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Classroom Social Support: A Multiple Phenomenological Case Study of Mathematics Graduate Teaching Assistants' Decision Making in the Classroom

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CLASSROOM SOCIAL SUPPORT: A MULTIPLE PHENOMENOLOGICAL CASE

STUDY OF MATHEMATICS GRADUATE TEACHING ASSISTANTS' DECISION

MAKING IN THE CLASSROOM

by

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CLASSROOM SOCIAL SUPPORT: A MULTIPLE PHENOMENOLOGICAL CASE STUDY OF MATHEMATICS GRADUATE TEACHING ASSISTANTS' DECISION MAKING IN THE CLASSROOM

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Research suggests that support offered by an instructor can have a significant impact on the student experience, both in terms of classroom performance and affective well-being. Research also suggests that there are different types of support that instructors can offer (e.g., emotional support, instrumental support, informational support, and appraisal support). Although such research suggests that students perceive and are affected by these different types of support in different ways, there does not appear to be research surrounding the decision-making process behind instructors offering the support or the extent to which social support is a priority for them in the classroom.

The present study is a qualitative phenomenological multiple case study in which the decision making of six mathematics Graduate Teaching Assistants (GTAs) was analyzed through the lens of support. This study consisted of both interviews and classroom observations and aimed to understand the goals and beliefs held by the GTAs in order to explain the decisions they made to offer support in particular ways. The findings of this study are presented in three chapters: Chapter 4 discusses two GTAs whose goals and beliefs provide clear insight into the types of support they offer their students. Chapter 5 discusses two GTAs whose decision making is more nuanced and examines their goals and beliefs through existing frameworks in the literature. Chapter 6

discusses two more experienced GTAs in order to better understand how the constructs explored throughout this dissertation can change over time. The findings of this dissertation suggest that GTAs possess a wide variety of goals and beliefs that impact their decision making in complex ways and that GTAs' goals, beliefs, and decision-making practices evolve over time. The conclusions from this research can help inform individual instructors' reflections on their teaching as well as professional development efforts of novice mathematics instructors.

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Chapter 1: Introduction

1.1 Background and Statement of the Problem

> *Imagine you are teaching a college-level course and one of your students sends you an email informing you that they did not complete their assignment because they were so focused on an essay for another class that they forgot about yours. How do you respond? Do you graciously grant an extension? Do you send them resources on time management? Do you offer to meet with them to discuss the material in further detail?*

Every day, educators are presented with opportunities to support their students in ways that go beyond simply teaching lessons in the classroom. Such decisions sit outside of strict content decisions yet remain embedded in the context of the course content and curriculum. In situations such as the one described above, there are many ways that an instructor might choose to support the student. Whether or not the instructor consciously considers their options before making this choice, a decision is being made.

In recent years, higher education researchers have become more concerned with student-teacher relationships and the impact that these relationships have on student experiences. Teachers are no longer considered couriers of knowledge. Many studies from the past 20 years provide evidence that a positive teacher-student relationship correlates with increased engagement, motivation, effort, achievement, and overall well-being for students (Furrer & Skinner, 2003; Niehaus et al., 2012; Prewett at al., 2019; Tennant et al., 2014). In mathematics, student-teacher relationships have even been found to have a direct impact on students' problem-solving abilities, self-efficacy, interest in mathematics, and overall mathematics achievement (Prewett at al., 2019; Valiente et al., 2019; Zhou et al., 2020).

The present study addresses a particular facet of the teacher-student relationship: social support. Specifically, this study explores the phenomenon of how novice

mathematics instructors decide to provide social support to their students and how the instructors perceive such support. *Social support* refers to any action that is intended to alleviate negative feelings that someone might be experiencing; in the classroom, social support goes well beyond instruction. A number of researchers have explored social support in the classroom, including the kinds of social support that students receive, student perceptions of the support, and the effects of this support on student experiences (Federici & Skaalvik, 2014; Tennant et al., 2014). However, little research has explored classroom social support from the perspective of the teacher, including the decision-making process behind offering these kinds of support. Tardy (1985) identified the direction of support (i.e., the distinction between the giver and receiver) as one of the most important characteristics of social support but acknowledged that it is usually the receiver who is the focus of research.

Since research suggests that social support has the potential to positively benefit students, but that different kinds of social support affect students in different ways, it is important to understand how the decisions to provide different kinds of support are made. Although much of this decision-making process occurs subconsciously, research suggests that in-the-moment decisions are determined by things that one can become aware of (Schoenfeld, 2011). An awareness of the decision-making process and the elements that it draws upon can better inform such a decision and lead to more intentional, productive support being offered.

1.2 Purpose Statement and Research Questions

The purpose of the present study was to explore how mathematics Graduate Teaching Assistants (GTAs) teaching first-year undergraduate mathematics courses

choose and characterize the types of social support they offer their students by exploring the GTAs' goals and orientations about teaching *(orientations* refers to one's beliefs and values)*. A secondary goal of this study was to consider how the goals, orientations, and ways of offering support differ among first-year GTAs and GTAs with more experience. The long-term intent of this research is to better understand the phenomenon of GTAs' making in-the-moment decisions related to social support so that GTAs can be more aware of their own methods of offering support and in turn, best serve their students. Such an understanding has the potential to contribute to professional development for all educators, not just graduate students. The primary questions that guided this research were

RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?

RQ2: How do GTAs offer social support to their students?

    a. How are a GTA's goals and orientations reflected in the social supports that they offer their students?

    b. How do GTAs relate their understanding of social support with the ways that they offer social support?

RQ3: How do the ways that GTAs think about and offer social support differ between first-year GTAs and experienced GTAs?

Chapter 2: Literature Review and Theoretical Framing

2.1 Overview of Literature

A goal of this study was to bridge the gap between two important areas of research: social support and teachers' in-the-moment decision making. This study explored these concepts within coordinated mathematics classrooms taught by GTAs. This chapter provides an overview of the existing literature related to these ideas.

First, Section 2.2 defines social support and discusses a framework for categorizing different kinds of social support. Section 2.3 discusses a theory of in-the-moment decision making with an emphasis on the elements that determine a person's decisions (namely their resources, orientations, goals, and subjective valuations). Applications and limitations of this theory are discussed, as well as sources of conflict within this theory. Section 2.4 discusses existing frameworks for organizing the constructs discussed in the theory of in-the-moment decision making; in particular, a framework for categorizing one's goals and a framework for categorizing one's beliefs will be introduced. Section 2.5 discusses existing literature on the existence of social support in mathematics education, and Section 2.6 provides a brief overview of relevant research on mathematics GTAs.

2.2 Social Support

2.2.1 Definition of Social Support

The term "social support" has been widely debated amongst psychologists and sociologists since the mid-20th century. House (1981) provided a summary of several definitions by experts of the time in various research fields; although House did not attempt to synthesize these into one catch-all definition, he did observe that there was

"considerable consensus about the general nature of social support, but considerable disagreement over specifics" (House, 1981, p. 16). In defining social support for their own research, Feeney and Collins (2015) noted that researchers almost always use the term to mean providing aid in response to stressful situations and then refine the broad definition for the purposes of their study.

For the sake of this study, I adopted this definition in its broad sense; that is, "social support" refers to any action that is done in response to or in anticipation of a stressful or difficult situation with the intention of alleviating or preventing these feelings and/or circumstances. Because this study is concerned with the social supports that teachers provide their students, "social supports" in this context refers to the things that teachers do to alleviate or prevent any negative emotions or difficult situations being experienced by their students regarding their educational experience. Although this definition could be made more precise, it was left intentionally vague to allow for a variety of actions to be considered social support. The definition used in this research has even been broadened from House's definition to include preventative social supports. This decision was made following a pilot study for this research in which I found that most of the social supports I observed in mathematics GTAs were preventative in nature. For instance, if an instructor expects that students will be confused by a particular exercise and provides them a hint before they get started, it is considered a preventative social support since they are providing the support in anticipation of confusion (rather than in response to it). For the remainder of this dissertation, "support" refers to "social support" and "support action" refers to the tangible action that took place in providing support.

2.2.2 Categories of Social Support

In addition to summarizing the popular definitions of social support of the time, House (1981) synthesized several prevalent frameworks for categorizing social supports. House suggested that all acts of social support fall into four categories: *emotional*, *instrumental*, *informational*, and *appraisal* support. These categories are not mutually exclusive; in fact, House suggested that most supports fall into at least two categories (House, 1981).

Emotional support includes "providing empathy, caring, love, and trust" and is recognized as possibly being the most important amongst the four categories of support (House, 1981, p. 24). Many studies have addressed the effects of emotional support on students and found that the effects are positive overall. For example, emotional support has been found to have positive impacts on motivation (Federici & Skaalvik, 2014), engagement (Furrer & Skinner, 2003), and both short- and long-term academic achievement (Niehaus et al., 2012). An absence of emotional support has also been found to be related to inattention, hyperactivity, and behavioral problems in school (Tennant et al., 2014).

It is worth noting that emotional support is not inherently positive: more so than the other three categories of support, emotional support raises concerns about boundaries and ethics within the classroom. For example, emotional support is sometimes associated with the sharing of inappropriate personal information and the abuse of power or authority dynamics (Aultman et al., 2009). Another risk associated with emotional support is that the ways that emotional support is offered (or whether it is offered at all) can be reflective of implicit biases. For instance, Babad (1990) found that teachers often

offer more emotional support to students who were perceived as high achievers than students perceived as low achievers, even when the circumstances in which the two types of students needed support were the same. In fact, Inan-Kaya and Rubie-Davies (2020) found that many behaviors associated with emotional support are perceived positively by some students and negatively by others and that the distinguishing factor is often whether or not the student believes they are liked by the teacher or not.

The second category of social support is *instrumental support*. Emotional and instrumental support are considered the most ubiquitous categories of social support and consequently, many research studies only address emotional and instrumental support (Federici & Skaalvik, 2014; Semmer et al., 2008). Instrumental support involves behaviors that are directly helping the recipient of the support by targeting the cause of the negative emotion. This includes actions such as giving someone money, doing tasks for someone, and modifying an uncomfortable environment (House, 1981). In a classroom, examples of instrumental support include teachers clarifying material, correcting mistakes, and modeling behaviors that support learning (Federici & Skaalvik, 2014). Federici and Skaalvik also suggested that instrumental support has the greatest positive impact on motivation and reduced anxiety (2014).

The last two kinds of social support, appraisal support and informational support, are much more difficult to clearly define; support actions within these categories are often misidentified as emotional or instrumental support (House, 1981). *Informational support* involves providing information that is not in itself helpful but that can be used by the recipient to improve their situation. This differs from instrumental support in that it is the responsibility of the recipient to make use of the information (instead of the support

being inherently beneficial). For example, in the scenario at the start of this paper, providing a student with time management resources would be considered informational support because it is up to the student to utilize the information and improve their situation. Cutrona and Russell (1990) suggested that informational support is beneficial for developing problem-solving skills and is therefore critical in mathematics classrooms.

Finally, *appraisal support* involves providing subjective information that can be used in self-evaluation. Like informational support (and unlike emotional support), appraisal support involves the transmission of information that the recipient must use for themselves. Appraisal support is evaluative by nature, but the evaluation can be implicit or explicit (House, 1981). For example, a teacher could tell their student explicitly that they are doing above average, or the teacher could tell the student what the average is and leave it up to the student to infer for themselves how they are doing. Regardless of how the information is delivered, the purpose of appraisal support is to give information so that the student can evaluate their own progress. Figure 1 depicts a visual representation of this framework.

Although House's framework was proposed in the 1980s, variations of it are still seen in research today. Although the number of categories and the titles of the categories vary, most modern categorization models are still reflective of House's work. For example, Feeney and Collins (2015) named the four categories *emotional*, *esteem*, *informational*, and *tangible* support; in terms of their definitions, these categories correspond to emotional, appraisal, informational, and instrumental support, respectively. Federici and Skaalvik (2014) chose to only use the emotional and instrumental categories

Figure 1

A Representation of House's Framework for the Categorization of Social Support
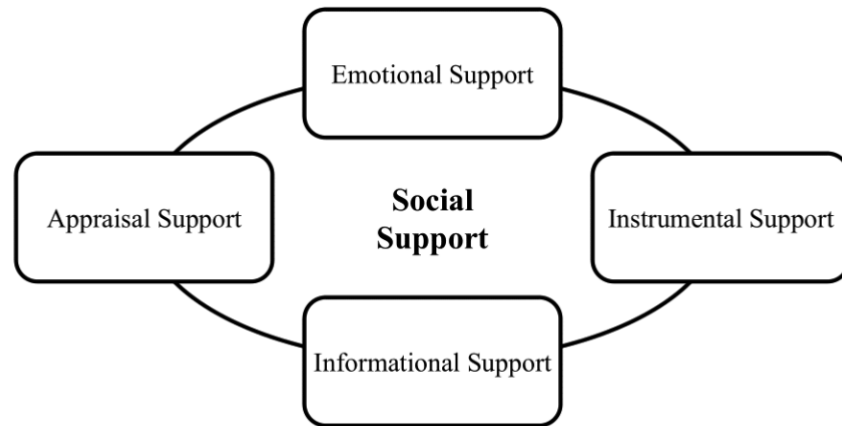
of social support in their study of the impacts of social support on student motivation, noting that those two categories were sufficient for the purposes of their work. Due to the substantial overlap among House's categories, some researchers choose to consolidate the categories. For instance, Wu et al. (2020) classified the categories as emotional support, informational support, and *substantial* support, where substantial support corresponds to House's instrumental support, and emotional support encompasses both of House's emotional and appraisal supports. Like the definition of social support itself, the titles and boundaries of the categories are flexible and can be adapted to meet individual researchers' needs. For the sake of this study, the categorizations proposed by House will be used.

2.2.3 Social Support and Student Achievement

As discussed in the previous section, social support can have positive impacts on many elements of the student experience; perhaps the most compelling example of this is

the positive effect of social support on students' academic achievement. According to Li et al. (2018),

> Social support provides university students with a sense of security and competence, which, in turn, helps them to address intellectual challenges more efficiently… Social support can provide solutions for individuals facing stressful problems, reduce the perceived importance of problems, or facilitate positive psychological reactions and behavioral responses (p. 121).

In a longitudinal study, Niehaus et al. (2012) found that adolescent students who reported receiving an increase in social support from their teachers over the course of an academic year had higher grades at the end of the year than students who did not.

Many studies have examined the relationship between social support and academic achievement by considering mediating variables between social support and academic achievement. For example, Federici and Skaalvik (2014) found that social support was at least moderately associated with motivation, effort, and help-seeking behaviors in mathematics classrooms; moreover, students' grades were positively correlated with their motivation and effort. Similarly, Furrer and Skinner (2003) found that social support has positive impacts on student engagement and sense of belonging, and therefore conclude that it also has positive impacts on student performance. Li et at. (2018) found that social support was positively related to academic self-esteem and that academic self-esteem was positively related to academic performance. Multiple studies (Tennant et al., 2014; Virtanen et al., 2020) have discussed the interrelatedness of social support, positive school behavior, and academic achievement of students.

2.2.4 Impacts of Social Support on Different Students

It is important to note that social support does not impact all students in the same ways; numerous studies explore how social support impact different demographics of students. For example, many studies have explored the different impacts of specific categories of social support and social support in general based on gender. Furrer and Skinner (2003) found that emotional support led to an increased sense of belonging for both adolescent boys and girls, but that the increase was higher for girls. The increased sense of belonging, however, was a stronger predictor of academic achievement for boys. Rueger et al. (2008) explored the perception of social support and found that adolescent boys self-reported receiving less social support in academic settings from their peers than girls did, but that both boys and girls believed that they received comparable amounts of support from their teachers. Hofer et al. (2022) found that when girls believed that they were receiving less social support than their male peers in a middle school mathematics classroom, the girls believed that it was because of poor academic performance (even if they were outperforming the boys); this suggests that even the perceived *lack* of social support impacts boys and girls differently. Although most research on the impact of social support on different populations of students has focused on differences across genders, other demographic factors have been studied as well, such as race (Rodríguez et al., 2017) and gender identity (Selkie et al., 2020). According to Selkie et al. (2020), "the most effective social supports match the needs of the individual" (p. 276), especially for minority populations.

2.2.5 Social Support from the Teacher's Perspective

Despite the large amount of research on types of social support and their effects in the classroom, such research is primarily focused on the student perspective. An examination of the categories of support from the teacher's perspective, including which types of support teachers offer or how they decide which to utilize, is a gap in the current literature that is potentially detrimental to classroom social support dynamics. The abundance of research suggesting that different types of social support impact different students in different ways implies that teachers should aim to provide support with intention: choosing social support based on personal preferences or "gut reactions" could lead teachers to choose a type of social support that is not helpful (or even damaging) to student success (Federici & Skaalvik, 2014). However, the way that one offers social support often cannot be planned for in advance and is determined as it is being offered. This means that it is important to not only consider what decisions instructors make in offering social support, but also the factors that determine how those decisions are made in the moment.

2.3 In-the-Moment Decision Making

The present study focused on the instructor's decision-making process related to offering social support to their students, viewed through the lens of Schoenfeld's 2011 model for goal-oriented decision making. Schoenfeld claimed that any goal-oriented decision making (including both large scale classroom teaching as well as tutoring and other individualized modes of instruction) can be modeled according to certain constructs. In particular, he described decision making as a function of several inputs (namely one's *resources*, *orientations,* and *goals*) which outputs a *subjective valuation*.

He concluded that if one knows the inputs that are present for a teacher in a particular circumstance and how the output is computed, then one can understand and explain the decision that was ultimately made. The resources-orientations-goals model (sometimes referred to as the ROG framework) appears in a great deal of recent education research, particularly in mathematics education research (e.g., Crooks-Monastra & Yee, 2022; Hannah & Thomas, 2011; Petropoulou et al., 2020; Thomas & Yoon, 2014; Woods & Weber, 2020).

2.3.1 Resources

The first of the inputs in the ROG framework, *resources*, encompasses both tangible and intangible assets that one can pull from in making decisions (such as material resources and social resources). Schoenfeld (2011) focused specifically on resources that one possesses in the form of *knowledge*. He defined knowledge as any information that someone has "potentially available to bring to bear in order to solve problems, achieve goals, or perform other such tasks" (p. 25), and went on to stress that their knowledge does not necessarily have to be correct, only that they perceive it as being a true piece of information. There are several categories that knowledge can fall into, such as facts, procedural knowledge, conceptual knowledge, and problem-solving strategies. According to Schoenfeld, the knowledge that a teacher possesses is particularly complex, because it includes not only content-specific information but often intricate information about their students' academic progress and personalities (Schoenfeld, 2011).

Schoenfeld went on to make several assertions about the nature of knowledge and how it contributes to decision making. For instance, Schoenfeld alleged that knowledge

comes in "packages" in the form of scripts and routines. Similarly, the way that someone recalls knowledge is associative since they will more easily call on pieces of knowledge that fit into the same scheme than the knowledge that they have conceptualized as being disjoint (Schoenfeld, 2011). More explicitly related to decision making, recalling knowledge often triggers particular responses and actions. Hinsley et al. (1977) suggested that mathematics students often decide how they are going to approach a word problem within the first three to five words of the problem statement. For example, if a problem began with "a river steamer", students in their study assumed that they would be computing the time it took the steamer to travel a particular distance, or that they would compute the distance that the steamer traveled if a time was given. More generally, people tend to recognize situations very quickly based on past experiences and recall knowledge (including how they reacted in the past) without even realizing that they are making the decision or that they are utilizing specific knowledge at all. Further, the knowledge that one possesses even shapes the way that one perceives new information: Schoenfeld described what people perceive as "a function of what they know; humans try to make new experiences fit with their current conceptions," even if that means acquiring knowledge that is objectively "wrong" (p. 29).

2.3.2 Orientations

The second construct in the ROG framework is orientations, which include one's beliefs, values, preferences, and other related concepts. According to Schoenfeld (2011),

How people see things (their "worldviews" and their attitudes and beliefs about people and objects they interact with) shapes the very way they interpret and react to them. In terms of socio-cognitive mechanisms, people's orientations influence

what they perceive in various situations and how they frame those situations for

themselves. (p. 29)

In contrast to knowledge, which captures the objective way someone views the world,

orientations encompass someone's subjective lens through which they operate; in

teaching, orientations capture teachers "view[s of] knowledge and learning, and suggest

how they may enact their classroom practice" (Luft & Roehrig, 2007). Orientations

influence which pedagogical actions teachers consider viable options and which actions

are ultimately "best" to use in the classroom and are therefore an important element of

lesson planning (Woods & Weber, 2020).

Schoenfeld (2011) acknowledged that studying orientations come with several

inherent limitations: most notably, orientations are much more difficult to capture than

knowledge. The subjective nature of orientations means that the orientations that

someone attributes to themselves might differ greatly from the orientations that an

outside observer might assume that they have. According to Schoenfeld,

I can't say for sure that people have beliefs, at least as I describe them. In fact,

many deny having specific beliefs that I attribute to them. However, if their

behaviors are consistent with the attribution of those beliefs, and attributing

beliefs makes their otherwise inexplicable behavior explicable, then I will

attribute those beliefs and use them in my models. To make a crude comparison,

someone may be convinced (and aver strongly!) that he or she has no racial biases

but may act in a way that is entirely consistent with a set of racist beliefs. My

model of that person's behavior would contain the racist beliefs—and if the

attributes were accurate, the model's actions would be consistent with the

person's. (p.51)

The orientations are being inferred by the researcher and attributed to the participants,

and "whether the [participants] actually 'have' them, and how they actually work, is open

to question" (Schoenfeld, 2011, p. 53).

It is important to note that orientations can change over time; the evolution of

teaching beliefs occurs through teacher reflection over time but can be quickened and

even shaped by professional development (Lee, 2019; Luft & Roehrig, 2007). For

example, Lee (2019) explored the impact of a pedagogy course on STEM GTAs'

teaching beliefs and found that GTA beliefs moved away from traditional teaching-

focused beliefs towards more student-centered beliefs focused on active learning. Hamre

et al. (2012) found that elementary school teachers who took a professional development

course demonstrated stronger beliefs about effective student-teacher interactions, and

those beliefs were reflected in more intentional interactions in the classroom. Even on a

long-term, cultural level, beliefs about teaching can change. In recent years, many

teachers who have been teaching for a long time have acknowledged that their role as an

educator has shifted from delivering knowledge to their students to facilitating the

acquisition of knowledge for their students. As a result, teachers' personal beliefs about

how they fit into their role as an educator have changed over time (Biesta et al., 2015).

2.3.3 Goals

The third and final construct in the ROG framework is goals. Schoenfeld (2011)

defined goals as "something that an individual wants to achieve, even if simply in the

service of other goals" (p. 21), although others have expanded this to include inclinations

to avoid things as well as achieving them (Hannula, 2006). Goals are not disjoint from orientations; in fact, orientations often play an important role in the establishment of goals. For example, someone's short-term goals for completing a mathematics problem are often a result of their beliefs about the importance of the problem in the subject, the necessity of the problem in the class itself, and their self-efficacy toward the particular problem (Hannula, 2006).

Schoenfeld (2011) argued that because most activities can be described as goal-oriented, most human behavior can be modeled in detail according to one's goals and subgoals. However, this does not mean that goals are always present on a conscious level. In fact, Schoenfeld admitted that although goals are pervasive in his modeling of decision making, "it is not at all clear that [goals] are ubiquitous in human behavior; there are many situations in which an individual appears to act in the moment, without having invoked any particular goal" (p. 53). Schoenfeld dismissed this limitation, arguing that just because someone is not aware of the goal that they are working towards does not mean that the goal is not present subconsciously and that as long as identifying such goals provides a better understanding of the overall decision-making process, it is worth making assumptions about the goals that are present (2011).

Like orientations, goals evolve over time for a variety of reasons; according to Thomas and Yoon (2014), "priorities may change, goals may be met, and new ones, including possible subgoals, established" (p. 230). For instance, goals might evolve to resolve conflict between conflicting goals. Thomas and Yoon examined the goals of a mathematics teacher who used many teacher-centered practices despite prioritizing student-centered approaches. Thomas and Yoon found that the teacher's goals conflicted

with one another: the teacher held goals about wanting to use student-centered approaches but also held goals about wanting to prepare their students for assessments and adhering to the prescribed curriculum (which the teacher believed were better achieved via teacher-centered practices). In this example, the teacher's goals (and therefore actions) adapted to balance their conflicting desires: "Although [the teacher] wished to use student-centered learning consistently throughout the lesson, he opted out of it in these instances to alleviate the tension he experienced from his conflicting instructional goals" (Thomas & Yoon, 2014, p. 228). Examples of conflicting goals is discussed further in Section 2.3.8.

Because many goals are in service of other larger goals, short-term goals often fluctuate in order to accommodate changing information. Section 2.3.6 discusses a student who effectively chose to not attempt a problem to avoid looking ignorant. The student likely did not enter the situation with the goal of not wanting to attempt the problem; the student likely developed this goal based on their "visceral reaction to the context in which she found herself" (Schoenfeld, 2011, p. 41) and to support their larger goal of not wanting to look unintelligent in front of their professor. For teachers, short-term goals are constantly evolving based on student needs. Teachers must balance what is best for their students on a day-to-day basis in service of their larger, long-term goals (Schoenfeld, 2011). For example, a teacher might possess the long-term goal of having all of their students pass an upcoming assessment; the teacher's short-term goals will vary as they determine what their students need in order to be successful on that assessment.

In a 2015 study, Priestley et al. found that many teachers were effective in achieving short-term goals (particularly goals that were imposed on them by their curriculum) but that many teachers lacked agency in considering and making strides toward long-term goals for themselves and their students. Long-term goals are extremely important for teachers; Robertson-Kraft and Duckworth (2014) found that the students of teachers who set and actively worked towards long-term goals related to improving student success had higher academic achievement than teachers who did not actively work towards long-term goals.

2.3.4 Subjective Valuations

The ROG model is based on the idea that someone's decision making is a function of their resources, orientations, and goals, but what the function actually *does* is based on the principle of *subjective valuations*. When faced with a decision, each potential option has multiple possible outcomes, and each possible outcome has perceived costs and benefits. The perceived costs and benefits can be anything of value to the person making the decision: costs can include "dollars, time, effort, or lost opportunities" (Schoenfeld, 2011, p. 17), but can also include emotional consequences such as embarrassment or social ostracization. Benefits might include gaining money, time, opportunities, social acceptance, feelings of accomplishment, and more. Whether something is a cost or a benefit (and the degree to which it is a cost or benefit) is subjective and is based on the decision maker's resources (what they know about the situation and the possible outcomes), orientations (how they feel about the situation and the possible outcomes), and their goals (what they hope to get out of that situation or subsequent situations).

Each outcome for each option also comes with a subjective likelihood (which is also a result of one's resources). An option's subjective value is "calculated" like a mathematical expected value: the subjective likelihood of each outcome is multiplied by that outcome's subjective cost/benefit to determine the subjective value of that outcome, and then the subjective values of each outcome are summed to determine that option's subjective value. Figure 2 shows what this computation might look like for an option with two possible outcomes.

Schoenfeld used the decision to purchase a lottery ticket to illustrate the idea of a subjective valuation. In this example, Schoenfeld assigned each option's outcomes a likelihood as a percentage and then converted that to a numeric value between zero and one; he also assigned each outcome a numeric value where a positive number was a positive outcome, a negative number was a negative outcome, and a value of zero reflected a neutral outcome. "Option 1" was to not purchase a lottery ticket at all. There was only one outcome associated with this option—not winning the lottery—and although this outcome had a 100% likelihood of occurring for this option (a numeric value of one), it had a subjective value of zero (since one would neither gain nor lose anything by not playing at all); this meant that the subjective value of Option 1 was zero. On the other hand, "Option 2" was to purchase a lottery ticket. This option had two possible outcomes: one could win the lottery or lose the lottery. The first outcome

Figure 2

A Generic Subjective Valuation Computation for an Option with two Outcomes

$$\left(\begin{array}{c}\text{Likelihood of}\\\text{Outcome \#1}\end{array}\right)\left(\begin{array}{c}\text{Value of}\\\text{Outcome \#1}\end{array}\right)+\left(\begin{array}{c}\text{Likelihood of}\\\text{Outcome \#2}\end{array}\right)\left(\begin{array}{c}\text{Value of}\\\text{Outcome \#2}\end{array}\right)=\left(\begin{array}{c}\text{Subjective Value}\\\text{of the Option}\end{array}\right)$$

(winning) had an extremely small likelihood but an extremely high positive numeric value since the effect of winning the lottery is life-changing for most people. The second outcome (losing) had an extremely high likelihood and a negative but negligible value (since the lottery ticket costs the person money but was likely inexpensive). Together, these outcomes resulted in a positive subjective value for Option 2. Figure 3 illustrates how the subjective value of each of these options was computed.

The costs, benefits, and likelihoods (and therefore the subjective values) of the outcomes associated with most in-the-moment decisions are not as clearly defined. Moreover, the costs, benefits, and likelihoods are typically subjective and vary greatly from person to person. For instance, in the example described above, a losing lottery ticket was assigned a negative but negligible subjective value since the cost of a lottery

Figure 3

Computing the Subjective Values of Options Associated with Purchasing a Lottery Ticket

ticket was likely inexpensive; however, some people would assign this outcome a larger

negative value depending on their financial security. Further, although there are objective

odds of winning a given lottery, some people perceive their chances of winning to be

higher than they actually are which would impact this computation. Section 2.3.6

explores an example of in-the-moment decisions in an educational setting, including how

the subjective values might be computed for the options associated with such a decision.

2.3.5 Application of the ROG Model

Though made up of many complex pieces, the ROG framework fits together quite

simply: if enough is known about someone's resources, orientations, and goals, then the

subjective valuations that they make can be understood; if their subjective valuations are

understood, then their in-the-moment decisions should be explicable as well. Figure 4

Figure 4

Schoenfeld's (2011) ROG Model for In-the-Moment Decision Making
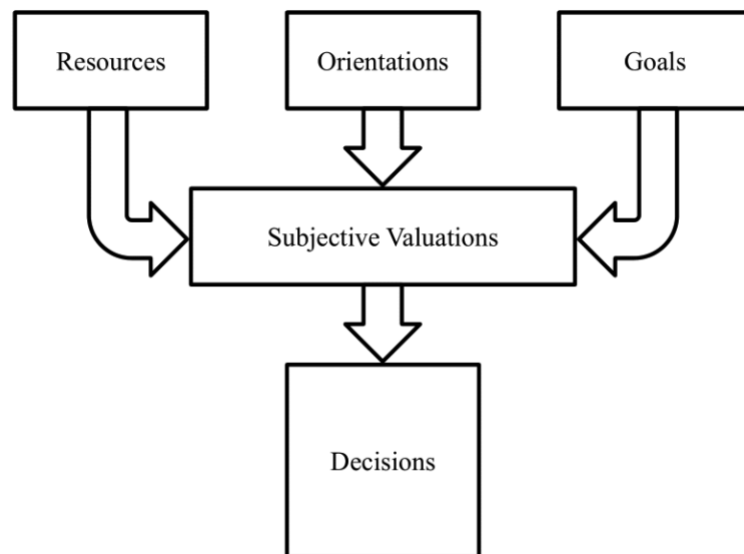
shows a diagram of the ROG framework and will form the basis of this study's theoretical framework.

The emphasis on *subjective* valuations is critical to the ROG framework: Schoenfeld (2011) says,

> The decisions that people make—even for decisions that seem fundamentally irrational viewed by others—can often be seen as justifiable and even sensible once one understands the values that the individuals attach to the various possibilities that might result from their actions. (p. 37)

For example, it might not be logical for a student to leave a question blank on an exam, but if that student lacks confidence and therefore *subjectively* perceives the cost of embarrassment that comes with the high likelihood of being wrong to be greater than the improbable benefit of them being correct, then leaving that question blank makes perfect sense (Schoenfeld, 2011).

