficial to extend

this data collection method to other academic speaking contexts that include live academic settings (e.g., academic presentations, advisor meetings, lab meetings, classroom discussion, etc.). This would help to explain how metacognition during academic speech compares in different settings. Language experience and proficiency data is limited to self-report for this study. Gathering other forms of evidence to represent language experience would be valuable. This could include English proficiency scores (e.g., graduate entry TOFEL scores), and including a speech performance rubric and score for the academic speaking tasks graded by both the participant and an expert.

A further limitation for this study is the context in which the speaking tasks were conducted. The speaking tasks were created to simulate real-world speaking tasks that were able to be completed online. This helped with data collection within time constraints and limited the need for in-person contact during the ongoing COVID-19 pandemic. Conducting these observations in a natural setting may lead to different findings. For this reason, a question in the semi-structured interview was included for participants to report how the processes they used during the speaking tasks were similar or different to the processes they used in real life.

Significance of Study

The present study explored metacognition of academic speech for international multilingual students using a mixed methods convergent design to collect metacognitive awareness scores, language experience in English, and metacognitive regulation during academic speaking tasks. The findings from this study built upon existing knowledge in the metacognitive field by refining the meaning of metacognition in the context of academic speech in English for international multilingual graduate students. This is the first study that provides insight into how

graduate students are thinking about their academic speaking. This study focused on engineering and computer science graduate students and findings suggest that international multilingual students and domestic monolinguals do not differ in how they self-report their metacognition in academic speech. Language background related to self-reporting in planning for general learning and studying but did not correlate or differ for other areas of metacognition.

Implications

Few studies within the metacognitive and linguistic fields have sought to focus on graduate level speaking environments and metacognition. The graduate journey has proven to be difficult yielding a 30-50% seven-year completion rate across fields (Council of Graduate Schools, 2020; Xu et al., 2018). Graduate programs require academic scholarship, research skills, critical thinking, and independence. An unfortunate finding from previous studies is that multilingual students that make up a significant portion of the graduate population in the U.S. have gone largely untracked (Andrade, 2015). Bringing forth the metacognitive experiences during speech for the international multilingual graduate population helps to highlight factors that relate to metacognition during speaking tasks.

Data analysis from this sample suggests that there are no significant differences in how multilingual and monolingual graduate students self-report their metacognitive skills, and each group varied in a similar way in how they used metacognitive regulation skills. Professors and colleagues that work with the graduate student population can apply these findings to their work with students in academic speaking settings. Simply understanding that these processes exist and that students are using them is helpful to know when interacting with graduate students while speaking. For example for speaking tasks given in class, professors could allow a few moments

for students to plan for their speech knowing that some students may physically write out a script, list bullet points, or plan in their mind. When colleagues are engaging with students in academic speaking they can keep in mind that students are likely trying to sound as fluent as they can in their academic speech with some students letting their speech flow including grammatical errors, and others may be slowing their speech and meticulously choosing each word and phrase. For speech activities during class or practicing academic speeches it would be advantageous to set the stage for who the audience will be because students reported finding this information important in their planning and evaluation process. Using measures from this study can also help to provide insight into students' academic speech. For example, recording a 1-5 minute academic speech and playing it back using the prompts can provide insight into the students' metacognitive regulation process and be used to inform future academic speech (e.g., what works well, what needs improvement, and what the speaker is doing to accomplish this).

Findings from this study provided evidence to understand how these students use metacognition during academic speech and how this varies depending on contexts like year in program or language background. Understanding what factors impact metacognition in academic speech and effective metacognitive skills will help in the development of academic speech interventions to help students and those that work with students to have successful academic speaking events. The MRASE and academic speaking observation checklist shows promise in being a reliable and valid measure of metacognitive regulation during academic speech for graduate students. Preliminary qualitative analysis suggests that the academic speaking tasks can potentially serve as an intervention.

