DIFFERENCES BETWEEN TEACHERS' AND STUDENTS' PERCEPTIONS OF TEACHERS' NEED-SUPPORTIVE PRACTICES

by

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Dedicated to my family whom I love the most

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ABSTRACT

There is little research that examines differences in perceptions of need-supportive practices between teachers and students. In the current study, three research purposes were (1) to examine variabilities of teacher and student absolute or relative rating gaps in need-supportive practices, (2) to investigate the relations between absolute or relative rating gaps of teacher and student perceived need-supportive practices and student outcomes, and (3) moderating effects on the relations between teacher-student perceptions gaps of need-supportive practices and student outcomes. Participants were 581 5th and 6th students and their 29 teachers in Seoul, South Korea. Students completed questionnaires about teacher need-supportive practices, motivation, basic psychological needs (perceived autonomy, competence, and relatedness), and autonomous motivation. Teachers also answered questionnaires about their own need-supportive practices and autonomous motivation. One-way ANOVA and Tukey post-hoc tests were used to examine the variabilities of teacher and student rating gaps of need-supportive practices. Also, hierarchical linear modeling was employed to test the hypothesized models. Student sex and their beginning-of-year achievement were controlled for throughout the analyses.

The results showed that absolute rating gap for structure was significantly smaller than the absolute rating gaps for both autonomy support and involvement. Also, the relative rating gap for autonomy support was significantly smaller than the relative rating gap for both structure and involvement, but the relative rating gap of involvement was significantly larger than the relative rating gaps for autonomy support and structure. Regarding relations between rating gaps and student outcomes, a smaller teacher-student absolute rating gap for involvement was related to greater student autonomous motivation, and perceived competence and relatedness. Additionally, students with overestimating teachers tended to report lower student autonomous motivation, and low need satisfaction than students with underestimating teachers. Teacher autonomous motivation and teacher experience functioned as moderators.

The findings revealed the importance of reducing perception gaps between teachers and students about need-supportive practices. In particular, the findings showed the significance of perception gaps about involvement for student outcomes. In addition, the current study indicates the importance of examining both absolute and relative rating gaps between teachers and students.

CHAPTER 1. INTRODUCTION

Students' academic motivation is critical for students' achievement and well-being in school. High quality classroom environments promote and support students' academic motivation (Patrick et al., 2016). Teachers can help create such classroom learning environments, via regular academic and non-academic interactions with their students to increase student motivation (e.g., Abós et al. 2018; Jang et al., 2012; Reeve, 2002).

Self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017), a prominent theory of motivation, views motivation as ideal when individuals feel autonomous and self-directed. In general, autonomous motivation occurs when individuals' basic psychological needs of autonomy, competence, and relatedness are met. There is a large body of research that supports the theoretical premises of SDT (Ryan & Deci, 2017, 2020). In educational contexts, teachers' instruction is considered to be optimal when it facilitates students' autonomous motivation, which occurs when it meets students' basic psychological needs. There are three types of teacher practices that meet students' basic needs: autonomy support (to promote autonomy), structure (to support competence), and involvement (to support relatedness). Because of the significant role of teacher need-supportive practices in meeting students' basic needs, promoting autonomous motivation, and, in turn, facilitating achievement, teachers' need-supportive practices have been a major focus in SDT research (Ryan & Deci, 2000, 2017, 2020).

There are a great many studies that investigate teachers' need-supportive practices (e.g., Reeve, 2002; Ryan & Deci, 2020; Stroet et al., 2013). However, in most of the studies researchers measured teacher practices by asking either students or teachers, but not both. This is problematic because there is considerable evidence beyond SDT-based studies that teachers and students typically perceive teachers' practices differently (e.g., Desimone et al., 2010; Wagner et al., 2016); researchers found the same in the few SDT-based studies that address this issue (e.g., Domen et al., 2020; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015). It is important, however, that more research is conducted about the discrepancies or gaps between teachers' and students' perceptions of need-supportive practices (which are based conceptually in SDT). Both teachers' and students' perceptions influence classroom processes and the quality of student engagement, and achievement. Specifically, teachers' perceptions of what they do in the classroom influence how they teach and how they interact with students (Aelterman et al., 2014),

whereas students' perceptions of their teacher's practices affect students' perceptions of themselves, their motivation, and their achievement (Jang et al., 2009, 2012; Kurdi et al., 2018; Stroet et al., 2013; Taylor & Ntoumanis, 2007).

For classrooms to function successfully, both teachers and students need to perceive the teacher's practices positively and similarly. However, if teachers consider they are highly autonomy supportive, provide optimal structure, and are very involved with their students, but their students do not share these positive perceptions, then teachers might not be promoting students' motivation and need satisfaction even though teachers believe they are. In this situation, teachers may be unlikely to change their behaviors, given that they view their actions positively, and they may blame students for low student motivation or achievement. Conversely, students may perceive their teacher's practices as highly need-supportive, but the teacher may view them less positively. Teacher dissatisfaction with their teaching is a significant precursor of negative affect, disengagement, and burnout (Skaalvik & Skaalvik, 2010, 2017), which are damaging for both themselves and their students. Significant differences between teachers' and students' perceptions may also complicate the synthesis and application of research results.

As I noted previously, there are only a few studies where researchers investigated the agreement between teachers' and their students' perceptions of need-supportive practices (Domen et al., 2020; Kunter & Baumert, 2006; Skinner & Belmont, 1993; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015). Together, these studies show that teacher-student agreement is moderate, at best, and imply that more research is needed to understand the differences in perceptions. Important issues that need investigating include: (1) whether teachers and students have smaller gaps in their perceptions for some types of need-supportive practices than others, (2) if the perception gap for need-supportive practices is related to student motivation and achievement, and (3) if teacher or student factors moderate the perception gaps. The current study focuses on these questions.

Other factors relevant to the current study involve methodological issues. These include the operationalization of (1) need-supportive practices, and (2) the gap between teacher-student perceptions. I also address these issues in the current study.

Across the few studies of teacher-student agreement of need-supportive practices there is little consistency in how need-supportive practices were considered. Specifically, both Skinner and Belmont (1993) and Taylor and Ntoumanis (2007) examined the three types of need-

supportive practices (i.e., autonomy support, structure, and involvement) separately. By contrast, Van den Berghe et al., (2015) combined the three types of need-supportive practices into one measure, and Kunter and Baumert (2006) considered only autonomy-support. It is arguably most useful to consider discrepancies between teachers' and students' perceptions of teacher practice separately by type, rather than combined, because teacher-student perceptions may vary more for some practices than others. Therefore, I consider teacher and student agreement about autonomy support, structure, and involvement practices separately in the current study.

Another important consideration for studies of differences between teacher and student perceptions is whether the gap is conceptualized and operationalized as an absolute or a relative difference. The *absolute rating gap* is the overall magnitude of the teacher-student discrepancy, regardless of who made the higher rating, whereas the *relative rating gap* indicates both the magnitude and the direction of the discrepancy. In calculating the relative gap, the student rating is typically subtracted from the teacher rating, so that a positive value indicates that the teacher's rating is greater than the student's whereas a negative value indicates that the student's rating is higher than the teacher's. Reflecting a tradition of generally privileging the student's perception over the teacher's, a positive relative gap score is usually interpreted as teachers overestimating the extent of their instructional practices, whereas a negative relative gap scores indicates teachers underestimating their practices. There is variability in how researchers operationalized the teacher-student rating gap. Some researchers considered the absolute gap (Bardach et al., 2018), some examined the relative gap (Rocchi & Pelletier, 2018), and others employed both (den Brok et al., 2006). In the present study I focus on both the absolute and relative rating gaps.

In summary, in the current research I examined three questions related to the agreement between teachers' and students' ratings of need-supportive teaching. Specifically, I asked: (1) do teachers and their students perceive some types of need-supportive practices more differently than other types of practices? (2) are students' autonomous motivation, need satisfaction (i.e., perceived autonomy, competence, and relatedness), and end-of-semester achievement related to the absolute or relative gap between teachers' and students' perceptions of teacher autonomy support, structure, or involvement, when controlling for student sex and beginning-of-year achievement? and (3) are teacher and student factors associated with the relations between absolute or relative gaps and student outcomes (i.e., moderating effect)?

CHAPTER 2. REVIEW OF LITERATURE

Theoretical Framework: Self-Determination Theory

Academic motivation is a central interest of educators because of its positive effect on students' learning and achievement. As one of the major theories of academic motivation, self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017) has been the framework for many studies involving students' motivation and its associations with their well-being, achievement, teachers' motivation, and teaching practices (e.g., Assor et al., 2002; Guay & Bureau, 2018; Haerens et al., 2015; Jang et al., 2010; Reeve & Jang, 2006; Roth et al., 2007; Ryan & Deci, 2017; Soenens et al., 2012; Taylor & Ntoumanis, 2007; Vansteenkiste et al., 2009).

According to SDT, there are three significant assertions regarding the relations among need support, basic psychological needs, and motivations (Deci & Ryan, 1985; Ryan & Deci, 2000, 2017). First, people engage in activities with qualitatively different motivations: either autonomous (i.e., self-determined) motivation, controlled motivation, or the absence of motivation (i.e., amotivation). Among the three, autonomous motivation is considered optimal (Ryan & Deci, 2000) because it positively influences one's well-being, health, and learning (Deci & Ryan, 2008; Guay et al., 2008; Miquelon & Vallerand, 2008; Ryan & Deci, 2017). SDT researchers contend that when their basic psychological needs (i.e., autonomy, competence, and relatedness) are met, people are autonomously motivated. The last assertion is that there are need-supportive practices that satisfy the basic psychological needs. Researchers recommend three types of need support, which match each need. That is, autonomy support, structure, and involvement meet the needs for autonomy, competence, and relatedness (Ryan & Deci, 2000, 2017).

These fundamental premises of SDT are applied to school settings (Ryan & Deci, 2000, 2017). First, students have qualitatively different motivations for engaging in learning activities (i.e., autonomous motivation, controlled motivation, and amotivation). Autonomous motivation is optimal. Second, when students' basic psychological needs (i.e., autonomy, competence, relatedness) are satisfied, they are autonomously motivated to learn. And third, types of need-supportive teaching practices (i.e., autonomy support, structure, involvement) are key to meeting

students' basic psychological needs. In the following section, I introduce each fundamental premise, which together form the basis of the current research.

Autonomous Motivation

In school settings, SDT presumes that students have different reasons to engage in learning-related activities (Ryan & Deci, 2000, 2017). Ideally, students are internally or autonomously orientated toward learning and schoolwork. Autonomously motivated people engage in activities because of the inherent pleasure the engagement brings (i.e., intrinsic motivation), because the activity is central to one's sense of self (i.e., integrated regulation), or because the activity is personally important (i.e., identified regulation) (Ryan & Deci, 2000, 2017).

There is a vast body of literature showing significant relations between students' motivation and their learning outcomes. A consistent finding is that students' autonomous motivation is related positively to adaptive learning outcomes, such as task persistence, positive affect, cognitive learning strategies, and high test scores (Deci & Ryan, 2000; Froiland et al., 2016; Guay & Bureau, 2018; Jang et al., 2009; Miserandino, 1996; Reeve, 2002; Standage et al., 2005; Vansteenkiste et al., 2004, 2009). Due to the benefits of autonomous motivation, researchers have focused on identifying factors that support students' autonomous motivation. Consistent with SDT, this research centers on the satisfaction of students' basic psychological needs (Ryan & Deci, 2000, 2017).

Basic Psychological Needs: Autonomy, Competence, and Relatedness

SDT postulates that when their basic psychological needs are met, people are autonomously motivated (Deci & Ryan, 2000; Ryan, 1995; Ryan & Deci, 2017). Basic psychological needs are human beings' innate needs that pertain to their psychological satisfaction (Deci & Ryan, 2000). SDT identifies three basic psychological needs: *autonomy*, *competence*, and *relatedness* (Deci & Ryan, 2000; Ryan & Deci, 2000). *Autonomy* refers to feeling psychologically free and self-directed or self-determined. *Competence* involves feeling able or efficacious in terms of completing tasks. *Relatedness* involves feeling connected to significant others or groups, such as peers, teachers, and school.

Many studies show that students' perceptions of their autonomy, competence, and relatedness, both individually and aggregated, are related to their motivation. Students with greater need satisfaction (a composite score of the three perceived needs) have higher autonomous motivation, self-determination (e.g., Garn et al., 2019; Haerens et al., 2015; Joe et al., 2017; Kaplan, 2018), and achievement (e.g., Hu & Zhang, 2017; Oga-Baldwin et al., 2017).

In other studies, researchers kept scores for the three needs separate. Results show that students with greater perceived autonomy have higher self-determination, achievement, engagement, and use of meta-cognitive strategies (Jang et al., 2009, 2012; Lavigne et al., 2007; Skinner et al., 2008; Soenens et al., 2012). By contrast, students with a low level of perceived autonomy tend to have high negative affect and low achievement (Miserandino, 1996). Students' perceived competence is related positively to their self-determination, achievement, persistence, positive affect, and use of higher-order learning strategies (e.g., critical thinking, meta-cognitive self-regulation) (Hardre & Reeve, 2003; Lavigne et al., 2007; Marshik et al., 2017; Mouratidis et al., 2013). Finally, relatedness is associated positively with student engagement (e.g., persistence, effort), positive affect (e.g., enthusiasm, satisfaction, interest), and autonomous motivation (Hu & Zhang, 2017; Skinner et al., 2008; Xiang et al., 2017).