2.3.6 Example of the Application of the Model

Schoenfeld (2011) described several examples of in-the-moment decisions that students and teachers make and used the ROG model to explain them. In each example, Schoenfeld considered the different options that the individuals had in these situations; explored the goals, orientations, and resources that the individuals might have based their decision on; and "computed" the subjective values of each option to ultimately explain their decision. An inherent limitation of explicitly computing subjective values is that Schoenfeld had to make assumptions about the perceived subjective value and subjective likelihood of different outcomes on the decision maker's behalf in order to assign numeric values to them. Although these assumed values are roughly approximated and

therefore might not be entirely accurate, the numbers used in the following example are for illustrative purposes in order to understand a seemingly unexpected decision.

One of the primary examples that Schoenfeld (2011) used to illustrate the utility of the ROG model involved a student making a seemingly inexplicable choice while working on a geometric construction problem, shown in Figure 5. Schoenfeld gave the student 20 minutes to attempt this problem and was surprised to find that she wasted a significant amount of time recreating the diagram shown in Figure 5 (instead of just working on the provided worksheet). After discussing what happened with the student, Schoenfeld modeled the possible options by computing the subjective values of each outcome. In this computation, Schoenfeld assigned each outcome a value from one to 10

Figure 5

A Geometric Construction Problem (from Schoenfeld, 2011, p. 31)

You are given two intersecting straight lines and a point P marked on one of them, as in the figure below. Show how to construct, using straightedge and compass, a circle that is tangent to both lines and has the point P as its point of tangency to one of the lines.
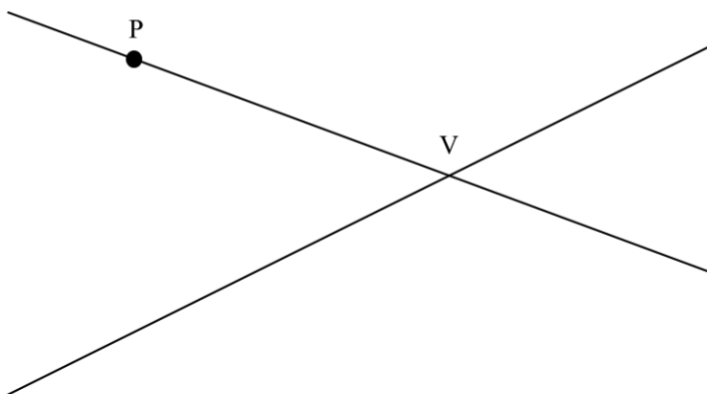
Note. From *How We Think* (1st ed., p. 31), by A. Schoenfeld, 2011, Routledge. Copyright 2011 by Taylor and Francis.

with one being an extremely negative outcome and 10 being an extremely positive outcome; he also assigned each outcome a likelihood as a percent that was converted to a numeric value between zero and one in the computation.

The first option that the student had was to attempt the problem and give it sincere effort. This option has two outcomes: the student might solve the problem correctly or she might not solve the problem correctly. After talking to the student about the problem, it became clear that she had little confidence in her ability to solve the problem correctly; Schoenfeld assigned this outcome a 25% probability and therefore the likelihood of the other outcome (not solving the problem correctly) had a 75% probability. The student described feeling afraid of looking stupid in front of her professor and therefore the subjective value of being unable to solve the problem correctly was very low (Schoenfeld assigned this a value of one out of 10). In contrast, the perceived benefit of doing the problem correctly would be very high, receiving a value of 10 out of 10. With these values in mind, the subjective value of this option is 3.25, shown in (1).

$$(0.25)(10) + (0.75)(1) = 3.25 \qquad (1)$$

The student's second option was to waste time and essentially not have to try to attempt the problem; according to Schoenfeld, "the time the student spent replicating the figure in the problem statement pretty much guaranteed that they would not have enough time to solve the problem" (p. 38). In this situation, the student had almost no chance of solving the problem correctly in the remaining time—Schoenfeld assigned this a one percent probability—to earn the benefits of having solved the problem correctly (which Schoenfeld again assigned a value of 10). However, in this option, the student is showing their instructor *some* understanding (namely of how to do geometric constructions by

replicating the figure); this is not a great benefit but is still positive, so Schoenfeld

assigned this outcome a value of five out of 10. Altogether, this yielded a subjective

value of 5.05, shown in (2).

$$(0.01)(10) + (0.99)(5) = 5.05 \tag{2}$$

Since the subjective value of the second option (wasting time replicating the diagram)

was higher than the subjective value of the first option (giving their full effort to the

problem), it made sense that the student would choose to waste time in this way.

Schoenfeld (2011) acknowledged that the student did not consciously consider

their options in this way:

Obviously, the student didn't make this kind of calculation: what she did was

almost certainly by way of a visceral reaction to the context in which she found

herself. But the calculation shows that if you assign the probabilities and

rewards… the subjective expected value of avoidance is better than the subjective

expected value of trying hard to solve the problem. Hence from her internal

subjective perspective, avoidance yields the better reward and is the better bet.

The difference in rewards isn't so great that you could guarantee she would do it,

but it is certainly a plausible option. (p. 41)

This example illustrates the main point of the ROG model: "Once you have a sense of the

individual's subjective valuations of different outcomes… then decisions that seem rather

strange 'from the outside' turn out to be quite reasonable" (p. 41). In this case, there were

several resources, goals, and orientations that impacted the student's subjective

valuations. The student came into the situation with resources in the form of knowledge

about geometric constructions. The student held orientations about their ability to solve

the problem that impacted the subjective likelihood of them succeeding at the task. The student also seemed to possess a goal related to self-preservation and wanting to not look stupid in front of their professor. Although the student's decision seemed strange at first, it could in fact be explained by considering her underlying resources, orientations, and goals.

2.3.7 Limitations of the Model

Because the present study relied heavily on Schoenfeld's ROG model, it is important to address the model's limitations. First, this model is most useful for *explaining* in-the-moment decisions, not necessarily for *predicting* them. If the decision is simple enough and enough is known about someone's resources, orientations, and goals, it is likely that a reasonable guess could be made about the course of action that they would take; however, the subjective valuations are determined by the individual, and it is extremely difficult to predict the extent to which someone will value particular outcomes. Further, this model can never be "proven"; its validity can only be tested. Schoenfeld even acknowledges that it is possible that a better model might exist that could eventually make his own obsolete, but until then, Schoenfeld (2011) makes a convincing validity argument for the ROG model.

A second important limitation of this model is the distinction between reality and the model itself, especially if the model is being applied by one person onto another. Although a person has goals and orientations, a model can only represent these constructs. Similarly, an individual makes decisions, but a model can only describe the decision that is being made. Even if an individual is applying the model to their own

behavior, there is a level of interpretation between the reality that one experiences and the reality that can be observed and modeled (Schoenfeld, 2011).

Another limitation of the ROG framework is that it does not consider broader influences on decision making that may not be captured within one's resources, orientations, and goals (Petropoulou et al., 2020). For example, emotions can play a significant role in in-the-moment decision making. For instance, a mathematics student's perseverance when solving problems is often impacted by emotion. According to Hannula (2015),

> Regardless of the overall disposition [attitudes, beliefs, values, motivational orientations], all problem solvers encounter positive and negative emotions that influence their solution process. In fact, emotions are an essential part of the problem solver's self-regulation. Moreover, problem solving takes place by social beings in the complexity of the learning environment where multiple goals need to be addressed. (p. 272)

Moreover, "the affective system is central to mathematical processing" (Cai & Leikin, 2020, p. 290). If a student is unable to complete a problem and decides to quit, this could be a reflection of the students' belief in their ability to solve the problem, but it is also possible that it is an emotion that changes the course of the student's behavior. Emotions are considered a direct link to one's motivation, and since behavior is often an expression of one's motivation, the relationship between emotion and behavior in not trivial (Hannula, 2006).

Another influence on decision making that the ROG model does not consider is contextual factors. Contextual factors are broad and extremely situation-dependent, but

for teachers, contextual factors might include time, who is present when a decision is being made (students, an observing supervisor, etc.), classroom behavior, and more. Time is a contextual factor that often influences instructional decisions: instructors often have to adapt their lessons due to time constraints (Thomas & Yoon, 2014), and such adaptations often occur in the moment. Schoenfeld (2011) describes an example where a teacher had to decide whether to explore a student's creative, unexpected strategy for solving a problem and noted that the teacher's decision was likely influenced by the limited amount of time for the lesson and wanting to stay on track. According to Schoenfeld, the lack of consideration of contextual factors is not a limitation of the model because these factors are not a part of the decision-making process at all; instead, the contextual factors exist outside of the decision and are just a part of the situation in which the decision maker must orient themselves *before* making the in-the-moment decision. Although contextual factors do not impact the decision-making process, they do affect the options that one has while making decisions, and such effects are not accounted for within the ROG framework.

Finally, an important limitation of the ROG model is that it only addresses in-the-moment decisions and fails to "take up the broader social, long-term and institutional dimensions of teachers' thinking" (Petropoulou et al., 2020, p. 352). Many decisions that instructors make are *not* made in the moment and are instead made in advance with intentionality. The ROG model cannot distinguish between in-the-moment decisions and premeditated decisions (without input from the decision maker) and therefore can be applied erroneously.

2.3.8 Conflicting Goals and Orientations

It is not uncommon for someone to hold multiple goals and orientations that sometimes oppose each other. According to Garner and Kaplan (2019),

> Teachers continuously negotiate and aim to resolve disharmony of elements (e.g., conflict between goals of student interest and high standardized test scores), misalignment of components (e.g., tension between personal goals and ontological beliefs about task demands), and disintegration of role identities (e.g., teacher vs. colleague). (p. 12)

When teachers hold conflicting goals and orientations, they either have to prioritize one over another or attempt to generate new goals and orientations that satisfy each of the conflicting elements.

One source of conflicting goals and orientations is filling multiple roles simultaneously. Different roles bear different values and objectives that are sometimes in contention with one another, and people who wear many different hats in their profession often have to prioritize a goal from one of their roles over those of the other. Several studies have examined the many roles that teachers fill concurrently and the conflicting goals and orientations they must balance as a result (Biesta et al., 2015; Pillen et al., 2013; Schellings et al., 2021; Shapira-Lishchinsky, 2011; Thomas & Yoon, 2014). For example, Bol and Strage (1996) looked at the misalignment of self-identified teaching objectives with assessment strategies in high school science classrooms. The teachers in this study identified numerous goals that they held for student growth (such as the improvement of study skills and an increased appreciation for the subject) that were not reflected in any of the district- and state-mandated assessments. In practice, the teachers

ultimately made decisions that adhered to the district- and state-mandated curriculum, suggesting that goals imposed by an institution often trump personal goals.

The conflict between personal goals and beliefs and the goals and beliefs of the institution was also explored by Biesta et al. (2015). In this study, many teachers disagreed with the beliefs that they perceived their district to be imposing on them. For instance, while discussing their beliefs about the purpose of education, many teachers discussed things beyond the curriculum (such as helping students reach their full potential and learning skills that go beyond the content). This is in contention with the purpose implied by the curriculum, which is often articulated through concrete and measurable learning objectives. In fact, many teachers described the structured nature of the curriculum as stifling to their personal beliefs about teaching and discussed intentionally deviating from the curriculum to better align with their personal teaching beliefs.

Thomas and Yoon (2014) also explored the conflict between personal goals and orientations with institutional goals and orientations, but they did so through the lens of Schoenfeld's ROG model (2011). Thomas and Yoon sought to understand why a secondary mathematics instructor occasionally deviated from a student-centered teaching approach despite their goals and orientations generally reflecting a desire to teach in this way. In addition to goals and orientations in support of student-centered approaches, the instructor also placed high value on fulfilling the requirements set by their district in terms of curriculum, assessment, and the use of class time. To resolve this conflict, the instructor formulated new goals that are "both an amendment and blend of other goals in the system" (p. 240). In particular, the instructor decided to prioritize using teacher-led demonstrations with large amounts of student participation. This new goal appeased both

pre-existing goals since it still involved significant student participation and gave students the tools they needed to be successful on upcoming assessments. The new goal did contradict the instructor's pre-existing goals to some extent: the goal was not entirely student-centered and it was not the suggested mode of instruction outlined in the curriculum. However, the new goal did enough to achieve both of the instructor's pre-existing goals that outcomes associated with this new goal yielded the highest subjective value.

A specific source of dissonance for many mathematics teachers is the conflict between being a "true" mathematician and being an educator who teaches a prescribed curriculum (Hannah et al., 2011). Paterson et al. (2011) explored this struggle, finding that the role that "won" determined many in-the-moment instructional decisions. For example, a university mathematics lecturer who prioritized their role as a teacher (over that of a mathematician) tended to sacrifice rigor and mathematical precision for the sake of adhering to the curriculum and staying on pace. In contrast, a lecturer who prioritized their role as a mathematician was frequently willing to deviate from the curriculum if it meant diving deeper into mathematical understanding, even if such understanding was not completely necessary for success in the course. In general, different mathematics instructors possess different goals and orientations and can therefore be expected to make different decisions, even when they are presented with the same situations. As a result, one can expect different mathematics instructors to provide social support to their students in vastly different ways.

Novice instructors (including GTAs) often face tensions between different goals and orientations that are relatively unique to their new role. Table 1 describes several

sources of conflict that may impact new teachers. Although instructors of all experience levels experience conflict between goals and orientations, the consequences can be higher for novice teachers as they tend to experience more conflicts and experience more negative emotional responses to them (Pillen et al., 2013; van der Wal et al., 2019). On the other hand, conflicting goals and orientations can have positive impacts on the development of new teachers' professional identities as "the ongoing process of identity development is triggered by tensions resulting from what teachers find to be important and desirable and what they experience in practice" (van der Wal et al., 2019, p. 60). van der Wal et al. (2019) found that instructors respond in a variety of ways when they experience such tensions, including engaging in reflection and seeking support or direction; further, the extent to which instructors believe that the tensions are resolved impacts the development of their teaching identity (i.e., believing that the tensions were resolved had a positive impact on teaching identity).

2.3.9 The Impact of Experience on Orientations and Goals

One's past experiences are instrumental in the establishment and evolution of one's orientations (Garner & Kaplan, 2019). For example, many pedagogical traditions exist because educators believe in the traditions' effectiveness; although an educator might possess knowledge that something was effective in the past, it is an orientation that leads them to believe it will continue to be effective in the present and future. For instance, many mathematics instructors believe that "chalk talk"—a practice in which the instructor writes work on the board while explaining its meaning—is the best way to teach mathematics. Whether or not this is true, research suggests that this belief is rooted in the traditional use of chalk talk in mathematics education: mathematics teachers were

Table 1

Sources of Conflicting Goals and Orientations for Novice Instructors

Source of Conflict	Conflicting Goals and Orientations
Transitioning from being a student to being a teacher (or, in the case of GTAs, balancing both roles simultaneously)	Novice instructors' orientations about who they are as a student might conflict with the goals they have for themselves as a teacher (such as wanting to be perceived as a "real adult"). This is also impacted by how novice instructors perceive themselves among their peers, as novice instructors often perceive themselves to be the youngest and/or least experienced person.[a]
Wanting to connect with students versus maintaining authority	Novice instructors often exhibit strong goals related to fostering relationships with their students while simultaneously wanting to maintain a sense of authority in the classroom; some instructors find that these goals are in contention with one another.[b]
Self-esteem and self-efficacy	Many novice instructors recognize that they possess the necessary qualifications to teach but often doubt their abilities to teach effectively.[c]
Personal versus imposed viewpoints	Instructors of all experience levels have viewpoints imposed on them (by their institution, district, supervisors, etc.) and are expected to prioritize corresponding goals. These viewpoints and goals often conflict with the instructors' personal goals and beliefs. This conflict is prevalent in novice instructors who often have more direct supervision (such as teaching mentors).[d]
Varied expectations	Many novice instructors feel pressure to invest time in extraneous teaching and service tasks. As a result, their belief that they must take on these tasks conflicts with the goals they hold about how much time they want to spend on teaching itself.[c]

[a] Schellings et al., 2021

[b] Pillen et al., 2013; Shapira-Lishchinsky, 2011

[c] Pillen et al., 2013

[d] Biesta et al., 2015; Thomas and Yoon, 2014; Pillen et al., 2013

themselves effectively taught mathematics using chalk talk and therefore they believe

that it is the best way to teach mathematics to their students as well (Woods & Weber,

2020).

For teachers (especially novice instructors), experiences with students often have

an impact on teachers' orientations. According to Schellings et al. (2021), "teachers strive

to be 'a certain kind of teacher' by enacting their personal ideals, professional values, and

goals that are directly related to their inner motives regarding teaching" (p. 4), but

relationships with and feedback from students often cause these ideals, values, and goals

to shift over time. Negative student feedback can impact teachers' professional

confidence whereas positive student feedback can improve or reinforce teachers' beliefs

about themselves (Schellings et al., 2021).

One of the greatest effects of gaining experience is on instructors' ability to

reflect on their practices. According to Farrell (2020),

> Reflective practice involves… teachers systematically looking at what they do,
>
> how they do it, why they do it, what the outcomes are in terms of students
>
> learning, and what actions… teachers will take as a result of knowing all this
>
> information. Thus experience combined with systematic reflection can lead to
>
> professional growth so that [teachers] can become more effective… teachers. (p.
>
> 277)

According to Schön (1983), such reflection is a natural part of any professional activity

(including teaching) and occurs iteratively as one gains more experience. The reflection

on experience will impact a teachers' goals and orientations over time as they reprioritize

what they hope to accomplish as an educator and as their beliefs about what is effective in the classroom evolves.

2.4 Existing Frameworks for Categorizing Goals and Orientations

Because this study is primarily concerned with the goals and orientations held by GTAs, it is worth considering existing structures for examining the goals and orientations of educators. The following subsections discuss two different frameworks for categorizing goals and orientations. These different frameworks will provide structure to the discussion of the goals and orientations held by participants in the present study.

2.4.1 Crooks-Monastra and Yee's Goals for Student Learning

In a 2022 study, Crooks-Monastra and Yee explored the goals held by graduate students teaching as instructors of record for the first time for precalculus courses. In particular, Crooks-Monastra and Yee examined the goals related to GTAs' decisions (both planned and in-the-moment) about teaching that focused on how students learn. Crooks-Monastra and Yee found that the most salient goals could be grouped into four overarching categories of goals: preparing students for the future; developing reasoning, sense-making, and understanding; developing productive dispositions; and developing procedural skills. Moreover, all four of these categories of goals were present to some extent for all graduate student instructors in the study. Table 2 (Crooks-Monastra & Yee, 2022, p. 146) summarizes their findings.

The first category of goals relates to preparing students for their futures, whether it be for future classes or their future careers. Many participants in the study explicitly stated that preparing students for the subsequent mathematics course was an important goal of theirs. Instructors in the study often referenced their students' future lives and

Table 2

*Summary of Goals and Aspects of the Goal*s (Adapted from Crooks-Monastra & Yee, 2020)

Goals	Aspects of Goals
Goal 1: Prepare Students for Their Future	Coursework; STEM Careers; Personal Study Skills
Goal 2: Develop Reasoning, Sense Making and Understanding	Understanding Why; Deriving or Proving; Sense Making and Developing Intuition; Applying or Connecting Concepts, Facts or Procedures
Goal 3: Develop Productive Dispositions	Enjoy Mathematics and/or Precalculus Class; Build Self-efficacy; View Mathematics as Useful; Willing to Persevere
Goal 4: Develop Procedural Skills	Content Skills to Solve Standard Problems; Recognize and Use Appropriate Tools; Know or Memorize Facts

Note. Adapted from Crooks-Monastra & Yee, 2022, p. 146

careers in STEM-related fields and wanted to teach students necessary lives and careers in STEM-related fields and wanted to teach students necessary skills, such as "learning how to learn, taking ownership of the learning process, and feeling personal satisfaction or pride in hard work" (Crooks-Monastra & Yee, 2022, p. 147).

The second category of goals expressed by participants in the study was aimed at helping students develop mathematical reasoning, sense making, and understanding. Participants in this study described "wanting students to conceptually understand or make sense of mathematics, to apply and connect concepts or ideas, to derive, prove, generalize, or conjecture about formulas or theorems, and develop intuition" (Crooks-Monastra & Yee, 2022, p. 147). Some participants extended the goals in this category to

include wanting students to develop intuition, connect various topics, and to think creatively when solving unfamiliar problems.

The third category of goals was to help students develop productive dispositions. Crooks-Monastra and Yee (2022) described this category as "affective goals for their students related to how students viewed themselves as learners of mathematics and how they understand the field of mathematics" (p. 148). Some participants brought this up as a goal when discussing wanting to change the negative dispositions that many of their students came into the class with. Some of the specific goals within this category were related to students' mathematical confidence, perseverance, and general appreciation of mathematics.

The fourth and final category of goals aims to help students develop procedural skills needed to carry out mathematical tasks. One participant stated that the goal of a particular class meeting was for students to be able to solve a specific type of problem with a specific skill, even if they did not understand where the procedure came from or why it worked. According to Crooks-Monastra and Yee (2022), these goals reflected the belief that mathematics courses at the precalculus level include "objectives for students to solve, compute, manipulate, or simplify, which often amounts to replicating or following procedures" (p. 149).

Although there was evidence that all the participants in the study held goals from each of the four categories, the four goals were not discussed by participants equally: "Some goals, such as the super objective of preparing students for their future, were clear and conscious in all [participants'] minds from the start to the end of the study. Other goals emerged or were discussed and identified more clearly as the semester progressed"

(p. 149). Moreover, the extent to which participants were aware of and were able to articulate different goals changed over the course of the study.

2.4.2 Luft and Roehrig's Teacher Beliefs

The Teacher Beliefs Interview (TBI) is a semi-structured interview protocol designed by Luft and Roehrig (2007) with the purpose of examining the beliefs about teaching and learning held by secondary STEM educators. The instrument includes seven open-ended questions as well as coding rubrics to categorize responses across five categories of teacher beliefs: traditional, instructive, transitional, responsive, and reform-based beliefs. Descriptions of each category of beliefs, as well as their classifications as teacher-focused or student-centered beliefs, can be found in Table 3. *Teacher-centered* teaching focuses on "transferring structured knowledge to students" (Justice, 2018, p.1) whereas *student-centered* teaching focuses on "facilitating understanding and fostering

Table 3

Categories of Teacher Beliefs (Synthesized from Luft & Roehrig, 2007)

Category	Description	Classification
Traditional	Beliefs emphasize the transfer of knowledge from the teacher to students	Teacher-centered
Instructive	Beliefs emphasize providing students with opportunities to learn; learning is directed by the teacher through experiences	
Transitional	Beliefs emphasize providing a supportive learning environment through teacher-student relationships	—
Responsive	Beliefs emphasize learning through collaboration among students	Student-centered
Reform-based	Beliefs emphasize students directing their own learning	

Note. Transitional beliefs are categorized as neither teacher-centered nor student-centered

conceptual change" (Justice, 2018, p.1). These two approaches towards teaching are reflective of behaviorist and constructivist perspectives, respectively, and are typically considered to form a spectrum (Serin, 2018). In a 2018 study, Justice found that statistics GTAs began graduate school with more teacher-centered beliefs but that they transitioned to holding more student-centered beliefs as they gained more experience in the classroom.

The distinction between teacher-centered and student-centered beliefs suggests that these five categories form a spectrum (Douglas et al., 2016; Mattheis & Jenson, 2014) as shown in Figure 6. Note that this spectrum is not meant to imply that one end of the spectrum is "bad" and the other is "good". Although recent research has suggested that student-centered teaching practices are more beneficial for student learning, there are benefits to both kinds of practices (Serin, 2018). Moreover, it is important to separate the actions from the underlying beliefs: for example, just because someone holds teacher-focused beliefs does not necessarily mean that they will use teacher-focused teaching practices. Through the lens of the ROG framework, it is possible that other resources, orientations, and goals could be prioritized over teacher-centered beliefs and student-centered teaching practices could be selected (Schoenfeld, 2011).

Figure 6

The Spectrum of Teaching Beliefs from Teacher-Centered to Student-Centered
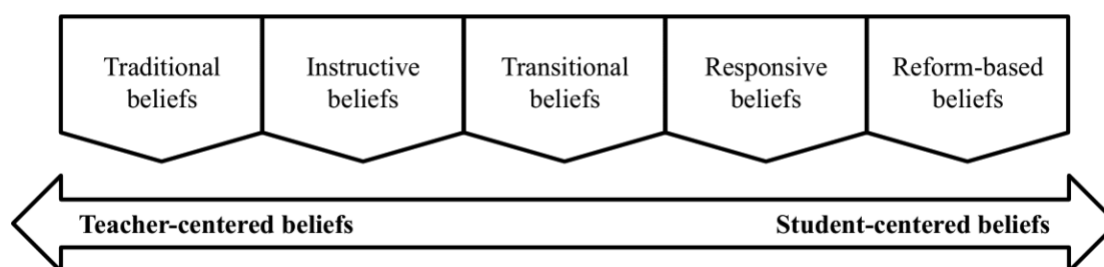
According to Schoenfeld's ROG model (2011), there is not a direct correlation between holding particular beliefs and specific instructional decisions. However, Lee (2019) found that STEM GTAs frequently referred to specific instructional activities when reflecting on different categories from the TBI. For example, when describing beliefs in the traditional belief category, GTAs often referenced lecturing and providing examples or metaphors to students. Instructive beliefs were frequently characterized by mentions of group work, hands-on or active learning, and formative assessments. Transitional beliefs were reflected by a consideration of GTA characteristics (such as wanting to be approachable or relatable) and discussions of equity.[1]

2.5 Social Support in Mathematics Education

Although the decision-making process behind social support is important in any discipline, the present study was concerned with how these concepts take shape specifically in mathematics education. In a 2020 study, Petropoulou et al. examined the goals, orientations, and teaching practices of two lecturers teaching comparable mathematics courses. The first instructor believed that students learn better in a supportive, student-centered environment, whereas the second instructor believed that students benefitted from a structured and organized classroom that aided them in completing their degree on time. These drastically different orientations were evident in the lecturers' teaching practices and the social supports that they offered: the first instructor tended to focus on student-led discovery and went out of his way to foster

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[1]Lee (2019) did not discuss responsive or reform-based beliefs because these were not present in their data.

student participation. The second instructor opted for a more traditional lecture structure

and selected activities that would support the students in passing the final exam. Overall,

this suggests that the goals and orientations that mathematics instructors have for both

themselves and their students play an important role in establishing their educational

practices and therefore influence the student experience.

2.6 Graduate Teaching Assistants in Mathematics

GTAs provide interesting and unique opportunities for the study of teaching

trajectories. Most GTAs enter graduate school with little or no formal teaching

experience but participate in extensive professional development in preparation for

teaching in undergraduate mathematics classrooms. Often, this professional development

is on-going and concurrent with their first few semesters of teaching. This means that

GTAs are simultaneously learning and implementing teaching strategies in ways that few

other populations of educators are (Rogers & Yee, 2018). Although many GTAs hold

important beliefs about learning and teaching mathematics prior to graduate school, many

beliefs continue to develop during their first years of teaching and as they undergo formal

professional development and pedagogical training for the first time (Luft & Roehrig,

2007).

2.6.1 Teacher Knowledge and Graduate Students

A common theme in the study of mathematics GTAs is that a strong

understanding of the mathematics GTAs are teaching does not necessarily mean they will

be effective in teaching it. Shulman's (1986) influential framework contains three

dimensions of teacher knowledge: *subject matter knowledge* (what is being taught),

pedagogical content knowledge (how to teach what is being taught), and *curricular*

knowledge (how what it being taught fits into the larger learning trajectory). Although Shulman's work is applicable to teaching in general, its importance in mathematics is evident. Thames and Ball (2010) said,

> Mathematical knowledge does matter for teaching. But it is not a mathematical expertise like that required for research in mathematics or for other kinds of quantitative work. Instead, mathematical knowledge for teaching is a kind of complex mathematical understanding, skill, and fluency used in the work of helping others learn mathematics. (p. 228)

Because teaching mathematics requires different kinds of knowledge than *doing* mathematics, it is important to distinguish between the different domains of knowledge.

Hill et al. sought to improve Shulman's work and to adapt it for mathematics by developing the mathematics knowledge for teaching (MKT) framework (2004). The MKT categorizes mathematics teachers' knowledge into two domains: *subject matter knowledge* (which consists of common content knowledge, knowledge at the mathematical horizon, and specialized content knowledge) and *pedagogical content knowledge* (which consists of knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum; Figure 7 illustrates the different domains outlined by the MKT.

Carrillo-Yañez et al. (2018) proposed another interpretation of Shulman's framework that is similar to the work of Hill et al. called the Mathematics Teacher's Specialized Knowledge (MTSK) model; the MTSK divides the knowledge possessed by

Figure 7

Domains of Knowledge from the MKT (adapted from Thames & Ball, 2010, p. 223)
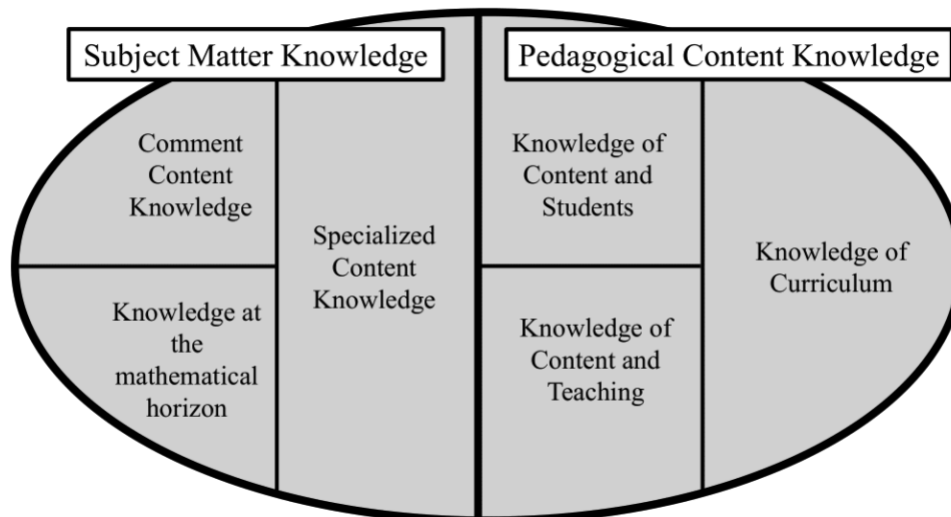
Note. Adapted from "What Math Knowledge Does Teaching Require?" by M. Thames and D. Ball, 2012, *Teaching Children Mathematics, 17*(14), p. 223. Copyright 2010 by National Council of Teachers of Mathematics.

mathematics teachers into *mathematical knowledge* (which included knowledge of the topics, the structure of mathematics, and practices in mathematics) and *pedagogical content knowledge* (which includes knowledge of mathematics teaching, features of learning mathematics, and mathematics learning standards). Unlike the MKT, the MTSK also addresses teachers' beliefs about mathematics and mathematics education, stating that

> The teacher's classroom practice is deeply influenced by what can be loosely termed a philosophy of mathematics, that is a more or less coherent set of conceptions and beliefs about mathematics, how it is learnt and how it should be

taught, which permeate the teacher's knowledge. (Carrillo-Yañez et al., 2018, p. 240)

Figure 8 illustrates the knowledge domains of the MTSK.