Future Research

One important future step would be to investigate the MRASE and observation checklist as valid measures of metacognitive regulation during academic speaking. These preliminary findings show that both these measures are reliable. The findings suggest that these measures are valid, however further investigation is needed for a more accurate analysis using psychometric measures like item response theory, and preferably with a larger sample size. Another promising finding was the potential for the academic speaking tasks to serve as an intervention. The majority of participants mentioned that the playback of speech with prompts provided an opportunity to notice things about their speech they otherwise would not have noticed. It would be interesting to follow up with participants to investigate in what ways participating in this study impacted their academic speech throughout the semester. Additionally, collecting speech performance data (academic speaking that was graded), and comparing a control group to an experimental group that completed several academic speaking tasks throughout a semester would reveal whether academic speaking tasks impact academic speech performance. It would be beneficial to see to what degree and for how long the impact lasts by including groups that received one, two, three, or four speaking tasks throughout the semester and measuring speech performance the following semester.

Collecting academic speech performance data would also be useful in examining the quality of metacognitive regulation skills in academic speech. The findings from this study confirm that students are using metacognitive regulation during academic speech, and the way that they use these skills varies. Linking how students plan, monitor, and evaluate to their actual speech performance would reveal what kinds of metacognitive regulation strategies are most

useful, when, and in what ways. Having speech performance data would also provide an opportunity to investigate other aspects of metacognition like calibration. This would explain how well students predict their academic speech performance in comparison to how well they actually perform. This is important to understand because students' thoughts impact their behavior. In theory, this would mean how well students think they'll do on a speaking task would impact how they engage with the task and therefore impact their resulting speech performance.

The speaking tasks also show promise as a way to train students to report their metacognitive regulation while speaking. There were several students from each case that had what they referred to as 'meta-moments' where they were describing a metacognitive regulation skill and then they would experience it in the moment and say things like, "It's happening right now." Using keywords or hand signals during speech to indicate a metacognitive regulation skill would provide a more accurate in-the-moment measurement of metacognitive regulation skills happening while speaking, which has not been conducted before.

A continuation of understanding different factors that impact metacognition in academic speaking settings is needed. This study focused on language background as a possible factor that would impact metacognitive regulation use during academic speaking tasks. Focusing on other factors may bring clarity to the varying degree of metacognitive regulation use. Factors could include self-efficacy, affect, and motivation in academic speaking. It was also apparent that the speaking task mattered in how participants used metacognitive regulation skills. It would be worthwhile to identify what types of academic speaking tasks are associated with specific graduate programs and how valued these speaking tasks are to success in the program.

It would be valuable to conduct this study on a larger scale to be able to draw some generalizable conclusions of how graduate students are using metacognition during their academic speech. This would be helpful in tracking trends in metacognitive regulation skill use in changing educational landscapes. For example, understanding how metacognitive regulation skill use is conducted in online versus in-person academic speech. Recent research in assessment of speaking has suggested using virtual reality to simulate natural speaking settings to collect proficiency data (Salaberry & Burch, 2021). Creating a task using virtual reality to replicate an academic speaking task would help with collecting data on a large scale.

Finally, participants indicated in their semi-structured interview that their metacognitive regulation skills grew and changed over time and in their graduate programs. Collecting longitudinal data to map this growth would also be valuable in a quest to understand the development over time of metacognition graduate populations.

Conclusion

This study has laid the groundwork within the field of metacognition in academic speech for multilingual graduate students. During this study one multilingual participant exclaimed, “Oh, my gosh do we think so much?” These preliminary findings have shown that multilingual graduate students are thinking about their thinking during academic speech, and using metacognitive regulations skills like planning, monitoring, and evaluating in a variety of ways that coincide with how monolingual students use these skills. Prior to this study the multilingual graduate student population had gone mostly untracked in graduate academic speaking, including the linguistic experiences of this population. Sharing findings from this study with the scientific community will bring forth the voices of international multilingual students and provide an

opportunity to learn from their diverse linguistic experiences and how this is applied in higher education academic speaking settings.