Need Supportive Practices: Autonomy Support, Structure, and Involvement

Because of the importance of satisfying students' basic psychological needs for their autonomous motivation, SDT researchers have paid considerable attention to examining how to meet students' needs. SDT conceptualizes three types of teacher need-supportive practices, which correspond theoretically to each need. Specifically, *autonomy support* satisfies the need for autonomy, *structure* satisfies the need for competence, and *involvement* satisfies the need for relatedness (Ryan & Deci, 2017).

Autonomy Support

Autonomy support helps students feel self-directed and promotes their inner motivational resources. In particular, it satisfies students' need for autonomy (Jang et al., 2012; Lavigne et al., 2007; Vallerand et al., 1997), although it also is associated with students' perceptions of

competence and relatedness (Jang et al., 2009; Sheldon & Krieger, 2007; Taylor & Lonsdale, 2010).

Practices that Provide Autonomy Support. SDT premises that teachers support students' autonomy with behaviors such as providing choices, explaining the importance or relevance of a learning activity, encouraging students' initiation, acknowledging students' feelings, and minimizing the use of control (e.g., Assor et al., 2002; Connell & Wellborn, 1991; Deci et al., 1994; Reeve, 2006). Various studies confirmed that these teacher behaviors are related positively to students' autonomy. For example, Deci and his colleagues (1994) conducted an experiment to examine the effect that providing choices and rationales and acknowledging students' feelings during lessons had on their autonomy, interest, and enjoyment. Higher levels of these autonomy-supportive practices were related to greater levels of students' autonomy, interest, and enjoyment toward lessons. Furthermore, Reeve and Jang (2006) studied associations between specific indicators of teacher autonomy-support and students' perceived autonomy. They found that offering encouragement, allowing students time to work in their own way, and allowing students to talk are the strongest predictors of students' perceived autonomy (βs = .30, .28, and .24, respectively). Assor et al. (2002) examined various types of teacher autonomy supportive practices to identify which was most important to satisfying students' emotional (e.g., comfort, enjoyment, and interest) and behavioral (e.g., persistence, participation) engagement. The results showed that clarifying the personal relevance of the learning activity was the most important predictor of student affect and engagement.

By contrast, teacher behaviors that prevent student autonomy have deleterious effects on students' autonomy and motivation (Assor et al.,2002; Reeve & Deci, 1996). Practices such as using controlling language (e.g., making "should" or "got to" statements, emphasizing competition) (Reeve & Deci, 1996) and suppressing criticism (Assor et al., 2002) are particularly harmful.

Student Factors Associated with Autonomy Support. As conceptualized, teacher autonomy support satisfies students' need for autonomy (Jang et al., 2012; Lavigne et al., 2007; Vallerand et al., 1997). For example, Jang and her colleagues (2012) found that Korean middle schoolers' early-semester perceived autonomy support predicted their end-of-the-semester autonomy satisfaction.

Of note, autonomy support satisfies not only autonomy, but also competence and/or relatedness needs (Hardre & Reeve, 2003; Jang et al., 2009; Rocchi et al., 2017; Sheldon & Krieger, 2007; Taylor & Lonsdale, 2010). For instance, Taylor and Lonsdale (2010) showed that students' perceptions of their physical education (PE) teacher's autonomy support were positively related to all three needs across cultures; results were similar with samples from the U.K. and Hong Kong.

Students who perceive greater teachers' autonomy support tend to have higher autonomous motivation, compared to those with less autonomy support (Black & Deci, 2000; Lavigne et al., 2007; Patall et al., 2018; Vallerand et al., 1997). In addition, students who perceive greater teacher autonomy support tend to have higher perceived autonomy, interest, enjoyment (Ferguson et al., 2011; Liukkonen et al., 2010; Patrick et al., 1993), effort, persistence (Assor et al., 2002; Reeve et al., 2004), engagement (Jang et al., 2009, 2010; Skinner et al., 2008), and achievement (Black & Deci, 2000; Jang et al., 2009, 2012; Vansteenkiste et al., 2004).

Furthermore, teacher autonomy support is related positively to students' motivation, mediated by student autonomy (Jang et al., 2009; Kaplan, 2018; Lavigne et al., 2007; Sheldon & Krieger, 2007; Taylor & Ntoumanis, 2007; Vallerand et al., 1997). Taylor and Ntoumanis' (2007) study within PE classes showed that greater student perceptions of their teacher's autonomy support is related to higher student self-determination via higher perceived autonomy. Also, Lavigne et al. (2007) found that both perceived autonomy and competence mediated the positive association between students' perceived teacher autonomy support and student motivation, however autonomy was a stronger mediator than competence.

Structure

Structure helps students focus on learning and develop their competence by creating organized and predictable learning environments. In education research generally, teacher structure has been studied most often in terms of classroom organization and management, such as establishing classroom order (Doyle, 2006) and reducing students' misbehavior during lessons (Brophy, 2006). However, from the SDT point of view, teacher structure allows students to experience success and efficacy, which helps students meet their need for competence, which in turn promotes their autonomous motivation (Jang et al., 2010).

Practices that Provide Structure. One teacher practice that provides structure is setting optimal challenges. Challenge helps students increase their competence by giving an opportunity to improve (Deci et al., 1996). Another practice that provides structure is contingency (Skinner et al., 1998). Contingency is the extent to which a social context (e.g., the teacher) provides students with consistent guidance toward attaining desired, and avoiding undesired, outcomes. It underscores teachers' consistent support and provision of information about student actions (cause) and outcomes (consequences). Other teacher structure practices are providing clear rules and expectations, guiding students to a goal, and offering informative (i.e., task-focused and personal control-promoting) feedback (Connell & Wellborn, 1991; Deci et al., 1996; Jang et al., 2010; Mouratidis et al., 2013; Reeve, 2006; Reeve & Jang, 2006; Skinner & Belmont, 1993). When teachers provide clear rules and expectations, students can work effectively and focus their effort towards attaining the learning goals. Additionally, teachers' constructive feedback helps students evaluate their skills and develop their metacognition. These practices help students to meet their goals and teachers' expectations, which enables students to feel competent.

Some researchers argued that these dimensions of teacher structure are also categorized based on the lesson process (Haerens et al., 2013; Reeve, 2006). For example, Reeve (2006) argued that the dimensions of structure are associated with lesson progress, which are before, during, and after the learning activity. Practices that provide structure before lessons involve communicating expectations, rules, and learning goals. Practices that convey structure during lessons involve offering students help and guidance. Practices that give structure after lessons include providing positive and constructive feedback for the future activity and checking students' understanding before they move on to the next activity.

Student Factors Associated with Structure. As premised in SDT, teacher provision of structure is related positively to students' perceived competence (e.g., Kurdi et al., 2018; Taylor & Ntoumanis, 2007; van Loon et al., 2012). Students who perceive greater classroom structure express a greater sense of competence (Taylor & Ntoumanis, 2007; van Loon et al., 2012), and autonomous motivation (Roth et al., 2007; Taylor & Ntoumanis, 2007).

Of note, teacher structure satisfies not only the need for competence, but autonomy and relatedness also. For example, Rocchi and her colleagues (2017) found that competence support (i.e., structure) satisfies all three needs, autonomy, competence, and relatedness. Similarly, Taylor and Ntoumanis (2007) showed that student-perceived teacher structure is associated with

student competence and relatedness, but not autonomy (βs = .14, .16, and -.04, respectively). Using longitudinal data, Kurdi and her colleagues (2018) found that elementary students in warm and highly structured classrooms felt competent (i.e., competence) and connected to their teacher (i.e., relatedness). Additionally, students with greater perceived teacher structure tend to have a higher aggregated need satisfaction score (Curran et al., 2013).

Teacher structure is associated with many positive student learning outcomes. In classrooms with more structure, students engage more and use more cognitive and meta-cognitive strategies, and show higher achievement (Hospel & Galand, 2016; Jang et al., 2010; Mouratidis et al., 2013; Sierens et al., 2009; Skinner & Belmont, 1993; van Loon et al., 2012) compared to students in classrooms with less structure.

Teacher structure appears to affect students' motivation, mediated by student perceived competence (Guay et al., 2017; Taylor & Ntoumanis, 2007). According to Guay and his colleagues (2017), when teachers perceive themselves as competence-supportive teachers (i.e., providing structure), students perceive greater competence, which in turn leads to greater autonomous motivation. Taylor and Ntoumanis' research (2007) also demonstrated the mediating role of perceived competence in the association between perceived teacher structure and student self-determination.

Involvement

Involvement encourages students to develop a sense of connection with their teachers, peers, classrooms, and schools (Connell & Wellborn, 1991; Niemiec & Ryan, 2009). SDT researchers have studied teacher involvement less often than autonomy support and structure, but research about teacher involvement is growing (e.g., Ayllón et al., 2019; Joe et al., 2017; Mack et al., 2017; Sparks et al., 2016).

Practices that Provide Involvement. Teachers communicate involvement by fostering warm, respectful, and cooperative interactions, being aware of students' needs and emotions, and being fair and trusting in how they relate to others. They also invest time and effort in helping students learn, and show caring about their own teaching (Haerens et al., 2013; Skinner & Belmont, 1993; Sparks et al., 2015, 2016; Stroet et al., 2015).

Among the three types of need-supportive practices, there is least research about specific involvement behaviors that support students' relatedness (Sparks et al., 2015). In a review, Stroet

and her colleagues (2013) identified that the teacher behaviors that satisfy the feeling of relatedness are characterized as affection, attunement, dedication of resources, and dependability. Sparks and her colleagues (2015, 2016) validated these teacher behaviors with student perspectives, both qualitatively (i.e., using semi-structured focus group interviews; 2015) and quantitatively (i.e., using confirmatory factor analysis; 2016), in physical education classes. They found that, specifically, students perceive that their relatedness is supported when their teachers: express awareness of students' ability, communication is friendly, conversation is individualized, show caring, promote cooperation, and show enthusiasm for teaching.

Student Factors Associated with Involvement. As conceptualized in SDT, studies show that teacher involvement meets students' need for relatedness (Kiefer et al., 2015; Stroet et al., 2016; Taylor & Ntoumanis, 2007; van Loon et al., 2012). For example, Sparks et al. (2016) found that PE teachers' involvement with 7th through 10th graders is linked positively to student relatedness.

Teachers' involvement satisfies not only students' perceptions of relatedness, but autonomy and competence (Rocchi et al., 2017; Ryan, 1995; Taylor & Ntoumanis, 2007). Ryan (1995) argued that the positive relationships and dependability between teachers and students (i.e. components of teacher involvement) promote satisfaction of not only relatedness, but also autonomy and competence in school. For example, Taylor and Ntoumanis (2007) showed that students with greater perceived teacher involvement view themselves as having higher autonomy, competence, and relatedness (βs = .25, .28., and 43, respectively).

Like autonomy support and structure, teacher involvement is positively related to students' adaptive outcomes. Students with greater perceived teacher involvement tend to have higher autonomous motivation (Kiefer et al., 2015; Taylor & Ntoumanis, 2007), interest, effort, attention, persistence, engagement, and achievement (Kiefer et al., 2015; King, 2015; Liukkonen et al., 2010; Skinner & Belmont, 1993). In line with Stroet and her colleagues' (2013) review, teacher support for students' relatedness is crucial for students' emotions and motivation.

Other studies indicate that the relation between teacher involvement and students' motivation is mediated by students' perceived relatedness. Sparks et al. (2016) showed empirical support for a structural path model whereby teacher involvement leads to students' relatedness, which in turn is positively related to autonomous motivation, and negatively related to controlled motivation and amotivation.

Agreement between Teacher and Student Perceptions of Need-Supportive Practices

Overwhelmingly, researchers measure teacher need-supportive practices by asking students to report on their perceptions of their teachers (e.g., Stroet et al., 2013), although researchers do sometimes use teacher reports (e.g., Abós et al., 2018; Guay et al., 2017; Taylor et al., 2008). Less often, however, both student and teacher reports of teacher need-supportive practices are included in one study (Domen et al., 2020; Skinner & Belmont, 1993; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015; Wagner et al., 2016). The few studies with both teacher and student reports tend to show little agreement between the two sources (Domen et al., 2020; Van den Berghe et al., 2015). That is, for example, teachers and students in the same classroom tend to not agree about the teachers' use of autonomy-supportive practices.