Figure 8

Domains of Knowledge from the MTSK (adapted from Carrillo-Yañez et al., 2018, p. 240)
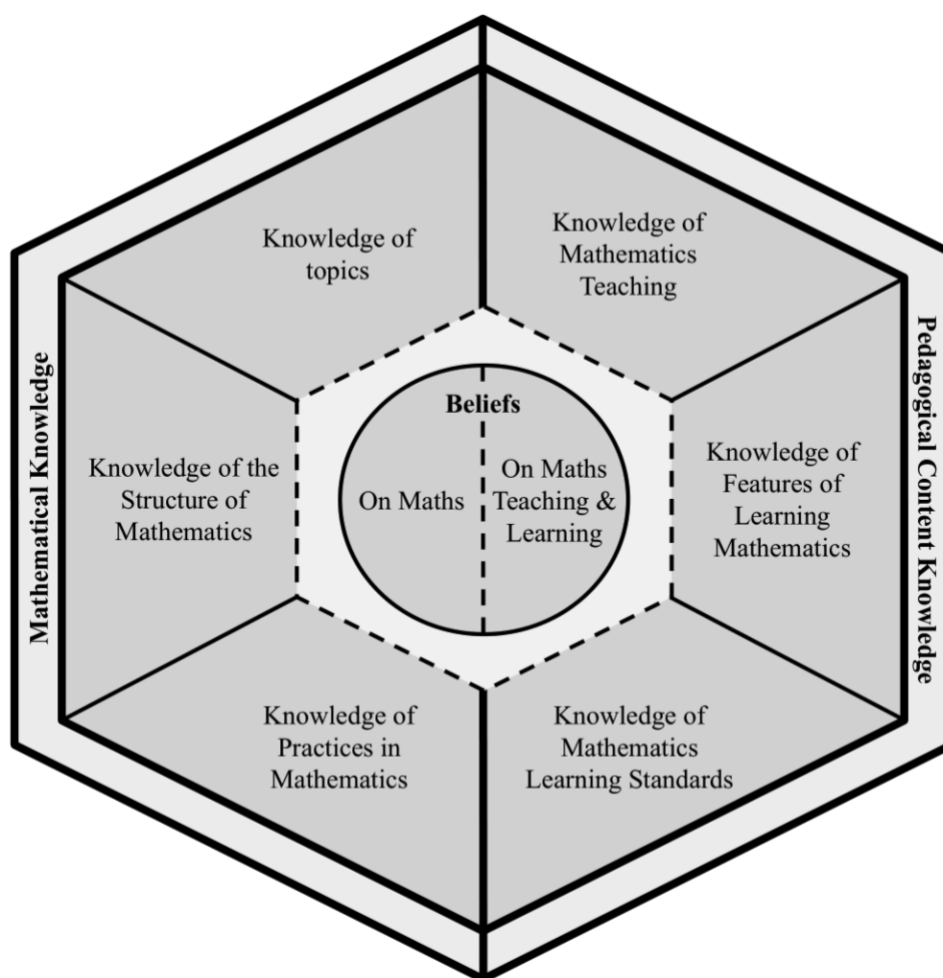
Note. Adapted from "The Mathematics Teacher's Specialized Knowledge (MTSK)," by J. Carrillo-Yañez et al., 2018, *Research in Mathematics Education, 20*(3), p. 240 (https://doi.org/10.1080/14794802.2018.1479981). CC BY.

Because most GTAs enter graduate school with little or no teaching experience, their pedagogical content knowledge is often underdeveloped. Although they certainly possess beliefs about how mathematics is learned and how it should be taught based on their experiences as a student, they lack the perspective of the educator to be well-rounded in their teacher knowledge. Because this knowledge is developed through the professional development that their institution and department provide, the professional development that GTAs in mathematics programs receive is imperative as it can have direct impacts on the teaching they do during and beyond graduate school (Ellis, 2014).

Chapter 3: Methods and Procedures

3.1 Rationale for a Qualitative Design

According to Merriam and Tisdell (2016), "qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (p. 5). The primary goal of the present research was to understand a phenomenon within the human experience according to those who have experienced it. This study was less concerned with the tangible actions of the participants, but rather how the participants understood, interpreted, and described their actions, and as a result the data were inherently descriptive. Moreover, this study was especially concerned with the elements that influence the decision-making process; such elements are specific to the individual and the context in which they live and were therefore not easily captured with quantitative data. This attention to the experience of individuals within the context of their own worlds is a critical component of qualitative research (Bogdan & Biklen, 2007).

According to Creswell (2020), another important element of a qualitative study is that a central phenomenon is explored in an open-ended way and that multiple perspectives are presented. Since this study aimed to fill a gap in the literature, it was inherently exploratory. This study was designed without preconceived assumptions about how participants would describe their goals and orientations or how they would offer social support. The data collection instruments were intentionally designed to be flexible so that participants could answer questions in ways that reflect their own experiences. The research questions of this study sought to describe the human experience, not quantify it, making this study better suited for a qualitative design than a quantitative one.

3.2 Qualitative Design Type

This study used a phenomenological multiple case study design. A case study design should be considered when the research is aiming to answer "how" and "why" questions (Baxter & Jack, 2008). Thomas (2016) says that a "case study is defined not so much by the methods that you are using to do the study, but the edges you put around your case—the direction in which you want your research to go and how far" (p. 21). This study was more concerned with *what* was being studied—GTAs teaching first-year undergraduate mathematics courses—than *how* it was studied, and it was looking to answer exactly the kinds of questions that made it a good fit for a case study.

Phenomenological studies, on the other hand, assume that "there is an essence or essences to shared experience" (Merriam & Tisdell, 2016, p. 26) and seek to capture and describe such shared experiences. The participants' personal knowledge and descriptions of the phenomenon of study is critical in providing a detailed and authentic portrayal of their experiences (Creswell & Poth, 2018). The phenomenon that was studied in the present research was the decision-making process behind offering social support in mathematics classrooms. Although GTAs are not always aware that they are making such decisions, making in-the-moment decisions is a ubiquitous part of teaching mathematics (Schoenfeld, 2011).

The use of a phenomenological case study approach allowed me to develop a holistic understanding of the phenomenon (making decisions related to offering social support) within bounded cases (inexperienced and experienced mathematics GTAs teaching calculus recitations at the University of Nebraska-Lincoln). *Who* was studied was just as important as *what* was studied. The participants of this study are inextricable

from their decision-making processes, necessitating a qualitative design that places value on both the cases and the phenomenon. Although using a case study approach meant that the findings are not fully generalizable, generalization was not a primary aim of this study. Instead, the findings can be used as a starting point for further research in the decision-making process behind classroom social support.

3.3 Context, Participants, and Sampling

3.3.1 Context of the Study

The participants for this study were graduate students in the Mathematics Department at the University of Nebraska-Lincoln (UNL). Most mathematics graduate students at UNL are supported as GTAs to teach within the department. Although the teaching trajectories differ among GTAs, there are several notable experiences that most graduate students in this department share. GTAs typically lead one or two Calculus I or Calculus II recitations during each semester of their first year. In their second year, GTAs have their first opportunity to be an instructor of record, usually for Intermediate Algebra, College Algebra, or Contemporary Mathematics. Beyond their second year, GTAs can request which courses they would like to teach; teaching assignments include a variety of precalculus, calculus, higher-level mathematics, and pre-service elementary teacher mathematics education courses. Some graduate students farther along in the program even request to return to teaching calculus recitations alongside the first-year GTAs. Graduate students also have opportunities to teach classes during condensed summer and winter sessions.

Due to the importance of teaching in the department culture, mathematics graduate students at UNL are provided various supports throughout their time as GTAs.

All first- and second-year GTAs participate in an intensive, multi-day orientation prior to the start of the school year. For first-year GTAs, this orientation is a full week and is designed to prepare them for their first experiences as teachers. GTAs learn about lesson planning, grading, classroom management, and the logistics of leading calculus recitations. Second-year GTAs, who are about to teach as an instructor of record for the first time, focus on larger pedagogical ideas and skills that will serve them in this elevated role. Although it is not required, GTAs in their third year and beyond are strongly encouraged to attend many of these sessions. During their second year, GTAs are also required to take a year-long pedagogy course. In this class, GTAs learn about learning and teaching theories, to analyze education research, and to explore how to apply education research to their own teaching practices. This course is intentionally concurrent with GTAs' first year as instructors of record in order to support them during what is often a challenging stage in their development as teachers. Finally, the department provides various optional seminars related to teaching; these include a Mathematics Education Doctoral Seminar and an informal GTA-led "teaching table" where graduate students can meet to discuss ideas related to their own teaching.

The teaching culture in the department is largely oriented around cooperation and coordination. Most of the courses that graduate students teach are coordinated courses, meaning that all instructors share materials (such as textbooks, student workbooks, assignments, and assessments) and collaborate on curriculum and lesson planning. Weekly coordination meetings allow the GTAs teaching the same course to discuss their individual classes and any triumphs or challenges that might be occurring.

3.3.2 The Sample and Sampling Criteria

The desired sample for this study was six GTAs teaching recitations for either Calculus I or Calculus II with two to four first-year GTAs and two to four GTAs in at least their fourth year of graduate school (henceforth, *experienced GTA* will refer to a GTA in at least their fourth year of graduate school, meaning that they had at least three full years of teaching experience at the time of this study). There are many recommendations for sample sizes in case study research; the decision to have six participants was largely based on suggestions in the literature for this type of research—suggestions range from one to 12 participants (Campbell, 2015; Njie & Asimiran, 2014)—as well as what was feasible for me in terms of collecting data. Having six participants not only fell within the range of recommended sample sizes but also allowed for both cases (the first-year and experienced GTAs) to be represented by at least two participants each within the sample.

For this study, the sample was selected according to what Merriam and Tisdell (2016) call a *typical* and *purposeful* sample. A "purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned" (Merriam & Tisdell, 2016, p. 96). A typical sample is "one that is selected because it reflects the average person, situation, or instance of the phenomenon of interest" (p. 97). For this study, GTAs were excluded from consideration if they had significant prior teaching experience, such as teaching during a master's program at another institution, having been a paid undergraduate teaching assistant, or teaching K-12 before going to graduate school. They were also excluded if they were doing doctoral research in mathematics education at the

time of the study. These exclusionary criteria were in place to help make the sample as typical as possible: although many GTAs (at other institutions and in other disciplines) do have significant experience teaching or doing education research, most GTAs at in the Department of Mathematics at UNL do not. Such GTAs could possess atypical knowledge about teaching and therefore were not reflective of a typical mathematics doctoral student.

All GTAs teaching recitations for Calculus I or Calculus II were invited to participate in the study as long as they were either first-year or experienced GTAs. A sampling survey was sent to all interested GTAs to assess whether they met the criteria of the study (see Appendix A for the sampling survey that was administered). After the exclusionary criteria removed ineligible GTAs from consideration, the resulting sample was four first-year GTAs and two experienced GTAs teaching a combination of both Calculus I and Calculus II.

3.3.3 Rationale for the Sample

GTAs were selected as the focus for this study for three reasons. First, most GTAs in the UNL Department of Mathematics enter graduate school with little or no formal teaching experience, meaning that their teaching trajectories are completely contained within their time at UNL. In terms of teaching experience, first-year GTAs can be expected to be quite similar; although the experienced GTAs will have had a variety of teaching experiences, most (if not all) of those teaching experiences will have taken place during their time at UNL within the Department of Mathematics. The structured professional development that new GTAs go through means that many resources (in the form of teaching knowledge) are relatively constant across GTAs in this department. For

example, all experienced GTAs will have taken the required pedagogy course during their second year and can therefore be assumed to understand major learning and teaching theories. Because first-year GTAs have not taken this course, it could be assumed that most of the first-year GTAs in this study were likely not familiar with these. In general, GTAs within the same department will have undergone the same professional development and taught from the same catalog of courses, meaning that differences among them are likely reflective of their personal goals and orientations. The same cannot be said of a sample of K-12 teachers or even the faculty within the UNL Mathematics Department who have received training from a wide variety of sources.

The second reason to study GTAs is the nature of the coordinated courses that they teach. The calculus courses are coordinated in the Department of Mathematics at UNL, perhaps more so than other classes since the recitations are primarily taught by first-year GTAs. The coordinated nature of the calculus courses meant that it could be assumed that the GTAs teaching these recitations were following the same lesson plans and using the same resources to support their teaching (such as the textbook, in-class activities, and assessments). These constant elements allowed the goals and orientations that differed among the participants to be the focus of the study. There are instructors within coordinated courses who are not GTAs (such as undergraduate teaching assistants and faculty lecturers), but within the UNL Mathematics Department, GTAs make up a significant proportion of the teaching force within the coordinated courses: during the semester in which data for this study was collected, GTAs taught 100% and 93% of the recitations for Calculus I and Calculus II, respectively.

3.4 Research Positioning and Reflexivity

According to Creswell (2020), "all researchers shape the writing that emerges, and qualitative researchers need to accept this interpretation and be open about it in their writings" (p. 223). It is important for me to reflect on my background, experiences, biases, and beliefs that could potentially influence this research. For example, I was nearly eligible for my own study: at the time of writing, I am an experienced GTA in the Mathematics Department at UNL and have therefore had many of the same teaching-related experiences as the participants in this study. Throughout data collection, data analysis, and writing, it was important that I separated myself from these shared experiences so that the findings of this study could be accessible and valuable to a wider audience than just the members of my own community.

I am also a mathematics education researcher; as a result, I am extremely invested in pedagogical best practices and am highly interested in what makes GTAs "good" teachers, and therefore I have both conscious and subconscious biases about what best practices are. Throughout the course of this study, it was imperative that I bracketed these feelings. The purpose of this dissertation is to describe the experiences of the participants, not to pass judgements based on my own beliefs.

On the other hand, my personal experiences as a GTA in the very community I studied provided an opportunity for unique insights and perspectives that researchers external to this community may have lacked. The questions that drove this study arose naturally during conversations with my advisors about my experiences as a GTA: I noticed that the ways that I offered social support were different than social supports offered by others in my cohort who had had very similar pedagogical training, and I was

curious why. I am interested in how GTAs decide to offer social support because (at the time of writing) I *am* a GTA who offers social support. I have goals and orientations that shape the ways I support my students daily, and I saw my experiences reflected in those of the participants in this study.

I did not attempt to suppress my own experiences and perspectives during the course of this study. Instead, I put measures in place to mitigate the impact that my biases might have. In particular, I used both peer review and member checking strategies to remain as objective as possible and to maintain the integrity of the study. These efforts are discussed in further detail in Section 3.7.

3.5 Data Collection Methods

3.5.1 Initial Interview

Data were collected in five stages. The first stage of data collection was a semi-structured, one-on-one interview with each participant. The purpose of this interview (henceforth known as the *initial interview*) was to develop an understanding of each participant's goals and orientations (related to social support and in general) and to begin exploring their conceptualizations of social support. During the first phase of the initial interview, participants were asked to list a variety of goals they have related to teaching and then order the goals by priority. Open-ended reflection questions were asked about the goals and their ordering in order to elicit evidence of related orientations. The second phase of the initial interview introduced participants to the definition of social support. Participants were asked to reflect on their initial impressions of this concept and to provide several examples of ways that they think they provide social support to their students. Participants were also given an opportunity to add goals related to social

support to the list they generated during the first phase. Finally, experienced GTAs were provided an opportunity to describe how their answers to certain questions may have been different during their first year of graduate school. If they indicated that their answers would have been different, they were asked to speculate on possible reasons that these changes might have occurred.

The overall goal of the interview was to develop a list of goals and orientations held by each GTA to guide my thinking in the next phase of data collection. This initial interview was audio-recorded for later analysis. A copy of the initial interview protocol can be found in Appendix B.

3.5.2 Pre-Observation Period

The second stage of data collection was a pre-observation period. I informally observed each GTA teaching for one week (two consecutive 75-minute class meetings each), taking unstructured field notes on my general impressions about their class. This stage allowed me to become acquainted with what a typical class session looked like for each participant prior to the formal observations that followed. Using unstructured field notes during the observations provided the flexibility to be present and experience the class as it was taught without preconceived expectations about what I would observe (Merriam & Tisdell, 2016; Mulhall, 2003). These notes were not formally analyzed but instead helped me decide what to focus my attention on during the next stage of data collection. They also helped me keep track of details and ideas between participants since most of the observation periods overlapped.

A secondary purpose of the pre-observation phase was to desensitize each GTA and their students to my presence. From a methodological perspective, classroom

observations can raise concerns of validity because observations are inherently intrusive: the instructor and their students are aware that they are being observed and therefore might change their behaviors (even subconsciously). Instructors in particular might experience an increase in anxiety if they believe that their performance is being evaluated, leading them to teach better or worse than they normally do (Kazdin, 1979; Kellehear, 2020; Waxman, 2013). Spending extra time in the classroom helped to establish trust and respect with the instructors and their students, which encouraged more authentic interactions during the formal observations (McDougall & Henderson-Brooks, 2021).

3.5.3 Formal Observation

The third stage of data collection was a formal observation. Each GTA was observed teaching their recitation for one week (two consecutive 75-minute class sessions). The classes were audio-recorded via a microphone worn by the instructor and detailed observation notes were taken with special attention being placed on examples of social support offered by the GTA. An observation protocol was used to organize these examples; a copy of this protocol can be found in Appendix C.

Immediately following the last class period of formal observation for each participant, I reviewed the list of observed social supports and selected five to eight examples to be discussed during the next phase of data collection. Examples were selected in such a way that multiple categories of social support were represented (based on my personal categorizations). I tried to select examples that represented a wide variety of actions (i.e., a mix of whole-class, small group, and individual interactions; a mix of

actions that were repeated and actions that occurred just once; examples that varied in length; etc.).

3.5.4 Follow-Up Interview

The fourth stage of data collection was a second one-on-one interview, henceforth known as the *follow-up interview*. The follow-up interview took place within six hours of the end of the formal observation for five of the participants and within 24 hours for the remaining participant. The purpose of the follow-up interview was to discuss the selected examples of social support that the GTA offered during the formal observation. I described each example in as much detail as possible (including which day the example occurred on, a summary of what happened, and which students were involved); the audio recording of each example was replayed upon request. GTAs were asked to reflect on why they offered each example of social support, whether they thought it was effective, and whether they considered it to be social support at all based on their own understanding of the definition of social support. Halfway through the interview, participants were introduced to House's (1981) framework for categorizing social support; a copy of the definitions handout that was provided to participants can be found in Appendix D. We then went through the list of examples of social support a second time; this time, participants were asked to categorize each example into House's framework and to explain their reasoning. How a support action is categorized is dependent on how the giver intends it to be received (House, 1981) and therefore it was imperative that the GTAs were given an opportunity to categorize it for themselves, even if I disagreed with their assessment. The follow-up interview protocol can be found in Appendix E.

3.5.5 Written Survey

The final stage of data collection was a written survey sent each participant by email; the data collected in this stage was not directly analyzed but was instead used as a form of member checking. An important aspect of the study was that I developed a list of orientations that I, the researcher, *inferred* each participant to have based on their responses during interviews and actions during observations. For this stage, I compiled a list of goals and orientations that I believed different participants held. The goals were written as statements (such as "I believe that…" or "I prioritize…"), and each participant was asked to state the extent to which they agree with each statement. Participants were also given an opportunity to explain their agreement (or lack thereof) with each statement if they chose.

Although it is not essential to the ROG framework (Schoenfeld, 2011) to verify researcher-identified orientations with the participants, knowing whether the participants agree or disagree with assertions made about them could shed light on both congruencies and incongruencies between their goals and actions. At the end of data analysis, I read the results of the survey and compared them to what I had learned about each participant. There were no egregious inconsistencies between the goals and orientations I believed each participant to hold and their survey responses.

This final phase of data collection was conducted via an online survey (rather than in an interview) for two reasons. First, an online survey with a long response window gave the participants time to reflect on each goal and orientation in the survey rather than asking the participants to agree or disagree with the statements in the moment during an

interview. Secondly, some statements could be emotionally triggering, especially if the

orientations are perceived as being negative or are related to sensitive topics.

3.6 Data Analysis Approach and Methods

3.6.1 First Coding Cycle

A pilot study indicated that multiple coding methods would be needed to analyze

the data through the lenses of the different research questions. The purpose of the first

phase of coding was to address *RQ1: What goals and orientations are present when

GTAs offer social support to their students and how do GTAs prioritize their goals and

orientations?* by focusing on the goals and orientations of each participant. This phase

used a combination of *structural* and *provisional coding* to develop parent and child

codes, respectively. Structural coding "applies a content-based or conceptual phrase

representing a topic of inquiry to a segment of data that relates to a specific research

question" (Saldana, 2016, p. 98); this method allows one to categorize excerpts related to

similar topics before moving onto further coding and analysis (MacQueen et al., 1998).

For the present study, parent codes were used to categorize data related to goals,

orientations, and social support, allowing for simultaneous coding. In provisional coding,

a codebook is developed prior to data collection, but can be "revised, modified, deleted,

or expanded to include new codes" (Saldana, 2016, p. 168). Child codes were developed

based on the literature review and experiential data (both from a pilot study and my

familiarity with the data) to capture different types of goals and orientations that

participants might express. Child codes included things like "Goals – Student

Performance" and "Orientations – Nature of Mathematics". The flexibility of provisional

coding allowed for codes to be continuously added as new goals and orientations emerged in the data.

The codes developed during this phase were used to code transcripts for both the initial and follow-up interviews for each participant. Each interview was coded multiple times to ensure that no codes or excerpts were missed. When I believed that there were no more new codes to be added to the codebook, the interviews were all coded one more time to verify this.

3.6.2 Proposition development

According to Yin (2018), a useful strategy in the data analysis of case study research is to "stipulate a presumed set of causal sequences about it [the subject of the study], or 'how' or 'why' some outcome has occurred" (p. 179). This was appropriate for this study because the research questions aimed to describe (and ultimately explain) how and why instructors offer different categories of social support. Yin proposed an iterative process in which preliminary explanatory *propositions* are compared to the data and revised throughout the study.

Prior to starting the second phase of coding, I took a step back from the data in order to develop a "big picture" understanding of how all of the participants fit together to answer the research questions and to portray the shared experience of making decisions related to social support. I wanted to begin organizing my findings according to what I found interesting and meaningful and to begin developing propositions that could drive the results sections of this dissertation. After reviewing the data that had been

collected and analyzed thus far and using peer debriefing[2] with my advisors, three

pairings emerged among the participants. For each pair, I then developed propositions

about how they contributed to the research questions and the overall shared experience

that was the focus of this study. The propositions not only determined the codebooks that

were used in the second cycle of coding but contributed to the overall focus of this

study's findings. A discussion of pairings and the propositions that were generated for

them can be found in Section 3.9.

3.6.3 Second Coding Cycle

The purpose of the second cycle of coding was to reexamine the data through the

lens of the propositions that were developed for each pair of participants using *hypothesis*

coding. In hypothesis coding, codes are generated "specifically to assess a researcher-

generated hypothesis" (Saldana, 2016, p. 171). In this case, an individualized code book

was developed for each participant based on the proposition(s) for each pair of

participants and my existing familiarity with the participants' data. Coding was repeated

until no new themes emerged.

3.7 Issues of Validity and Rigor

Merriam and Tisdell (2016) justified the need for a valid and rigorous design by

saying that "to have any effect on either the practice or the theory of a field, research

studies must be rigorously conducted; they need to present insights and conclusions that

ring true to the readers, practitioners, and other researchers" (p. 238). It was imperative

that this study was designed and conducted in such a way that the participants believe

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[2]Peer debriefing is discussed in more detail in Section 3.7.

that it has done their experiences justice, and that others in mathematics education can find meaning in its findings. To establish the validity of my study, five of the validity procedures outlined by Creswell and Miller (2000) were used. Although these are not the only procedures that a researcher can (or should) use, Creswell and Miller identified these as being among the most common procedures in qualitative research.

The first two validation procedures used were the closely related researcher reflexivity and researcher positioning. Researcher reflexivity includes a disclosure of any orientations that I possess that could potentially influence the study, whereas researcher positioning involves sharing the ways that my social positions might impact the way that I conduct the study or interpret it (Creswell & Miller, 2000; Reyes, 2017). Establishing validity in this way was particularly important for this study because of my closeness to the study. It was important to reflect on and to be transparent about my positioning with the study and the biases that I could have brought into the study. See Section 3.4 for positioning and reflexivity.

The third procedure used to establish credibility was member checking. Member checking "shifts [the validity procedure] from the researchers to participants... It consists of taking data and interpretations back to the participants in the study so that they can confirm the credibility of the information and narrative account" (Creswell & Miller, 2000, p. 127). This study required a great deal of researcher interpretation: I had to infer information about the participants' goals and orientations from their interview responses and I had to make assumptions about their motivations based on their actions. It is important that my interpretations of the goals, orientations, and actions of each participant align with their own perceptions. To ensure alignment between my

interpretations and the participants' realities, member checking was present at three phases of this study. First, during the follow-up interview, participants were given an opportunity to categorize their social support actions for themselves. Second, the written survey was administered to calibrate my understandings of the participants' orientations with their self-identified beliefs. Finally, each participant was given the opportunity to review the chapter of which they were the focus to give feedback on what was written about them.

The fourth validity procedure utilized in this study was peer debriefing. According to Creswell and Miller (2000),

> A peer review or debriefing is a review of the data and research process by someone who is familiar with the research or the phenomenon being explored… [The peer reviewer] provides support, plays devil's advocate, challenges the researchers' assumptions, pushes the researchers to the next step methodologically, and asks hard questions about methods and interpretations. (p. 129)

Peer debriefing was implemented over the entire course of the research process: I met regularly with my advisors to discuss design choices, my interpretations of results, and how I communicated findings in my writing. Peer debriefing helped ensure that the research was held to a high standard of credibility and validity at all stages.

The fifth validation procedure that was used was triangulation. Although triangulation usually refers to using multiple forms of data collection (i.e., *method triangulation*), it also includes utilizing multiple theoretical perspectives and theories (i.e., *theory triangulation*) (Carter et al., 2014; Marshall & Rossman, 2016). Data was

collected both in interviews and through participant observation. This allowed me to triangulate the participants' words with their actions. Further, the initial interview focused on the participants' hypothetical reflections of social support and the follow-up interview was concerned with their perspectives on the tangible actions that took place. Together, these two perspectives triangulated their idealistic perspectives on social support with how they viewed the practice itself. Theory triangulation was used as well: the study itself was based on two very different theoretical frameworks (Schoenfeld's model for in-the-moment decision making (2011) and House's framework for the categorization of social support (1981)), and other existing frameworks were consulted to make sense of the data (see the use of Crooks-Monastra and Yee (2022) and Luft and Roehrig (2007) in Chapter 5). These frameworks all have merit in their respective fields but utilizing them together allowed me to substantiate my findings in a more rigorous way (Carter et al., 2014).

3.8 IRB and Ethical Considerations

This study adhered to the requirements of the University of Nebraska-Lincoln's Institutional Review Board (IRB). I have completed the Collaborative Institutional Training Initiative (CITI) program and have renewed this certification as required during the research process. Members of my committee who have had access to data and preliminary reports have done so as well.

To maintain an appropriate balance of power between myself and the participants of this study, I did not hold any positions of authority that could have upset this balance. All GTAs in this study participated voluntarily and were reminded at each stage of data collection that they reserved the right to withdraw from the study without negative

consequences. Participants were made aware of who my advisors were and were informed of the extent to which the advisors would have access to data.

All participants were assigned a gender-neutral pseudonym at the start of the study in order to protect their identities. The pseudonyms were used at each stage of data collection and analysis. Any data (such as original interview transcripts) that contained participants' real names or potentially identifiable details were blinded immediately. In addition to de-identifying the data, some details were anonymized to further mask their identities (such as disguising whether each participant taught for Calculus I or Calculus II). These steps were especially important for this study due to the small, community-oriented nature of the Department of Mathematics at UNL.

My research advisors were included on the IRB so that I could discuss the data collection and analysis with them. However, they are also members of the Mathematics Department who serve in leadership capacities and may have preexisting relationships with the participants. To mitigate the influence of any biases on my advisors' parts, all information was de-identified before my advisors had access to it and pseudonyms were used in all discussions with my advisors.

Since observations and audio recordings took place in classrooms, I had to consider the rights and privacy of the students in these classes. The recordings were not shared with anyone other than those who were present for the class itself, namely me and the participant. The recordings were not shared with my research advisors and no identifying information from the recordings themselves are included in any research reports. In order to include student quotations and summaries of student interactions with their instructors, all students in the classroom during observations were informed of my

presence at the start of each class; they were informed that I would be taking notes and recording audio and that their identities would be protected according to measures approved by the university's IRB. Names and other identifying information about students were blinded in interview transcripts.

3.9 Reporting of Findings

As discussed in Section 3.6.2, the findings of this study are reported in the following three chapters according to pairs of participants. Chapter 4 provides an introduction to the ROG framework (Schoenfeld, 2011) by closely examining the goals and orientations of two GTAs, Blake and Riley, in order to explain their decisions to offer particular categories of social support. Blake and Riley were selected for this first results chapter because they provided the clearest example of how the ROG framework can be used. A majority of Blake's actions were categorized as informational support, and an analysis of Blake's goals and orientations aligned with their actions. On the other hand, Riley's actions primarily reflected informational and instrumental social support whereas their goals and orientations suggested the use of emotional support. However, an examination of how Riley might have "computed" subjective values of different types of social support gave a reasonable explanation to the misalignment of their actions, goals, and orientations, just as Schoenfeld suggested.

Chapter 5 explores the goals and orientations of Casey and Hayden through the lenses of two frameworks discussed in Section 2.4 (namely Crooks-Monastra and Yee's 2022 work on GTA goals and Luft and Roehrig's 2007 work on teachers' beliefs). Casey's and Hayden's goals, orientations, and support actions were not necessarily reflective of any particular category of social support. Analyzing Casey's and Hayden's

goals and orientations through external structures provides new opportunities to connect goals and orientations to their social support actions. The findings in this chapter overall suggest that Casey's and Hayden's decision making is much more situation-dependent than that of Blake or Riley, but that interesting patterns could still be found.

Finally, Chapter 6 discusses Avery and Tate, two experienced GTAs. Section 6.3 discusses how Avery's and Tate's goals, orientations, and ways of offering social support have changed since their first years of graduate school. Although many changes are discussed, two common themes that arose were that the demands of graduate school vary from year to year and that the GTAs' capacity to meet such demands changes as well. Sections 6.4 offers a comparison of Avery and Tate and Section 6.5 offers a comparison between these experienced GTAs and the first-year GTAs discussed previously.

Throughout this dissertation, present tense verbs are used to describe the state of each participant (including their goals and orientations). It is understood that such states are in constant flux and the true current state of the participants may no longer reflect what is written here. However, for the purpose of making the document more reader-friendly, present tense verse are used. In addition, an effort was made to transcribe direct quotes in a way that reflects the grammar and cadence of the speakers, even when this produced incorrect grammar.

Chapter 4: Blake and Riley

4.1 Introduction

Before pursuing the intricacies of Schoenfeld's ROG framework (2011), it is important to develop a foundation of how the model can be used and what it can accomplish. In this chapter, the ROG framework provides a lens through which the social support actions of two first-year GTAs are examined. The first GTA, Blake, demonstrates a tendency towards informational support over emotional, instrumental, and appraisal social support. Blake has strong conceptions of what it means to learn mathematics and to solve mathematics problems at the calculus level, and an examination of Blake's goals and orientations related to these conceptions offers a possible explanation of their tendency towards informational support. In particular, Blake's desires for students to struggle productively with material and develop an arsenal of mathematical tools align well with the principles of informational support. The second GTA, Riley, provides a more nuanced example of how the model can be used to analyze the phenomenon of study: upon initial inspection, Riley's goals and orientations suggest that they would rely most heavily on emotional support in the classroom, but in practice, they opt for informational and instrumental support much more frequently. It is not until their goals and orientations are examined more closely that their social support actions fit into Schoenfeld's ROG framework (2011), suggesting that the model's use is not always straightforward. Overall, Blake's and Riley's cases demonstrate how the framework can be used and call attention to some subtle challenges in its application and thus contribute to the discussion of the following subset of the research questions (a complete list can be found in Section 1.2):

RQ1:   What goals and orientations are present when GTAs offer social support to

their students and how do GTAs prioritize their goals and orientations?

RQ2:   How do GTAs offer social support to their students?

a.   How are a GTA's goals and orientations reflected in the social supports

that they offer their students?

b.   How do GTAs relate their understanding of social support with the ways

that they offer social support?

Each section within this chapter will focus on each participant's use of a subset of

the categories of social support (namely Blake's use of informational support and Riley's

use of informational/instrumental support over emotional support). Despite this, it is

important to note that both Blake and Riley have goals and orientations in favor of all

four categories of social support and demonstrated social support actions across each

category during observations. The choice to limit the discussions of each participant to a

specific selection of categories of social support is meant to highlight the interesting

dimensions of each case through the lens of Schoenfeld's ROG framework (2011); it is

not meant to diminish the multifacetedness of the participants themselves.