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APPENDICES

Appendix A

Demographic Survey

Participant selection	Are you a graduate student enrolled in a U.S graduate program?	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Are you identified as an international or domestic student?	<input type="checkbox"/> International <input type="checkbox"/> Domestic
	Do you identify as multilingual or monolingual?	<input type="checkbox"/> Multilingual <input type="checkbox"/> Monolingual
Graduate Program	List the program you are currently enrolled in.	<i>Fill in the blank</i>
	List the year you started your graduate program.	<p>— — — —</p> <p>(List four boxes and only allow number entries)</p>
	Are you currently a full-time or part-time graduate student?	<input type="checkbox"/> Full-time <input type="checkbox"/> Part-time
Gender	What is your current gender identity?	Check all that apply <input type="checkbox"/> Non-binary/ Gender non-conforming <input type="checkbox"/> Woman <input type="checkbox"/> Man <input type="checkbox"/> Self-identify (please specify): _____
Age	List the year you were born.	— — — —
Ethnicity	List the ethnicity you identify as.	<i>Fill in the blank</i>
Interviews	Can we contact you to participate in a follow up interview?	<input type="checkbox"/> Yes <input type="checkbox"/> No Email: _____
Email	Would you like to be entered in the \$50 Amazon gift card drawing?	<input type="checkbox"/> Yes <input type="checkbox"/> No <i>*If selecting yes participant will be taken to a google form that asks for their email address.</i>

Appendix B

Language Experience and Proficiency Questionnaire (LEAP-Q)

(1) Please list all the languages you know **in order of dominance**:

(2) Please list all the languages you know **in order of acquisition** (your native language first):

(3) Please list what percentage of the time you are *currently* and *on average* exposed to each language.

(*Your percentages should add up to 100%*):

Language:

Percentage

(4) When choosing a language to speak with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report percent of total time.

(*Your percentages should add up to 100%*):

Language:

Percentage:

All questions below refer to your knowledge of *these questions will be repeated for each language listed.*

(1) Age when you...:

began acquiring:

became fluency in:

(2) Please list the number of years and months you spent in each language environment:

A country where ___ is spoken (years and months)

A family where ___ is spoken

A school and/or working environment where ___ is spoken

(3) On a scale from zero to ten, please select your *level of **proficiency*** in speaking, understanding, and reading from the scroll-down menus:

Speaking:

Understanding spoken language:

(4) In your perception, how much of a foreign accent do you have in **language**? (scale 1-10)

(5) Please rate how frequently others identify you as a non-native speaker based on your accent in **language** (scale 1-10)

Appendix C

Metacognitive Regulation in Academic Speaking in English (MRASE)

Never	Rarely/Infrequently	Sometimes	Most of the Time	Always
1	2	3	4	5

*The following questions refer to the speaking you do in your graduate program.

1. I think about what I need to say before I begin speaking about an academic topic in English. (P; 6)
2. I set specific goals before I begin speaking about an academic topic in English. (P; 8)
3. I ask myself questions about the speaking task before I begin speaking about an academic topic in English. (P; 22)
4. I think of several ways to approach a speaking task and choose the best one when speaking about an academic topic in English. (P; 23)
5. I organize my time to best accomplish my speaking goals when speaking about an academic topic in English. (P; 45)
6. I consciously focus my attention on important information when speaking about an academic topic in English. (IM; 13)
7. I ask myself if the speaking task is related to what I already know when speaking about an academic topic in English. (IM; 43)
8. I visualize or follow an organizational structure in my mind to help me organize my speaking while speaking about an academic topic in English. (IM; 37)
9. I think through changing strategies when I fail to say what I wanted to say when speaking about an academic topic in English. (D; 40)
10. I find myself mentally pausing when speaking about an academic topic in English to check the comprehensibility of what I'm saying to the listener. (CM; 34)
11. I know how well I did once I finished speaking about an academic topic in English. (E; 7)
12. I ask myself if there was an easier way to do things after I finish speaking about an academic topic in English. (E; 19)
13. I ask myself how well I accomplish my goals once I'm finished speaking about an academic topic in English. (E; 36)
14. I ask myself after I've spoken about an academic topic in English if I expressed everything I wanted to while speaking. (E; 50)
15. I ask myself if I best conveyed my thoughts after finishing speaking about an academic topic in English. (E; 49)