Theoretically, student motivation and need satisfaction rely on teachers enacting need-supportive practices and students interpreting them as such. If teacher perceptions of what they do differ from student perceptions of what teachers do, then either the teacher's views are inaccurate, student perceptions are inaccurate, or both. The outcome may be similar, however; teachers' practices do not promote student motivation and need satisfaction. Although studies show that students' perceptions are generally not congruent with teachers' perceptions of teaching practices, there are no studies, to the best of my knowledge, where researchers investigate the impact of the discrepancies between teacher and student perceptions of teacher need-supportive practices on student outcomes. Therefore, it is still not clear that disagreement between teacher and student perceptions of need-supportive practices cause critical problems. Moreover, teacher and student factors that might affect differences between teacher and student perceptions of teaching practices have not been examined in SDT. Investigating these factors together will be helpful to understand the incongruent perceptions between teachers and students and how teachers can effectively communicate their support of students' psychological needs.

In addition, if teachers and students do not agree about teacher need-supportive practices, the results of research may differ depending on which respondent is chosen. Also, implications of research for practice may vary. Low agreement between teacher and student perceptions may raise questions about the construct validity of the instruments used, which may affect results.

I next review the literature that examined the relation between teacher and student perceptions of need-supportive practices and variables associated with the discrepancies in

perceptions. Then, I present factors that might moderate the relations between discrepancies of teacher-student perceptions and student outcomes.

Relations between Teacher and Student Perceptions of Need-Supportive Practices

A few studies based in SDT have examined the agreement between teacher and student perceptions of teaching practices (Domen et al., 2020; Skinner & Belmont, 1993; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015). Across those studies, agreement is modest, at best. Similar studies framed in other theories have also found low agreement about teacher practices (Bardach et al., 2018; den Brok et al., 2006; Kunter & Baumert, 2006).

In a study involving 11 to 16-year-old students in physical education classes, Taylor and Ntoumanis (2007) found that teacher ratings of their involvement were related significantly to student ratings of teacher involvement ($\beta = .24$). However, teacher and student ratings were not related to each other for either autonomy support or structure (βs = .12 and −.04, respectively). Taylor and Ntoumanis (2007) concluded that teacher perceptions of some types of need-supportive practices may differ from student ones. They did not suggest reasons for the results but recommended that interventions for teachers focus not only on enhancing the level of need-supportive teaching practices, but also on understanding students' perspectives regarding how they consider their teachers.

Domen and her colleagues (2020) focused on teachers' autonomy support and structure and used both teacher and student versions of the Teacher as Social Context Questionnaire (TASCQ; Belmont et al., 1992). The 3rd to 6th graders' perceptions of teacher autonomy support and structure did not form separate factors, therefore, Domen et al. (2020) combined the scores into a single measure of need-supportive practices. Teacher and student perceptions were not correlated, either within classrooms (rs = -.02 − .04) or between classrooms (r = .04). Van den Berghe and her colleagues (2015) also used the TASCQ to measure PE teacher- and student-perceived teacher need-supportive practices in a secondary school. Consistent with the previous studies, the correlation between teachers' and students' perceived teacher need support was not significant (r = .03).

With 3rd to 5th graders and their teachers, Skinner and Belmont (1993) examined the relations between teacher and student perceptions of need-supportive practices across a school year with the TASCQ. The results indicated that the correlations between teacher and student

perceptions of autonomy support, structure, and involvement in Fall were not significant (*r*s = .07, .02, and .13, respectively). However, the correlations of teacher and student perceived autonomy support and involvement in Spring were significant (*r*s = .20 and .23, respectively). It might be that as time goes by teachers and students understand each other better, consequently, their perceptions become more similar from Fall to Spring.

These four SDT-based studies that examined the perception gaps between teachers and students adopted different combinations of need support. Domen and her colleagues (2020) included autonomy support and structure, which were combined into a single measure. Van den Berghe and her colleagues (2015) aggregated ratings across the three types of practices (Van den Berghe et al., 2015), and in two other studies the three types of need supportive practices were analyzed separately, rather than in the same model (Skinner & Belmont, 1993; Taylor & Ntoumanis, 2007).

Another study addressed the agreement between teacher and student perceptions about teacher instruction from an achievement goal perspective (Bardach et al., 2018). Bardach and her colleagues (2018) examined the associations between teacher and student perceptions of four dimensions of classroom mastery goal structure (i.e., a classroom environment that emphasizes learning, individual improvement, and effort). These dimensions were task, autonomy, recognition/evaluation, and grouping. The results showed that the agreement between teacher and student ratings varied across the dimensions. Specifically, teacher and student perceived grouping practices (i.e., teacher support of cooperative groups) were significantly correlated (*r* = .43). However, the relations between teacher and student perceptions of task, autonomy, and recognition/evaluation practices were not significant (*r*s = .03, -.05, and .11, respectively). The researchers argued that observable and relatively objective practices, such as grouping (e.g., physically working together), may be perceived relatively objectively, resulting in greater agreement between teacher and students, compared to practices that involve more inferences (e.g., a recognition/evaluation practice).

Likewise, Kunter and Baumert (2006) analyzed 9th grade mathematics lessons using Programme for International Student Assessment (PISA) data. The results indicated that the agreement between teacher and student ratings of math instruction varied across instructional constructs. For example, the agreement on classroom management was high (*r* = .64), agreement on setting challenging tasks was moderate (*r* = .35), and there was no agreement about the tempo

of interaction during lessons (r = .10). The researchers concluded that the more concrete and relatively objective behaviors are, the higher the agreement is between teachers and students.

Most studies considered the correlations between teachers' and students' perceptions (Desimone et al., 2010; Domen et al., 2019; Kunter & Baumert, 2006; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015). Correlations between teachers' and students' perceptions only inform the extent to which they agree, but do not help researchers understand the implications of these differences or factors associated with the perception gaps. Doing that involves focusing on the teacher-student differences themselves. A few studies have examined the differences between teachers' and students' perceptions, including whether there are differences among the perception gaps, and what factors are associated with the perception gaps (Bardach et al., 2018; den Brok et al., 2006). However, of the four SDT-based studies that included both teacher and student perceptions of need-supportive practices, none of them considered the difference in ratings specifically, but they examined correlations between teachers' and students' perceptions.

Measuring the Difference between Teacher and Student Perceptions

There are two ways to conceptualize and measure the difference between teachers' and students' perceptions: the absolute gap between the two ratings and the relative gap. The *absolute rating gap* is the overall magnitude of the teacher-student discrepancy, regardless of who made the higher rating. The *relative rating gap* indicates both the magnitude and the direction of the discrepancy. In calculating the relative gap, the student rating is typically subtracted from the teacher rating, so that a positive value indicates that the teacher's rating is greater than the student's whereas a negative value indicates that the student's rating is higher than the teacher's. Reflecting a tradition of generally privileging the student's perception over the teacher's, a positive relative gap score is usually interpreted as teachers overestimating the extent of their instructional practices, whereas a negative relative gap score indicates teachers underestimating their practices.

None of the four SDT-based studies that examined the relations between teacher's and students' perceptions of need-supportive practices used rating differences, but employed just correlations. Other studies not framed in SDT employed rating differences between teachers and students. There is variability in how researchers operationalized the teacher-student rating gap.

Bardach and her colleagues (2018) took an achievement goal theory perspective to consider the absolute gap between teacher and student ratings of teacher practices. Specifically, they examined factors related to the perception gaps between teachers and students, and found there were negative relations between the absolute rating gap of mastery goal structure and average class achievement. By contrast, Rocchi & Pelletier (2018) used the relative gap to investigate how coaches' overestimation or underestimation of their need-supportive coaching was related to athletes' need satisfaction. They found that athletes who agreed with their coach on need-supportive coaching tended to report higher need satisfaction than athletes with an overestimating or underestimating coaches. Also, compared to athletes with an overestimating coach, athletes with an underestimating coach tended to report higher need satisfaction. den Brok and his colleagues (2006) considered both the absolute and relative gap between teachers and students. They found that the absolute difference between teachers and students was greater for some types of teaching practice than others, and that teachers tended to perceive their own practices more positively than students did.

Because the absolute and relative gaps indicate different information, in the present study I focus on both the absolute and relative rating gaps. That is, I explore how student motivation-related outcomes are associated with the difference between teachers' and students' perceptions of need-supportive instructional practices, both in terms of the absolute difference (i.e., regardless of whose ratings are higher) and the relative difference (i.e., whether teachers over- or under-estimate compared to their students).

Summary

In summary, only a small number of studies have measured both teacher and student perceptions of the teacher's instructional practices. These studies found, in general, low to modest levels of agreement. Only four studies were both conducted in classrooms and based in SDT (i.e., Domen et al., 2020; Skinner & Belmont, 1993; Taylor & Ntoumanis, 2007; Van den Berghe et al., 2015), therefore there is still little known about teacher and student differences in perceptions of teachers' need-supportive practices. Also, each study adopted different combinations of need-supportive practices. Given that the three types of need-supportive practices are conceptually different, although related to each other (Ryan & Deci, 2017), it is

necessary to examine the differences between teacher and student perceptions of all three need-supportive practices and include them in the same model.

None of the four SDT-based studies that examined the relations between teachers' and students' perceptions of need-supportive practices focused on how these perceptions differed. One study addressed the relative gap, but it was not conducted in classrooms (Rocchi & Pelletier, 2018). Given that each measure has different information, it is important to use both approaches to measuring the perception gaps. Therefore, I examine both absolute and relative differences between teacher and student perceptions of all three need-supportive practices (i.e., autonomy support, structure, and involvement). I include the three types need-supportive practices in the same model and use multilevel modeling.

Impacts of Disagreement between Teacher and Student Ratings of Teaching Practices

There are only a few studies that investigated the impacts of teachers and students holding incongruent perceptions of teaching practices, and none of these was framed in SDT. Relatedly, however, a SDT study by Rocchi and Pelletier (2018) considered the implications of differences in coaches' and athletes' perceptions of coaching practices. Specifically, they examined the associations between coaches' and female athletes' perceptions of coaches' autonomy support, structure, and involvement, and whether the rating differences predicted the athletes' need satisfaction. The researchers considered the relative rating gap, and categorized coaches as overestimating, in agreement, or underestimating their practices coaches compared to the athletes' perceptions. They found that when athletes' perceptions of need support were aligned with their coaches' perceptions, the athletes were more likely to have high need satisfaction of autonomy, competence, and relatedness. Furthermore, the athletes who reported greater need-supportive coaching than their coaches did (i.e., underestimating coaches) had greater need satisfaction than did the athletes with overestimating coaches (i.e., coaches' ratings were higher than the athletes). If the results also apply to school contexts, they would imply that agreement between teacher and student perceptions of need-supportive teaching is relevant to students' need satisfaction. And, in particular, they suggest that classrooms where teachers perceive their need-supportive instruction as similar to or less than their students' perceptions are more beneficial for students. I examine this hypothesis in the current study by considering whether students' autonomous motivation and need satisfaction (i.e., perceived autonomy,

competence, and relatedness) is associated with the absolute or relative agreement between teacher and student perceptions of need-supportive practices.

Another study investigated the role of agreement between teacher- and student-perceived teacher instructional practices from an achievement goal perspective (Bardach et al., 2019) using the absolute rating gap. They found that consensus between teachers' and their students' perceptions of instruction that emphasized the importance of personal improvement (i.e., mastery goal structure) predicted classroom climate among classmates, and cooperative learning strategies. Specifically, higher consensus of teacher and student reports of teacher instruction predicted a more positive and less negative classroom climate and more cooperative learning compared to classroom with lower teacher-student consensus. Although the research was not conducted within a SDT framework, the results indicate that agreement between teachers and students on teaching practices is associated with students' outcomes.

In research that did not address motivation, den Brok and his colleagues (2006) examined the associations of disagreement between teacher and student perceptions about teaching practices and patterns of teacher instruction. The researchers created a measure of the relative gap between teacher and student perceptions. Specifically, they created three groups of teachers: overestimating (teacher score > student score), underestimating (teacher score < student score), and convergence (teacher score = student score). The results indicated that the relative teacher-student gap was associated with teachers' instructional profile. That is, teachers who overestimated the clarity of their instruction (similar to structure in SDT) and their loose control (similar to autonomy support in SDT) were more likely to be classified as "ineffective" compared to underestimating or convergent teachers. The researchers also considered the absolute gap between teachers' and their students' ratings (i.e., without considering whose ratings were higher). They found that when there is a large absolute gap between teachers' and students' perceptions of teacher control (opposite of autonomy support in SDT), the teachers tended to be characterized as "ineffective."

Summary

In summary, only a few studies have examined the impact of the agreement between teacher and student perceptions of teaching practices. These few studies found that congruent absolute rating between teacher and student on teaching practices were related positively to

positive student outcomes (e.g., need satisfaction, positive classroom climate). Regarding relative rating gaps between teachers and students of instructional practices, students with teachers who overestimate their use of positive practices are less likely to report positive outcomes compared to students with underestimating teachers.

Because of the dearth of research, little is known about student outcomes associated with incongruent perceptions between teachers and their students about teachers' need-supportive practices. Based on the previous literature, I expect that when teachers' perceptions of their instruction differ from students' perceptions of what teachers do, there will be negative motivational outcomes for students. Accordingly, I examine how the agreement between teachers and students on need-supportive practices (teacher autonomy support, structure, and involvement) is related to students' autonomous motivation, need satisfaction, and achievement. For all analyses I considered both the absolute and relative gap in teacher-student perceptions.