4.2 Blake

The purpose of this section is to demonstrate how Schoenfeld's ROG framework

(2011) can be used to explain some of the social support actions offered by Blake, a first

year GTA. During the interviews and observations, it was evident that Blake gravitated

towards offering informational support over the other three categories of social support

(House, 1981). In coding for Blake's goals and orientations, two compelling themes

emerged that could explain Blake's tendency towards informational support: their

perspectives on what mathematics is and how mathematics problems should be solved. This section describes Blake's goals and orientations related to these themes and then explains how they are reflected in Blake's social support actions.

4.2.1 An Introduction to Blake

Blake is a first year GTA whose enthusiasm for teaching was evident from the start of the study. When talking about their reasons for coming to a mathematics doctoral program, Blake said,

> I want to learn more about math, but then on top of that one, I want to become the best math educator that I can be. So teaching for me is extremely important… I find joy in teaching these topics, leading students through problems, helping them understand, and just also in general like just helping them enjoy mathematics.

Prior to graduate school, Blake sought out various opportunities to teach in informal settings (such as tutoring) and continued to seek out opportunities to improve their teaching throughout their first semester.

Blake puts a great deal of energy into their teaching, including developing rapport with their students. Throughout this study, it was evident that Blake knew and cared about their students. For instance, Blake knew their students' names and frequently addressed them by name. Blake demonstrated a knowledge of students' interests and activities outside of class and often asked them about those interests before class and between activities. One particular example that stood out to me was that one of their students left class five minutes early every day; Blake later explained that the student had another class immediately after recitation across campus, so the two had made an arrangement that allowed the student to leave early so long as it was not disruptive. This

is just one of many examples illustrating Blake's compassion for their students and the effort that they put into developing genuine relationships with them.

4.2.2 Goals and Orientations Related to the Nature of Mathematics

When reflecting on what mathematics is and what it means to solve mathematics problems, Blake regularly compared it to solving a puzzle. When asked about their goals, Blake said, "I always think of it [math] as a puzzle, so hopefully I can transfer that to them [my students]. Like this is like a fun puzzle, here are the rules that you can use." They went on to say that, like a puzzle, much of their enjoyment in mathematics comes from the sense of accomplishment one gets after overcoming the challenge:

> *I* [speaker emphasis] enjoy doing math, like mathematics is fun to me. It's frustrating, it's annoying, sometimes it's heartbreaking… But like, I'm here in a PhD program because I enjoy doing and teaching and just like, being a part of mathematics. And so if I can get my students to then feel some of that same enjoyment… If they did a thousand-piece puzzle and like, a really cool [math] problem, like if I can get the idea in their head that that is possible? Then I've already won. I've done most of what I want to do.

These ideas—that mathematics is like a puzzle and that it is more enjoyable if it is challenging—are personal beliefs of Blake's that present as goals that they have for their students and are frequently reflected in their day-to-day teaching practices. For example, during observations Blake often encouraged students to try problems that the students may find challenging; such encouragement differed from group to group, suggesting that Blake was not only aware of the current performance levels of individual students, but

also that they had a sense of what degree of difficulty would be challenging and rewarding for different students.

One way that Blake challenges students in order to foster such a sense of accomplishment is by utilizing productive struggle as an instructional tool. *Productive struggle* refers to a perspective of learning that promotes teaching strategies centered on "engaging a learner in confusion or doubt... or leveraging the power of cognitive dissonance for decision making and problem solving" (Trinter & Hughes, 2021, p. 2). It "can be thought of as purposefully reacting to an unclear challenge so that progress is made or learning advanced" (SanGiovanni et al., 2020, p. 17). According to Hiebert and Grouws (2007), struggle is a necessary ingredient for developing a deep understanding, especially in a problem-solving setting. Engaging in productive struggle has been found to have positive impacts on self-efficacy, attitude, perseverance, and creativity in mathematics students (Gray, 2019; Hassi & Laursen, 2015; Hawthorne et al., 2022; SanGiovanni et al., 2020). According to Hawthorne et al. (2022),

> [Engaging in productive struggle] results in an increase in student empowerment, as students are able to see their own role in generating mathematical insight instead of viewing mathematics as a discipline that only involves the application of procedures and the ideas of others. (p. 237)

Moreover, Kapur (2014) found that mathematics students who engaged in productive struggle significantly outperformed students who were taught through direct instruction.

Blake's interview responses suggested that they place a high value on the use of productive struggle in their mathematics classroom. Blake said,

I'm okay if my students are not comfortable by the time they leave [class], as long

as they did that— whatchamacallit in active learning... The productive struggle.

As long as they engage in that then I don't necessarily need them to leave

knowing everything.

Blake also discussed wanting students to engage in productive struggle outside of class

before they seek help: when discussing how they would support a student who has had to

miss a significant amount of class, Blake said,

I want to make sure that [my students] have been able to self-sufficiently catch up

on the material [and] feel okay with it. That they've grappled with it a little bit.

They've done a little bit of that productive struggle where I couldn't oversee it.

In general, Blake's use and perceptions of productive struggle align with their beliefs

about the nature of mathematics, particularly their belief that mathematics problems

should be challenging.

Blake explicitly cited productive struggle as an influence on their decision making

related to social support, particularly to the use of informational support. When

discussing their feelings about instrumental support, Blake said,

Instrumental is… the thing that I think I *want* [speaker emphasis] to do the most,

even though I know it's definitely the wrong thing to do… It's productive

struggle. I should be providing them hints, clues, telling them that they're doing a

great job, and like giving them the tools to succeed. I should not be sitting down

and doing the problems with them. So [instrumental support] is the one that I try

to, I guess, stay away from.

This quote not only explains why Blake tries to avoid providing too much instrumental support but also supports their use of informational support (which is discussed in more detail later in this section).

4.2.3 Goals and Orientations Related to Solving Mathematics Problems

Throughout the study, Blake referred to a metaphorical "toolbox" full of various "tools" that students possess to approach different kinds of mathematical problems. For example, Blake described the process of problem solving in a calculus class as, "You took this set of tools, you applied it to a problem, and then you got to a solution. That is a great tool. That is a great general tool." In the second interview, Blake even acknowledged their repeated use of this metaphor:

> I've been using very often the metaphor of like, we have our bag of tools and then a bunch of math is just figuring out in what ways we can use them, in what ways can we combine them, what are some of the limitations, but also [what] are some of the like further stuff that we can use with these tools? So you can't work with tools if you don't know what's in your toolbox.

This belief is reflected in Blake's teaching practices. For example, during the observed classes, Blake wrote important theorems and definitions on the board before class started; when class began, they encouraged students to refer to these resources as they worked through problems. When asked why they chose to start class this way, Blake said,

> Few things suck and bring up as many negative feelings in math as when you don't even know where the heck to start. So to have at least the definition… You can't work with tools if you don't know what's in your toolbox. So I guess in my

case, at the very least everyone has the same set of starting tools and so they can

at least get started.

In fact, when helping students one-on-one in class, Blake often explicitly asked students

what tools they had in their toolboxes and asked them which ones they might be able to

use.

Blake's beliefs about mathematics being like a puzzle that can be solved using

"tools" from one's "toolbox" are not only present in their goals and orientations but in the

social support actions that they offer in the classroom. More so than any other category,

Blake tends to use informational support in the classroom; the following subsections will

describe their tendency towards informational support and will explain how this is a

reflection of their goals and orientations discussed thus far.

4.2.4 Blake's Use of Informational Support

Most of the examples of social support that were observed in the classroom are best

categorized as informational support. Table 4 outlines some of these examples and offers

a brief explanation of why informational support is the best categorization for them.

There were some examples of social support that seemed to fit better into other categories

that Blake categorized as informational support for reasons I had not considered. For

example, there was a group of students who chose to skip one of the assigned problems;

the problem was arguably non-standard for the topic of study in that the calculus aspects

of the problem were straightforward, but it was bogged down with complicated

computations and tedious algebraic procedures. When the students told Blake they had

decided to skip the problem, Blake made light of it, even going as far as to laugh along

with the students when one of them jokingly crossed the entire problem out of their

Table 4

Examples of Informational Support Offered by Blake

Example of Informational Support	Justification for Categorization
Before class (and as students started to work individually and in small groups), Blake wrote all the major theorems, rules, definitions, etc. that were needed for today's lesson up on the board.	Blake was providing a resource for students that was not inherently helpful to any particular problem that students might have been working on in that moment; students were still responsible for identifying the theorem/rule/definition that would be helpful and determine how to use that theorem/rule/definition effectively.
While Blake was helping a student, the student kept flipping through their notebook searching for a rule. Blake encouraged the student to make a list on one page with all the rules they had learned recently so that they would have them all in one place to refer to.	Advising the student to create a reference page is informational support because Blake is not providing them with something helpful but is suggesting something that would be helpful if the student were to follow through.
Blake checked in with a student who had missed two weeks of class; during that conversation, Blake reminded the student of their office hours and of the mathematics department's tutoring center.	Blake gave this student the tools to seek out help, but it was up to the student to get help if they needed it.

workbook. My initial impression was that Blake's reaction would be considered

emotional support (if it was even an example of social support at all) because Blake was

empathizing with the students and validating their frustrations with the problem by

indirectly giving them permission to skip a frustrating problem. However, Blake

interpreted this action as informational support. Blake argued that by encouraging the

students to skip the problem after struggling with it for a long time, they were indirectly

giving the students information that they could benefit from; in particular, Blake was

hoping that students would infer that this problem was not "standard" and that their

frustration was probably coming from long computations and not the calculus problem itself. When categorizing this example, Blake said,

> I want to put it into informational support again because like… I'm not telling them to skip the problem… If you don't think that this is going to be productive use of your time, I'm going to agree with that. And then like you should move on to something else. So I'm not fixing the problem… I'm validating their feelings of like [their] intuition on like "I could be doing something more productive." Great. Yes. Here's some other things to do… Maybe now think about why this question is maybe not as helpful as maybe some of the other ones are.

Although Blake emphasizes validating the students' feelings (which suggests emotional support), Blake is prioritizing the information that this validation is conveying. The *action* suggests emotional support, but the *intention* was to provide informational support.

Overall, informational support was the most frequent category of social support that was observed, both in terms of my initial categorizations and Blake's categorizations during the follow-up interview. When asked what category of social support they think they provide the most of, Blake explicitly identified informational support, saying, "I think informational… I think I try to start off strong with informational at the beginning of the semester, like set up my Canvas[3] page, have all the resources available, and make sure that they're aware of those." The use of informational support is a repeated in-the-

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[3]Canvas is the Learning Management System used at UNL.

moment decision that Blake makes, and therefore according to Schoenfeld's ROG model (2011), any such decision should be a reflection of their goals and orientations.

4.2.5 Explaining Blake's Use of Informational Support

Many of Blake's goals and orientations are related to their beliefs about the nature of mathematics and mathematical problem solving; in fact, all the examples of informational support discussed thus far can be attributed to such conceptions. For example, Blake writing theorems and definitions on the board before class reflects their belief about how mathematics problems should be solved. Blake believes that the best way to approach mathematics problems is to have a "toolbox" of "tools" at one's disposal; as a result, Blake perceives it to be their job as an educator to ensure that students have the tools necessary to solve a particular problem. By writing the relevant definitions and theorems on the board at the start of each class, Blake guarantees that every student at least has the required tools to approach any problem that might arise that day.

Even the example of informational support that I had expected to be categorized as emotional support in which Blake enabled students to skip a problem that was frustrating them makes sense when juxtaposed with Blake's beliefs about the nature of mathematics. Blake believes that mathematics is like a puzzle and that enjoyment in mathematics often comes from completing the challenge. In this example, the students were frustrated by the problem because it was mired with tedious computations, not with the calculus aspects of the problem. Blake's argument is that the students were not benefitting from doing those computations because that problem was not representative of the skill they were supposed to be practicing. In the context of Blake's perception of

mathematics being like a puzzle, this problem was forcing the students to do the puzzle in the dark: it would be an impressive feat to complete the puzzle, but it would not have been representative of what solving a puzzle really is. This particular problem was in contention with Blake's beliefs about what mathematics should be, so it is understandable that Blake would encourage the students to skip that problem with the hopes that the students would recognize what made the exercise futile.

On a larger scale, Blake's general tendency towards informational support over the other categories is aligned with their beliefs about the nature of mathematics and problem solving as well. Many of Blake's goals and orientations reflect their beliefs that mathematics problems are puzzles to be solved, that the puzzles are more satisfying if they are challenging, and that one needs tools to approach the puzzles in the first place. In terms of social support, these beliefs are reflected in the fact that Blake fosters an environment that values productive struggle and has a teaching philosophy in which students cultivate their own "toolbox" of theorems, rules, and definitions; such attributes are closely aligned with informational support. In fact, research has suggested that in mathematics classrooms, informational support is one of the most beneficial categories of social support for developing problem-solving skills (Cutrona & Russell, 1990). When reflecting on social support in general, Blake said, "I should be providing them hints, clues, telling them that they're doing a great job, and giving them the tools to succeed. I should not be sitting down and doing the problems with them", which is indicative of someone who values the general use of informational support.

Overall, an investigation of Blake's case provides insight towards both *RQ1: What goals and orientations are present when GTAs offer social support to their*

students? and *RQ2: How do GTAs offer social support to their students?* In particular, analysis suggests that Blake's beliefs about the nature of mathematics and how it should be solved are not only present when offering social support to their students, but a driving factor in many of the in-the-moment, day-to-day instructional decisions that they make (see Section 4.4 for a further discussion of how Blake contributes to the research questions). Blake's clear tendency towards informational support provides an opportunity for a relatively straightforward application of Schoenfeld's ROG framework (2011); in the following section, I discuss another GTA whose goals, orientations, and actions are not related as directly.

4.3 Riley

In this section, I discuss another first-year GTA, Riley. Like Blake, the interviews with Riley left a seemingly clear portrayal of what kind of social support I would expect to see in observations: Riley's responses indicated that they place high value on emotional support and suggested that this category of support would be prominent during the observations. However, unlike Blake, Riley's actions reflected different categories—informational and instrumental—more frequently and therefore Riley's decisions were not as easily explained. This section provides a description of Riley's goals and orientations through the lens of different categories of social support, followed by a discussion of how unexpected social support decisions may have come to be.

4.3.1 An Introduction to Riley

Like Blake, Riley's love for teaching was noticeable throughout the study. When asked how they feel about teaching, Riley said, "I love teaching. It's my favorite thing to do. It's what I want to do with my life. It's what I put most of my effort into." When

asked how teaching factors into their career goals after graduate school, Riley responded, "It is *the* thing I plan to do beyond grad school." Riley puts a great amount of time and energy into their teaching and seemed to have generally good rapport with their students during the observed classes.

Many aspects of Riley's passion stem from their own experiences as a student. When talking about their goals and beliefs related to teaching, their responses often included anecdotes about things in their own experiences as a student that had gone well that they wanted to carry forward to future generations of students, or things that had gone poorly that they wanted to change. For example, Riley shared the following anecdote about receiving judgement-free help from a professor:

> I was in a proof-based class, and I went to office hours and my professor showed me how to do this thing. And I was like, "That makes sense. I would have never known how to do that. How would I have ever known how to do that?" And she's like, "Well, you know how to do it now." And I was like, "Oh yeah, I forgot that I was like… Here to learn."

This experience and others like it appear to have been formative in Riley's trajectory as an instructor and is related to many of the goals they discussed throughout this study (such goals are discussed later in this section).

4.3.2 Goals and Orientations Related to Emotional Support

Following the initial interview, Riley's goals and orientations were more clearly aligned with one particular category of social support (namely, emotional support) than those of any other participant in this study. Riley emphasized wanting students to feel comfortable in the classroom and expressed a desire to alleviate and prevent threats to

this by targeting the source of the emotions themselves. Table 5 provides an overview of some of Riley's goals and orientations related to emotional support.

All the goals and orientations in Table 5 are related to emotional support because the emphasis is being placed on the negative emotions that students are (or could be) experiencing: for example, the quotation in the first row of Table 5 is indicative of Riley's desire for students to feel comfortable making mistakes and is rooted in their desire to prevent or alleviate the discomfort often associated with making mistakes. In this example, Riley is trying to eliminate the discomfort or embarrassment that the student was likely experiencing by assuring the student that it is normal to not know something, whether it be for calculus specifically or from prerequisite material.

Although it is difficult to quantify which category of social support someone would utilize the most, Riley's discussion of their goals and orientations during the initial interview left the impression that emotional support would be represented the most during the formal observations. Despite this, a majority of the examples of social support that were observed in the classroom were best categorized as informational and instrumental support. According to the ROG framework, such a disconnect between someone's goals and orientations and their actions suggests the presence of more goals and orientations that the researcher may not have yet considered (Schoenfeld, 2011). What follows is an examination of Riley's goals and orientations related to informational and instrumental support and a discussion of why Riley might have utilized these categories of social support the most despite emotional support seeming to be more important to them.

Table 5

Overview of Riley's Goals and Orientations Related to Emotional Support

Goal/Orientation	Supporting Quotation
Wants students to feel comfortable making mistakes; wants to validate students' struggles	"I had a student earlier today who was doing all of the [calculus] right, except she didn't know how to subtract fractions. And she had been too scared to ask up until this point. Cause she was like, 'Stupid question. I don't know how, I know this is like elementary school'. And I was like, 'no, we have to learn so much. I would be surprised if something didn't fall through the cracks'."
	"I am trying to remove the word 'easy' from my vocabulary, because nothing about this is easy. Calculus is not easy. I think once you understand what's going on, the problem can become simpler or shorter… But before you understand how to do it, it makes no sense. And so I think people are exceptional at invalidating themselves and their abilities and their talents."
	"If they're comfortable around me, I think they'll be more willing to learn and they'll be willing to open up and make mistakes and actually engage with the material."
Students' progress should be rewarded and/or celebrated	"People are prone to trend towards despair in math classes… I don't know what it is about math, but there's just some predisposition that you're either good at it or you're not, and people are so willing to think that they're bad at it. So I think it's the job of the educator to really put a lot of legwork in to reassure them that they're doing okay."
Wants to be accessible and approachable to their students	"If a student has something that they need to talk to me about, I want to be someone that they can come and talk to me about that."
	"I don't want to be a strict instructor. I don't want my students to be afraid of me."
Students are more willing and able to learn if they are happy; students are less able to learn if they are unhappy	"It's more difficult to be actively stressed when you're laughing, or just like smiling or having a good time, basically… If you can help that, you're actively improving the happiness of your students and decreasing their stress. If you can be having fun, it relaxes them, it loosens them up, it makes them more willing to learn."
	"I think [making learning fun] drives almost everything else, right? If you're having fun, you'll do well in the class. If you're having fun, you'll more easily understand the material… I enjoy [math], I want them to enjoy it, I want everyone to be having a good time."

4.3.3 Goals and Orientations Related to Informational and Instrumental Support

While coding Riley's interviews for evidence of goals and orientations related to informational and instrumental support, two themes arose. First, Riley believes that learning mathematics often requires memorization of many rules, definitions, techniques, or other smaller tools. Riley even referenced their own experiences as a graduate student, saying,

> It can feel like that for me, especially in [one of my own classes] sometimes where it's like, I feel like I need to memorize hundreds of different individual tips [and] tricks. And if I don't memorize them all, everything seems impossible.

This belief is often reflected in the ways that Riley provides social support to their students, such as when they offer general suggestions that can simplify a wide variety of problems (e.g., rewriting radicals in exponential form) or hints that are applicable to specific problems that students are working on.

Secondly, Riley seems to possess the belief that the purpose of the class they are teaching is for students to learn the material and ultimately earn a "good" grade. Although the goals and orientations that Riley emphasized during the first interview were primarily related to emotional support, they did identify wanting students to understand the material and wanting students to do well in the class as their two highest priority goals. According to Riley,

> The point of the class is to learn the material and understand it. That's the whole point that they're in the class, I hope… That is probably their [the students'] goal, and so I want my goals to align with their goals. I mean, I'm an educator, it's not really about me. It's about making sure that they learn what they need to.

Riley's belief that the purpose of the class is for students to learn manifests as informational and instrumental support; this is unsurprising since these forms of social support are most closely associated with direct learning, especially in mathematics (Cutrona & Russell, 1990; Sikora, 2019; Wong et al., 2018).

In sum, Riley's goals and orientations suggest that they value emotional support much higher than the other categories: a majority of Riley's goals and orientations are indicative of someone who is especially concerned with student emotions and who prioritizes cultivating positive emotions in the classroom. However, Riley's two highest ranked goals relate to informational and instrumental support, and they opted for these categories most frequently during the classroom observations. An important component of the ROG framework that has not yet been considered is Riley's subconscious use of subjective valuations to determine the relative value of different social support actions (Schoenfeld, 2011). What follows is a possible explanation of how Riley's subjective valuations of their in-the-moment decisions during the observed class meetings caused them to utilize informational and instrumental support despite seeming to value these categories less.

4.3.4 Explaining Riley's Actions Using Subjective Valuations

An important component of Schoenfeld's ROG framework (2011) is subjective valuations. Although resources, orientations, and goals are what influence one's in-the-moment decisions, it is the computation of subjective values that determine which choice is ultimately made. As discussed in Section 2.3.6, an inherent limitation of attempting to compute subjective values is that assumptions have to be made about the perceived subjective value and likelihood of each outcome based on the decision maker's resources,

orientations, and goals in order to assign a numeric value to each option. Although it is impossible to do so in a completely accurate away (especially on someone else's behalf), it is worth considering how Riley might have subconsciously computed subjective values since their actions did not clearly align with their most prominent goals and orientations.

To understand Riley's use of social support, I make two assumptions: first, I consider a generic opportunity to offer social support (instead of a specific example). Although each such opportunity is unique and Riley's decisions might vary, Riley's social support actions in a general sense are focused on to better understand their general decision making. Specific examples of social support are discussed in this section, but the overall goal is to understand Riley's use of social support on a broader level. Second, I assume that in each generic opportunity to offer social support that there are two options: providing emotional support and providing informational/instrumental support. Although there are certainly other decisions that Riley could make (such as offering appraisal support or not offering social support at all), the purpose of this section is to understand Riley's use of informational and instrumental support over emotional support and therefore a comparison of just these two options is most relevant.

As discussed in Section 4.3.2 and Section 4.3.3, Riley's goals and orientations suggest that they place a higher value on the use emotional support than any other category of social support but that they still place a high value on the use of informational and instrumental support. To understand Riley's decisions, it is important to consider the different outcomes associated with each type of social support. In general, the outcomes associated with each option essentially reduce to the effectiveness of the support in alleviating the student's negative emotion; that is, for both options, the potential

outcomes are "the support alleviated the negative emotion" and "the support did not alleviate the negative emotion".

During the observations, the situations where Riley offered social support were scenarios where informational and instrumental support seemed more appropriate than emotional support. For example, during observations, many of Riley's students were struggling with problems that involved fractional and negative exponents. One such student asked for help on one of these problems and went as far as saying "I give up" when they became frustrated by the exponents in the problem. In this situation, Riley gave the student a mini lesson on how to work with exponents that are not whole numbers, going well beyond what the student needed for the particular problem they were working on. While discussing this example, Riley said, "The end goal would be for them to sort of retain this [information] across multiple settings and when I'm not around." They went on to say,

> It's simple once you know how to do it and if you don't know how to do it, it's impossible. And so if you see a square root and you don't think to move it into exponent form, it [the problem] is impossible. And so that can be quite frustrating until you get, like, a tip or trick that suddenly makes it possible again… [In one of my classes] I feel like I need to memorize hundreds of different individual tips [and] tricks. And if I don't memorize them all, everything seems impossible. And so trying to condense the advice that I give into more general forms is hopefully a way that they can be preserved so that students can remember. And it's one less thing that might make a problem impossible for them.

This suggests that in this situation, Riley places more value on alleviating the underlying cause of frustration through informational support than they do on addressing the frustration directly through emotional support. Riley seems to have deemed informational support as more appropriate because of its long-term effects on the students' overall understanding of an important algebraic concept. Most of the opportunities to provide social support that arose during the observations were similar to this example in that informational and/or instrumental support seemed more appropriate than emotional support. Although there was certainly emotional support offered during the observations (such as Riley reassuring students that their struggles were valid and encouraging students to take a break if they were getting frustrated by a problem), it was not as frequent as informational and instrumental support.

In terms of subjective valuations, the effectiveness and appropriateness of different kinds of social support impact the likelihood of positive and non-positive results of each potential outcome (*non-positive* here refers to outcomes that are negative or neutral). For example, because informational and instrumental support seemed to be the most appropriate in a majority of the situations that arose, the likelihood of a positive outcome from offering informational/instrumental support was high and the likelihood of a non-positive outcome was low. On the other hand, because emotional support was perceived to be less appropriate or effective in these situations, the likelihood of a positive outcome from offering emotional support was low and the likelihood of a non-positive outcome was high.

It is difficult to assess the subjective value of non-positive outcomes associated with each type of social support. When comparing the value of neutral outcomes for each

type of social support (i.e., the value of outcomes where the negative emotions are not alleviated or prevented but they are not made worse), it is fair to assume that they would be comparable: if Riley had offered emotional support and the student's emotions were not affected, that is no more or less valuable than Riley having offered informational or instrumental support and the student's emotions not being affected. On the other hand, *negative* outcomes likely do have different values for the different options. For example, a negative outcome that could be associated with emotional support is a student feeling like a boundary has been crossed and a negative outcome that could be associated with informational support is a student feeling like the teacher is not really answering their questions. The subjective values that Riley places on each of these negative outcomes are likely different and are dependent on their goals and orientations. The values and likelihoods of non-positive outcomes will vary based on each situation; however, *products* of the values and likelihoods will be relatively small (because outcomes with a large, negative value typically have a very small likelihood), and thus the overall subjective values of non-positive outcomes will be estimated as equal for the two options (offering emotional versus informational/instrumental support).

Figure 9 shows a sample of how Riley's subjective valuation computations could have occurred. Overall, if the subjective values of the non-positive outcomes are approximately equal between the two options, then the subjective value of offering informational or instrumental support is higher than the subjective value of offering emotional support. Although Riley places a high value on emotional support, the likelihood of a positive outcome is relatively low because emotional support is often not appropriate in the kinds of in-the-moment scenarios that arise in the classroom. In

Figure 9

An Overview of the Subjective Valuation Computations for Riley's use of Emotional and
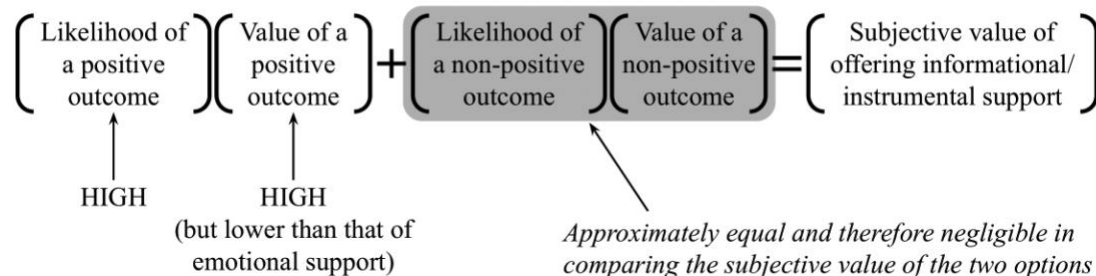
Informational/Instrumental Support
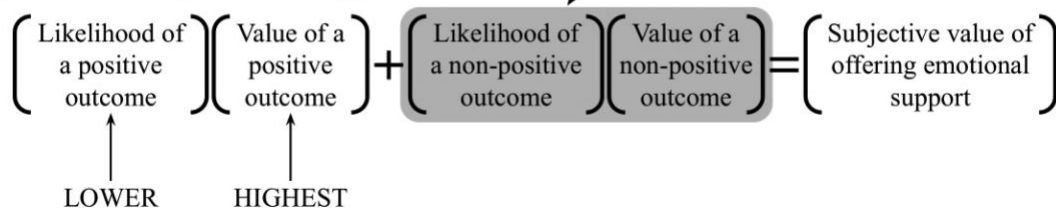
Note. The labels of "HIGH", "LOWER", and "HIGHER" were determined by the

researcher based on the perception of Riley's goals and beliefs as discussed in previous

chapters. These labels are not intended to be exact but are instead meant to provide a

relative scale for how Riley might assign value to these factors.

contrast, the likelihood of a positive outcome is relatively high for

informational/instrumental support because the situations that arise are better addressed

by these kinds of support. Despite the value of informational and instrumental support

being lower than that of emotional support, Riley does still place a high value on these

kinds of social support. As a result, the product of the likelihood and value of outcomes

associated with informational/instrumental support exceeds that of emotional support, and therefore Riley's decision to use informational and instrumental support in the classroom makes more sense.

This computation does not mean that Riley will never offer emotional support. In fact, there were multiple times during the observations that Riley offered emotional support to their students. Two notable examples of emotional support from the observations were that Riley encouraged an exasperated student to take a short break to clear their head and that Riley repeatedly made a point to offer validation to students who were struggling. In these two examples, because students were vocally expressing their exasperation and frustration, it is likely that Riley perceived there to be an increase in the value of a positive outcome for emotional support (or alternatively, an increase in the likelihood of a negative outcome in the absence of emotional support). As a result, Riley would determine that emotional support would be a better choice.

An orientation that likely impacts Riley's decisions between emotional and informational/instrumental support is that Riley seems to perceive emotional support as a "prerequisite" to other kinds of social support. According to Riley, "if they [students] are comfortable around me, I think they'll be more willing to learn and they'll be willing to open up and make mistakes and actually engage with the material." This quote can be interpreted as meaning that if students feel comfortable in the classroom (either from receiving emotional support or from other influences), then they will be in a position where informational and instrumental support are more appropriate to their needs. In the examples of informational and instrumental support discussed in this section, the students did not seem to be in need of emotional support and thus Riley perceived these other

kinds of support to be more appropriate. It is very possible that in a situation where Riley perceived an equal need for emotional support and informational/instrumental support that they would choose to offer emotional support due to them placing a higher value on this kind of support itself.

It is also worth noting that there is not a one-to-one relationship between student needs and the types of social support that are appropriate to those needs. Riley's goals and orientations appear to be most clearly aligned with emotional support as they are directly tied to student emotions (e.g., their goal of not wanting students to *feel* anxious, their belief that *feeling* comfortable benefits learning, etc.). However, emotional support is not the only way to curate student emotions. For instance, instrumental support often does more to reduce anxiety in mathematics classes than emotional support (Federici & Skaalvik, 2014). Although Riley's goals and orientations suggest that they would take a direct approach to combatting negative emotions by using emotional support, they could be just as (if not more) effective taking an indirect approach by utilizing informational and instrumental support in many situations.

Overall, Riley's case adds to our understanding towards both *RQ1: What goals and orientations are present when GTAs offer social support to their students?* and *RQ2: How do GTAs offer social support to their students?* Although many of Riley's goals and orientations differ from Blake's, they still provide an overall impression of how Riley would typically choose to offer social support in the classroom. Unlike Blake, the categories of social support that Riley offered during the observations differed from what was expected, indicating that the correlation between GTAs' goals and orientations and their social support actions is often subtle and dependent on the specific situation in

which the support is being offered. Riley's contributions to these research questions are discussed in further detail in the following section.

4.4 Discussion

Blake and Riley serve as an excellent starting point in understanding how Schoenfeld's ROG framework (2011) can be used to understand the phenomenon of GTAs' making decisions about social support in the classroom. An examination of Blake's teaching was the most straightforward application of the model in the present study. Specifically, Blake's belief that mathematics is a challenging puzzle to be solved and their goal of equipping students with various tools to approach this puzzle offer a logical explanation of their tendency towards informational support in the classroom. Although Riley's case did not initially fit into the model as well—Riley's goals and orientations suggest a tendency towards emotional support despite opting for informational and instrumental much more frequently in practice—subjective valuations could be used to make sense of this misalignment between their goals, orientations, and social support actions. In subsequent chapters, two GTAs whose social support actions are not as easily explained are discussed; however, these two new cases serve as an example of how the framework can be used and the kinds of connections that can be drawn between one's goals, orientations, and actions.