Note. Letters and numbers in parentheses represent the related question from the MAI (Schraw & Dennison, 1994)

Appendix D

Metacognitive Awareness Inventory (MAI)

Never	Rarely/Infrequently	Sometimes	Most of the Time	Always
1	2	3	4	5

1. I ask myself periodically if I am meeting my goals. (M) (CM)
2. I consider several alternatives to a problem before I answer. (M) (CM)
3. I try to use strategies that have worked in the past. (KC;D)
4. I pace myself while learning in order to have enough time. (P)
5. I understand my intellectual strengths and weaknesses. (KC;D)
6. I think about what I really need to learn before I begin a task (P)
7. I know how well I did once I finish a test. (E)
8. I set specific goals before I begin a task. (P)
9. I slow down when I encounter important information. (M) (IM)
10. I know what kind of information is most important to learn. (KC;D)
11. I ask myself if I have considered all options when solving a problem. (M) (CM)
12. I am good at organizing information. (KC;D)
13. I consciously focus my attention on important information. (M) (IM)
14. I have a specific purpose for each strategy I use. (KC;P)
15. I learn best when I know something about the topic. (KC;C)
16. I know what the teacher expects me to learn. (KC;D)
17. I am good at remembering information. (KC;D)
18. I use different learning strategies depending on the situation. (KC;C)
19. I ask myself if there was an easier way to do things after I finish a task. (E)
20. I have control over how well I learn. (KC;D)
21. I periodically review to help me understand important relationships. (M) (CM)
22. I ask myself questions about the material before I begin. (P)
23. I think of several ways to solve a problem and choose the best one. (P)
24. I summarize what I've learned after I finish. (E)
25. I ask others for help when I don't understand something. (M) (D)
26. I can motivate myself to learn when I need to. (KC;C)
27. I am aware of what strategies I use when I study. (KC; P)
28. I find myself analyzing the usefulness of strategies while I study. (M) (CM)
29. I use my intellectual strengths to compensate for my weaknesses. (KC; C)
30. I focus on the meaning and significance of new information. (M) (IM)
31. I create my own examples to make information more meaningful.(M) (IM)
32. I am a good judge of how well I understand something. (KC; D)

33. I find myself using helpful learning strategies automatically. (KC; P)
34. I find myself pausing regularly to check my comprehension. (M) (CM)
35. I know when each strategy I use will be most effective. (KC; C)
36. I ask myself how well I accomplish my goals once I'm finished. (E)
37. I draw pictures or diagrams to help me understand while learning. (M) (IM)
38. I ask myself if I have considered all options after I solve a problem. (E)
39. I try to translate new information into my own words. (M) (IM)
40. I change strategies when I fail to understand. (M) (D)
41. I use the organizational structure of the text to help me learn. (M) (IM)
42. I read instructions carefully before I begin a task. (P)
43. I ask myself if what I'm reading is related to what I already know. (M) (IM)
44. I reevaluate my assumptions when I get confused. (M) (D)
45. I organize my time to best accomplish my goals. (P)
46. I learn more when I am interested in the topic. (KC; D)
47. I try to break studying down into smaller steps. (M) (IM)
48. I focus on overall meaning rather than specifics. (M) (IM)
49. I ask myself questions about how well I am doing while I am learning something new.
(M) (CM)
50. I ask myself if I learned as much as I could have once I finish a task. (E)
51. I stop and go back over new information that is not clear. (M) (D)
52. I stop and reread when I get confused. (M) (D)