Potential Moderators of the Relations Between Disagreement in Teacher-Student Perceptions and Student Outcomes

Some researchers have examined possible reasons for discrepancies between teachers' and students' perceptions of teachers' instructional practices. I review the factors that have been considered related to not only differences between teacher and student perceptions of teaching practices, but also students' outcomes. These factors include teacher experience, teacher motivation, and class averaged achievement (e.g., den Brok et al., 2006; Domen et al., 2019; Kunter & Baumert, 2006; Rocchi & Pelletier, 2018; Wagner et al., 2016).

Teacher Experience

Teacher experience may moderate the relations between teacher-student agreement of instructional practices and student outcomes. Brekelmans and her colleagues (2002) examined how teachers' years of teaching is associated with secondary teachers' and students' perceptions of teacher control. The results indicated that the agreement between teachers' and students' ratings of teaching practices differed depending on teacher experience. Specifically, as the length of teachers' career increased, the gap between teachers' and students' perceptions of teacher control decreased. However, den Brok and his colleagues (2006) found that the absolute gap between teacher-student perceptions of instruction was not related to teacher experience. Given

the mixed results, it is not clear that the difference between teacher's and students' perceptions of teaching practices vary depending on teacher experience. Therefore, I include years of teaching as a moderator to test whether it moderates the associations between perception gaps and student outcomes.

Teacher Motivation

A second factor that may influence both discrepancies in teacher-student perceptions and student outcomes is teacher motivation. Bardach et al. (2018) examined whether the agreement between teachers' and students' reports of classroom mastery goal structure is related to teachers' need satisfaction. The results showed that teachers' perceived autonomy, competence, and relatedness were not associated with the absolute teacher-student rating gap. They argued that teacher need satisfaction was not proximal enough to predict the teacher-student rating gap, but suggested that teacher motivation may. However, teacher motivation has not been tested as a moderator in the relations between teacher-student perception gap and student outcomes. Given that one's autonomous motivation moderates his or her autonomy and work performance (Dysvik & Kuvaas, 2011), teacher's teaching performance (i.e., teaching practices) may differ according to the level of teacher autonomous motivation. Therefore, in the current study I considered teacher motivation as one of the moderators.

Student Achievement

Students' class-averaged incoming achievement may moderate the associations between differences in teachers' and students' perceptions of teaching practices and student outcomes (Bardach et al., 2018; Desimone et al., 2010). Bardach and her colleagues (2018) found that the differences between teacher and student perceptions of classroom mastery goal structure were smaller when class-averaged achievement was higher. They explained the reason for this finding that teachers might have different expectations for their students depending on the students' abilities, and these expectations could affect how teachers create classroom environments. It may be that class-averaged beginning achievement moderates the relations between differences in teacher-student perceptions and student outcomes.

Summary

In summary, only a few studies have examined factors that are related to differences between teachers' and students' perceptions of teacher instruction and student outcomes. Most of these studies focused on a single factor. Therefore, I examined whether teacher experience, teacher motivation, and class-averaged beginning achievement moderated the relations between discrepancies in teacher-student perceptions of need-supportive practices and student outcomes.

Overview of the Study

Teacher and student perceptions of teaching practices tend to differ. There have been only a few published studies that identify the relation between these differences in perceptions and students' outcomes. Of those studies, only one used a SDT framework; it involved coaching athletes rather than education. Also, to the best of my knowledge, none of the studies explored both the absolute and relative differences between teachers and students' perceptions of need-supportive practices. Therefore, in the present study I investigated the following questions:

1. Is the absolute or relative gap between teacher and student perceptions similar for teacher autonomy support, structure, and involvement?

2. Are students' autonomous motivation, need satisfaction (i.e., perceived autonomy, competence, and relatedness), and end-of-semester achievement related to the absolute or relative gap between teacher and student perceptions of teacher autonomy support, structure, and involvement, when controlling for student sex and beginning-of-year achievement (see Figure 1)?

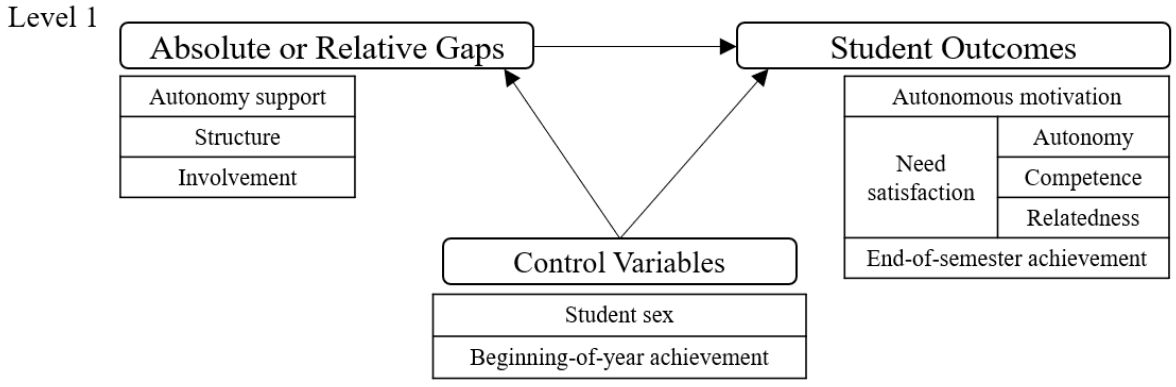

Figure 1. Hypothesized model to test the relations between teacher-student rating gaps and student outcomes controlling for student sex and beginning-of-year achievement.

3. Do teacher experience, teacher autonomous motivation, or class-averaged beginning-of-year achievement moderate the relations between teacher-student absolute or relative rating gaps of teacher need-supportive practices and students' outcomes (autonomous motivation, perceived autonomy, competence, and relatedness, and end-of-semester achievement) (see Figure 2)?

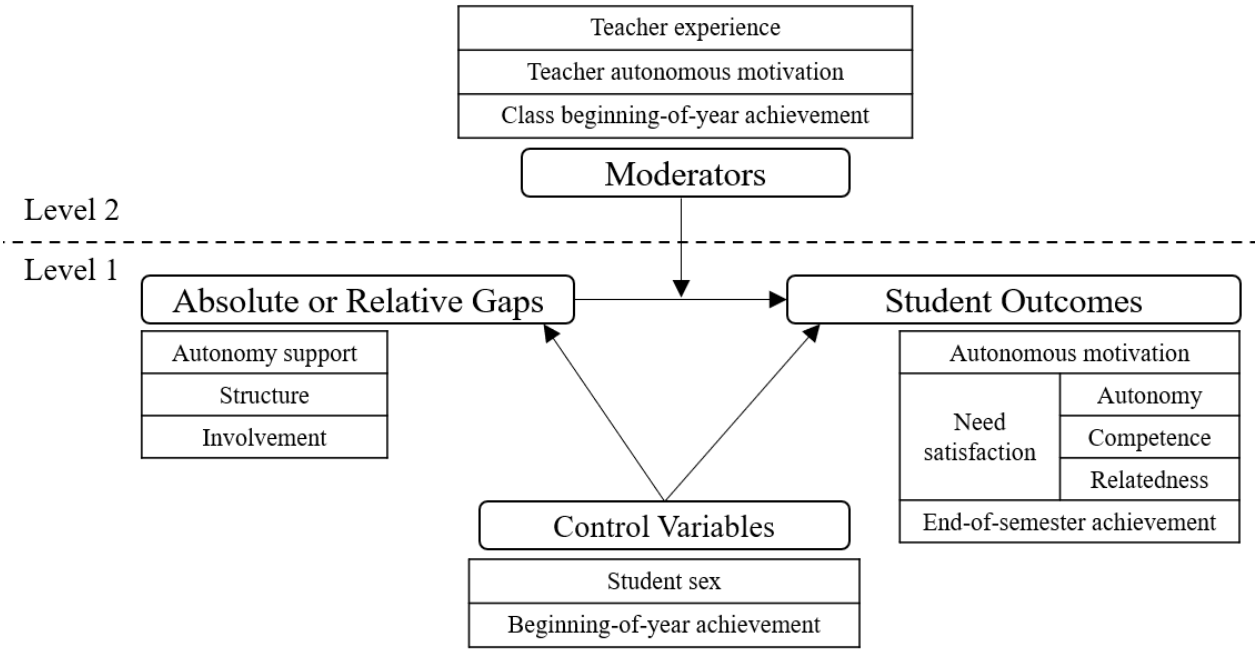

Figure 2. Hypothesized model to test moderating effects of teacher experience, autonomous motivation, and class beginning of year achievement on the relations between teacher-student rating gaps and student outcomes controlling for student sex and beginning-of-year achievement.

CHAPTER 3. METHOD

Participants

Fifth and sixth grade teachers and their students participated in the present study. There were 581 students (385 5th grade and 196 6th grade) from 29 classrooms in three public elementary schools in Seoul, South Korea. These schools were located in mixed lower- and middle-class districts. All student participants were Korean and aged between 10 and 12 years (M = 10.98, SD = .67). There were slightly more girls (n = 309; 53.2%) than boys (n = 272; 46.8%).

There were 29 teachers, comprised of 6 males (20.7%) and 23 females; 19 taught 5th grade and 10 taught 6th grade. Their years of teaching experience varied widely (M = 11.01 years, SD = 9.86 years).

Procedure

I surveyed students and their teachers near the end of the spring semester, which was the first semester of the school year in South Korea. At the beginning of survey administration for each class I gave the teacher a copy of the survey, directions and an envelope, then the teacher left the classroom for the duration of the survey. I assured students and teachers that I would keep their responses confidential. I collected students' completed surveys at the end of class. The teachers were asked to complete the surveys by the end of the day and then seal it in the envelope provided for collection.

In South Korea, the school year starts at the beginning of March. Students' math tests were administered by the school in March (beginning of the school year) and May (end of the first semester). I collected both scores from students' school records at the end of the semester.

Measures

All questionnaire items have a 5-point Likert-scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). All items were in Korean and specific to math lessons. Some of the measures (i.e., teacher reports of their need-supportive practices, teacher motivation, and student perceptions of the teacher's need-supportive practices) were not available in Korean, therefore I

translated them from English, and a Korean-English bilingual colleague backward-translated them. The original and the backward-translated version were identical. All items are shown in Appendix.

Teacher Need-Supportive Practices

The *Teacher as Social Context Questionnaire* (TASCQ; Belmont et al., 1992) measures teachers' use of autonomy support, structure, and involvement practices. There are two versions: one for students and one for teachers. Both student (e.g., Ahn et al., 2019; Skinner & Belmont, 1993) and teacher (e.g., Domen et al., 2020; Taylor & Ntoumanis, 2007) versions have been used widely to assess need-supportive practices and have produced reliable and valid data.

Teacher Perceptions

The *Teacher as Social Context Questionnaire—Teacher Report* (*TASCQ—T*) assesses teachers' self-perceived need-supportive practices. Each question begins with the stem "When I am in math class with my students…" The TASCQ-T contains 41 items, which comprise three scales: *Autonomy Support* (12 items), *Structure* (15 items), and *Involvement* (14 items). Twenty-four of the items (8 items for each of Autonomy Support, Structure, and Involvement) are parallel to those contained in the student version. Because I wanted parallel scales for teachers and students, I retained only those 24 items.

The initial internal consistency reliabilities of each subscale were low to moderate (Autonomy Support $\alpha = .64$, Structure $\alpha = .49$, and Involvement $\alpha = .68$), but they were acceptable when 6 items were removed. This resulted in 6 items measuring Autonomy Support (e.g., I try to give these students a lot of choices about classroom assignments; $\alpha = .72$), 5 items for Structure (e.g., When these students don't understand something, I explain it a lot of different ways; $\alpha = .73$), and 7 items for Involvement (e.g., These students are easy to like; $\alpha = .72$).

Student Perceptions

The Teacher as Social Context Questionnaire—Student Report (*TASCQ—S*) measures student perceptions of their teacher's need-supportive practices. Each question starts with "In math class, my teacher does…". The measure includes 24 items, with 8 items each for *Autonomy*

Support, *Structure*, and *Involvement*. I selected the 18 items that were parallel to those in the final teacher version. This included 6 items measuring Autonomy Support (e.g., My teacher gives me a lot of choices about how I do my schoolwork; α = .80), 5 items for Structure (e.g., My teacher makes sure I understand before he/she goes on; α = .76), and 7 items for Involvement (e.g., My teacher likes me; α = .85). I conducted confirmatory factor analysis (CFA) to examine the validity of the final student version; the model was a moderately good fit ($\chi 2[130] = 533.715$, $p < .001$; CFI = .92; TLI = .90; RMSEA = .073).

Autonomous Motivation

Students

Student *autonomous motivation* was measured with the Intrinsic Motivation and Identified Regulation subscales of the Korean Academic Self-Regulation Questionnaire (K-SQR-A; A. Y. Kim, 2002). All items are responses to the stem "I study math because….." The *Intrinsic Motivation* subscale contains five items (e.g., It's fun.), as does the *Identified Regulation* subscale (e.g., I believe accumulating knowledge is valuable). I aggregated the two subscales to create a 10-item measure of Autonomous Motivation (α = .91), following the procedure of other studies (e.g., Abós et al., 2018; Ratelle et al., 2007; Stroet et al., 2015), and based on theoretical conceptualization of the construct (Ryan & Deci, 2020).