The cases in this chapter offer interesting perspectives towards the research questions, and the similarities between Blake and Riley raise important questions about what goals, orientations, and patterns of social support might be characteristic to all mathematics GTAs, either in their first years or in general. The most notable similarity between Blake and Riley is their attitudes about teaching: both demonstrated a passion

for teaching, stating that it was not only their career goal but their primary motivation for attending graduate school in the first place. It was evident that both of them take pride in improving their teaching and actively enjoy the time spent in the classroom. During the interviews, both Blake and Riley talked about developing rapport with their students, and during observations I could see that they put time and effort into creating genuine relationships with their students.

Blake's and Riley's passion for teaching was arguably the most noticeable attribute during the interviews and certainly contributes to *RQ1: What goals and orientations are present when GTAs offer social support to their students?* However, it does not paint a complete picture of how these two GTAS offer social support. Does one's most apparent goals and orientations determine their social support actions? As evidenced by Blake and Riley, the answer to this question is no. Despite having one of their "biggest" orientations in common, Blake and Riley differed in many other goals and orientations and ultimately offered social support in the classroom in very different ways. An important element of Schoenfeld's work (2011) is the fact that one's goals and orientations can only be used to *explain* one's actions, not predict them. As demonstrated by Blake and Riley, one cannot say that just because two GTAs share particular goals and orientations, they will offer social support in the same ways, no matter how prominent those goals and orientations might be. GTAs are multifaceted and have a plethora of goals and orientations on which they subconsciously base decisions, and therefore our understanding towards *RQ2: How do GTAs offer social support to their students?* is highly dependent on the individual.

Another question that arises from Blake's and Riley's similarities is what other qualities might be present in GTAs who are different from them? Not only were Blake and Riley comparable in their passions for teaching, but their goals and orientations had a high level of consistency (which is discussed in the next chapter); what do the goals, orientations, and social support actions look like for GTAs who differ from Blake and Riley in these respects? The next chapter examines the cases of Hayden and Casey, two first-year GTAs who provide an interesting contrast to Blake and Riley and offer a more nuanced exploration of how Schoenfeld's framework (2011) can be used to understand the ways that GTAs make decisions related to social support.

Chapter 5: Casey and Hayden

5.1 Introduction

Chapter 4 examines how the social support actions of two GTAs, Blake and Riley, could be explained using Schoenfeld's ROG framework (2011). Despite evidence of all four categories of social support being present in each of Blake's and Riley's goals and orientations, each GTA demonstrated clear tendencies towards particular categories of social support. As a result, explaining Blake's and Riley's tendencies towards actions in these categories is relatively straightforward. However, the connection between someone's goals and orientations and their social support actions is not always this clear; in fact, it is not always evident that someone has a preference or tendency towards a particular category of social support at all.

This chapter examines the goals, orientations, and social support actions of two first-year GTAs, Casey and Hayden. Unlike the GTAs in Chapter 4, Casey's and Hayden's goals and orientations did not suggest that either GTA would tend towards any category of social support over the others. Both Casey and Hayden have goals and orientations that reflect several categories of social support and their support actions were more evenly distributed across the four categories than the support actions of Blake or Riley. In terms of the ROG framework (Schoenfeld, 2011), this is not problematic: the ROG framework treats decisions as isolated events and therefore each social support action can be explained independently of one another.

The fundamental difference between the participants of Chapter 4 and those of the present chapter is that Blake's and Riley's goals, orientations, and social support actions generally correspond to one to two categories of social support each, whereas Casey's

and Hayden's do not. The purpose of this chapter is to offer a possible explanation of this phenomenon, namely that Riley's and Blake's goals and orientations were generally congruous,[4] and that Casey's and Hayden's were not. Although none of Casey's or Hayden's goals and beliefs seem to be in direct contention with each other, their goals and beliefs do seem more varied and widespread. A possible explanation of Casey's and Hayden's support actions being distributed across all four categories of social support and their apparent lack of tendency towards any category is that the goals and beliefs that impact their decisions are themselves spread across different categories.

To understand the variation among Casey's and Hayden's goals and orientations, their goals and orientations are examined in this chapter through the lenses of existing frameworks for categorizing goals and orientations. First, Crooks-Monastra and Yee's 2020 framework for the categorization of mathematics instructors' goals is used to discuss Casey's and Hayden's goals. An important element of Crooks-Monastra and Yee's work is that all the GTAs in their study held goals in all four categories. However, different categories do correspond to different instructional choices, and therefore how a GTA prioritizes these goals will impact their in-the-moment teaching decisions.

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[4]For example, Chapter 4 discusses how all of Blake's goals and orientations are in support of their overarching belief that mathematics is a fun and challenging puzzle and their overarching goal of providing students with the tools to approach unfamiliar problems. None of the goals and orientations discussed contradict or work against these driving goals and orientations. Even Riley's goals and orientations, which reflected all four categories of social support to some extent, all work in support of their overall goals of wanting students to feel comfortable and wanting students to learn the material.

Next, the five categories of teacher beliefs from the TBI (Luft & Roehrig, 2007) are used to categorize various beliefs held by Casey and Hayden. Like Crooks-Monastra and Yee's (2022) work, the categories from the TBI are not necessarily disjoint for a given teacher. However, different beliefs correspond to different instructional decisions, and therefore holding beliefs across a variety of categories could lead to a wide array of instructional choices (Lee, 2019).

A discussion of Casey's and Hayden's goals and orientations within the context of these two existing frameworks contributes to the discussion of the following subset of the research questions (a complete list of research questions can be found in Section 1.2):

RQ1: What goals and orientations are present when GTAs offer social support *to their students and how do GTAs prioritize their goals and orientations?*

The following section provides a brief overview of each of Casey's and Hayden's cases before an in-depth analysis of their goals and orientations in the sections that follow.

5.2 Introduction to Casey and Hayden

5.2.1 Casey

Casey is a first-year GTA whose feelings about teaching were more neutral than Blake's and Riley's. When asked how they feel about teaching, Casey simply said, "It's important to do. I appreciate doing it. It is something that I hope to get better at." Whereas Blake and Riley described teaching as their ultimate career goal, Casey described it as one element of their future career. When asked whether they plan to teach beyond graduate school, Casey said, "Yes, because theoretically I'm going to be a professor and then teaching is definitely like, you know, a key part of that."

Although there was notable overlap between Casey's list of goals and the goals discussed by Blake and Riley, the order in which Casey discussed their goals is indicative of different priorities. When asked to list their goals, the first three goals Casey mentioned had to do with students learning the material. Casey said,

> I would say… making sure that the students are comfortable with the material, making sure that they are comfortable continuing on to, like, learn more math, and making sure that they are satisfied with their performance in the class. So not necessarily like, oh, everyone needs to get straight As, but like, you know, if a student's like, it's a dream to get a B in the class, like, you know, if I can get them a B, or they get a C and they're satisfied with that… As long as they are comfortable and happy with their outcome.

This provides contrast to Blake's and Riley's initial lists of goals which included more attention to the affective side of the student experience (such as Blake discussing wanting students to enjoy their time in the class and Riley discussing wanting students to feel comfortable in the classroom). The fact that Casey did not initially mention the affective student experience is not to say that Casey does not prioritize this, but it does suggest that their goals and beliefs are prioritized in different ways than Blake's and Riley's (subconsciously if not consciously).

Another notable contrast between Casey and the GTAs discussed in Chapter 4 is that many of the goals that Casey listed were goals that address their own role as an instructor whereas Blake's and Riley's goals were primarily about the students. For example, Casey discussed wanting to be flexible in order to reduce students' stress whereas Riley discussed wanting students to not be stressed about the class. Although the

result of these goals is the same—students not being stressed—the difference in tone suggests that the ways that Casey and Riley conceptualize their goals and beliefs may differ. In particular, this difference is perhaps indicative of Casey holding more teacher-centered beliefs (which is discussed in more detail in Section 5.4).

5.2.2 Hayden

Hayden is a first-year GTA who struggled to articulate their feelings about teaching. When asked how they feel about teaching, Hayden said,

> I don't know. It's fine. Generally speaking, I like explaining things to people and I like helping them… I haven't had a lot of experience with teaching in terms of like, a group experience… I'm better at… working more in a one-on-one environment, even within a group structure, you know, running around working with each student one-on-one is better for me. So that's what I guess I like about it.

Like Casey, Hayden sees teaching as potentially being a part of their future career, but they do not see it as *the* future career. When asked whether they see themselves continuing to teach after graduate school, Hayden said,

> I don't know… I mean, if I do end up, you know, researching or, working in any university somewhere, I'll be doing it and that's something I'd like to do… I will probably, regardless of where I end up, I will be teaching to some degree, one way or another. So yes, I probably will be doing teaching even though it's maybe not my ultimate goal.

Despite being unsure about their feelings towards and future in teaching, Hayden described their teaching style in such a way that clearly aligned with their previous

statements about teaching. For example, in one of the quotes above, Hayden discussed feeling more comfortable working with students in a one-on-one setting. Hayden went on to say,

> [I] try to have some sort of open rapport with the students. Let them have some freedom in what they can do, especially while they're, you know, working through the problems. I try as best as I can to get to know them at least decently well on an individual level so I can have a better connection.

Hayden went on to state that individualization was an important part of their teaching style in that they want to tailor their instruction to whatever the particular student they are helping needs.

5.3 Casey's and Hayden's Goals

5.3.1 Social Support in the Categories of Goals

Section 2.4.1 discussed a 2022 study in which Crooks-Monastra and Yee explored the goals held by mathematics graduate student instructors. Crooks-Monastra and Yee found that all the goals discussed by their participants fell into four categories: preparing students for the future; developing reasoning, sense-making, and understanding; developing productive dispositions; and developing procedural skills. Table 2 (originally in Chapter 2, replicated on the next page) summarizes these four categories of goals and some of their characteristics.

Table 2

Summary of Goals and Aspects of the Goals

Goals	Aspects of Goals
Goal 1: Prepare Students for Their Future	Coursework; STEM Careers; Personal Study Skills
Goal 2: Develop Reasoning, Sense Making and Understanding	Understanding Why; Deriving or Proving; Sense Making and Developing Intuition; Applying or Connecting Concepts, Facts or Procedures
Goal 3: Develop Productive Dispositions	Enjoy Mathematics and/or Precalculus Class; Build Self-efficacy; View Mathematics as Useful; Willing to Persevere
Goal 4: Develop Procedural Skills	Content Skills to Solve Standard Problems; Recognize and Use Appropriate Tools; Know or Memorize Facts

Note. Adapted from Crooks-Monastra & Yee, 2022, p. 146

Every participant in the study by Crooks-Monastra and Yee (2022) showed evidence of goals in all four categories; however, the four goals were not discussed equally by each participant. The extent to which each goal was discussed varied between participants, as did the timing of when each goal was discussed (for example, wanting to prepare students for the future was something all participants discussed at the beginning of the study, whereas some participants did not discuss the other goals until later in the study). Crooks-Monastra and Yee also noted that the extent to which participants were able to recognize and articulate their goals fluctuated throughout the study.

There is not a clear correspondence between the four categories of goals proposed by Crooks-Monastra and Yee (2022) and the four categories of social support proposed by House (1981). However, certain categories of goals do suggest some types of social support that one might offer if they prioritize a goal within that category. For example,

Goal 3 (Develop Productive Dispositions) includes wanting students to enjoy mathematics; because this goal is directly related to a student emotion (namely, enjoyment), it can be expected that an instructor who prioritizes this goal might utilize emotional support. Goal 4 (Develop Procedural Skills) includes wanting students to know or memorize facts which suggests the use of informational support since informational support is defined as providing information (such as facts) that the receiver can use on their own. Other goals from this framework have more ambiguous connections to House's framework: for instance, Goal 1 (Prepare Students for their Future) focuses on developing personal study skills and skills that will be beneficial in their future careers. This can be achieved through various social supports such as appraisal support (e.g., telling students that a certain career requires competency in certain skills) or instrumental support (e.g., working through problems with students to model solutions).

The categories of goals proposed in this framework (Crooks-Monastra & Yee, 2022) provide an opportunity to categorize and compare the goals of the GTAs in the present study. For example, most of Blake's goals discussed in Section 4.2 are reflective of Goal 3 (Develop Productive Dispositions) and Goal 4 (Develop Procedural Skills). Blake frequently discussed their own belief that mathematics is like a fun and challenging puzzle and that they want students to develop a similar perception of mathematics; Blake discussed wanting students to see that the work they are doing is useful and to develop a willingness to persevere by fostering productive struggle, all of which correspond to Goal 3. Blake also repeatedly used a metaphor of wanting to help students accumulate "tools" for their "toolbox" and wanting to help students learn when different tools were more appropriate (reflective of Goal 4). Although Blake did discuss goals related to the other

two categories, most of their goals fell into Goal 3 and Goal 4. Moreover, most of Blake's support actions were best explained by the goals in the latter two categories.

Like Blake, Riley's goals also spanned all four of the categories discussed in this framework (Crooks-Monastra & Yee, 2022), but some of the goal categories were much more prominent. In particular, Riley's highest priority goals fell into Goal 3 (Develop Productive Dispositions) and Goal 1 (Prepare Students for their Future). Riley repeatedly discussed wanting to foster a positive affective experience for their students, including wanting them to enjoy the class and to feel proud of their accomplishments (reflective of Goal 3). Riley also prioritized wanting students to be successful in the class for the sake of their futures: Riley discussed wanting students to develop the skills they would need in subsequent math courses as well as more general college skills (such as being willing to go to instructors' office hours), which fall into Goal 1. Riley does prioritize Goal 3 despite their actions being more reflective of Goal 1; as discussed in Section 4.3, this apparent dissonance can be explained by considering the in-the-moment stimuli that impact Riley's decisions and the way that they place subjective value on the different goals.

Unlike Blake and Riley, Casey's and Hayden's goals are much more evenly spread across the four categories of goals proposed by Crooks-Monastra and Yee (2022). In particular, whereas Blake's and Riley's goals each tend to fall into two of the four categories, Casey's and Hayden's goals are each reflective of all four goal categories. What follows is a discussion of Casey's and Hayden's goals within the context of this framework and a possible explanation of how this contributes to the overall understanding of Casey's and Hayden's goals, orientations, and social support actions.

5.3.2 Introduction to Casey's and Hayden's Goals

Before examining Casey's and Hayden's goals through the lens of Crooks-Monastra and Yee's (2022) framework for mathematics graduate student instructor goals, it is important to discuss Casey's and Hayden's goals in a general sense and to discuss how their goals compare to the different categories of social support. Neither Casey's nor Hayden's goals suggest that they would offer a particular form of social support over others. For example, Casey's four highest ranked goals seem to correspond to three to four different categories of social support. Their highest goal is for students to feel comfortable in the classroom and their third highest goal is to put measures in place to reduce students' stress, both of which focus on the students' emotional experiences and therefore suggest a desire to provide emotional support. Their second highest goal is for students to feel comfortable with the material; goals related to students learning the material often reflect a desire to provide informational or instrumental support. Their fourth highest goal is for students to feel satisfied with their performance in the class, suggesting a desire to provide appraisal support. Because their highest goals reflect all the categories of social support, it is not clear which categories they would tend towards when making in-the-moment decisions.

Hayden's goals also did not suggest a tendency towards a single category of social support, but in a different way than Casey's. Most of Hayden's highest ranked goals are related to students learning the material and therefore suggest a desire to provide informational and instrumental support. Their second, third, and fourth highest goals are for students to master the material, for students to practice mathematics problem-solving skills, and for students to know the material well enough that they feel

comfortable attempting unfamiliar problems. However, their highest goals and lowest goals are related to emotional support. Their lowest ranked goals are for students to enjoy the time they spend in class and to improve the group dynamics for students working together in class, both of which focus on the affective student experience and hence suggest the use of emotional support. On the other hand, Hayden identified their highest goal as wanting to help students who are experiencing extreme stress, depression, or anxiety. Although most of Hayden's goals reflect a desire to provide informational and instrumental support, the polarization of goals related to emotional support makes it unclear which categories they would tend to use in practice.

Like their goals, Casey's and Hayden's support actions during the formal observations spread across all four categories of social support. At least one example of each category of social support was observed for each of Casey and Hayden and there was no single category that stood out as being more common than the others during the formal observations. Part of the challenge in connecting Casey's and Hayden's goals to their respective social support actions is that a ranking of goals is difficult to interpret. For instance, what should be given more weight: Hayden's highest-ranked goal being related to emotional support or that most of their goals were related to informational and instrumental support? Although ranking someone's goals does provide insight into how they prioritize their goals, it does not indicate the relative weight that they place on each goal.

Crooks-Monastra and Yee's (2022) four categories of goals held by math GTAs do not perfectly align with the four categories of social support proposed by House (1981), but connections can be drawn between the two frameworks. In the following

section, the four categories of goals are examined through the lens of social support. The purpose of this examination is to provide extra structure to the discussion of Hayden's and Casey's goals to better understand how their goals relate to their varied social support actions.

5.3.3 Examining Casey's and Hayden's Goals and Social Support Actions

Like the participants in Crooks-Manastra and Yee's 2022 study, each of Casey's and Hayden's goals span all four categories of goals. For example, Casey's goals included wanting students to feel confident going into subsequent math courses (reflective of Goal 1), wanting students to feel comfortable connecting various concepts in the class (reflective of Goal 2), wanting to reduce students' stress in the course (reflective of Goal 3), and wanting to provide students with the appropriate tools required in the course (reflective of Goal 4). Likewise, Hayden's goals included wanting students to master the material so that they are prepared for their next math class (reflective of Goal 1), wanting to emphasize the motivation behind different ideas (reflective of Goal 2), wanting students to enjoy their time in class (reflective of Goal 3), and wanting students to feel comfortable attempting unfamiliar problems (reflective of Goal 4).

Unlike Blake and Riley (whose actions primarily reflected one to two goal categories despite having goals in all four categories), Casey's and Hayden's social support actions during the formal observations reflected goals across all four categories relatively evenly. Table 6 summarizes some examples of social support offered by Casey and Hayden, the corresponding goal(s) that these actions reflect, and which goal category these goals reflect. Table 7 provides an overall summary of the prominent goal categories for each participant.

Table 6

Examples of Casey's and Hayden's Social Support Actions and Corresponding Goals

Instructor	Example of Social Support	Corresponding Goal	Goal Category
Casey	Casey defined a mathematical concept using imprecise language to make it more accessible and relevant to what students needed it for in subsequent courses.	Wants students to feel comfortable with the material	Goal 1: Prepare Students for their Future
Casey	Casey connected the calculus material to students' prerequisite knowledge by reviewing factoring strategies that students might use in calculus problems that they might have forgotten.	Wants students to feel comfortable with the material	Goal 2: Develop Reasoning, Sense Making and Understanding
Casey	Casey started class by celebrating students completing a significant assignment.	Wants students to be proud and satisfied with their performance	Goal 3: Develop Productive Dispositions
Casey	Casey told students which formulas would be provided on an exam and which students were expected to memorize.	Wants students to have the skills they need to succeed on assessments	Goal 4: Develop Procedural Skills
Hayden	Hayden explained something in a way that was not very rigorous to make it more accessible and relevant to what students would need it for in the future.	Wants students to master the material	Goal 1: Prepare Students for their Future
Hayden	When students were confused by a problem involving a parameter, Hayden encouraged them to plug in a number for the parameter to make sense of what the parameter was doing.	Wants students to feel comfortable attempting unfamiliar problems	Goal 2: Develop Reasoning, Sense Making and Understanding
Hayden	Hayden allowed and encouraged students to have conversations that were not related to math as long as they were still making progress on the assigned problems.	Wants students to enjoy the class	Goal 3: Develop Productive Dispositions
Hayden	Hayden worked through a particularly challenging problem for their students, detailing each step of the procedure.	Wants students to master the material	Goal 4: Develop Procedural Skills

Table 7

Summary of Each Participants' Goal Categories

	Participant			
	Blake	Riley	Casey	Hayden
Goal 1: Prepare Students for their Future		X	X	X
Goal 2: Develop Reasoning, Sense Making and Understanding			X	X
Goal 3: Develop Productive Dispositions	X	X	X	X
Goal 4: Develop Procedural Skills	X		X	X

Table 6 illustrates that Casey's and Hayden's goals are spread across all four categories of goals and that the social support actions that they offer in practice reflect goals from all four categories as well. Even actions that are reflective of the same goal do so in different ways. For example, Casey's goal of wanting students to feel comfortable with the material was categorized differently in different contexts: the first example of social support that was reflective of this goal was when Casey chose to define a mathematical concept using imprecise language. Casey explained that they used imprecise language because their students did not need the precise definition to be successful in this class or even in the next math class that most of them would take. When justifying their use of an imprecise definition, Casey said,

> I think [another math class] is a lot more mathematically rigorous in terms of definitions and whatnot than [this math class]. I don't think it's important for what a lot of these students are going to be doing. You know, I've got chemistry majors and nursing majors and like people who are just here for their math credits. They

don't need a rigorous definition of something that's not really part of the course material.

Because Casey is motivated by what students will see in a future course, wanting students to feel comfortable with the material fits into Goal 1 in this case. Another example of social support that was reflective of Casey's goal of wanting students to feel comfortable with the material was that Casey took time to review factoring strategies, knowing that many students may have forgotten such techniques. In this case, Casey wanted students to feel comfortable connecting the calculus material to past material; Casey was motivated by wanting to connect different mathematical procedures, and wanting students to feel comfortable with the material is best categorized as Goal 2 in this scenario.

Similarly, Hayden's goal of wanting students to master the material fits into different goal categories depending on the context. The first example of social support reflective of this goal was that Hayden chose to explain a concept in a way that was not highly rigorous. Like Casey, Hayden sacrificed rigor because it was not necessary for student understanding or for their future mathematical endeavors. Another example of social support reflective of Hayden's goal of wanting students to master the material was that they worked through all the details of a challenging problem, highlighting the details of the procedure. Hayden stated that they were motivated by wanting students to know the steps of that procedure: "It is giving them a basic framework for how they can solve other problems that aren't necessarily related to this and telling them the importance of that." In this case, wanting students to master the material fit best into Goal 4 since the focus is on procedural skills.

Blake's and Riley's goals fits into Crooks-Monastra and Yee's (2022) framework in a structured way that makes it easy to find trends within their respective goals; however, this is not possible for Casey and Hayden. Casey's and Hayden's goals are spread across all four categories, and their actions are reflective of goals in all four categories. Moreover, how their goals are categorized is often situation dependent. As a result, it is difficult to find patterns relating Casey's and Hayden's goals within the framework presented by Crooks-Monastra and Yee (2022). Moreover, because the different categories of goals loosely correspond to the four categories of social support, this means that it is difficult to identify social support trends within Casey's and Hayden's goals.

Overall, examining Casey's and Hayden's goals through the lens of the four categories of goals (Crooks-Monastra & Yee, 2022) provides insight towards *RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?* Because the four categories of goals have connections to the four categories of social support, examining the extent to which an instructor's goals fit into Crooks-Monastra and Yee's framework could illuminate connections between the instructor's goals and their social support actions. Casey and Hayden each had goals representative of all four goal categories and did not have any particular category that stood out as being more important to them than others; this is in great contrast to the GTAs discussed in Chapter 4 who each had two categories that most of their goals fell into. In terms of social support actions, Casey's and Hayden's actions were reflective of goals across all four categories; even goals that were reflected by multiple support actions fit into different goals categories in different contexts.

According to the ROG model (Schoenfeld, 2011), one's actions are (partly) a reflection of their goals and how those goals are prioritized. Because Casey's and Hayden's actions are reflective of a wide variety of goals spanning a variety of categories, different goals likely take priority in different scenarios. In sum, this suggests that the ways that Casey and Hayden each prioritize goals for the sake of in-the-moment decision making is highly situation-dependent.

5.4 Casey's and Hayden's Orientations

5.4.1 Social Support in the Categories of Orientations

Section 2.4.2 discussed the Teacher Beliefs Interview (TBI) which proposed four categories of teacher beliefs. Descriptions of each category of beliefs, as well as their classifications as teacher-focused or student-centered beliefs, can be found in Table 3 (originally in Chapter 2, replicated below). The beliefs included in the TBI are not

Table 3

Categories of Teacher Beliefs (Synthesized from Luft & Roehrig, 2007)

Category	Description	Classification
Traditional	Beliefs emphasize the transfer of knowledge from the teacher to students	Teacher-centered
Instructive	Beliefs emphasize providing students with opportunities to learn; learning is directed by the teacher through experiences	
Transitional	Beliefs emphasize providing a supportive learning environment through teacher-student relationships	—
Responsive	Beliefs emphasize learning through collaboration among students	Student-centered
Reform-based	Beliefs emphasize students directing their own learning	

Note. Transitional beliefs are categorized as neither teacher-centered nor student-centered

inherently reflective of any specific instructional decisions; instead, the five categories of

beliefs are related to how knowledge should be transferred and how learning takes place

(Luft & Roehrig, 2007). However, Lee (2019) found connections between the beliefs

held by STEM GTAs and the instructional activities they opted for. For example, beliefs

in the traditional belief category were often associated with traditional lectures whereas

beliefs in the instructive category were associated with group work and active learning.

This aligns with Schoenfeld's ROG framework (2011) which asserts that actions are

partially determined by one's beliefs. According to Schoenfeld, someone having a lot of

beliefs in a particular category of beliefs should not be considered a *predictor* of certain

decisions, but it can be used to explain specific in-the-moment decisions as they arise.

In general, it is difficult to find connections between the categories of beliefs and

the categories of social support because the categories of beliefs are related to learning

and instruction whereas social support often occurs as a supplement to learning and

instruction. However, social supports and instructional activities are not unrelated: since

social supports often augment instructional activities and instructional activities are often

social supports themselves, Lee (2019) suggests that since teaching beliefs correspond to

particular instructional activities, teaching beliefs correspond to certain social supports as

well. For example, working through examples for students is often considered a social

support since it has the potential to alleviate confusion; moreover, it would likely be

categorized as either informational or instrumental support (depending on the context).

Working through an example is a teacher-focused teaching practice and doing so

frequently would suggest that someone holds traditional or instructive teaching beliefs.

This does not mean there is a correspondence between informational/instrumental social

support and traditional/instructive teaching beliefs, but it does suggest opportunities for general parallels between these two frameworks to be drawn.

The categories of beliefs proposed in this framework (Luft & Roehrig, 2007) grant an opportunity to reassess the beliefs of the GTAs discussed in Chapter 4: for instance, many of Riley's beliefs discussed in Section 4.3 are reflective of transitional beliefs. Riley believes that in order for students to learn, they first have to be comfortable (in the classroom, with the instructor, with prerequisite material, etc.). This aligns with transitional beliefs which are characterized as beliefs that emphasize providing a supportive learning environment. Moreover, instructors with transitional beliefs believe that they can cultivate this supportive learning environment through the relationships they form with their students (Luft & Roehrig, 2007). Riley frequently discussed wanting students to feel comfortable asking them questions and coming to them for help outside of class. Many of Riley's goals were related to how they position themselves within the teacher-student relationship (such as wanting to balance being an authority figure and being approachable) which is indicative of someone with transitional beliefs. Riley certainly holds beliefs in other categories of beliefs: for instance, Riley believes that sometimes it is appropriate to do challenging problems *with* students and sometimes it is appropriate to do challenging examples *for* students (reflective of instructive and traditional beliefs, respectively). Riley also discussed wanting students to develop rapport amongst themselves so that they could rely on one another for support as they learn (reflective of responsive beliefs). However, most of the orientations discussed by Riley relate best to the transitional belief category. Figure 10 illustrates where most of Riley's beliefs clustered on the spectrum of teacher beliefs.

Figure 10

Riley's Beliefs on the Spectrum of Teacher Beliefs from the TBI[5]
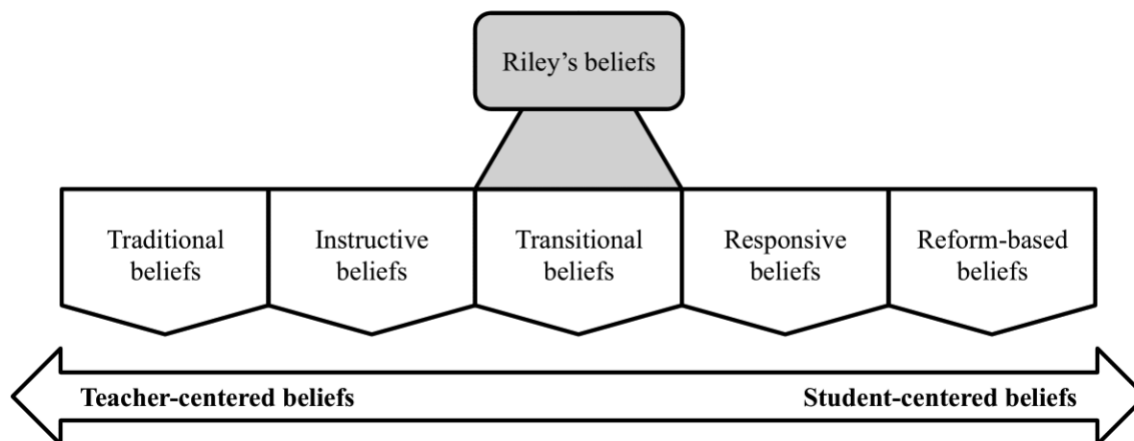
Whereas Riley's beliefs mostly reflect transitional beliefs, Blake's beliefs tended

to fall closer to the two extremes of the spectrum as shown in Figure 11. Some of the

most prominent themes of Blake's interviews were their goals to provide students with

tools to solve unfamiliar problems and to help students become familiar enough with

those tools to use them appropriately on their own. This suggests that Blake values

students directing their own learning, reflective of reform-based beliefs. On the other

hand, many of Blake's goals are related to wanting to provide opportunities for learning

to their students, particularly through the use of productive struggle. During observations,

Blake often sat down with students and worked problems with them, occasionally taking

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[5]This figure (and subsequent figures showing how GTAs' beliefs fit onto the spectrum of teacher

beliefs) does not illustrate how all of the GTA's beliefs are categorized. Riley holds beliefs in all five

categories. The purpose of this figure is to illustrate where *most* of Riley's relevant beliefs are categorized.

Figure 11

Blake's Beliefs on the Spectrum of Teacher Beliefs from the TBI
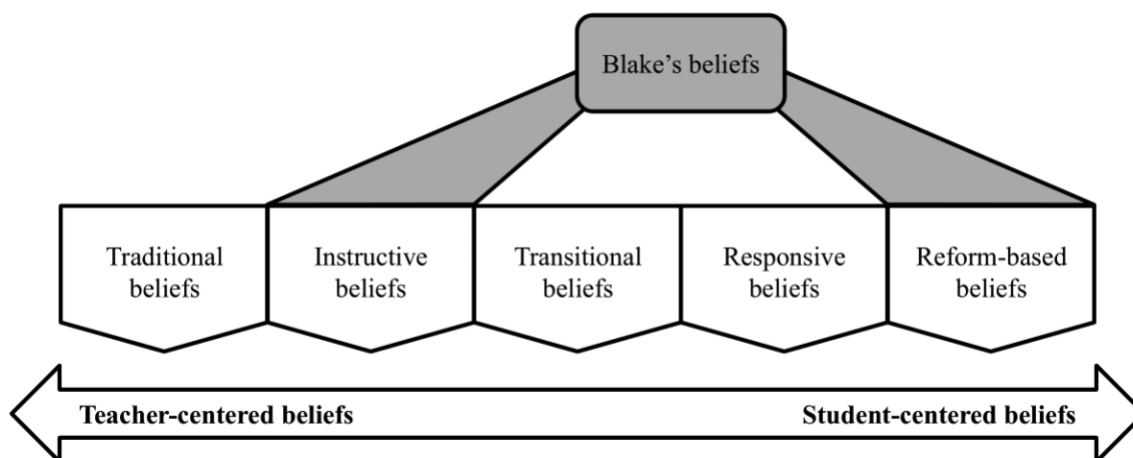
the lead on the solving. Blake would direct students to work on problems that they

thought were appropriately challenging for those particular students. Blake would start

class by providing students with the theorems and rules that they would need to be

successful on that day's exercises. All of these actions suggest that Blake values their role

in the learning process; although Blake prioritizes letting students do the work themselves

(even if that means struggling with it for a while), Blake does facilitate the learning

experiences in their class. This suggests that Blake holds many instructive beliefs, which

are characterized as beliefs that learning is directed by the teacher providing opportunities

and experiences.