Knowledge of Cognition: Question #s

Declarative: 5, 10, 12, 16, 17, 20, 32, 46,

Procedural: 3, 14, 27, 33

Conditional: 15, 18, 26, 29, 35

Regulation of Cognition: Questions #s

Planning: 4, 6, 8, 22, 23, 42, 45 (7)

Monitoring: *Information monitoring:* 9, 13, 30, 31, 37, 39, 41, 43, 47, 48;

Comprehension monitoring: 1, 2, 11, 21, 28, 34, 49; *Debugging strategies:* 25, 40, 44, 51, 52 (22)

Evaluation: 7, 19, 24, 36, 38, 50 (6)

Appendix E

Speaking Tasks

Introduction	<p>Thank you so much for meeting with me. If at anytime you no longer want to participate in this study please say, “I’d like to stop” and no data will be stored. Before we begin, do you verbally consent to participate and to be recorded?</p> <p>Hit record</p> <p>We will complete two tasks, the approximate time it will take to complete the tasks is 30 minutes, however that may vary depending on the time you spend with each task. While these are simulations, try to engage with these as best you can to how you would if these events were really happening.</p>	
TASK 1 Academic Networking (Introduction)	<p>Check Zoom is recording</p> <p>Pretend you are in a room with well-known professionals in your field of study who you have not met before. Your task will be to create an introduction about yourself. For reference, try to keep your introduction between 1- 5 minutes. I’ll link a google doc with the points that you may want to be included in your introduction. You can take notes in the document if needed but it’s not necessary. This is not for an evaluation, I’m just curious about what you think about when you’re speaking.</p> <p>Link google doc the google doc is linked in the chat, take as much time as you need to prepare although it’s not required you take time to prepare, and let me know when you’re ready.</p>	<p>Google Doc:</p> <ol style="list-style-type: none"> 1. Current field of study in your program. 2. Did anything inspire you to study this topic? 3. Future professional goals.
Evaluation	<ul style="list-style-type: none"> ● Are you having any thoughts right now you can share? ● How do you think the speaking 	

	<p>event went? (Evaluation)</p> <ul style="list-style-type: none"> ○ How well do you feel like you introduced yourself? ○ What would you change? ○ Rate yourself 	
Planning	<ul style="list-style-type: none"> ● In what ways did you plan for this speaking event? 	<p>For analysis:</p> <ul style="list-style-type: none"> ● Include time stamp of how long participant planned ● Observation of planning (e.g., movements, writing, thinking aloud)
Monitoring	<p>Now I'm going to play back the audio recording of the speaking task. During the playback I will pause it throughout when I'd like you to share what you were thinking while speaking. I'd also like you to ask me to pause the playback by saying 'PAUSE' or raising your hand when you would like to share what you were thinking during your speaking.</p>	<p>Prompting if needed: Here are examples of things you might share.</p> <ul style="list-style-type: none"> ● How had you planned to say this part? ● What were you doing to help you meet your speaking goal at that moment?
TASK 2 Academic Content (Classroom Discussion)	<p>Now we will move on to task two, is that okay with you?</p> <p>Academic Content: You are participating in a classroom discussion and your assignment is to present a short overview of a favorite academic resource you have engaged in related to your field (e.g., an academic reading, podcast, documentary) that you could share a little bit about. Similar to task one, the timing should be between 1-5 minutes. I'll link a google doc with</p>	<p>Google Doc:</p> <ol style="list-style-type: none"> 1. Main topic. 2. Something that you learned. 3. Something you still have a question about.