Teachers

I measured teacher *autonomous motivation* with the Intrinsic Motivation and Identified Regulation subscales of the Situational Motivation Scale (SIMS; Guay et al., 2000), which have produced reliable and valid data (e.g., Taylor & Ntoumanis, 2007). All items are responses to the stem: "I teach my class math because…" The *Intrinsic Motivation* subscale has four items (e.g., I think that teaching this class is interesting), as does the Identified Regulation subscale (e.g., I think teaching this class is good for myself). I created a measure of teacher autonomous motivation by combining both subscales. Counter to theoretical expectations and results from others' research (e.g., Guay et al., 2015; Roth et al., 2007), one of the Identified Regulation items (i.e., it is my personal decision.) was negatively related to other items. I therefore removed that item, resulting in a 7-item scale (α = .86).

Student Needs Satisfaction

I measured students' needs satisfaction with the Korean Basic Psychological Needs Scale (K-BPNS; Lee & Kim, 2008). The measure has three subscales, each with five items: *Autonomy* (e.g., … I generally feel free to express my ideas and opinions), *Competence* items (e.g., … I feel that I am very effective), and *Relatedness* items (e.g., … I feel that people care about me). CFA indicated a low factor loading (.29) for one Autonomy item; the fit was improved when I deleted that item:($\chi 2[72] = 254.206$, $p < .001$; CFI = .93; TLI = .91; RMSEA = .066). The internal consistency reliabilities were as follows: Autonomy ($\alpha = .66$), Competence ($\alpha = .79$), and Relatedness ($\alpha = .74$). Although the reliability of the autonomy scale was less than ideal, it is similar to Jang and her colleagues' (2012) research with South Korean middle school students (i.e., .67).

Teacher Experience

Teachers reported their years of teaching experience when they completed the survey questionnaire.

Student Achievement

Students' math achievement was measured with their school-administered math tests. They are pencil-and-paper tests with a maximum score of 100. Items come from the Korea Education and Research Information Service's (KERIS) test bank of statistically-validated test questions, which correspond to the learning goals of the national curriculum.

Plan of Analyses

Calculating the Teacher-Student Rating Gaps in Need-Supportive Teaching

I considered two ways that teachers' and students' ratings of need-supportive teaching (i.e., autonomy support, structure, and involvement) may differ: the absolute difference and the relative difference. I created both types of rating gap scores for each of the three need-supportive practices using SPSS Statistics 26.

Absolute Rating Gap (ARG)

I calculated an absolute rating gap (ARG) score for each student, indicating the difference between the student's and his or her teacher's perceptions of the teacher's autonomy support, structure, and involvement. Recall, the ARG indicates the differences between teacher and student ratings, but not which of them gave a higher rating. This involved matching parallel items for teachers and students within each of the three subscales. I then calculated the difference between the two respondents' scores for each item in the subscale, and then calculated the mean for the subscale (i.e., ARG = mean of each item's difference).

Relative Rating Gap (RRG)

I also created a measure of the relative rating gap (RRG) for each student, indicating the extent to which the teacher's perceptions of his or her use of the three need-supportive practices (autonomy support, structure, and involvement) were greater than the student's perception. Like with the ARG, I paired parallel student and teacher items. For each item I subtracted the student score from the teacher score, and then calculated the mean across items within the subscale (i.e., RRG = mean of each item's (teacher rating score – student rating score). Accordingly, a positive score indicates that teachers rated their practices more highly than did students, whereas a negative score represents students assigning higher ratings to the practices than the teacher did.

Descriptive Statistics

I examined descriptive statistics (i.e., means, standardized deviations, kurtosis, and skewness) and correlations using SPSS Statistics 26. I also tested unconditional (random effect analysis of variance) models to identify the intraclass correlation coefficients (ICCs) of student outcomes (dependent variables) using HLM 8 (Raudenbush et al., 2019) software.

Comparing the Rating Gaps between Teacher and Student Perceptions of Teacher Need-Supportive Practices

I also conducted one-way analysis of variance (ANOVA) and Tukey post hoc tests to examine whether the ARG and RRG scores differed depending on the type of need-supportive practices (i.e., Research Question 1. Do teachers and their students perceive some types of need-

supportive practices more differently than other types of practices?). I report 95% confidence intervals (CI) and post-hoc results.

Relations between Teacher-Student Rating Gaps and Student Outcomes

I next addressed the second research question by examining, in five separate models, whether the gap between teachers' and students' ratings of need-supportive teaching was related to student outcomes (i.e., autonomous motivation, autonomy, competence, relatedness, and end-of-semester achievement). Each model contained the same three Level 1 predictors (rating gaps for autonomy support, structure, and involvement) and two student control variables (student sex and beginning-of-year achievement). I conducted these five analyses with the ARG scores first, and then repeated them after replacing the ARG with RRG; therefore, a total of 10 models were built.

The analyses involved HLM 8 (Raudenbush et al., 2019) software, with full maximum likelihood estimation. I adopted grand mean centering for each of the Level 1 independent variables with the exception of student sex. The following is an example equation for 1 of the 10 models tested; the outcome shown is student autonomous motivation and the independent variables involve teacher-student ARG.

Level 1 Model

$$\text{S\_AutonomousMotivation}_{ij} = \beta_{0j} + \beta_{1j}(\text{S\_SEX}_{ij}) + \beta_{2j}(S\_Begin\_Achievement_{ij}) + \beta_{3j}(ARG\_AS_{ij}) + \beta_{4j}(ARG\_ST_{ij}) + \beta_{5j}(ARG\_IN_{ij}) + r_{ij}$$

For each model I report the coefficients for all independent variables. I also report the reduction in the proportion of variance after adding the set of Level 1 independent variables (i.e., percentage of variance explained by the added variables; Raudenbush & Bryk, 2002).

Moderators of the Relations between Rating Gaps in Need-Supportive Practices and Student Outcomes

The third research question addressed whether the classroom level variables of teacher experience, teacher autonomous motivation and class-averaged beginning-of-year achievement moderated the relations between the teacher-student rating gap for need-supportive practices and student outcomes. For the Level 1 models that showed significant ($p < .05$) relations between the absolute (or relative) rating gaps and student outcomes, I built and tested Level 2 models to

examine potential moderating effects of the Level 2 variables. Specifically, to each model I added the three Level 2 predictors to the intercept (testing the main effect) and the Level 1 slopes (ARG or RRG for each of autonomy support, structure, and involvement; testing the mediating effect).

I again employed grand mean centering for all Level 1 and 2 independent variables, with the exception of student sex. If a Level 2 coefficient on the Level 1 slope was significant ($p < .05$), it would indicate that the Level 2 independent variable moderates the relation between the Level 1 predictor and the dependent variable. In other words, these Level 2 coefficients indicate the direction and magnitude of influence in the Level 2 independent variables on the Level 1 slopes. The following is an example equation for the full model; the outcome shown is student autonomous motivation and the independent variables involve teacher-student ARG.

Level 1 Model

$$S\_AutonomousMotivation_{ij} = \beta_{0j} + \beta_{1j}(S\_SEX_{ij}) + \beta_{2j}(S\_Begin\_Achievement_{ij}) + \beta_{3j}(ARG\_AS_{ij}) + \beta_{4j}(ARG\_ST_{ij}) + \beta_{5j}(ARG\_IN_{ij}) + r_{ij}$$

Level 2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(T\_Experience_j) + \gamma_{02}(T\_Auto\_Mot_j) + \gamma_{03}(Class\_Begin\_Achievement_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(T\_Experience_j) + \gamma_{32}(T\_Auto\_Mot_j) + \gamma_{33}(Class\_Begin\_Achievement_j) + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(T\_Experience_j) + \gamma_{42}(T\_Auto\_Mot_j) + \gamma_{43}(Class\_Begin\_Achievement_j) + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51}(T\_Experience_j) + \gamma_{52}(T\_Auto\_Mot_j) + \gamma_{53}(Class\_Begin\_Achievement_j) + u_{5j}$$

For each model I report the coefficients for the Level 1 and Level 2 independent variables. I also report the proportional reduction in variance to identify whether or not the Level 2 independent variables function as moderators of the slopes (involving Level 1 independent variables on dependent variable). To assess model fit, I present the deviance statistics. Significant deviance statistics indicate that the full model is significantly different from the Level 1 model and support the premise that the full model is more appropriate than the Level 1 model.

CHAPTER 4. RESULTS

Descriptive Statistics

I examined the descriptive statistics (see Table 1) for all variables before calculating the ARG and RRG. I also examined correlations among the teacher and student variables, which are shown in Table 2.

Table 1. *Descriptive Statistics and Reliabilities for Teacher and Student Variables*

Variable	No. of items	*M*	*SD*	Skewness	Kurtosis	α
Teacher Report (*N* = 29)						
Teacher experience (years)		11.01	9.86	0.89	−0.08	—
Need Supportive Practices						
Autonomy support	6	3.56	0.64	−0.18	1.17	.72
Structure	5	3.85	0.56	0.10	−0.18	.73
Involvement	7	3.90	0.47	−0.40	0.14	.72
Autonomous Motivation	7	3.67	0.61	−0.05	−0.02	.86
Student Report (*N* = 581)						
Need Supportive Practices						
Autonomy support	6	3.68	0.77	−0.39	0.34	.80
Structure	5	3.80	0.78	−0.55	0.30	.76
Involvement	7	3.35	0.79	−0.20	0.22	.85
Need Satisfaction						
Autonomy	4	3.81	0.73	−0.64	1.16	.66
Competence	5	3.31	0.80	−0.12	0.01	.79
Relatedness	5	3.51	0.77	−0.19	−0.02	.74
Autonomous Motivation	10	3.39	0.84	−0.28	−0.09	.91
Math Achievement (*N* = 581)						
Beginning-of-year score	—	84.74	15.38	−1.58	2.64	—
End-of-semester score	—	81.98	16.12	−1.49	2.59	—

Table 2. *Correlations for Student and Teacher Variables*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Teacher (N = 29)																
1. Teacher experience	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Autonomy support	.39*	—	—	—	—	—	—	—	*.03*	—	—	—	—	—	—	—
3. Structure	.46*	.69**	—	—	—	—	—	—	—	*.02*	—	—	—	—	—	—
4. Involvement	.38*	.65**	.76**	—	—	—	—	—	—	—	*.07*	—	—	—	—	—
5. Autonomous motivation	.49**	.45*	.64**	.62**	—	—	—	—	—	—	—	—	—	—	—	—
6. Class beginning-of-year achievement	−.02	.08	.08	−.04	−.00	—	—	—	—	—	—	—	—	—	—	—
Student (N = 581)																
7. Sex [a]	.01	−.02	−.03	−.03	−.03	.01	—	—	—	—	—	—	—	—	—	—
8. Beginning-of-year achievement	.06	.07	.12	.02	.07	.34**	.03	—								
9. Autonomy support	−.22**	.03	.10*	.10*	.13**	.20**	−.05	.17**	—	—	—	—	—	—	—	—
10. Structure	−.25**	·01	.10*	.14**	.09*	.22**	−.01	.18**	.79**	—	—	—	—	—	—	—
11. Involvement	−.20**	−.02	.07	.09*	.08	.18**	.01	.16**	.78**	.69**	—	—	—	—	—	—
12. Autonomy	−.07	.03	.07	.07	.16**	.13**	−.09*	.25**	.45**	.37**	.39**	—	—	—	—	—
13. Competence	.05	.06	.07	.07	.10*	.15**	.01	.39**	.31**	.31**	.37**	.46**	—	—	—	—
14. Relatedness	−.01	.01	.05	.03	.12**	.11*	.07	.24**	.37**	.32**	.46**	.50**	.61**	—	—	—
15. Autonomous motivation	−.03	.02	.02	.02	.11**	.13**	−.04	.35**	.33**	.36**	.37**	.47**	.69**	.48**	—	—
16. End-of-semester achievement	.05	.08	.09*	.09*	.06	.31**	.05	.75**	.18**	.21**	.18**	.21**	.41**	.23**	.35**	—

Note. [a] Sex was coded 0 = male and 1 = female. *Italic coefficients* are correlations between teachers' self-rating and class averaged students' ratings of autonomy support, structure, and involvement scores. * $p < .05$, ** $p < .01$.

The correlations supported the theoretical premises of SDT. Students' autonomous motivation was related significantly to their teacher's autonomous motivation, although the correlation was small (r = .11, p < .01). Student autonomous motivation was also related positively to their need satisfaction (rs = .47 - .69, ps < .01), perceptions of their teacher's need-supportive practices (rs = .33 - .37, ps < .01), and both beginning-of-year and end-of-semester achievement (rs =.35, ps < .01, respectively). Consistent with previous studies (Domen et al., 2020; Van den Berghe et al., 2015), correlations between teachers' and students' ratings of teacher structure and involvement were significant but small (rs = .10 & .09, ps < .05, respectively); the correlation for autonomy support was not statistically significant (r = .03).