Like Blake's and Riley's beliefs, Casey's and Hayden's beliefs seem to span

multiple categories of beliefs in the TBI framework (Luft & Roehrig, 2007). Whereas

Riley's beliefs mostly hovered around the middle of the spectrum and Blake's beliefs

spanned both ends of the spectrum, Casey's beliefs tend to cluster around one end of the

spectrum and Hayden's beliefs are perhaps the most evenly distributed of any participant

discussed in this dissertation. What follows is a discussion of Casey's and Hayden's beliefs within the context of the TBI categories and a possible explanation of how this contributes to the overall understanding of Casey's and Hayden's goals, orientations, and social support actions.

5.4.2 Examining Casey's Orientations and Social Support Actions

As discussed in Section 5.3, Casey's goals are distributed across all of the categories of goals proposed by Crooks-Monastra and Yee (2022); in contrast, most of Casey's beliefs that arose during this study reflect only one to two of the five categories of beliefs, namely traditional and instructive beliefs (shown in Figure 12). For example, Casey described explaining things to their students as a primary aspect of their job, and when discussing the instructors of their own graduate courses, Casey said, "[It's] literally their job, as far as I'm concerned, to teach me things." Casey also said, "The whole point of the class is [that] we keep putting barricades in front of them [the students], and then

Figure 12

Casey's Beliefs on the Spectrum of Teacher Beliefs from the TBI
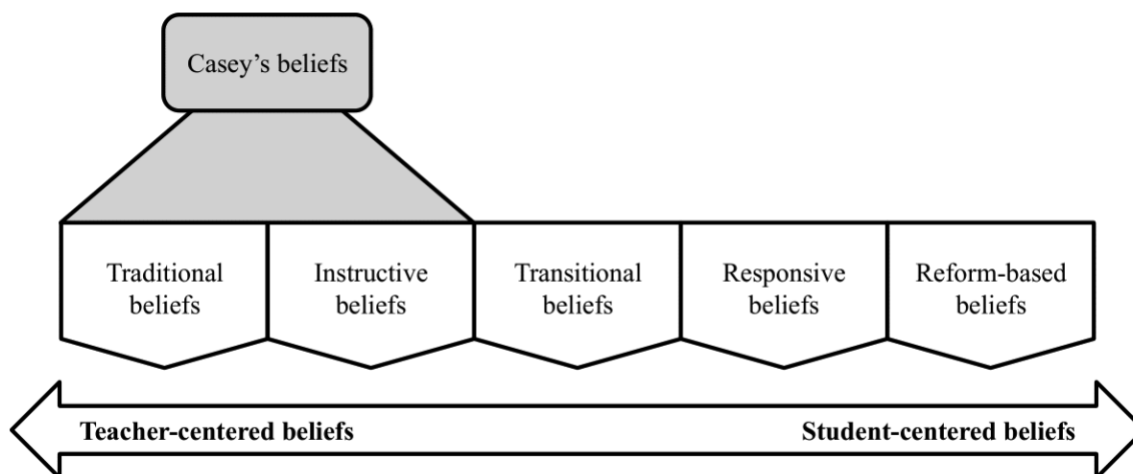
it's my job to help them get over [the barricades]." These reflections on what it means to be a mathematics instructor suggest that Casey believes that instructors should play a large role in the learning process; such beliefs are suggestive of the more teacher-centered traditional and instructive belief categories.

Casey also holds beliefs that actively oppose some of the more student-centered categories of beliefs. For example, Casey stated that it is not their job to become friends with their students or to cultivate relationships between students. They said, "Forming social bonds, potentially friendship… That's cool if it happens, but I don't think that's really my job." Believing that it is not their job to cultivate social relationships with their students opposes the transitional belief category (which emphasize the role of the teacher-student relationship in the learning process). During the observations, Casey did not force students to work together if they were making progress independently. This suggests that Casey might not have strong responsive beliefs as this category emphasizes collaboration between students. These examples do not mean that Casey does not have beliefs in the transitional or responsive belief categories, but it does suggest that Casey's beliefs in these categories may be a lower priority for them.

As discussed by Lee (2019), since traditional and instructive beliefs are classified as teacher-centered beliefs, certain instructional activities are often associated with these categories of beliefs. Instructors in Lee's study who held traditional beliefs often referenced instructional activities that focused on the teacher delivering information to the students, such as traditional lectures and providing fully worked examples. Instructors who held instructive beliefs referenced instructional activities that focused on teacher-provided learning opportunities, such as hands-on activities and facilitated group work.

These connections are supported by many of Casey's actions in the classroom: calculus recitations at UNL are expected to have active learning activities and are thus inherently centered around group work. Within these structures, Casey is very hands-on in the learning process: during the observed class meetings, Casey provided many examples to their students and even mini lectures to remind students of important concepts. They provided a lot of structure to their students' learning experiences by directing which problems they would work on at certain points throughout the class and by redirecting and providing extra support to students who were not making progress on their own.

The prominence of beliefs in the teacher-centered categories of beliefs can be seen in Casey's social support actions as well. Section 5.3 discussed how Casey's social support actions spanned several categories of instructor goals, but in the context of instructor beliefs, Casey's social support actions were fairly consistent. Some of the examples of social support discussed in Section 5.3 included Casey defining a concept using imprecise language, Casey reviewing an algebra topic that students would need to do the calculus topic they were studying, and Casey telling students which formulas they needed to memorize for an upcoming exam. Although these examples reflect a variety of types of goals, they all support Casey's beliefs about their role in the learning process. Casey is directly providing information to their students and facilitating their learning and understanding.

In terms of Schoenfeld's ROG framework (2011), Casey's beliefs provide much more clarity about their social support actions than their goals did on their own. As discussed in Section 5.3, because Casey's goals spanned all of the categories of goals proposed by Crooks-Monastra and Yee (2022), it was difficult to explain trends in

Casey's social support actions. Casey's actions reflected a wide variety of goals and even reflected the same goals in a variety of ways. In contrast, most of the examples of social support that Casey offered can be explained to a certain extent by their traditional and instructive beliefs. Although these beliefs do not necessarily explain why they offered particular *categories* of social support, these beliefs do help explain the actions themselves. These ideas contribute the discussion of *RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?;* see Section 5.5 for a further discussion of how Casey's beliefs contribute to this research question.

5.4.3 Examining Hayden's Orientations and Social Support Actions

Examining Hayden's social support actions and the goals and orientations that those actions reflect through the lens of the five categories of teacher beliefs (Luft & Roehrig, 2007) reveals evidence from all five categories. For example, Hayden believes that students can benefit from seeing worked examples: during the observations, Hayden identified problems that students were working from and then worked those examples at the board for the students. This belief is considered a traditional belief since it focuses on the transmission of information from the teacher to the students. Hayden said,

> Guiding them through solving the problem, I'm pretty good with that, 'cause I know how to do it and I think I can explain it decently well... I mean, that's one way in which I can help at least get them out of a rut that they're in. I mean, that's [what] I do probably the best.

Hayden also holds beliefs on the opposite end of the spectrum: for instance, Hayden frequently sat silently with groups and let them lead the conversation, only contributing

when students asked for help or when students clearly needed redirection. This suggests that Hayden believes that students can be productive on their own which is a reform-based belief since it focused on the teacher mediating student learning (as opposed to leading it). Table 8 describes several examples of social support offered by Hayden during observations, as well as orientation(s) that can be used to explain each example and the corresponding category of beliefs for those orientations. Note that some orientations could fit into multiple categories.

Although Blake's and Riley's beliefs tend to fall into just a few categories each, it is reasonable to expect that many teachers' beliefs would be spread much more evenly. The TBI categorizes individual beliefs, not people (Luft & Roehrig, 2007), so it is not concerning to see that Hayden's beliefs span all the categories relatively evenly. However, this has interesting consequences due to the spectral nature of the categories of beliefs. Figure 13 illustrates the spread of categorizations of Hayden's beliefs.

Figure 13

Hayden's Beliefs on the Spectrum of Teacher Beliefs from the TBI
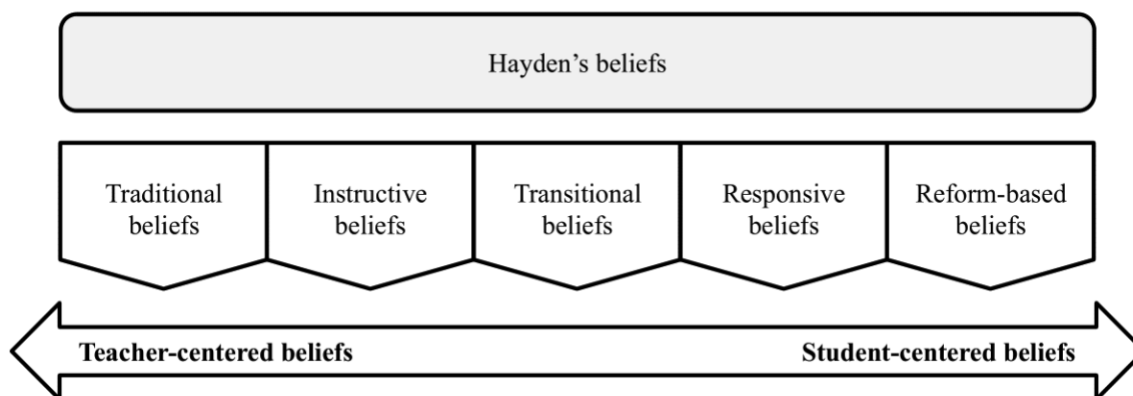
Table 8

Examples of Hayden's Social Support Actions and Corresponding Orientations

Example of Social Support	Hayden's Corresponding Orientation(s)[a]	Belief Category
Hayden presented the solution to a problem that they noticed students were struggling with.	Students can benefit from seeing worked examples.	Traditional
Hayden gave a hint to the class for a problem that they noticed students were struggling with.	Students sometimes need guidance to make progress on problems.	Instructive
Hayden admitted that they did not remember how to do something from trigonometry that was needed for a problem.	Being transparent can help develop rapport with students.	Transitional
Students were complaining about something that their lecturer had done. Hayden validated their feelings but defended the lecturer, reminding students that there was a reason behind the lecturer's choices.	Letting students vent can help develop rapport with students. Students' relationship with their lecturer is important.	Transitional
A student was sitting at a table by themselves; Hayden insisted that they move to work with people.	Students benefit from collaboration	Responsive
Hayden sat down to check in with a group that was in the middle of discussing a problem but stayed silent until the students asked for Hayden's input.[b]	Students can be productive without instructor input	Responsive or Reform-based

(Right margin arrows: "Teacher-centered beliefs" pointing up, "Student-centered beliefs" pointing down)
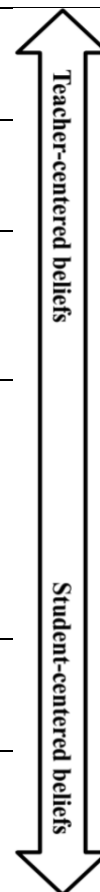
[a]The orientations described in this column are not solely inferred from the examples; there was other evidence from the data to support Hayden having these beliefs.

[b]When asked about this interaction during the second interview, Hayden said that they had stayed silent intentionally because they did not want students to think their discussion was "wrong"; in this case, inaction would be considered a social support since it was done intentionally.

As discussed in Section 5.4.1, there is not a clear correspondence between the five categories of teaching beliefs and the four categories of social support. However, Hayden's beliefs, being distributed across all five categories, can be used to explain the wide variety of social supports offered by Hayden. As discussed in Section 5.3, Hayden offered a wide variety of social support actions during observations; not only were the support actions varied in terms of their categorizations as social supports, but they were varied in terms of the types of beliefs that can be explained by (see Table 8). According to Schoenfeld (2011), beliefs impact actions and thus actions should be explainable via beliefs. Since Hayden has a wide range of beliefs, it makes sense that they would use a wide variety of social supports; conversely, since Hayden used a wide variety of social supports, it is understandably difficult to explain their choices to utilize particular categories of social support over others.

In terms of contributions towards *RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?*, Hayden's case demonstrates that GTAs' orientations do not necessarily fit into the "boxes" suggested by Luft and Roehrig's categories of teaching beliefs (2007). However, since Schoenfeld's ROG framework (2011) considers individual decisions, connections can still be drawn between the variation in Hayden's beliefs and the variation in their actions. A further discussion of how Hayden's beliefs contribute to this research question can be found in the next section.

5.5 Discussion

Although the GTAs in Chapter 4 provide a starting point for understanding how Schoenfeld's ROG framework (2011) can be used to understand GTAs' use of social

support, Casey and Hayden provide opportunities for a more nuanced discussion of how social support actions can be explained by goals and orientations. During data collection, it was unclear whether there were any trends in Casey's or Hayden's goals, orientations, or social support actions. Their support actions spanned all of the categories of social support proposed by House (1981); although the ROG framework is not intended to *predict* someone's actions, I had hoped to see similar trends arise as they had for Blake's and Riley's support actions discussed in the previous chapter. A closer look at Casey's and Hayden's goals and orientations through the lenses of two existing frameworks did not necessarily make such trends appear, but it did provide an opportunity for a deeper understanding of how the goals, orientations, and social support actions are connected.

An examination of Casey's and Hayden's goals through the lens of Crooks-Monastra and Yee's categories of goals (2022) suggests that GTAs can possess a wide variety of goals. Although Blake's and Riley's goals fit into two categories of goals each, Casey's and Hayden's goals are spread across all four categories relatively evenly. Moreover, how Casey's and Hayden's goals are categorized within this framework is often situation dependent. Whereas it might be expected, for example, that Riley would typically prioritize goals that fall into Goal 3 (Develop Productive Dispositions), it is unclear whether Casey or Hayden would prioritize any particular category of goals. This is not better or worse than there being trends in Blake's and Riley's goals: it is simply different. Chapter 7 will discuss implications and applications of this study, including how the findings of this study can inform GTA professional development; knowing that some GTAs' goals are clustered around one to two of Crooks-Monastra and Yee's

categories (2022) whereas other GTAs' goals span all categories provides a deeper understanding of GTAs' goals, both in general and related to social support.

Examining Casey's and Hayden's orientations through the lens of Luft and Roehrig's categories of teaching beliefs (2007) provided similar insight to just how varied GTAs' goals and orientations can be. Since the five categories of beliefs form a spectrum from teacher-centered beliefs to student-centered beliefs, there is a natural and ordinal way to compare the beliefs of different GTAs. The four GTAs discussed thus far reflect nearly every possible outcome, namely being centered on the spectrum (Riley), being clustered on one end of the spectrum (Casey), being split across the two extremes of the spectrum (Blake), and spanning the entire spectrum (Hayden) (see Figure 14). Examining Casey's and Hayden's cases through the lenses of these different frameworks offers new perspectives towards *RQ1: What goals and orientations are present when GTAs offer social support to their students?* The cases of the GTAs discussed in Chapter 4 might suggest that the goals and orientations of a particular GTA would be unvaried: in terms of the two different frameworks discussed in this chapter, it might be expected that every GTA has one to two categories of goals and one to two categories of beliefs that characterize them as an instructor. Casey's and Hayden's cases show that it is possible for individual instructors to span *all* categories within these frameworks. Although this finding does not indicate *what* goals and orientations are present when GTAs offer social support, it does illustrate *how* goals and orientations can be present (namely that they can be much more varied than one might expect). Since actions (including social supports) are determined by goals and orientations (Schoenfeld, 2011), the level of variety in someone's goals and orientations could correlate to the level of variety in their social

Figure 14

Beliefs Held by Each Participant on the Spectrum of Teacher Beliefs from the TBI
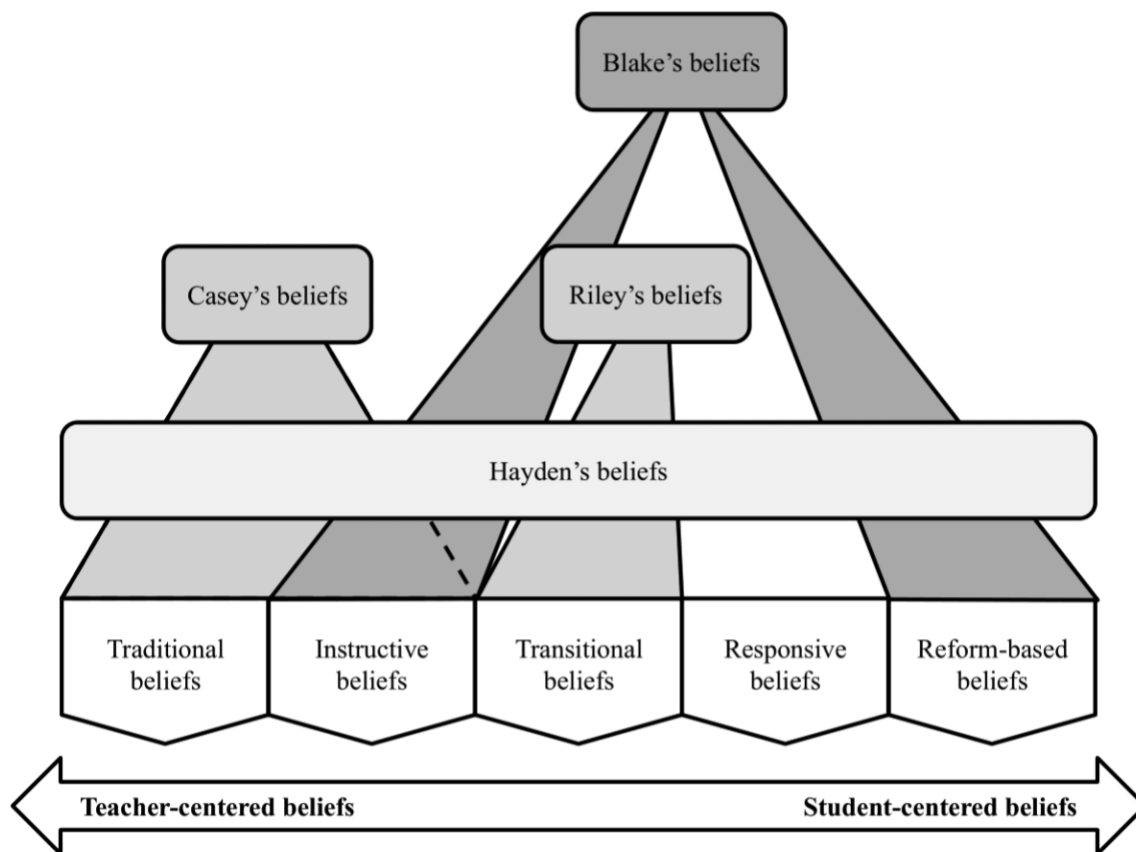
support actions. There were no apparent trends in the types of social support that Casey

and Hayden offered during the present study which further supports this idea.

Thus far, this study has examined the phenomenon of in-the-moment decision

making of four mathematics GTAs. Although the goals, orientations, and social support

actions of these four participants have varied greatly, all four GTAs have been first-year

GTAs. The next chapter discusses two experienced GTAs, Avery and Tate, to not only

explore how goals, orientations, and social supports may be different between more

experienced instructors, but to also examine how these constructs might change over

time.

Chapter 6: Avery and Tate

6.1 Introduction

The previous chapters explore the dynamic relationship between the goals, orientations, and social support actions of four GTAs. Examining these four cases through the lenses of several frameworks (Crooks-Monastra & Yee, 2022; House, 1981; Luft & Roehrig, 2007; Schoenfeld, 2011) provides insight towards both *RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?* and *RQ2:How do GTAs offer social support to their students?* Because all four GTAs discussed in Chapter 4 and Chapter 5 are first-year GTAs, one dimension of the phenomenon of interest that has not yet been explored is how goals, orientations, and social support actions might change over time.

This chapter examines the goals, orientations, and social support actions of two experienced GTAs, Avery and Tate, who are each in at least their fourth year as a mathematics GTA. Examining two GTAs with more experience not only furthers the discussion of the first two research questions, but will begin a discussion of the study's final research question:

RQ3:   How do the ways that GTAs think about and offer social support differ

between first year GTAs and experienced GTAs?

This chapter first provides an overview of each of Avery's and Tate's cases. The ways in which these GTAs have changed since their first years in the program are discussed, followed by an exploration of how Avery and Tate compare to one another and how they compare to the first-year GTAs discussed in Chapter 4 and Chapter 5.

6.2 Introduction to Avery and Tate

6.2.1 Avery

Avery is an experienced GTA whose passion for teaching was salient throughout the study. Avery not only described teaching as something they enjoy doing, but as a driving factor in their personal education and future career goals. When asked how they feel about teaching and whether it is something they plan to do beyond graduate school, Avery said,

> I feel really positively about teaching. Teaching is honestly my focus. I know that I'm getting like a PhD in mathematics and that's what I should be using, but like, my calling is to teach others mathematics. I have a very positive view on teaching and I spend a lot of time sort of researching and implementing different things to be the best teacher that I could be.

Avery went on to say that an ideal job for them after graduate school would be one that is teaching-focused that required little research. Avery's desire to learn more about teaching in order to improve their craft was evident throughout the interviews: when Avery was asked to explain some of their instructional choices, they often made reference to specific teaching and learning theories. They also described an iterative process within their teaching where they would sometimes try something new and then change what they had done based on how it went in practice. Overall, Avery demonstrated a high level of passion for teaching and a strong commitment to becoming a better teacher.

During the early stages of data analysis, a lot of similarities between Avery and Riley (who was discussed in detail in Section 4.3) emerged. In particular, both Avery and Riley frequently discussed the affective side of the student experience and seemed very in

tune with their students' emotional well-being. Avery discussed taking a "whole human approach" to their teaching, saying,

> Each of my students have this whole rich life outside of my classroom and that directly impacts their ability to be successful in my course. And so it's important to sort of take into account everything about them and their experience in order to sort of like appropriately help them learn the material.

The attention that Avery paid to their students' emotions suggested that they might tend towards using emotional support since emotional support is the category that aims to prevent and alleviate negative emotions directly.

Another similarity between Avery and Riley is the extent to which their own experiences as students seems to impact their teaching. Although Avery and Riley are certainly not the only participants in this study to reference their own experiences as students, they discussed it the most frequently. When asked to discuss their goals, Avery said,

> One of my goals is just for my students to be comfortable at all times… I mean, I personally was a very anxious student all the time. And so I always felt uncomfortable in my classrooms for any number of reasons, not necessarily anything that the instructor did or didn't do, but just, I was always an anxious, uncomfortable person in the classroom and I don't ever want my students to feel that way. Because while you're feeling anxious and uncomfortable, there's no way you're going to interact with the mathematics, right?

In addition to empathizing with their students based on personal experiences, Avery uses their own experiences to inform the instructional decisions they make in response. For

example, Avery discussed the amount of anxiety they would experience if they feared being called on to present without warning and conjectured that their students would feel the same way. To alleviate this stress, Avery lets students know in advance that students will be asked to present problems; students are told which problems are going to be presented and given the opportunity to volunteer for specific problems in advance. This gives students time to do the problem and get feedback on their work from Avery before they are asked to present, decreasing the amount of stress students might be feeling about presenting. This is just one of many examples of ways that Avery implements structures in their classroom to prevent and alleviate stressors that they anticipate students having based on their own experiences as a student of mathematics.

6.2.2 Tate

Tate is another experienced GTA who provides an interesting contrast to Avery. Although Tate decided to go to graduate school to become a professor and does love teaching, teaching is no longer something they necessarily see themselves doing beyond graduate school. They attribute this change of heart to experiencing teaching in graduate school and learning that there are elements of teaching that they do not like, such as curriculum planning. Overall, Tate enjoys being in the classroom and working with students, even though teaching is not something they see themselves doing long-term.

When asked to describe their teaching style, Tate said,

I think like the main word I would use is kind of relaxed. I try and connect with the students. And I just feel like if they feel comfortable talking to me, they'll feel more comfortable talking about the material. So that's really my main goal is to

just get them to be open with me about what they understand and don't

understand.

Tate's desire to connect with their students could be seen during the classroom

observations: Tate frequently sat down with students and engaged with students in

conversations about things other than math. Tate asked them how they were doing and

seemed to know a lot about what their students did outside of class (such as other classes

and extracurricular activities). Tate intentionally engages students in conversations that

are not related to mathematics as a way of forming genuine relationships with their

students.

Many of Tate's goals and orientations are similar to the goals and orientations

discussed by the first-year participants: for example, Tate's highest priority goals

included wanting students to learn the material (which was discussed by all four first-year

GTAs) and wanting students to develop a positive relationship with mathematics (which

was discussed in depth by Blake). Tate seems to believe that students are better equipped

to learn if they feel comfortable, that students can benefit from their instructor making

mistakes, and that students do not necessarily have to work in groups to be successful;

such beliefs are shared by Riley, Hayden, and Casey, respectively.

6.3 Change Over Time

Because Avery and Tate have much more experience as GTAs than the

participants discussed in previous chapters, Avery's and Tate's cases provide a unique

opportunity to discuss how GTAs' goals, orientations, and social support orientations can

change over time. Because the data for this study was only collected during one semester,

the data does not directly capture Avery's and Tate's goals and orientations during their

first years. However, during each interview, Avery and Tate were asked to discuss how their responses to certain questions might have been different during their first years and why any changes might have occurred. For example, when they were asked how they would rank their goals during the first interview, Avery and Tate were asked how their ranking might have differed during their first year as a GTA. In both interviews, Avery and Tate were asked to discuss how the ways that they provide and think about social support has changed since their first year. Although asking Avery and Tate to describe their goals, beliefs, and social support actions from more than three years prior could introduce recall bias, I will take their current interpretations on their past selves to be accurate perceptions of their growth as instructors.

6.3.1 Avery's Change Over Time

When Avery discussed how they have changed since their first year of graduate school, they repeatedly mentioned how their ability to manage the demands of graduate school have changed. Avery discussed feeling overwhelmed at the start of graduate school and how that impacted their teaching. Avery said,

> It was my first time teaching and so I was nervous. I was quite stressed about it… And I was a bit of a disaster. It's my first year of grad school. It's my first year being in charge of a classroom on my own.

One particular consequence of balancing the demands of graduate school was that Avery was unable to connect with their students on a social level. Avery said,

> My first year, I was definitely overwhelmed. You know, first-year graduate student, first time actually being in charge of a whole classroom of students. It's sort of a lot to deal with all in one go, and so I was so focused on helping them

learn the material that— I mean, I knew their names, most of them, at least. But that was about it. That's about all I knew about any of my students the first couple of semesters I taught because I just didn't have my own personal social capacity to support them socially.

Avery went on to explain that as they advanced through graduate school and improved as an instructor, the extent to which they could support their students in a social capacity increased:

Sort of a big growing experience in terms of me being an instructor is that I have become more socially competent… in being a teacher, and I've been able to then utilize that social energy to get to know my students, to know where they're at, to keep track of… That this is, you know, my student who is particularly social and honestly they don't thrive with this non-social student because the non-social student gets stressed out being with the social student, and, you know, sort of knowing how that's going… Even just these little things of sort of knowing where my students are at socially and how that's impacting them in the classroom has been like a big shift in how I've been able to teach.

In terms of social support, Avery becoming more aware of their students' personalities and social needs makes Avery better equipped to offer types of social support that benefit their students the most. For example, Avery discussed a student needing an extension on an assignment because their laptop had been run over by a car. Avery explained that in their first year as a GTA, they might have assumed that a student who was asking for an extension might have had something going on in their personal lives that was creating a barrier to their success in the class and therefore might have needed emotional support.

However, Avery now has the ability to get to know their students and knows that the student's laptop was broken, so when the student asked for the extension, Avery was able to simply grant the extension (likely categorized as instrumental support) without expending time or energy on an unnecessary type of social support.

In addition to simply not having the capacity to connect with their students, Avery discussed several barriers that prevented them from offering particular types of social support to their students during their first year. Avery said, "I do not have the capacity… to do any sort of emotional support for my students because *I'm* [speaker emphasis] already stressed."[6] Avery explained that they could not offer appropriate appraisal support because they did not yet understand how students should be performing:

> I can't give [my students] very much appraisal support because I don't know what's expected of them. I don't know where they're supposed to be. I don't know if they should be showing up to recitation having no idea how to do the workbook. I don't know if they should be showing up absolutely being able to just crush all the questions. I can't give them any sense of appraisal support because I don't know what the benchmark is.[7]

Avery mentioned a similar barrier to providing informational support:

> I can't give them very much informational [support] 'cause I don't know what resources are out there, right? The only thing I knew about was the [math tutoring

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[6] Although Avery is speaking in the present tense, it is clear from the context that Avery is speaking about their past self.

[7] See Footnote 6

center]. I didn't know when [my students' calculus lecturers] were holding office hours. I didn't know what resources to go to if they were missing anything. I didn't know what chapter in the textbook we were working on and maybe I should have, but I didn't.[8]

Avery attributed their inability to provide instrumental support to not being prepared (e.g., doing the workbook problems in advance, looking at the students' online homework assignments, etc.) as a result of being stressed by their own coursework.

Despite feeling unable to provide social support in their first year, Avery said that they now feel "competent and capable" of providing all four categories of social support to their students. Avery said,

I've had more time to practice teaching and for it to be a less stressful thing. It's always going to be a stressful thing in my life and I recognize that, but I am more capable with the practice that I have, the techniques that I have, that even though I am somewhat stressed to teach, it is not at the detriment of my students.

Avery explained that they now feel like they have overcome all of the aforementioned barriers to providing social support: Avery now has the capacity to provide emotional support to their students. They have a better understanding of how the success in the course is measured and of the resources that are available to students so that they can better offer appraisal and informational support, and they are better able to prepare for class in order to offer instrumental support effectively.

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[8] See Footnote 6

6.3.2 Tate's Change Over Time

Whereas Avery discussed changes to their goals, orientations, and social support actions through the lens of overcoming barriers, Tate attributed such changes to the experiences they gained as they progressed through graduate school. While discussing how their goals have changed since their first year, Tate said, "I think a lot of [the change] is from experience, that when I've tried to do things like this before, maybe they weren't as effective as I expected them to be." For example, Tate described prioritizing providing students with supplemental review materials during their first year but not prioritizing that now:

I think an example [of how my goals have changed] would be providing written study materials, like maybe working through an old exam and posting solutions or something. I find that a lot of times students don't even end up looking at it at all. Especially if I wait to post the solutions, because I'm like, "Try the problems on your own and then I'll post solutions the day before the exam" or something… But I'll reference things like, "Hey, did you look at that little derivative cheat sheet thing that we posted on Canvas?" And they'll be like, "Oh, I didn't know that was there." It's like, okay, well you didn't look [laughs]. I feel like they just get overwhelmed with all the information being thrown at them that it seems like too much. So I guess a big difference that has changed since first year for me with regards to creating study materials, is that my first year, I just thought, okay, I need to provide a structure for them to make everything as easy as possible. And what I realize now is that there is already a lot of structure and providing any more is like smothering and it doesn't allow them to blossom.

Another example of how Tate's experiences as a GTA have caused change in their goals, orientations, and social support actions is their perceptions of their students. Tate said, "I think maybe I forgot when I came into grad school that [my students] are still learning how to be students. So they don't know how to find their textbook or syllabus necessarily." Tate went on to explain that now that they have a better sense of who students in undergraduate mathematics courses are, they are better able to support them. For instance, Tate explained that they must remind themselves that many first-year college students have never heard of office hours before and have to be explicitly told what office hours are in order to attend them. Tate also discussed that many first-year college students have never had to navigate an online learning management system and therefore Tate puts care into organizing their Canvas page in an intuitive way.