	<p>points you may want to include in your discussion. You can take notes there, but this is not necessary. You can take as long as you need to prepare. Let me know when you are ready to begin and I will record. Link the google doc</p>	
Evaluation	<ul style="list-style-type: none"> ● Are you having any thoughts right now you can share? ● How do you think the speaking event went? (Evaluation) <ul style="list-style-type: none"> ○ How well do you feel like you introduced yourself? ○ What would you change? ○ Rate yourself 	
Planning	<ul style="list-style-type: none"> ● In what ways did you plan for this speaking event? 	<p><i>For analysis:</i></p> <ul style="list-style-type: none"> ● Include time stamp of how long participant planned ● Observation of planning (e.g., movements, writing, thinking aloud)
Monitoring	<p>Now I'm going to play back the audio recording of the speaking task. During the playback I will pause it throughout when I'd like you to share what you were thinking while speaking. I'd also like you to ask me to pause the playback by saying 'PAUSE' or raising your hand when you would like to share what you were thinking during your speaking.</p>	<p><i>Prompting if needed:</i> Here are examples of things you might share.</p> <ul style="list-style-type: none"> ● How had you planned to say this part? ● What were you doing to help you meet your speaking goal at that moment?
Reliability	<p>Think about the processes you used during this task, how are they similar or</p>	<p><i>Prompting if needed:</i></p> <ul style="list-style-type: none"> ● Speaking with colleagues,

	<p>different to the processes you normally use while speaking in your academic program?</p>	<p>classroom discussions, speaking during academic events, lab meetings?</p> <ul style="list-style-type: none">• Do you normally evaluate?
End of Interview	<p>Thank you so much for your participation in the study. At the conclusion of this meeting, I will send a link for a \$25 Amazon gift card to the email you listed in the survey. Do you have any questions?</p>	<ul style="list-style-type: none">• Member checking

Appendix F

Observation Checklist

Definitions		
	General Definition (Schraw & Dennison, 1994)	Related to Speaking
Planning	Planning, goal setting, and allocating resources prior to learning.	Approach a speaking task thinking of strategies that one will use (e.g., things I might do as I go into the activity).
Monitoring	<p>(CM) Assessment of one's learning or strategy use.</p> <p>(IM) Skills and strategy sequences used to process information more efficiently (e.g., organizing, elaborating, summarizing, selective focusing).</p> <p>(D) Strategies to correct comprehension and performance errors.</p>	Monitoring one's audience, fluency, logic of thoughts and using this to regulate speech and make changes. This includes having ways to manage high cognitive load during speech (e.g., stress on memory system and focus). Anything used on the fly to deal with problem solving during speech.
Evaluation	Analysis of performance and strategy effectiveness after a learning episode.	Looking back to the speaking task and analyzing one's performance (e.g., what I would do next time, analyze what I did).

Note. General definitions (Schraw & Dennison, 1994). Speaking definitions (personal communication Nietfeld, 2020).

Continued Observation Checklist

Task			Task			Task		
Planning	1	2	Monitoring	1	2	Evaluating	1	2
Participant thought about what to say before beginning (P; 6)			Participant indicated consciously focusing attention on important information when speaking (CM; 13)			Participant knows how well they did once they finished the task (E; 7)		
Participant set specific goals before beginning (P; 8)			Participant indicated relating the speaking task to what they already knew (IM; 43)			Participant thinks about if they expressed everything they wanted to while speaking. (E; 50)		
Participant asked questions about the speaking task before they begin (P; 22)			Participant indicated creating or following an organizational structure while speaking to help them organize their speech. (IM; 37; 41;47)			Participant indicates thinking through if there was an easier or more effective way to do things after they finished the task (E; 19)		
Participant thought of several ways to approach a speaking task and choose the best one (P; 23)			Participant thought through changing strategies when failing to say what they wanted to say (D; 40)			Participant indicates asking themselves how well they accomplished their goals after they finished the task (E; 36)		
Participant organized time to best accomplish the speaking task (P; 45)			Participant indicated mentally pausing during academic speaking to check the comprehensibility of what they were saying. (CM; 34 [21/49])			Participant indicates asking themselves if they best conveyed their thoughts through speaking after they finished the task (E; 38)		
Total			Total			Total		