Table 3 shows the correlations among the variables included in the hypothesized models: 1) Level 1 control variables (student sex, student beginning-of-year achievement), 2) Level 1 predictors (ARG or RRG for autonomy support, structure, and involvement), 3) Level 2 predictors (teacher experience, teacher autonomous motivation, class averaged beginning-of-year achievement), and 4) dependent variables (student autonomous motivation, student-reported autonomy, competence, and relatedness, and student end-of-semester achievement).

The Involvement ARG is related negatively to students' autonomous motivation and need satisfaction (rs = −.14 to -.22, ps < .01), and to end-of-semester achievement (r = -.10, p < .05). That is, as the gap between student and teacher perceptions of the teacher's involvement practices increases, student motivation, need satisfaction, and achievement decreases. The Structure ARG is related negatively to students' autonomous motivation, perceived autonomy, and end-of-semester achievement (rs = -.10, -.13, & -.12, ps < .05, respectively). Unexpectedly, the Autonomy Support ARG was related positively to student perceived relatedness (r = .11, p < .05).

Correlations between the RRG and student autonomous motivation and perceived need satisfaction tended to be higher than those for the ARG. Specifically, the RRG for all three need-supportive practices were related negatively to students' perceptions of autonomy, competence, and relatedness (rs = -.20 to -.40, ps < .01), student autonomous motivation (rs = -.24 to .33, ps < .01), and end-of-semester achievement (rs = -.08 to -.12, ps < .05). That is, the higher teachers rated their own need-supportive practices relative to students' ratings, the lower students' motivation, need satisfaction, and achievement were.

Table 3. *Correlations among Variables in the Hypothesized Models*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Level 1 control variables																
1. Student sex [a]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Beginning-of-year achievement	.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Level 1 predictors																
ARG																
3. Autonomy support	−.05	−.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4. Structure	−.07	−.08*	.58**	—	—	—	—	—	—	—	—	—	—	—	—	—
5. Involvement	−.05	−.07	.38**	.49**	—	—	—	—	—	—	—	—	—	—	—	—
RRG																
6. Autonomy support	.03	−.09*	−.12**	.14**	.41**	—	—	—	—	—	—	—	—	—	—	—
7. Structure	−.02	−.15*	−.05	.30**	.41**	.76**	—	—	—	—	—	—	—	—	—	—
8. Involvement	−.03	−.12*	−.00	.22**	.62**	.72**	.67**	—	—	—	—	—	—	—	—	—
Level 2 predictors																
9. Teacher experience	.02	.06	−.06	.09*	.18**	.38**	.42**	.31**	—	—	—	—	—	—	—	—
10. Teacher autonomous motivation	−.03	.07	−.01	.07	.08*	.12**	.25**	.18**	.39**	—	—	—	—	—	—	—
11. Class beginning-of-year achievement	−.02	.34**	.02	−.10*	.02	.03	−.10*	−.01	.18**	.21**	—	—	—	—	—	—
Student outcomes																
12. Autonomous motivation	−.04	.35**	.01	−.10*	−.22**	−.24**	−.30**	−.33**	−.03	.11**	.21**	—	—	—	—	—
13. Autonomy	−.08*	.25**	.00	−.13*	−.18**	−.30**	−.25**	−.30**	−.05	.16**	.15**	.50**	—	—	—	—
14. Competence	.01	.39**	.05	−.04	−.14**	−.20**	−.23**	−.31**	.05	.10*	.17**	.69**	.49**	—	—	—
15. Relatedness	.07	.24**	.11*	−.04	−.19**	−.28**	−.25**	−.40**	−.01	.12**	.13**	.48**	.50**	.61**	—	—
16. End-of-semester achievement	.05	.75**	−.05	−.12*	−.10*	−.08*	−.11**	−.12**	.05	.06	.14**	.35**	.27**	.41**	.23**	—

Note. [a] Sex was coded 0 = male and 1 = female. ARG = absolute rating gap, RRG = relative rating gap. * $p < .05$, ** $p < .01$.

Among the Level 2 predictors, the RRG for autonomy support, structure, and involvement were related positively to years of teaching (*r*s = .31 to .42, *p*s < .01) and teacher autonomous motivation (*r*s = .12 to .25, *p*s < .01). The correlations tended to be weaker between the ARG measures and teacher experience and autonomous motivation (*r*s = -.06 to .18).

Regarding ICC values, for all student outcomes less than 8% of the variance was between classes. The ICCs are 7.25%, 7.55%, 3.13%, 3.33%, and 4.69% for student autonomous motivation, autonomy, competence, relatedness, and end-of-semester achievement, respectively. Even though there was very little difference between classes I adopted multilevel analyses to avoid the biased results of single level analysis with nested data.

Comparing the Rating Gaps of Teacher Need-Supportive Practices

I conducted one-way ANOVA and Tukey post-hoc tests to examine whether the ARG or RRG differed for the three need-supportive practices. The results are shown in Table 4.

ARG

There was a significant difference in the ARG between teachers' and students' perceptions across the need-supportive practices ($F(2, 1740) = 6.657$, $p = .001$). Specifically, the structure ARG ($M = 1.02$, $SD = 0.50$) was significantly smaller than the gap for both autonomy support ($M = 1.11$, $SD = 0.53$) (95% CI = [−0.16, −0.02], $p < .05$) and involvement ARG ($M = 1.13$, $SD = 0.53$) (95% CI = [−0.17, −0.03], $p < .01$). There was no significant difference between the ARGs for autonomy support and involvement ($p = .89$). This means that teachers' and students' perceptions about the teachers' use of structure were more similar than their perceptions of autonomy support and involvement.

Table 4. *Descriptive Statistics, one-way ANOVA, and Tukey Post-hoc test of ARG and RRG*

Type of Gap		Mean	SD	ANOVA	Comparison Type	Mean Difference	SE	Sig.	95% Confidence Interval	
									Lower Bound	Upper Bound
ARG	Autonomy support	1.11	0.53	0.21	Structure	0.09*	0.03	0.01	0.02	0.16
					Involvement	−0.01	0.03	0.89	−0.09	0.06
	Structure	1.02	0.50	0.18	Autonomy support	−0.09*	0.03	0.01	−0.16	−0.02
					Involvement	−0.10*	0.03	0.00	−0.17	−0.03
	Involvement	1.13	0.53	0.14	Autonomy support	0.01	0.03	0.89	−0.06	0.09
					Structure	0.10*	0.03	0.00	0.03	0.17
RRG	Autonomy support	−0.09	1.00	0.49	Structure	−0.18*	0.05	0.00	−0.31	−0.06
					Involvement	−0.68*	0.05	0.00	−0.81	−0.55
	Structure	0.09	0.89	0.44	Autonomy support	0.18*	0.05	0.00	0.06	0.31
					Involvement	−0.50*	0.05	0.00	−0.62	−0.37
	Involvement	0.59	0.86	0.31	Autonomy support	0.68*	0.05	0.00	0.55	0.81
					Structure	0.50*	0.05	0.00	0.37	0.62

Note. ARG = absolute rating gap, RRG = relative rating gap, SD = standard deviation, SE = standard error. * The mean difference is significant at the 0.05 level.

RRG

Students perceived slightly higher, on average, autonomy support than did their teachers ($M = -0.09$, $SD = 1.00$). By contrast, teachers and students tended to agree about structure (M = 0.08, SD = 0.89), whereas teachers rated their involvement higher ($M = 0.59$, $SD = 0.86$) than their students did, on average. There was a significant difference in the teacher-student RRG across the three need-supportive practices ($F(2, 1740) = 85.211$, $p < .001$). Specifically, the post-hoc tests showed that the autonomy support RRG was significantly smaller than the RRGs for structure (95% CI = [−0.31, −0.06], $p < .01$) and involvement (95% CI = [−0.81, −0.55], $p < .01$). Also, the structure RRG was significantly smaller than the involvement RRG (95% CI = [−0.62 −0.37], $p < .01$). Because the RRG also includes the direction of the difference in perceptions, the results demonstrated that teachers, on average, underestimated their autonomy support but overestimated their structure and involvement.

The ARG Between Teachers' and Students' Perceptions of Need-Supportive Practices

I tested three models (i.e., unconditional, Level 1, and full models) for each of the five student outcomes. The unconditional model, and the ICC calculated from it, identified the proportion of variability in the outcome that was between classrooms. I reported these values in the previous section, as a part of the descriptive statistics.

The Level 1 model involved entering the five student-level independent variables (i.e., student sex, beginning-of-year achievement, ARG for autonomy support, structure, and involvement) and a student outcome variable (i.e., autonomous motivation, autonomy, competence, relatedness, or end-of-year achievement). I conducted five such models, one for each of the five outcomes.

The full model involved adding the three Level 2 independent variables (i.e., years of teaching, teacher autonomous motivation, and class averaged beginning-of-year achievement) to each of the five Level 1 models to examine their main effects and interaction effects. I report the results of both the Level 1 and full models consecutively, by student outcome. The summary of the HLM results is presented in Table 5, and detailed results are shown in Tables 6 through 10.

Table 5. *Summary of Significant Results*

	Student outcomes (selected model)							
	Autonomous motivation (Level 1)	Autonomy (Full)	Competence (Level 1)	Relatedness (Full)	Autonomous motivation (Full)	Autonomy (Full)	Competence (Full)	Relatedness (Full)
Predictors	ARG				RRG			
Autonomy support RG				0.31		−0.15		
Structure RG					−0.24		−0.18	
Involvement RG	−0.32		−0.22	−0.35	−0.30	−0.14	−0.33	−0.43
Teacher autonomous motivation		0.22		0.19 *× IN −0.44*	0.32	0.33	0.19	0.32 *× AS −0.29*
Teacher experience							*× IN 0.02*	
Student sex		−0.14			−0.12	−0.14		
Beginning-of-year achievement	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01

Note. RG = rating gap, ARG = absolute rating gap, RRG = relative rating gap, AS = autonomy support, IN = involvement. *Italic coefficients* indicate moderating effects. Only significant coefficients ($p < .05$) are presented.

Student Autonomous Motivation

Level 1 Model

In the model (see Table 6), the overall students' mean autonomous motivation score was 3.53 (γ_{00}) after controlling for students' sex (γ_{10}) and beginning-of-year achievement (γ_{20}). Students' beginning-of-year achievement was positively related to their autonomous motivation. Specifically, with a one-point increase in students' beginning-of-year achievement, their autonomous motivation increases by 0.02 point ($p < .001$).

The relation between ARG for involvement and students' autonomous motivation was negative ($\gamma_{50} = -0.32$, $p < .001$). When the ARG between teachers' and students' perceptions of teacher involvement is smaller, students' autonomous motivation is higher. However, the ARG for autonomy support and structure did not predict students' autonomous motivation (ps > .05). By adding the Level 1 independent variables, 20.3% of the within- and 60% of the between-class variance in student autonomous motivation were explained.

Full Model

Neither teacher autonomous motivation, teacher experience, nor average class beginning-of-year achievement was related to student autonomous motivation. Additionally, there was no significant interaction with either the ARG for autonomy support, structure, or involvement (ps > .05; see Table 6). Adding the Level 2 predictors explained an additional 48% of the between- and 1.96% of the within-class variance over the Level 1 model in student autonomous motivation.

Deviance statistics showed that the full model was not statistically different from the Level 1 model ($\chi^2(12) = 17.53$, $p = .13$). Also, there were no main effects of the Level 2 predictors. Therefore, the Level 1 model is more appropriate than the full model.

Table 6. *Parameter Estimates for the ARG in Need-Supportive Practices and Student Autonomous Motivation*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.37***	0.06	**3.53*** **	**0.10**	3.53***	0.10
Teacher experience (γ_{01})					−0.01	0.00
Teacher autonomous motivation (γ_{02})					0.15	0.08
Class beginning-of-year achievement (γ_{03})					0.01	0.01
Sex						
Intercept (γ_{10})			**−0.11**	**0.06**	−0.11	0.06
Beginning-of-year achievement						
Intercept (γ_{20})			**0.02*** **	**0.00**	0.02***	0.00
Autonomy support ARG						
Intercept (γ_{30})			**0.18**	**0.09**	0.18	0.09
Teacher experience (γ_{31})					−0.01	0.01
Teacher autonomous motivation (γ_{32})					−0.20	0.17
Class beginning-of-year achievement (γ_{33})					0.01	0.02
Structure ARG						
Intercept (γ_{40})			**−0.03**	**0.10**	0.01	0.11
Teacher experience (γ_{41})					0.02	0.01
Teacher autonomous motivation (γ_{42})					−0.22	0.21
Class beginning-of-year achievement (γ_{43})					−0.00	0.02
Involvement ARG						
Intercept (γ_{50})			**−0.32*** **	**0.08**	−0.35***	0.08
Teacher experience (γ_{51})					−0.00	0.01
Teacher autonomous motivation (γ_{52})					0.03	0.16
Class beginning-of-year achievement (γ_{53})					−0.01	0.01
Random components (variance)						
Intercept (τ_{00})	0.05***		**0.02** **		0.01**	
Beginning-of-year achievement (τ_{11})			**0.00**		0.00	
Autonomy support ARG slope (τ_{22})			**0.03**		0.03	
Structure ARG slope (τ_{33})			**0.09** **		0.12**	
Involvement ARG slope (τ_{44})			**0.03**		0.03	
Variance within classes (σ^2)	0.64		**0.51**		0.50	
Model deviance	1415.90		**1302.09**		1284.56	
Number of parameters estimated	3		**22**		34	

Note. Sex was coded 0 = male and 1 = female. ARG = absolute rating gap. **Bolds** are the values for the superior model. *$p < .05$. **$p < .01$. ***$p < .001$.