Like Avery, Tate discussed how the demands of graduate school impacted their teaching. In particular, Tate discussed how their responsibilities as a student during their first year were less flexible than the responsibilities they have now. For example, first-year graduate students often have weekly homework deadlines for multiple classes, whereas experienced GTAs are primarily focused on personal research that is much more flexible. Tate said that the flexibility they have with their current work makes it easier for them to balance their responsibilities as a student with their responsibilities as a teacher and therefore they can put more energy into their teaching when needed.

Another change over time that Tate discussed was their expectations for their students. Tate said,

I think in my first year, maybe I had much higher hopes for convincing students that math is fun [laughs]... I think I've become more realistic with them about

what this class is doing for them, because in my years, I've realized what most students want out of the course. And a lot of them don't want to fall in love with math... Even if they do end up enjoying it, that's not what they're trying to get out of the course. What they care about is doing well and getting whatever tools they need for their field.

This shift impacted the way that Tate provides emotional support:

I think the kind of support that I've adjusted the most is some sort of emotional support that involves me saying, "I can empathize with you. This is hard. Especially if you're not enjoying it, this is hard. Let's get through it together," kind of thing. Which was not my approach in first year. I think it was more like, "Oh, but come on, it is cool."

Empathizing with students is not unique to experienced GTAs: validating students' struggles is something Riley frequently did during observations and discussed during interviews. However, unlike Riley, Tate grounded these actions in their experiences in a way that Riley was unable to do yet.

6.4 A Comparison of Avery and Tate

As seen by the participants discussed in Chapter 4 and Chapter 5, first year mathematics GTAs hold a wide variety of goals and orientations and offer social support to their students in a variety of ways. Since Avery and Tate have each been in the same department for three or more years, examining their cases provides an opportunity to consider whether GTAs get more similar in terms of their goals, orientations, and support actions over time or whether the differences GTAs enter graduate school with are amplified over time. Although comparing just two GTAs cannot be used to make claims

about the similarities and differences among *all* experienced GTAs, it does provide a

starting point for a discussion about the long-term trajectories of GTA goals, orientations,

and social support actions. Avery's and Tate's respective interviews and observations

gave rise to several common themes; this section will discuss such themes and whether or

not Avery and Tate seemed to agree on each idea.

6.4.1 Students' Relationships with Mathematics

One of the most apparent similarities between Avery's and Tate's goals is their

prioritization of improving students' relationships with mathematics. Although this goal

is not unique to the experienced GTAs—for instance, Blake explicitly named this as one

of their highest priority goals—Avery and Tate did discuss this goal in the most detail.

While discussing their goals, Tate said,

> I guess my main goal is for [my students] to have a good relationship with
>
> mathematics. Maybe it's not their favorite subject, but I would like them to leave
>
> thinking, "I can do calculus now. I passed the class. Maybe I don't need to do it
>
> anymore," but with some confidence and some comfortability with the subject.

As discussed in the previous section, Tate's expectations for what improving their

students' relationships with mathematics looks like has become more realistic over time.

Avery also discussed wanting to help improve students' perceptions of

mathematics and explained that many students come into college with negative

relationships with math already in place:

> Improving my students' outlook on mathematics as a whole is quite important
>
> because a lot of times, they will come in with some less than positive experiences.
>
> A lot of my students have… had instructors that had less than positive views on

mathematics in the past, which [the students] have brought with them. Or…

maybe math has just always been their worst subject and they've always been told

that that's fine, because who needs math? And so we have sort of all these varying

backgrounds and beliefs of math, either not being their thing or being something

where it's okay to be bad at or, you know, being told— I've had students who

have been told that they're just bad at math by instructors before coming into my

classroom. And they internalize that and they come into my classroom and they

say, "I'm bad at math, but I just have to pass this class." And so one of my goals

is to always sort of... to revert that expectation and to have students understand

that they can do this.

In practice, Avery tries to rectify students' negative preexisting relationships with

mathematics by providing positive feedback on what students do well (as opposed to

focusing on what students have done wrong). Avery said,

Sort of a way this influences my classroom practices is that I provide as much

encouragement as possible… Like you have to let a student know if they're doing

something wrong, sure, absolutely. But always pointing out the things that they've

done right or done well or even just like letting them know that you appreciate the

effort that they've put in or the enthusiasm they've had for the material, and then

sort of working from there to be like here's where we can improve.

The fact that the first-year GTAs in this study did not discuss students' relationships with

mathematics in great detail does not mean that they do not care about students'

perceptions of the subject. Instead, it is possible that they do not prioritize this goal

highly or at all at this stage of their teaching careers (see Section 7.2.3 for a further discussion of this).

6.4.2 Building Rapport with Students

Another commonality between Avery's and Tate's reflections was the extent to which they prioritize developing genuine relationships with their students. According to Avery, getting to know their students is a critical component in effective teaching:

> Each of my students have this whole rich life outside of my classroom and that directly impacts their ability to be successful in my course. And so it's important to sort of take into account everything about them and their experience in order to sort of like appropriately help them learn the material.

According to Avery, knowing their students is also important in offering them social support. For example, Avery described helping a student and nearly saying, "You would have learned this in a previous math class," before realizing that that student might *not* have learned that in a previous math class. Avery had to reframe how they provided help to that student based on what they know about that student's needs and background. According to Avery,

> Each of [my students] sort of has their own unique background and backstory, and so approaching that and creating an environment where all of them feel like they're being met at where they're at is sort of a big task in terms of [social support].

In practice, Avery works towards developing rapport by being receptive to students' personal barriers. For example, Avery described being flexible and accommodating to students who have to miss class or assignments due to circumstances in their personal

lives. For instance, when a student had to miss a lot of class due to a death in the family, Avery was willing to extend assignments longer than what other instructors might have encouraged. According to Avery, it was more important to send the message that Avery cared about the student's personal well-being than to have them submit the assignment right away.

Tate also discussed the importance of developing rapport with their students. To Tate, building relationships with their students is an important first step in making sure the students can learn the material. When asked to describe their teaching style, Tate said,

I think like the main word I would use [to describe my teaching style] is kind of relaxed. I try and connect with the students. And I just feel like if they feel comfortable talking to me, they'll feel more comfortable talking about the material. So that's really my main goal is to just get them to be open with me about what they understand and don't understand.

Tate also described getting attention from the instructor as an inherent right of each student in the course:

I definitely don't want people to feel like they're being ignored. That'd be the worst thing, is for them to leave class and feel like I only pay attention to, I don't know, the students that are doing well or something. Or the students that are doing well feeling like I only pay attention to the students that aren't doing well is also an issue. They're all paying for the same class, you know, they all deserve the same attention.

In practice, Tate begins working to build rapport with their students on the first day of the semester:

A lot of the times on the first day, I don't even want to talk about math. I'll have

them working on some problem, but then I'm going from table to table, just like

getting names, chatting about something, I don't know, whatever maybe they

have a question about the math and then we talk about it, but I'll never bring it up.

Tate continues to foster these relationships throughout the semester by engaging students

in conversation during class that is unrelated to math in between helping students with

math problems. According to Tate,

I think one of the ways that I try and achieve this [making students feel

comfortable] in recitation is when I sit down at the tables… I talk about

something that is not math. And I think that talking about non-math things with

my students is a form of social support because it grounds the course. They don't

feel like I'm some scary professor that's coming around their shoulder just to see

what they did wrong everywhere. Like, no, I'm just there trying to help them

figure out the math. And if they get that vibe from me, that's like the best thing

that I can hope for.

Overall, Tate uses relationships with students as a foundation of their teaching.

According to Tate, "If they [students] do connect with me, it makes course planning

easier because, you know, you just kinda hang out and talk about math together."

Connecting with their students is a high priority for Tate and they believe that everything

else in teaching follows from this foundation.

6.4.3 Assessing Student Learning

Avery and Tate both discussed the difficulties in creating a formal assessment that

accurately gauges students' understanding and learning. They both described wanting to

assess students in an accurate and appropriate way, but discussed multiple barriers that stand in the way of this. When discussing their desire for students to learn the material, Tate said,

> Of course I want them to learn the material, but whatever that means [laughs]. It's kind of hard to assess what their learning has been in the course. I don't think written exams are the greatest assessment of their learning.

Avery expressed a similar sentiment, saying,

> My last goal is… that the ways in which we perform assessments on the students are appropriately examining sort of their knowledge of the subject, which is honestly the thing that I struggle with the most. I find this extremely difficult because usually you can't tell that assessment is doing the wrong thing until you get to know a student super well and then see what the assessment has done and notice that there is definitely a huge disjoint between those two things.

Avery gave a specific example of a student who had repeatedly failed a mastery-based assessment more than 10 times despite demonstrating mastery of the topic during class and office hours. Avery said, "There tends to be this disjoint between what I know my students to know and how they're being assessed on that knowledge."

Tate also gave an example of the disconnect between what their students know and how that knowledge is assessed: while reviewing for an upcoming exam, a group of students had approached a problem in an unconventional but mathematically correct way. Tate described the challenge of navigating giving students feedback on their work because although their solution was correct, their work did not align with what the exam was assessing. Tate said,

I'm actually impressed that they [did the problem the way they did] and I want them to know that that is a viable option, but that this wasn't what we were testing for there… I didn't tell them any of these things, but in that moment, I'm thinking like, "Hmm, this rubric item on the exam would definitely say, '[Did the problem a particular way], plus three points'." But [the way they did it] is totally okay. So I guess in that moment, I'm just like, wow, this is cool, you found out a different way to do it, but also you should know that we were looking for you to do it this other way.

One specific barrier to accurately assessing student learning is the nature of coordinated courses. Avery said,

It can be difficult in convened courses. Right now… I'm not in charge of any of the grading decisions and I'm finding that difficult because we have to prioritize consistency between sections as opposed to assessing the students the best we can.

Tensions between personal goals and institutional structures force instructors to either make a choice between the two or to develop new goals as a compromise (Thomas & Yoon, 2014; see Section 2.3.8 for further discussion of conflicting goals and orientations). In this case, Avery's personal goal of wanting to assess students' learning in an accurate way is in contention with the structures imposed on them.

6.4.4 The Use of Appraisal Support

During the follow-up interview, participants were asked to consider which category of social support they offer the least; both Avery and Tate identified appraisal

support as being the category they offer the least of. Avery described intentionally avoiding giving too much appraisal support to their students:

> As much as I want to make sure students know sort of where they're at in the course… My biggest fear in terms of giving them, "This is what the average student is doing and you are falling short of that" is that it causes students to panic or to feel stress or to feel bad about their experience in the math situation that they're in… I sort of have to recognize that I am ruining some emotional support or needing to introduce unhealthy amount of additional emotional support if I provide too much appraisal support to the student who is not meeting benchmarks.

Avery went on to say,

> Sometimes I do sort of hide the appraisal support a little bit to validate that they are just where they are in their mathematics journey and that we are going to do our best to get them as far as we can… Instead of saying, "you're behind and we need to get you up", just saying, "there's so much mathematics here that we can engage with and let's engage with that math and just see where we can get to." And a lot of times when you approach it that way, you will then get to where you want to be. Whereas if you say, "you're way back here and the expectation is that you're here," they just say, "well, that's way too far ahead of where I am" and they drop out.

Although Avery certainly does offer appraisal support to their students, Avery's choice to "hide" appraisal support at times is reflective of their belief that students should be treated as unique individuals.

Tate also identified appraisal support as being the category of social support that they offer the least of, but Tate expressed a desire to provide more of it. Tate said,

I have often reflected about my teaching that I need to say more about what students are doing well, especially for students that are struggling… To find something to make them feel good about. This is something that… I've thought about, but I haven't done a great job of providing that support. I feel like it's hard to when you're in the moment… You have the time after class to think about it, you're like, "Oh man, I really should have let them know that this part was good," but at the time you're really trying to get them to the right answer quickly. And then you kind of skip over the fact that like… there was some good work there already, like we could have built on it. I don't know. It's like this time pressure thing.

In this case, Tate's personal goal is in contention with the logistical restrictions of the course, namely the amount of time spent in the classroom.

6.4.5 Lesson Planning

Perhaps the most striking difference between Avery and Tate were their opinions on preparing lessons. When asked to consider goals that they think other GTAs hold that they do not personally prioritize, Avery said,

I know of some people whose goals are just to be done with it. There are definitely graduate students who don't have a focus on teaching. And so… It's not that they're going to be a poor instructor, but they tend to be an unprepared instructor… I have observed lots of classrooms and a lot of times I'll be like, "Why did you choose to do this?" And they'll be like, "Well, I came up with that

on the spot, I hadn't worked it through, I didn't really think about whether or not

it would be good for the students, but it just sort of seemed right to put an

example of that in the middle, so I did." And it's just like that unpreparedness,

which comes from a sense of prioritizing being a [graduate] student over

prioritizing being a teacher. Which there's different schools of thoughts on all of

that. But sort of, they have teaching as a lower priority, which impacts their

students directly.

Tate, in fact, does prioritize their responsibilities as a student; they rectify putting less

time into lesson planning by prioritizing their relationships with their students. Tate said,

One goal of mine is having to prioritize research with teaching. So I'm trying to

teach and prepare my course in a way that is time efficient. And that's like the

main goal for me. But for my students, of course, I don't want to give them like

less of an effort or anything like that. So in terms of… course planning, I don't

really prioritize that. The way I prioritize my students is by connecting with them

on a personal level. And that's a big, huge goal of mine in the classroom and in

recitations especially. Which then if they do connect with me, it makes course

planning easier because, you know, you just kind of hang out and talk about math

together and that's how I see recitation going.

Through the lens of Schoenfeld's ROG framework (2011), the contrast between how

Avery and Tate choose to prepare lessons highlights how someone's decisions reflect

their goals and orientations. Both Avery and Tate value the time in class and want to give

students a positive classroom experience, but they have different beliefs about what that

should look like. Avery believes that a good lesson is the result of detailed, well-thought-

out plans, whereas Tate believes that a good lesson is the result of knowing and understanding their students' needs. Neither perspective is inherently better than the other, but instead reflects different priorities and values.

6.5 Comparing Avery and Tate to First-Year GTAs

In addition to considering how Avery and Tate compare to each other, it is worth considering how they together compare to the first-year GTAs in this study. Although the participants in this study should not be treated as representative groups of *all* first-year GTAs and experienced GTAs, highlighting similarities and differences between these two groups can highlight how the goals, orientations, and support actions of mathematics GTAs might change over time. Moreover, considering how the two groups compare to one another may suggest effects of the professional development that the GTAs have between being a first-year and an experienced GTA.

Most of the noticeable differences between the first-year and experienced GTAs are in the extent to which certain topics were discussed. In particular, many of the things that Avery and Tate discussed in detail were not discussed by the first-year GTAs at all. This does not mean that the first-year participants do not care about these things; it is more likely that these things were not discussed because they are things that first-year GTAs have not yet had to consider. The following sections highlight some of the topics that Avery and Tate discussed and explores whether the first-year participants discussed that topic as well.

6.5.1 Refinement of Teaching Practices

One of the topics that Avery and Tate discussed that the first-year participants did not discuss in detail was a desire to improve their teaching practices. Both Avery and

Tate discussed a process of "trial and error" in which they reflected on what was and was not working as they taught in order to make changes over time. Avery said, "I spend a lot of time sort of researching and implementing different things to be the best teacher than I could be." During the interviews, Avery often justified their instructional choices by explaining why they did *not* choose other options. For example, Avery uses a particular system for assigning groups to present problems during class. When they were asked to explain why they do it that way, Avery outlined several different ways they had done it in the past or could think to do it and discussed why those choices were not right for them and their students. This illustrates a process of reflection that Avery goes through when making instructional decisions, whether it be reflecting on what has happened in the past or what could happen as a result of changes.

Similarly, Tate described modifying classroom structures based on things that have happened in the past. For example, Tate explained that they used to provide a lot of written review materials for students leading up to exams, but that they do not now because they have observed in the past that students often do not utilize the materials or that students are overwhelmed by the sheer number of resources they are provided. Like Avery, this suggests that Tate reflects on their teaching and strives to improve it.

None of the first-year participants discussed refining their teaching practices, but multiple first-years discussed *wanting* to refine their teaching. In contrast, although both Avery and Tate discussed refining their teaching practices, neither of them identified this as a goal of theirs. This difference is likely a result of the fact that first-year GTAs have not yet had a chance to engage in long-term reflection of their teaching. Many participants in this study (first-year and experienced GTAs alike) described their first

year as a GTA as being about figuring out the basics of teaching; Avery and Blake each went as far as describing the first-year as being about "survival". In contrast, GTAs in their fourth year of graduate school and beyond have likely mastered the basics and are now able to focus on reflection and refinement. It is possible that Avery and Tate did not describe refinement as something they *want* to do because they were already doing it.

6.5.2 Consideration of Assessment Practices

As discussed in Section 6.4.3, Avery and Tate both expressed a desire to assess student learning in accurate and appropriate ways. In contrast, assessment practices were not brought up by any of the first-year participants in any substantial ways. Avery mentioned that assessment practices were not a priority for them during their first year because they were not yet a part of the exam-writing process. Many graduate students at UNL do not contribute to writing exams until their second or third year of graduate school, so it is possible that the first-year GTAs in this study have not considered their role in assessing student learning and therefore have not yet considered the extent to which they prioritize assessments.

6.5.3 Improving Students' Relationships with Mathematics

As discussed in Section 6.4.1, Avery and Tate both identified wanting to improve their students' perceptions of mathematics as a high priority goal. In contrast, this was discussed in detail by only one of the first-year participants in this study. The fact that the first-year GTAs in this study did not discuss students' relationships with mathematics in great detail does not mean that they do not care about students' perceptions of the subject. Instead, it is possible that they do not prioritize this goal highly or at all at this stage of their teaching careers. As discussed in Section 6.3.1, Avery felt unable to prioritize very

many goals during their first year because they were overwhelmed with the demands of the first year of graduate school. When asked how their goals were different during their first year, Tate also explained that many of their current goals simply were not on their radar yet during their first year. It is likely that the first-year participants *do* in fact have this goal to some extent, but that they might not yet be prioritizing it or even recognizing it yet. In fact, wanting to help students develop positive dispositions is one of the four categories of goals that Crooks-Monastra and Yee (2022) found to be ubiquitous among the mathematics GTAs in their study. This suggests that although this is an important goal to many GTAs, it is often one that does not become a priority until later in a graduate student's teaching trajectory.

6.5.4 Prioritization of Student Learning

Unsurprisingly, a commonality among the goals of all six participants in this study was their prioritization of student learning. Although their ranking of this goal varied, each participant described wanting students to learn the material as being one of their highest priority goals. In fact, many participants used language that suggests they believe this is an "obvious" goal for them to have. For example, when asked to list their goals related to teaching, Avery said, "My other goal is clearly like, you know, learning the material." Hayden said, "Well obviously the first thing would be just mastery of the material." Tate said, "I mean, of course I want them to learn the material." Moreover, many participants suggested that student learning was the point of the class. For example, Riley said, "The point of the class is to learn the material and understand it. That's the whole point that [students] are in the class, I hope." Casey said, "The goal is to get them comfortable with the material. They're in the class for that purpose. And so that's pretty

central because that is, you know, the actual goal of education for the most part." Although the fact that all six participants expressed similar dispositions about the importance of learning as a goal is striking, it cannot be taken to mean that all mathematics GTAs will hold this belief. However, it does suggest that this could be a commonality among most GTAs.

It is worth noting that Avery and Tate talked about this goal with more nuance than the first year GTAs did. In particular, they both discussed that although they do still prioritize student learning, this goal has become less important to them over time. According to Tate,

I mean, of course I want them to learn the material, but whatever that means. It's kinda hard to like assess what their learning has been in the course… I guess my main goal is for them to have a good relationship with mathematics. Maybe it's not their favorite subject, but I would like them to leave thinking, "I can do calculus now. I passed the class. Maybe I don't need to do it anymore." But with some confidence and some comfortability with the subject.

Avery discussed how their prioritization of student learning has changed since their first year, saying,

I do believe [during my first year] that I very much more highly prioritized my students learning the material, which right now is fourth [on the ranking of goals]. I just wanted them to learn the material… I was just like, I'm coming in and my goal is to help them learn the calculus, right? That's my only purpose. I'm not here to get to know them as people, I'm not here to grade them, like assessment wasn't really on my mind either 'cause I wasn't really super involved in that. I

was just there to make sure that they knew, you know, this is the derivative of this

function. This is how you find the tangent line, sort of making sure that they knew

sort of all of these high-level objectives while sort of ignoring the fact that like

there's a whole person there and they need help in terms of inclusion, in terms of

feeling confident in their abilities, all that kind of stuff.

The fact that the goal of wanting students to learn the material has become a lower

priority for both Tate and Avery over time not only indicates in general that priorities

change for graduate students, but that this particular goal may be one that decreases in

importance for many graduate students as they gain experience as an instructor.

6.6 Discussion

Avery and Tate provide the first opportunity to consider *RQ3: How do the ways*

that GTAs think about and offer social support differ between first year GTAs and

experienced GTAs? Although Schoenfeld's ROG framework (2011) only applies to

goals, orientations, and decisions in specific moments, considering how GTAs' goals and

orientations change over time can deepen the understanding of how their decision making

changes over time as well. One of the most prominent themes discussed by Avery and

Tate was how their capacity for offering social support changed as the demands of

graduate school (and their ability to manage those demands) changed. Both Avery and

Tate discussed not being able to put as much time and effort into teaching during their

first year because they were overwhelmed by their own course work and the general

stress of graduate school; both went on to explain that not only have the demands of

graduate school decreased in their last few years, but their ability to balance such

demands have improved as well.

One of the most interesting differences between Avery and Tate that arose was their conflicting opinions on what putting effort into teaching looks like. Avery believes that to give students the educational experience they deserve requires time spent on lesson planning; in contrast, Tate believes that one can sacrifice the time if they are compensating by putting effort into developing strong relationships with their students. Despite being in the same department and receiving comparable training and support, Avery's and Tate's beliefs about teaching diverged into opposing values. This suggests that the values that GTAs develop over the course of their graduate school careers are not solely determined by the training they receive, but that their individual experiences can play a role in this development.

There were not any notable differences between *how* the first-year and experienced GTAs offered social support to their students. Like the first-year participants discussed in previous chapters, both Avery and Tate were observed offering a wide variety of social supports spanning all four categories. However, Avery's and Tate's *reflections* on their social supports showed much more depth than those offered by the first-year participants. In particular, during the second interview when asked to explain why they had offered a specific social support action, many of the first-year GTAs' responses truly indicated an in-the-moment decision; their responses suggested that they did not necessarily think about what they were doing as they did it and that they did not necessarily reflect on their decision afterwards. In contrast, Avery's and Tate's responses suggested that they had encountered situations like these before and made an intentional decision (still in-the-moment but based on reflection and experience). This suggests that

as GTAs progress through the first few years of teaching, GTAs engage in more reflection on their teaching practices and have more intentionality behind their decisions.

According to Schön (1983), people who engage in professional activities (such as teaching) often encounter situations that their training did not explicitly prepare them for. Schön suggested that professionals overcome these situations by engaging in a process known as *reflection-in-action* in which they analyze what they are experiencing and consider why their usual ways of operating are not appropriate in this situation. By engaging in reflection-in-action repeatedly, professionals evolve their practices over time and develop a repertoire of responses for increasingly nuanced situations. In terms of the ROG framework (Schoenfeld, 2011), Schön's reflection-in-practice (1983) suggests a feedback loop between someone's goals and orientations and the decisions they make. Figure 15 illustrates the feedback loop created by the ROG framework and reflection-in-action.

As an example of applying the reflection-in-action framework, an instructor might

Figure 15

The feedback loop created by Schoenfeld's ROG framework (2011) and Schön's reflection-in-action (1983)
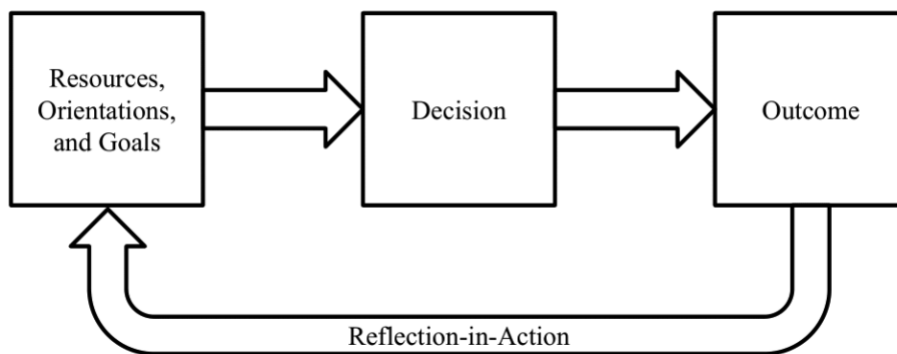
encounter a situation in which a student requires social support and the teacher's experience does not tell them how to respond. The instructor makes a decision based on their existing resources, orientations, and goals. After the decision is made and the social support is offered, the instructor reflects on the outcome of that decision (either consciously or subconsciously). This could alter the instructor's resources (their knowledge about the effectiveness of their response), goals (what they hope the outcome of their response would be), and orientations (their beliefs about the value of such a response). When a similar situation arises in the future, the instructor will be able to think back on their previous experiences and reflections to make a more informed decision the second time. Over time, this loop repeats as the instructor's reflection leads to gains in expertise, allowing them to better support their students in this type of situation.

The phenomenon of gaining expertise over time through reflection-in-action is illustrated by Avery's and Tate's ability to engage in reflection on past experiences in order to make decisions in the present. Avery and Tate have developed an arsenal of responses to situations in which they perceive students to need social support and are able to justify their responses based on the reflections in which they have already engaged. This contrasts with the first-year GTAs whose responses suggested that they were primarily being driven by instinct and were only expanding upon on their decision afterwards because they were prompted to during the research interviews. This is not to say that the first-year GTAs are incapable of engaging in reflection of their practices; the first-year participants simply lack the experience on which to engage in reflection-in-action organically.

Chapter 7: Discussion

7.1 Overview of the Study

The purpose of this dissertation is to explore how mathematics GTAs teaching

first-year undergraduate mathematics courses choose and characterize the types of

support they offer their students by exploring the GTAs' goals and orientations about

teaching. Although many facets of student-teacher relationships have been studied by

education researchers in recent years, research on social support is typically limited to

student perceptions. The goals and beliefs of graduate students have been studied

(Crooks-Monastra & Yee, 2022; Lee, 2019; Luft & Roehrig, 2007), but no research has

been found to examine GTA goals and orientations through the lens of social support. As

a result, this dissertation aims to explore the phenomenon of GTA decision making

related to social support, thus bridging the gap between two existing bodies of literature.

In order to understand the goals and orientations held by mathematics GTAs

related to social support, I conducted a qualitative phenomenological multiple case study

consisting of interviews and observations of six mathematics GTAs. The purpose of the

interviews was to explore the goals and orientations held by each GTA, both in the

context of social support and beyond. The purpose of the observations was to collect

evidence of the different ways that the GTAs offer social support to their students in

practice. The primary objective during data analysis was to develop an understanding of

how the social support actions of each participant could be explained by their goals and

orientations. What follows is a summary of the findings of this dissertation through the

lens of each research question, followed by a discussion of this study's limitations,

implications, and potential for future research.

7.2 Summary of Findings

7.2.1 GTA Goals and Orientations

The first question that guided this dissertation was *RQ1: What goals and orientations are present when GTAs offer social support to their students and how do GTAs prioritize their goals and orientations?* The purpose of this question to was to develop a basic understanding the goals and orientations held by GTAs related to social support. Although literature already exists exploring GTAs' goals and orientations in general (Crooks-Monastra & Yee, 2022; Lee, 2019; Luft & Roehrig, 2007), it does not specifically examine these ideas through the lens of social support.

The analysis of some GTAs' goals and orientations suggested that they might tend towards certain categories of social support over other categories. For example, Section 4.2 discussed how most of Blake's goals and orientations suggest that Blake values informational support; in practice, Blake *did* use informational support over the other categories of social support. Section 4.3 discussed how Riley's goals and orientations suggest that they would use emotional support the most; although Riley tended to use informational and instrumental support the most in practice, this disconnect between their goals and orientations and their actions provided insight into how they assess the value of each category of social support and how they ultimately make decisions.

Not every GTA's goals and orientations suggest that they would value a particular category of social support. In fact, Chapter 5 discussed how the goals and orientations held by Casey and Hayden show little to no correlation to any particular category of social support at all. These two cases provide an opportunity to use existing structures to make sense of the GTAs' goals and orientations. Examining Casey's and Hayden's goals

through Crooks-Monastra and Yee's categories of goals (2022) suggested that GTAs possess a wide variety of goals and that more variety can make their decisions more situation-dependent than GTAs whose goals appear more aligned. Examining Casey's and Hayden's orientations through Luft and Roehrig's categories of teacher beliefs (2007) provided more insight into how these GTAs make decisions by exploring whether their beliefs reflected teacher-focused or student-centered teaching practices (or a combination of both). Ultimately, Casey's and Hayden's cases highlight how varied and nuanced GTA decision making can be.

The results of this dissertation do not point towards one set of goals and orientations held by graduate students. Instead, they highlight a wide variety of goals, orientations, and prioritizations that are reflected in GTAs' social support actions in a variety of ways. Even GTAs who held similar goals and orientations prioritized them in different ways and therefore the actions that reflected shared goals and orientations differed as well. The next section discusses the connection between goals, orientations, and social support actions in more detail.

7.2.2 GTAs' Social Support Actions

The second question that guided this dissertation was *RQ2: How do GTAs offer social support to their students?* with sub-questions *How are a GTA's goals and orientations reflected in the social supports that they offer their students?* and *How do GTAs relate their understanding of social support with the ways that they offer social support?* The purpose of these questions was to explore the phenomenon of GTA decision making related to social support by examining ways that GTAs actually support their students in practice and how the social supports they offer relate to their goals and

orientations. The analysis of these questions was heavily influenced by Schoenfeld's

ROG framework for in-the-moment decision making (2011). Whereas RQ1 sought to

understand the goals and orientations held by GTAs when they made decisions related to

social support, RQ2 attempted to explain the decisions that GTAs ultimately made

through the lens of their orientations, goals, and subjective values.

Explaining the connection between goals, orientations, and social support actions

differed for each participant because the goals and orientations of each participant varied

so greatly. Section 4.2 explored Blake's goals, orientations, and social support actions

and found that they were all generally reflective of informational support; as a result, the

ROG framework (Schoenfeld, 2011) provided a simple explanation of the connection

between these constructs. In contrast, because there was an apparent misalignment of

Riley's goals and orientations (which suggest that they value emotional support the most)

and their actions (which mostly reflected informational and instrumental support), the

ROG framework had to be considered with more nuance. Section 4.3 explored Riley's

goals, orientations, and social support actions from the perspective of multiple categories

of social support and culminated in an explanation of their "misaligned actions" by

considering the relative, subjective value that they placed on different types of support in

different situations. Although Riley tends to place the highest value on emotional support,

the situations in which Riley offers social support tend to be better suited for

informational and instrumental support. That Riley does not often offer emotional support

in the classroom does not mean that Riley does not value this kind of support, nor does it

mean that they are making decisions that contradict their goals and beliefs; rather, this

suggests that Riley is taking the appropriateness of different categories of social support into consideration when deciding which type of support to offer their students.

The discussion of the connections between the participants' goals and orientations and their social support actions was more subtle in Chapter 5 and Chapter 6. Unlike Blake and Riley, the participants discussed in these later chapters did not have an apparent social support "type" and therefore each social support action had to be treated as an independent decision. This is not inherently negative; in fact, the ROG framework is intended to be used on independent decisions (Schoenfeld, 2011). Although Blake's and Riley's tendencies towards certain types of social support provide insight into how many GTAs provide support, the other participants offer a realistic portrayal of how situation-dependent offering social support can be. Many GTAs value one category in some situations and another category in other situations, and therefore their actions do not necessarily show trends.