Student Perceived Autonomy

Level 1 Model

In Table 7, I reported the HLM results for students' perceived autonomy. The mean score of students' perceived autonomy was 4.02 (γ_{00}). Overall, girls assessed their autonomy 0.15 (γ_{10}) points lower than boys did. Students' beginning-of-year achievement was related positively to their perceived autonomy. With a one-point increase in students' beginning-of-year achievement, students tended to rate their autonomy higher by 0.01 points ($p < .001$).

The relation between the ARG for structure and students' perceived autonomy was negative, but marginally significant ($\gamma_{40} = -0.20$, $p = .046$). For every point reduction in the teacher-student structure ARG, the students perceived their autonomy higher by 0.20 points. However, neither the ARG for autonomy support nor involvement predicted students' ratings of autonomy ($p > .05$). By adding the Level 1 independent variables, 20.4% of the within-class variance in students' perceived autonomy was explained.

Full Model

In the full model (see Table 7), teacher autonomous motivation was related positively to students' perceived autonomy ($\gamma_{02} = 0.22$, $p < .01$). When teachers perceive they are more autonomously motivated for teaching, their students rate their own autonomy higher. There were no significant interactions with Level 2 predictors. Interestingly, the significant relation between the ARG for structure and student autonomy in the Level 1 model became non-significant with the full model. Because the coefficient was marginally significant ($p = .046$), the structure ARG might not be a meaningful predictor of student perceived autonomy. After adding the Level 2 predictors, an additional 50% of the between-class variance in student autonomy was explained.

The deviance statistics indicated that the full model was not statistically different from the Level 1 model ($\chi^2(12) = 17.99$, $p = .12$), however the Level 2 predictors explained almost half of the between-class variance in student autonomy, and there was a main effect for teacher autonomous motivation ($p < .01$). Therefore, the full model is more appropriate than the Level 1 model.

Table 7. *Parameter Estimates for the ARG in Need-Supportive Practices and Student Perceived Autonomy*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.81***	0.05	4.02***	0.09	**4.02*** **	**0.09**
Teacher experience (γ_{01})					**−0.01**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.22****	**0.08**
Class beginning-of-year achievement (γ_{03})					**0.01**	**0.01**
Sex						
Intercept (γ_{10})			−0.15**	0.05	**−0.14****	**0.05**
Beginning-of-year achievement						
Intercept (γ_{20})			0.01***	0.00	**0.01*** **	**0.00**
Autonomy support ARG						
Intercept (γ_{30})			0.18	0.11	**0.18**	**0.10**
Teacher experience (γ_{31})					**−0.01**	**0.01**
Teacher autonomous motivation (γ_{32})					**−0.12**	**0.19**
Class beginning-of-year achievement (γ_{33})					**0.00**	**0.02**
Structure ARG						
Intercept (γ_{40})			−0.20*	0.09	**−0.16**	**0.09**
Teacher experience (γ_{41})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{42})					**−0.14**	**0.17**
Class beginning-of-year achievement (γ_{43})					**0.02**	**0.02**
Involvement ARG						
Intercept (γ_{50})			−0.15	0.09	**−0.17**	**0.09**
Teacher experience (γ_{51})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{52})					**−0.03**	**0.18**
Class beginning-of-year achievement (γ_{53})					**−0.01**	**0.02**
Random components (variance)						
Intercept (τ_{00})	0.04***		0.04***		**0.02*** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support ARG slope (τ_{22})			0.16***		**0.11*** **	
Structure ARG slope (τ_{33})			0.09*		**0.06***	
Involvement ARG slope (τ_{44})			0.09*		**0.09***	
Variance within classes (σ^2)	0.49		0.39		**0.39**	
Model deviance	1255.63		1171.30		**1153.31**	
Number of parameters estimated	3		22		**34**	

Note. Sex was coded 0 = male and 1 = female. ARG = absolute rating gap. **Bolds** are the values for the superior model. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Student Perceived Competence

Level 1 Model

Table 8 shows the results of the HLM analyses for student perceived competence. In the Level 1 model, the overall mean score for student perceived competence was 3.31 (γ_{00}). Students' beginning-of-year achievement was related positively to students' competence. With a one-point increase in students' beginning-of-year achievement, the students perceived their competence higher by 0.02 points ($p < .001$).

The relation between the ARG for involvement and students' perceived competence was negative ($\gamma_{50} = -0.22$, $p < .05$). With a one-point decrease in the involvement ARG between teachers and students, it is expected that students rate their competence higher by 0.22 points. However, the ARG for autonomy support and structure did not predict student competence (*p*s > .05). By adding the Level 1 independent variables, 25.8% of the within- and 50% of the between-variance in student perceived competence was explained.

Full Model

The results showed no main effects for Level 2 predictors. I also tested for interaction effects of the Level 2 predictors (in Table 8). No interaction effects were found. The Level 2 predictors explained an additional 78% of the remaining between-class variance in student perceived competence.

The deviance statistics indicated that there was no statistical difference between the Level 1 model and full model ($\chi^2(12) = 12.41$, $p = .41$). Also, because the Level 2 predictors did not have significant coefficients for main effects or meaningful interactions, the Level 1 model is more appropriate than the full model.

Table 8. *Parameter Estimates for the ARG in Need-Supportive Practices and Student Perceived Competence*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.30***	0.04	**3.31*** **	**0.10**	3.29***	0.09
Teacher experience (γ_{01})					0.00	0.00
Teacher autonomous motivation (γ_{02})					0.10	0.07
Class beginning-of-year achievement (γ_{03})					0.00	0.01
Sex						
Intercept (γ_{10})			**−0.02**	**0.06**	−0.01	0.06
Beginning-of-year achievement						
Intercept (γ_{20})			**0.02*** **	**0.00**	0.02***	0.00
Autonomy support ARG						
Intercept (γ_{30})			**0.17**	**0.09**	0.15	0.09
Teacher experience (γ_{31})					−0.02	0.01
Teacher autonomous motivation (γ_{32})					0.05	0.17
Class beginning-of-year achievement (γ_{33})					−0.01	0.02
Structure ARG						
Intercept (γ_{40})			**−0.01**	**0.10**	−0.00	0.10
Teacher experience (γ_{41})					0.02	0.01
Teacher autonomous motivation (γ_{42})					−0.14	0.18
Class beginning-of-year achievement (γ_{43})					0.01	0.02
Involvement ARG						
Intercept (γ_{50})			**−0.22***	**0.09**	−0.21*	0.09
Teacher experience (γ_{51})					0.01	0.01
Teacher autonomous motivation (γ_{52})					−0.22	0.17
Class beginning-of-year achievement (γ_{53})					−0.00	0.02
Random components (variance)						
Intercept (τ_{00})	0.02*		**0.01***		0.00*	
Beginning-of-year achievement (τ_{11})			**0.00**		0.00	
Autonomy support ARG slope (τ_{22})			**0.04**		0.05	
Structure ARG slope (τ_{33})			**0.08***		0.08*	
Involvement ARG slope (τ_{44})			**0.10**		0.07	
Variance within classes (σ^2)	0.62		**0.46**		0.46	
Model deviance	1383.31		**1251.36**		1238.95	
Number of parameters estimated	3		**22**		34	

Note. Sex was coded 0 = male and 1 = female. ARG = absolute rating gap. **Bolds** are the values for the superior model. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Student Perceived Relatedness

Level 1 Model

In the Level 1 model (see Table 9), the overall students' mean perceived relatedness was 3.34 (γ_{00}). Students' beginning-of-year achievement was related positively to their relatedness. With a one-point increase in students' beginning-of-year achievement, their perceived relatedness increased by 0.01 points ($p < .001$).

The relation of the autonomy support ARG to student relatedness was positive ($\gamma_{30} = 0.34$, $p < .01$). For every point increase in the teacher-student autonomy support ARG, students perceived their relatedness higher by 0.34 points. The involvement ARG was related negatively to students' perceived relatedness ($\gamma_{50} = -0.32$, $p < .01$). When the teacher-students rating gap for involvement decreased, the students perceived their relatedness higher. However, the ARG for structure did not predict students' relatedness. By adding the Level 1 independent variables, 26.69% of the within-class variance in student relatedness was explained.

Full Model

There was a positive main effect of teacher autonomous motivation on student perceived relatedness ($\gamma_{02} = 0.19$, $p < .01$; see Table 9). When teachers perceived they were autonomously motivated for teaching, their students perceived greater relatedness. Teacher autonomous motivation also moderated the relation between the involvement ARG and student relatedness ($\gamma_{52} = -0.44$, $p < .05$). As shown in Figure 3, teacher autonomous motivation strengthened the negative relation between the involvement ARG and student relatedness. When the involvement ARG was small, its association with student relatedness was almost the same regardless of the level of teacher autonomous motivation. However, as teacher autonomous motivation for teaching increased, the negative relation between the involvement ARG and student relatedness became greater.

After adding the Level 2 predictors, an additional 33.3% of the between- and 2.17% of the within-class variances in student relatedness were explained. The deviance statistics showed that the full model was statistically different from the Level 1 model ($\chi^2(12) = 24.20$, $p = .02$). Also, considering the main effect and interaction effect of teacher autonomous motivation, the full model is better than the Level 1 model.

Table 9. *Parameter Estimates for the ARG in Need-Supportive Practices and Student Perceived Relatedness*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.50***	0.04	3.34***	0.10	**3.34*** **	**0.10**
Teacher experience (γ_{01})					**−0.00**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.19***	**0.08**
Class beginning-of-year achievement (γ_{03})					**0.01**	**0.01**
Sex						
Intercept (γ_{10})			0.09	0.06	**0.10**	**0.06**
Beginning-of-year achievement						
Intercept (γ_{20})			0.01***	0.00	**0.01*** **	**0.00**
Autonomy support ARG						
Intercept (γ_{30})			0.34**	0.09	**0.31****	**0.09**
Teacher experience (γ_{31})					**−0.01**	**0.01**
Teacher autonomous motivation (γ_{32})					**0.06**	**0.17**
Class beginning-of-year achievement (γ_{33})					**0.02**	**0.02**
Structure ARG						
Intercept (γ_{40})			−0.06	0.08	**−0.03**	**0.09**
Teacher experience (γ_{41})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{42})					**−0.14**	**0.17**
Class beginning-of-year achievement (γ_{43})					**0.01**	**0.02**
Involvement ARG						
Intercept (γ_{50})			−0.32**	0.10	**−0.35*** **	**0.09**
Teacher experience (γ_{51})					**0.02**	**0.01**
Teacher autonomous motivation (γ_{52})					**−0.44***	**0.19**
Class beginning-of-year achievement (γ_{53})					**−0.01**	**0.02**
Random components (variance)						
Intercept (τ_{00})	0.02**		0.03***		**0.02*** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support ARG slope (τ_{22})			0.07**		**0.05****	
Structure ARG slope (τ_{33})			0.02		**0.04***	
Involvement ARG slope (τ_{44})			0.15***		**0.10*** **	
Variance within classes (σ^2)	0.58		0.46		**0.45**	
Model deviance	1341.37		1247.99		**1223.79**	
Number of parameters estimated	3		22		**34**	

Note. Sex was coded 0 = male and 1 = female. ARG = absolute rating gap. **Bolds** are the values for the superior model. *$p < .05$. **$p < .01$. ***$p < .001$.

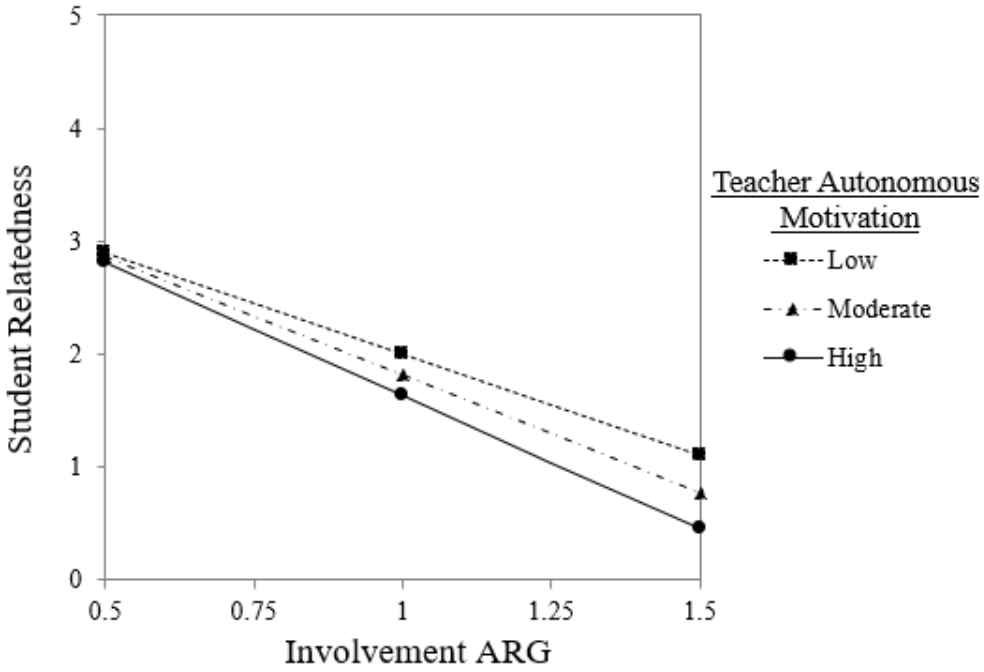

Figure 3. Graph of the moderating effect of teacher autonomous motivation on the relation between the ARG for involvement and student relatedness using unstandardized scores. For teacher autonomous motivation, low is 1SD below the mean, moderate is the mean, and high is 1SD above the mean. ARG = absolute rating gap.