7.2.3 GTAs' Change Over Time

The final research question driving this dissertation was *RQ3: How do the ways that GTAs think about and offer social support differ between first year GTAs and experienced GTAs?* Two experienced GTAs were included in this study in order to provide contrast to the four first-year participants. Because data was only collected during one semester, it is impossible to say conclusively what Avery's and Tate's goals, orientations, and social support actions were like in their first years as graduate students; however, their reflections on how these constructs have changed over time do suggest how other GTAs might change as well.

Both Avery and Tate discussed how their goals, orientations, and actions have changed over time. Avery discussed an increase in confidence in their teaching abilities as well as an increase in their capacity to know and support their students. Both Avery and Tate discussed how the demands of graduate school shifted over time and how that impacted their teaching and ability to provide social support. In particular, they both found their later years in the program to be less demanding (due to lighter class loads and independence in scholarly activity) and therefore had more time and energy to devote to their students and to engage in reflection-in-action (as discussed in Section 6.6). Although this is not going to be true for all GTAs (since the demands of each year vary between programs), it does suggest a relationship between perceived level of demand and the amount and/or quality of social support that GTAs can offer.

The primary difference between the findings for the first-year participants and the findings for the experienced GTAs in this study is the experienced GTAs' ability to consciously base their decisions on reflections of past experiences. As discussed in Section 6.6, the first-year participants described making decisions related to social support based largely on intuition; although they were able to justify their rationale for offering social support the ways that they did, they often described being driven by a particular type of support "feeling right" or basing their decision on their own experiences as students. In contrast, Avery and Tate frequently referenced past experiences as a GTA in which they had faced similar situations. This suggests that experienced GTAs are able to engage in Schön's reflection-in action (1983) by reflecting on past experiences to evolve their teaching practices and decision making in the future. As the first-year participants in this study gain more experiences, they will likely engage

in reflection-in-action and be able to reflect on their experiences in order to make more informed decisions related to social support.

7.3 Limitations

7.3.1 Limitations due to Study Design

An inherent limitation of this study is its lack of generalizability. Because case studies typically focus on a small number of cases, it is difficult to extrapolate results to a larger population, especially if the cases are bounded by very specific qualifications (Campbell, 2015; Njie & Asimiran, 2014). In addition to the implicit limitations of a case study design with only six participants, the selection of the participants themselves inhibits the generalizability. The GTAs in this study were all members of the same department and therefore received similar professional development, pedagogical training, and teaching-related experiences. Because such experiences impact goals and orientations (and therefore decisions), the goals, orientations, and social support actions held by these participants may be very different than those held by mathematics instructors at different stages of their careers or at different institutions. Although it can be speculated that similar patterns may arise with other novice mathematics instructors, the results of this study cannot be generalized with any degree of certainty. However, the purpose of this study was not generalizability; the purpose was to explore the phenomenon of GTAs' decision making through the lens of social support and to develop rich descriptions of their lived experiences. Although such rich description is not generalizable, it can inform the work of other researchers and practitioners who can apply the findings of this dissertation to similar work.

The logistics of the study also gave rise to certain limitations. For example, the amount of data collected was limited to two interviews and two weeks of observations. Had more data been collected, it is possible that different conclusions could have been drawn about the participants in this study. Moreover, there was a certain level of convenience in the dates of the observations that may have impacted the results as the social support actions offered by a GTA will vary day to day. For example, observing a GTA on a day when students are very confused and asking for a lot of support could illuminate different social support actions than a day where students seem to grasp the lesson and are not in need of as much social support. Although the week of informal observation prior to the formal observation helped me determine what a "normal" day looked like for each participant, it is impossible to know how observing on different days might have impacted the data. Despite the limitations that the logistics of this study gave rise to, the study was designed in such a way to capture the general experience of the six participants within the constraints of the researcher's and participants' schedules. The amount of data that was collected was appropriate based on the scope and purpose of the present study, and modifications could be made if needed (see Section 7.5 for a discussion of potential future research that can be conducted by adapting the design of this study in different ways).

It is also important to consider the possible effects of including GTAs from both Calculus I and Calculus II recitations. In addition to meaning that the GTAs from the two courses were teaching different lessons, there are notable differences between the structures of the two courses that may have impacted this study. For example, at the time of data collection, Calculus II was exclusively using web-based assessment structures

whereas Calculus I used a blend of web-based assessment and traditional paper exams. As a result, there seemed to be a stronger emphasis placed on how students' work was written in Calculus I than in Calculus II. Although there was not a noticeable difference between the ways that Calculus I and Calculus II instructors were offering social support, the difference in course structure suggests that GTAs might have different priorities depending on which course they were teaching (and consequently, their decision making might have been influenced). Despite this limitation, I decided to include GTAs from both courses in order to achieve the desired sample size for this study.

The effect of day-to-day variation in social support also impacted my ability to accurately compare the participants. Although the observations for all six participants took place within a few weeks of each other, they were staggered enough that very few observations occurred during the same lessons for the different participants. Some topics are naturally harder for teachers and students than others, and therefore the difficulty of the lesson that was observed could have impacted the degree to which students needed and received social support. For instance, if I happened to observe one participant during easier lessons than a second participant, it might come across that the first participant did not offer as much social support as the other, simply because their students did not require as much on the days they were observed. Although the data may have been more consistent if each participant was observed teaching the same lessons, the observations were staggered for two reasons. First, many of the participants taught at the same time as each other and therefore requiring that the observations were all during the same lessons would have decreased the number of participants in the study. Secondly, allowing for

different lessons to be observed allowed me to spread the observations out over the course of a semester, decreasing my own burnout as an observer.

The inclusion of experienced GTAs introduced a few limitations. Firstly, this study did not capture longitudinal change. The purpose of the final research question was to explore how the goals, orientations, and social support actions differed between first-year GTAs and experienced GTAs. Although an attempt was made to compare the first-year participants of this study to the experienced participants, Chapter 6 also explored how Avery and Tate had each compared to their first-year selves. Because there was no primary observational or interview data from Avery's and Tate's first years, the discussion of how they changed over time was based on their reflections during interviews. Avery and Tate could have unintentionally misreported the goals, orientations, and social support actions from their first years as a result of recall bias. Although I decided to treat their recollections as factual for the sake of this dissertation, it is worth noting that subsequent experiences can alter how people view their past selves. This limitation was a reasonable sacrifice to make for this study: although longitudinal change certainly could be studied (as discussed in Section 7.5), it was not possible to collect five to seven years of data for this dissertation. The comparative aspect of the final research question could have been excluded to make longitudinality a nonfactor, but including data that is potentially subject to recall bias was more valuable than not including the comparative element of this study at all.

Another limitation of including experienced GTAs teaching calculus recitations is that the pool from which these GTAs could be selected was extremely limited. Very few experienced GTAs teach calculus recitations, and those who do often have specific

reasons for requesting to teach these courses (ranging from a perception of reduced workload to a desire to gain additional experience in Calculus courses). As a result, it is unclear whether Avery and Tate are representative of a typical GTA in their fourth year and beyond. This could have been remedied by including experienced GTAs regardless of the course they were teaching, but that would have decreased my ability to compare the experienced GTAs to the first-year GTAs (who were exclusively teaching calculus recitations).

7.3.2 Limitations due to Theoretical Background

In addition to limitations as a result of the study design, the theory around which this study was designed leads to limitations. First, the definitions of social support and the categories of social support are subjectively open to interpretation. House (1981) intentionally left the definition of social support open to interpretation; Feeney and Collins (2015) encourage defining social support and its categories broadly so that the definitions can be interpreted within whatever context they are being used in. For this study, I opted to use broad definitions to allow each participant to understand social support and its categories in ways that made sense to them so that they would not be limited by rigid, pedantic definitions. However, this led to participants interpreting these definitions in slightly different ways. Some participants seemed to have a much more limited interpretation of social support than others. Similarly, the categories themselves seemed to be interpreted differently by different participants which impacted the ways that they categorized their own social supports. Although the ways that GTAs categorized their support actions was not a primary focus of this study, it is worth noting that variation between participants' interpretations likely arose. When appropriate during data

analysis, I attempted to calibrate results by focusing more on the participants'

explanations for categorizations than the categories themselves (e.g., if a participant

categorized a support as informational support but their explanation suggested that they

meant instrumental support, I interpreted their categorization as instrumental support).

When the distinction between two categories of social support was less important, I chose

to not distinguish between them at all (such as in Section 4.3 where informational and

instrumental support were considered together).

Since the ROG framework (Schoenfeld, 2011) played a central role in this study,

it is important to consider its limitations as well. Schoenfeld himself discussed several

limitations of the ROG framework: for example, every element of the ROG framework is

subjective and difficult to capture. Although someone can describe their goals and

beliefs, it is often challenging to accurately put goals and beliefs into words. This

limitation is amplified when a researcher is analyzing someone else's goals, orientations,

and decisions, because there is an extra level of interpretation between the decision

maker's goals and orientations and the way that those goals and orientations are reported

and understood by the researcher. It is impossible to capture *every* goal and orientation

that relates to a particular decision, and although this study attempted to focus on the

most relevant goals and orientations to the decisions that were discussed, it is very

possible that important, influential goals and orientations were missed (because I, as the

researcher, simply did not notice or consider them within the data or because the

participant themselves were not aware of those goals/orientations and did not discuss

them during the interviews). However, knowing that some goals and orientations were

certainly missed during data collection does not affect the findings about the goals and orientations that *were* included in the data.

The computation of subjective valuations (such as those in Section 4.3.4) comes with important limitations as well. In particular, these computations require the researcher to assign a numeric value to something that is extremely subjective. In his work, Schoenfeld (2011) decided to assign outcomes for different decisions a value ranging from one (extremely bad) to 10 (extremely good), but the delineations between numbers are unclear (especially if one allows for continuous values). Assigning numeric values to outcomes is made even more difficult if someone else is doing it on the decision maker's behalf. In this study, I did not attempt to assign numeric values to outcomes to compute any participant's subjective values, but I did speculate the relative magnitude of these values in order to explain the decisions that the participants make. The subjective nature of these computations makes it impossible to determine how accurate any analysis based on these estimated computations might be. However, the computations do not need to be completely accurate in order to draw meaningful conclusions from them: for example, the computation described in Figure 9 provides an overview of Riley's decision making despite lacking concrete numbers and is reflective of Riley's goals and orientations without having been determined by Riley themselves.

Finally, Schoenfeld (2011) acknowledged that because the ROG framework is only used to explain actions (as opposed to predicting them), it is easy to make data work in the researcher's favor. For example, Section 4.3 discussed how I initially believed that Riley would offer emotional support more than any other category of social support based on their goals and orientations; however, after it became clear during observations

that Riley offered informational and instrumental support most frequently, I was able to find evidence that Riley actually does place a very high value on these other kinds of support. Using this retroactive perspective on Riley's goals and orientations, I was able to make sense of Riley's decisions within the ROG framework. This raises the question of whether I would have noticed Riley's goals and orientations related to informational and instrumental support had they not been necessary in explaining Riley's actions. Although there is certainly evidence of these goals and orientations, this example does highlight that the ROG framework can be molded to fit the needs of the researcher. To mitigate potential bias that my interpretations may have introduced, I engaged in frequent peer debriefing with my advisors to discuss the assertions I was making about the participants (see Section 3.7 for more information about peer debriefing).

7.4 Implications

It is evident from the literature that the support that students receive can have a meaningful impact on their educational experience and that different kinds of support impact different students in different ways. There is also a great deal of research exploring the different goals and orientations held by novice mathematics instructors and how these varying goals and orientations impact their decision making. However, there is little research bridging the gap between novice instructors' goals and orientations and the decisions they make related to social support in the classroom. This study not only confirms that mathematics GTAs hold a wide variety of goals and orientations, but also highlights ways that these goals and orientations influence the ways that they offer social support to their students.

The findings of this study suggest an explicit link between GTAs' personal goals and orientations and the decisions they make in the classroom that directly impact student experiences in undergraduate mathematics courses. Pragmatically, this raises concerns of whether certain goals and orientations held by graduate students could lead to "bad" social support that a mathematics department does not agree with (for example, some departments might discourage too much emotional support in order to maintain boundaries between students and their instructors). It also raises concerns of inequities if students enrolled in multi-section courses taught by different GTAs are receiving different kinds of social support in ways that significantly impact their experiences in the class. It is not surprising that different GTAs have different goals and orientations; although varied personalities can be valuable within a teaching force, it is important that mathematics departments are aware of the influences that might be impacting students enrolled in their courses.

On a more individual level, this study suggests the importance of personal reflection on one's goals, orientations, and social support actions. Because most decisions to offer social support are made subconsciously and, in the moment, many instructors do not actively reflect on why they make the decisions they do. Further, many instructors do not actively acknowledge the goals and orientations that impact these decisions or even recognize the impact that their goals and orientations have on their decisions at all (Schoenfeld, 2011). Reflecting on one's goals, orientations, and actions can help to identify biases that impact instructional decision making and lead instructors to make more intentional decisions (Stenberg & Maaranen, 2022).

The following sections discuss the implications of this study for particular interested parties. First, Section 7.4.1 discusses the implications for department administrators, particularly those involved with instructor professional development. Next, Section 7.4.2 discusses the implications this study has for my personal teaching as a GTA who will soon be entering a teaching-focused career. Finally, Section 7.4.3 discusses implications for GTAs in general.

7.4.1 Implications for Professional Developers

Although most decisions to offer social support are made subconsciously in the moment, research suggests that goals and orientations can be modified over time through professional development, especially for novice educators (Calleja, 2021; Lee et al., 2020; Thurm & Barzel, 2020). Combined with the results of this study, this suggests that it might be possible to cultivate goals and orientations within a mathematics department that are in service of the department's mission (or at least that it might be possible to minimize goals and orientations that are in contention with the department's mission). Departments may want to explicitly consider and discuss the goals and orientations held by their instructors and shape professional development efforts to encourage alignment between instructors' personal goals and orientations and the departments' priorities and values.

For example, a department might discourage the use of certain types of emotional support in order to maintain boundaries between students and instructors. Such a department might consider educating its instructors on the risks associated with emotional support with the intention of cultivating beliefs that will minimize the use of what the department believes are inappropriate emotional supports. Another department

might prioritize hands-off instruction, valuing students persevering through challenges with little to no direct intervention by the instructors. As a result, this department may prefer its instructors lean towards informational support over instrumental support since these categories primarily differ in the extent to which the giver of support is involved in the solving of a problem. This department might consider educating its instructors on the value of hands-off teaching approaches and student-guided perseverance in order to instill the belief that informational support is of higher value than instrumental support.

The findings discussed in Chapter 6 suggest that GTAs' goals, beliefs, and social support actions can undergo great change by even the fourth year of graduate school. Avery and Tate, the experienced GTAs in this study, largely attributed the changes they experienced in their goals, beliefs, and social support actions to gaining experience and engaging in reflection about their past decisions. Such reflection occurs naturally as one gain's more experience (Schön, 1983), but integrating reflection into professional development has the potential to expedite the process. I had personally never given much thought to the goals and beliefs that I hold about teaching or the ways that I offer social support to my students prior to conducting this study. In fact, I had never heard the term "social support" before and had never thought about the interactions I have with my students through this lens. This suggests a gap in the professional development that I received; although I do not think that this gap was detrimental to my development as a GTA, I have seen changes in my teaching since conducting this research (which is discussed in detail in Section 7.4.2). Departments should consider whether this gap is worth filling in service of their own priorities and values as a department.

More research needs to be done exploring the relationship between GTAs' goals and orientations and their social support actions in order to determine what professional development activities are beneficial. However, activities intended to engage GTAs in reflection may be a great place to start. For example, explicitly giving GTAs opportunities to reflect on their personal goals and beliefs has the potential to make GTAs aware of the influences on their teaching that they had not considered before. Educating GTAs on how their goals and orientations impact their decision making (Schoenfeld, 2011) can make GTAs more cognizant of the decisions they make and why they make them; the connection between goals, orientations, and decisions is something that many GTAs have likely not considered, and being aware of the literature on this subject can help them be more intentional with the decisions that they make. Finally, introducing GTAs to the definition of social support and House's framework for categorizing social support (1981) can inspire GTAs to reflect on how they offer social support to their students. During the present study, one participant stated that they found House's framework helpful in thinking about the different ways they offered social support and how students might perceive such support. Introducing GTAs to this framework has the potential to make them more reflective on their social support actions and in turn make them more intentional with the types of social support they choose to utilize.

Even if a department is unable to provide any of the aforementioned professional development, it is important that departments are aware of the various goals and beliefs that GTAs might be entering a program with. As discussed throughout this dissertation, GTAs possess a wide variety of goals and orientations that impacted their decisions, and such decisions had a direct impact on the students' experiences. In Chapter 5, examining

GTAs' goals and orientations through the lenses of existing frameworks suggested not only that GTAs hold varied goals and orientations, but that the goals and orientations span every category. Individually, some GTAs' goals and orientations clustered into a few categories whereas others spanned entire spectra. From an administrative standpoint, it is important to be aware that the GTAs that make up a department's teaching force hold diverse goals and beliefs and therefore will be making diverse decisions.

7.4.2 Implications for Personal Teaching

Throughout the course of this study, I have reflected on my positioning as both a mathematics education researcher and a mathematics educator. The design of this study encouraged participants to reflect on their goals and orientations in ways that they might not have before and to find connections between these goals and orientations and the social support actions that they employ in the classroom. As I collected, analyzed, and reported on the data, I could not help but consider my own goals, orientations, and social support actions and how these constructs impact my teaching on a day-to-day basis. For example, I realized that I tend to offer appraisal support to my students more than I had expected. I believe that this is a reflection of my goal to improve students' mindsets. I place a high value on students believing in themselves, and I believe from my experience that being told that they are doing a great job is a good way to accomplish this. Although awareness of the connection between my goal and my actions does not necessarily change my day-to-day teaching practices, it is satisfying to be able to explain my actions and to justify why I choose to offer support in this way.

In general, considering how different people value different kinds of social support has better equipped me to interact with my students because I have become more

aware that they might value different kinds of social support than I do. I often find myself getting frustrated when students seem to just want me to give them the answer to a problem they are asking questions about; I sometimes find myself writing this off as them being lazy or not caring about their learning. However, reframing these thoughts in terms of this study has helped me see that they might be valuing instrumental support (me directly helping them with the problem they are working on) over informational support (me indirectly helping them by providing broader information to them in the form of hints or scaffolding). Although this realization does not necessarily change what I do, I like to think that I have become more understanding of the things my students do and the decisions they make because I recognize that their actions are a function of their goals and beliefs and are therefore not inherently negative.

7.4.3 Implications for GTAs

As discussed in the previous section, conducting this research has given me opportunities to reflect on my own goals, orientations, and social support actions. Whether or not such reflection has impacted my teaching in tangible ways, it has undoubtedly helped me view my teaching through a new lens and I believe that I am better equipped to make intentional decisions regarding social support as a result. Although a typical GTA is unlikely to engage with the topics discussed in this dissertation in as much depth, any GTA can use the principles discussed in this dissertation as a starting point for important reflection and growth.

Schoenfeld's ROG model (2011) might be interpreted as implying that one lacks autonomy over their decisions: one possesses certain resources, orientations, and goals, and those determine the decisions that are made. However, resources, orientations, and

goals are ever-changing and fluid. As discussed in the previous section, by reflecting on the ways that my decisions reflect the goals and orientations that I hold (that I was perhaps not even aware of), I have been able to reframe my perception of my students and how my decisions impact them. This is itself a modification to the body of resources, orientations, and goals that I possess.

Reflection is an important part of improving one's teaching, especially at the beginning of one's career. Any GTA—whether they are at the beginning of their program or the end of their program—can engage in reflection on the decisions they make and the goals and orientations that inform such decisions. Although the connections between goals, orientations, and social support actions varied between each participant in the present study, connections between goals and orientations and the decisions that were made undoubtedly exist, suggesting that such connections can be found for any GTA.

7.5 Future Research

This study was intended to begin to build a bridge between two existing bodies of literature—instructor decision making and classroom social support—by exploring and describing the relationships between mathematics GTAs' goals, orientations, and social support actions. The exploratory nature of this study gives rise to several possibilities to be expanded upon in future research. In particular, the present study can be adapted to increase its focus, widen its breadth, or expand its depth, any of which would provide more insight on the phenomenon of interest.

Because this study was exploratory in nature, it was difficult to predict exactly what the data would look like. As a result, the data for each participant was slightly different and took the discussion in different directions. In particular, Chapter 4 discusses

GTAs whose goals and orientations generally supported their use of a few type of social support, whereas Chapter 5 discusses GTAs whose goals and orientations were widespread and whose actions were varied and situation-dependent. Knowing that such different types of GTAs exist and having an idea of what social support looks like for each group provides an opportunity to further explore the difference between these two types of GTAs. A possibility for future research would be to explore the extent to which GTAs fit into these two categories and to directly compare the goals, orientations, and social supports offered by them.

The breadth of this study can be expanded upon by including more participants. Because this was an exploratory case study, it was appropriate to have only six participants in order to explore each participant in depth. However, this study provides a baseline for what the data would look like if this study were to be replicated, and therefore a similar research project could be implemented with more participants. Having more participants would make the results more applicable to mathematics educators on a broad level.

The depth of this study can be expanded by decreasing the number of participants and/or increasing the amount of data collected for each participant. The amount of data that was collected for each participant certainly provided an overview of their most prominent goals, orientations, and social support actions, but more interviews and longer periods of observations would have painted a more complete picture. This would be especially helpful in understanding how these constructs change over time: although this study did allow for the experienced GTAs to reflect on how they have changed over time,

a longer study could include data from a GTA in their first year and from that same GTA as they complete their program years later.

Finally, there are several directions this research could go in terms of utility. This study aimed to develop an understanding of GTAs' decision making related to social support but did not explore how such an understanding could be used. As discussed in Section 7.4.1, the findings of this study can have implications for graduate student professional development. Future research could include looking at how GTAs' goals and orientations related to social support are impacted by professional development or looking at the impact of social support training on GTA teaching practices.

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Appendix A: Sampling Survey

Thank you for your interest in participating in this study. This survey is meant to determine your eligibility for the study; the answers you provide will not be used in the study itself. Your responses will be kept completely confidential and will be destroyed after sampling is completed, regardless of whether you participate in the study. Each question on this survey is optional, but please be aware that failing to answer a question could make you ineligible for the study.

1. What is your name?

2. What course do you teach?

3. What days and times do you teach? If you teach multiple sections, please list all of them.

4. Please describe any prior teaching experiences you've had.

5. What is your research area? If you have not declared a research area, please state so but also feel free to list any areas that you are considering at this time.

6. Are you willing to have someone observe your class?

7. Are you willing to have someone audio record your class?

8. What are your top three goals as a Graduate Teaching Assistant?

Appendix B: Initial Interview Protocol

Introductory script: Thank you for taking the time to meet with me today. This interview is meant to explore your goals as an instructor and to capture your thoughts on how you provide social support to your students. This interview should take about 45-60 minutes. Anything you say in this interview will be kept confidential, and no names will be used in any research reports. Your participation in this interview and this study is voluntary, so you can answer each question to whatever extent you feel comfortable without any negative impacts for you.

I will record this interview so that I can capture your responses verbatim. Is that okay? [Begin recording.] Before we begin, do you have any questions about the study, your participation, or anything else?

0. I want to start by asking you a few background questions.

    a. First, can you tell me about any teaching experiences you had prior to coming to UNL, if you had any?

    b. How do you feel about teaching?

    c. Is teaching something you plan to do beyond graduate school?

    d. How would you describe your teaching style?

1. I want to start by talking about some of your goals as an instructor.

    a. What are some of your goals as a GTA? As you list these, can you please explain why each of them are important to you? [As GTA answers, write these on notecards to be used in Q4]

      b. [Prompt if needed] What are some other goals you have?

2. What are some things that you know are goals or priorities for other GTAs that you don't necessarily consider to be a goal for yourself?

3. I've been keeping track of the goals you identified. [Give them the notecards] You've identified these as things that are goals or are not goals for yourself as a GTA.

      a. [If I had to paraphrase any of them] I've tried to capture the essence of the goals (and non-goals) you described. Would you like to modify the way I've phrased any of these?

      b. Next, I'm going to have you to place these in order from your highest priority to lowest priority. As you're doing so, I'd like you to say a little bit about how you're deciding the order they're going in.

      c. [Experienced GTAs only] How would you have ordered these during your first year as a GTA?

4. Now I want to shift gears to talk about social support. By "social support", I'm referring to any action that someone does to try to alleviate a negative feeling that someone else might be experiencing, such as stress, fear, or anxiety. What do you think of when you hear "social support"? Do you have any questions about this definition? [Let the participant discuss and define their understanding of social support; it does not have to perfectly match the definition used in this study, but if it is significantly different, work to align their definition with that of the study. This is an opportunity for them to ask questions about the definition of social support.]

5. As a GTA, what goals do you have for offering social support to your students? [They might repeat some goals they listed in Q2, or they might bring up some new goals]

    a. [If they list goals that were not mentioned in Q2] Where do these goals fall in the ranking you made in Q4?

6. What is one way that you provide social support to your students?

    a. Why do/did you offer support in this way?

    b. How do you think your students perceive this support?

    c. To what extent do you think this response aligns with the goals you've listed today and the way that you've ranked them?

    d. [Experienced GTAs only] How would your responses to these questions have differed during your first year as a GTA, if at all? Why?

7. [Repeat Q6 and its sub-questions until at least 3-5 examples are provided. Depending on the number/breadth of examples that the participant brings up on their own, refer to some or all the following prompts.]

    a. [Prompt] How do you provide support to students who are struggling with the material in class?

    b. [Prompt] How do you provide support to students who are struggling with the material outside of class?

    c. [Prompt] How do you provide support to students who appear to struggle socially in class?

    d. [Based on these prompts, more examples might arise]

8. [Experienced GTAs only] Thinking over all the things we've talked about today, are there any areas that you think you've changed as a result of your experiences since your first year?

9. Do you have any other thoughts about your goals and priorities, either in general or in the context of social support in the classroom?

Appendix C: Formal Observation Protocol

This is a condensed version of the observation protocol; the protocol was filled out

electronically in real time so that more space could be added as needed.

Participant: Date: Map of classroom:

Goals[9]	Orientations[10]

Time	Support[11]	Important Information[12]	Potential Categorization(s)[13]	Potential Goal/Orientation[14]

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[9] This space is to list any goals that the GTA discussed during their initial interview as well as goals that I believe they have based on the informal observation period. If I observe evidence of a new goal, I will add it here.

[10] This space is to list any orientations that I believe the GTA has based on the initial interview and the informal observation period. If I observe evidence of a new orientation, I will add it here.

[11] This column is for me to give a brief description of the social support action that I observed.

[12] This column is for me to list extra contextual information about the social support action, such as a description of the conversation that preceded the action.

[13] This column is for me to capture my initial impression of what category each example of social support might fit into.

[14] This is a place for me to capture my first instinct of any goals and/or orientations that this example of social support might reflect.

Appendix D: Categories of Social Support Handout

Emotional support	Instrumental support

• Someone is in a difficult situation and you try to help with the emotions they're experiencing
• Includes things like providing empathy, caring, love, and trust
• Examples:
    o Going with someone to a stressful doctor's appointment so that they don't feel alone.
    o Letting a friend vent so that they feel heard.
	• Someone is in a difficult situation and you try to help fix the situation itself
	• Examples:
	    o Helping someone pay their bills
	    o Talking through a problem with someone to help them come up with a solution

Informational support	**Appraisal support**

• Providing someone with information that is not inherently helpful but can be helpful if they use it
• Example: Telling someone with back pain about your chiropractor
	• Giving someone information to be used in self-evaluation
	• Examples:
	    o A boss tells their employee that they're doing a great job
	    o A boss tells their employee how the average employee is doing

Appendix E: Follow-Up Interview Protocol

Introductory script: Thank you for taking the time to meet with me today. This interview is meant to explore the social supports that I saw you offer your students during the classroom observation and to consider how you perceive these supports. This interview should take about 45-60 minutes. Anything you say in this interview will be kept confidential, and no names will be used in any research reports. Your participation in this interview and this study is voluntary, so you can answer each question to whatever extent you feel comfortable without any negative impacts for you.

I will record this interview so that I can capture your responses verbatim. Is that okay? [Begin recording.] Before we begin, do you have any questions about the study, your participation, or anything else?

0. Before we get to the "real" interview questions, I want to start by asking you how you thought the last two weeks have gone?

    a. Do you think they were representative of what "normal" is like for your class?

    b. What do you think has gone well?

    c. What do you think could have gone better?

    d. Do you have any other comments about how the last two weeks have gone?

1. I want to start by reminding you of the definition of social support that we talked about in your first interview. We defined "social support" to be to any action that

someone does to try to alleviate a negative feeling that someone else might be experiencing, such as stress, fear, or anxiety. Some examples that you provided were [*list 2-3 examples of social support described by this participant during the initial interview*].

Do you have any questions about this definition, or any thoughts about social support that have come up since we last spoke?

In this interview, I want to talk about specific examples of social support that I saw you use when I observed your class. I'm going to ask you the same set of questions for each example, and we'll go through as many examples as we have time for. You might not remember doing all of these things, and that's okay. You might not remember why you did what you did, and that's also okay. It's okay to answer these questions hypothetically, or however makes sense to you. If needed, I can play back the audio recording for these situations.

Examples: *This space will be used to list 5-10 examples of social support that were observed during the formal observations.*

2. [Go through the following questions for as many examples as there is time for in the first ~30 minutes of the interview]

    a. [Describe the example]

    b. Why did you say/do this?

    c. What negative feeling were you trying to alleviate for you student(s)? [If they don't remember, remind them that it's okay to speculate]

      d.   How do you think this action alleviates this negative feeling?

      e.   Do you think it's effective?

Now that we've talked about your perception of these supports, I want to add a little structure to it. A psychologist named James House created a framework for social support and claims that all social supports can be sorted across four categories. I'm going to start by giving you the definitions of the four categories, give you some examples that are not related to the classroom, and then give you a chance to ask questions about the framework. After we have a good understanding of the categories, I'm going to have you categorize all of the examples we've talked about so far.

[Give participant the Categories of Social Support Handout]

The first type of support is *emotional support*. If someone is in a difficult situation and you try to help with the emotions they're experiencing, it is emotional support. This includes things like providing empathy, caring, love, and trust. Examples of emotional support might include going with someone to a stressful doctor's appointment so that they don't feel alone or letting a friend vent so that they feel heard.

The second type is *instrumental support*. If someone is going through a difficult situation and you try to help fix the situation, it's instrumental support. Examples include helping a friend pay their bills or talking about their problems to come up with a solution.

The third kind of support is *informational support*. This support involves providing information that is not in itself helpful but could be used by the person you're giving it to in order to improve their situation. Some examples include telling someone with back pain about your chiropractor. This doesn't fix the problem, but if they choose to use this information, it could be.

The fourth category of support is *appraisal support*, which involves giving someone information that can be used for self-evaluation. For example, a supervisor might tell someone they oversee that they're doing a great job, or they might tell them how the average employee is doing so that the employee can determine their relative performance for themself.

One thing I'd like to stress is that these are not disjoint. In fact, many examples of support fall into more than one category. What questions or comments do you have about these categories?

3. Now I want to go back through each of the examples we've discussed and give you a chance to categorize them.
    a. [Remind them of the example]
    b. How would you categorize this?
    c. Why?
4. Now that we've talked about the specific examples of social support that I saw you provide, I want to open it back up to you as a teacher on a broader level.

    a. In terms of the categories of social support, which category do you think you provide the most of?

    b. Which category do you provide the least of? Why?

5. [Experienced GTAs only] How do you think the ways that you provide social support to your students has changed since you were in your first year?

6. That was my last formal question. Do you have any other thoughts that you'd like to share about social support that you don't think have been captured by the questions I've asked today?