Student End-of-semester Achievement

Level 1 Model

Table 10 demonstrates the results of the HLM analyses for student end-of-semester achievement. In this model, the overall mean score of students' end-of-semester achievement was 80.25 (γ_{00}) after controlling for students' sex and beginning-of-year achievement. With a one-point increase in students' beginning-of-year achievement, the students' end-of-semester achievement was higher by 0.88 points ($p < .001$). None of the ARG for any of the three need-supportive practices was related to students' end-of-semester achievement. Because no Level 1 coefficients were significant, I did not conduct the full model (i.e., there were no significant relations to moderate).

Table 10. *Parameter Estimates for the ARG in Need-Supportive Practices and Student Achievement*

	Unconditional		Level 1 model	
Variable	Estimate	SE	Estimate	SE
Fixed effects				
Intercept (γ_{00})	81.82***	0.94	80.25***	1.49
Sex				
Intercept (γ_{10})			0.44	0.73
Beginning-of-year achievement				
Intercept (γ_{20})			0.88***	0.06
Autonomy support ARG				
Intercept (γ_{30})			1.71	1.16
Structure ARG				
Intercept (γ_{40})			−1.25	1.20
Involvement ARG				
Intercept (γ_{50})			−1.27	1.22
Random components (variance)				
Intercept (τ_{00})	12.19***		22.49***	
Beginning-of-year achievement (τ_{11})			0.08***	
Autonomy support ARG slope (τ_{22})			9.76	
Structure ARG slope (τ_{33})			11.04	
Involvement ARG slope (τ_{44})			19.92*	
Variance within classes (σ^2)	247.68		70.78	
Model deviance	4868.80		4242.20	
Number of parameters estimated	3		22	

Note. Sex was coded 0 = male and 1 = female. ARG = absolute rating gap. *$p < .05$. **$p < .01$. ***$p < .001$.

The RRG Between Teachers' and Students' Perceptions of Need-Supportive Practices

In this set of analyses, I repeated the previous five HLM models after substituting the ARG (between teachers' and students' perceptions of need-supportive practices) with the RRG. I first entered the five Level 1 independent variables (i.e., student sex, beginning-of-year achievement, RRG for autonomy support, structure, and involvement). For the full model I added the three Level 2 independent variables (i.e., teacher experience, teacher autonomous motivation, and class averaged beginning-of-year achievement). I conducted a Level 1 and full model for each student outcome variables (i.e., autonomous motivation, autonomy, competence, relatedness, and end-of-semester achievement). Tables 11 through 15 show the detailed results.

Student Autonomous Motivation

Level 1 Model

In the model (see Table 11), the mean score of students' autonomous motivation was 3.56 (γ_{00}), after controlling for students' sex (γ_{10}) and beginning-of-year achievement (γ_{20}). Overall, girls perceived their autonomous motivation 0.13 points lower than the boys did. The beginning-of-year achievement was also related positively to students' autonomous motivation. With a one-point increase in students' beginning-of-year achievement, their autonomous motivation increases by 0.01 point ($p < .001$).

The relations between students' autonomous motivation and the RRG for structure ($\gamma_{40} = -0.22$, $p < .001$), and involvement ($\gamma_{50} = -0.26$, $p < .001$) were negative. When teachers' self-ratings of their use of structure and involvement exceed their students' ratings of teacher structure and involvement, students perceived their autonomous motivation lower. The results indicate that students with teachers who overestimate the structure and involvement they provide are less likely to be autonomously motivated to learn than are students with teachers who underestimate these practices. By adding the Level 1 predictors, including the control variables, 25% of the within- and 20% of the between-class variance in student autonomous motivation were explained.

Table 11. *Parameter Estimates for the RRG in Need-Supportive Practices and Student Autonomous Motivation*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.37***	0.06	3.56***	0.10	**3.54*** **	**0.10**
Teacher experience (γ_{01})					**−0.01**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.32*** **	**0.07**
Class beginning-of-year achievement (γ_{03})					**0.01**	**0.01**
Sex						
Intercept (γ_{10})			−0.13*	0.06	**−0.12***	**0.06**
Beginning-of-year achievement						
Intercept (γ_{20})			0.01***	0.00	**0.01*** **	**0.00**
Autonomy support RRG						
Intercept (γ_{30})			0.13	0.07	**0.14**	**0.07**
Teacher experience (γ_{31})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{32})					**−0.24**	**0.13**
Class beginning-of-year achievement (γ_{33})					**−0.01**	**0.01**
Structure RRG						
Intercept (γ_{40})			−0.22***	0.06	**−0.24*** **	**0.06**
Teacher experience (γ_{41})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{42})					**0.03**	**0.11**
Class beginning-of-year achievement (γ_{43})					**0.01**	**0.01**
Involvement RRG						
Intercept (γ_{50})			−0.26***	0.06	**−0.30*** **	**0.06**
Teacher experience (γ_{51})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{52})					**−0.04**	**0.11**
Class beginning-of-year achievement (γ_{53})					**0.01**	**0.01**
Random components (variance)						
Intercept (τ_{00})	0.05***		0.04***		**0.01** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support RRG slope (τ_{22})			0.05		**0.02**	
Structure RRG slope (τ_{33})			0.01		**0.01**	
Involvement RRG slope (τ_{44})			0.00		**0.00**	
Variance within classes (σ^2)	0.64		0.48		**0.48**	
Model deviance	1415.90		1263.69		**1239.76**	
Number of parameters estimated	3		22		**34**	

Note. Sex was coded 0 = male and 1 = female. RRG = relative rating gap. **Bolds** are the values for the superior model. *$p < .05$. **$p < .01$. ***$p < .001$.

Full Model

Teacher autonomous motivation was related positively to students' autonomous motivation ($\gamma_{02} = 0.32$, $p < .001$). For every point increase in teacher autonomous motivation, student autonomous motivation increased by 0.32 points ($p < .001$). None of the Level 2 predictors moderated the relations between the RRG for need-supportive practices and student autonomous motivation (see Table 11).

The Level 2 predictors explained an additional 75% of the between-class variance over the Level 1 model in student autonomous motivation. The deviance statistics showed that the full model was statistically different from the Level 1 model ($\chi^2(12) = 23.93$, $p = .02$). Also, teacher autonomous motivation had a main effect on student autonomous motivation. Therefore, the full model is more appropriate than the Level 1 model.

Student Perceived Autonomy

Level 1 Model

As shown in Table 12, the mean score for students' perceived autonomy was 4.01 (γ_{00}). Overall, girls assessed their autonomy 0.15 (γ_{10}) points lower than boys did. Students' beginning-of-year achievement was related positively to their autonomy. With a one-point increase in students' beginning-of-year achievement, they tended to rate their autonomy higher by 0.01 points ($p < .001$).

The relation between the RRG for autonomy support and students' autonomy was negative ($\gamma_{30} = -0.22$). For every point increase in the RRG for autonomy support, it is expected that students' autonomy would be 0.22 points lower. That is, when teachers rated their use of autonomy supportive practices higher than their students did, students assessed their own autonomy lower. In other words, students with teachers who overestimated their autonomy support were less likely to satisfy students' autonomy needs than were students with teachers who underestimated their autonomy support. However, neither the RRG for structure nor involvement predicted students' ratings of autonomy. By adding the Level 1 predictors, 24.49% of the within-class variance in student autonomy was explained.

Table 12. *Parameter Estimates for the RRG in Need-Supportive Practices and Student Perceived Autonomy*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.81***	0.05	4.01***	0.10	**3.99*** **	**0.09**
Teacher experience (γ_{01})					**−0.00**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.33*** **	**0.07**
Class beginning-of-year achievement (γ_{03})					**0.01**	**0.01**
Sex						
Intercept (γ_{10})			−0.15**	0.05	**−0.14** **	**0.05**
Beginning-of-year achievement						
Intercept (γ_{20})			0.01***	0.00	**0.01*** **	**0.00**
Autonomy support RRG						
Intercept (γ_{30})			−0.22**	0.07	**−0.15***	**0.06**
Teacher experience (γ_{31})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{32})					**−0.18**	**0.12**
Class beginning-of-year achievement (γ_{33})					**−0.00**	**0.01**
Structure RRG						
Intercept (γ_{40})			−0.01	0.06	**−0.05**	**0.06**
Teacher experience (γ_{41})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{42})					**−0.03**	**0.10**
Class beginning-of-year achievement (γ_{43})					**0.00**	**0.01**
Involvement RRG						
Intercept (γ_{50})			−0.11	0.06	**−0.14***	**0.06**
Teacher experience (γ_{51})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{52})					**0.03**	**0.11**
Class beginning-of-year achievement (γ_{53})					**−0.00**	**0.01**
Random components (variance)						
Intercept (τ_{00})	0.04***		0.05***		**0.01*** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support RRG slope (τ_{22})			0.02*		**0.02***	
Structure RRG slope (τ_{33})			0.01		**0.02**	
Involvement RRG slope (τ_{44})			0.02		**0.02**	
Variance within classes (σ^2)	0.49		0.37		**0.37**	
Model deviance	1255.63		1131.77		**1104.65**	
Number of parameters estimated	3		22		**34**	

Note. Sex was coded 0 = male and 1 = female. RRG = relative rating gap. **Bolds** are the values for the superior model. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Full Model

Table 12 shows that teacher autonomous motivation was related positively to students' autonomy ($\gamma_{02} = 0.33$, $p < .001$). After adding the Level 2 predictors, the involvement RRG coefficient changed from being non-significant ($\gamma_{50} = -0.11$, $p = .07$) to significant ($\gamma_{50} = -0.14$, $p = .02$), on the other hand, the autonomy support coefficient decreased from −0.22 to −0.15. Regarding the involvement RRG, it indicated that students with teachers who overestimated their involvement perceived less autonomy than did students with teachers who underestimated their involvement. None of the Level 2 predictors moderated the relations between RRG for need-supportive practices and student perceived autonomy.

The Level 2 predictors explained an additional 80% of the between-class variance in student autonomy over the Level 1 model. The deviance statistics showed that the full model was statistically different from the Level 1 model ($\chi^2(12) = 27.12$, $p < .01$). Considering teacher autonomous motivation's main effect, the proportional reduction in the variance statistic, and the deviance statistics, the full model is more appropriate than the Level 1 model.

Student Perceived Competence

Level 1 Model

The overall mean score of student perceived competence was 3.35 (γ_{00}). Students' beginning-of-year achievement was related positively to their perceived competence. With a one-point increase in students' beginning-of-year achievement, their rating of competence was higher by 0.02 points ($p < .001$).

The relation between RRG for involvement and students' perceived competence was negative ($\gamma_{50} = -0.33$, $p < .001$, see Table 13). When teachers' judgement of their involvement was one point higher than their students' perceptions, the students' perceived competence was lower by 0.33 points. It means that students with teachers who overestimated their involvement tended to report lower perceived competence than did students with underestimating teachers. By adding the Level 1 independent variables, 30.65% of the within-class variance in student competence was explained.

Table 13. *Parameter Estimates for the RRG in Need-Supportive Practices and Student Perceived Competence*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.30***	0.04	3.35***	0.10	**3.30*** **	**0.09**
Teacher experience (γ_{01})					**0.01**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.19***	**0.08**
Class beginning-of-year achievement (γ_{03})					**−0.00**	**0.01**
Sex						
Intercept (γ_{10})			−0.05	0.06	**−0.04**	**0.06**
Beginning-of-year achievement						
Intercept (γ_{20})			0.02***	0.00	**0.02*** **	**0.00**
Autonomy support RRG						
Intercept (γ_{30})			0.10	0.06	**0.13**	**0.06**
Teacher experience (γ_{31})					**−0.01**	**0.01**
Teacher autonomous motivation (γ_{32})					**−0.15**	**0.12**
Class beginning-of-year achievement (γ_{33})					**−0.00**	**0.01**
Structure RRG						
Intercept (γ_{40})			−0.13	0.07	**−0.18****	**0.06**
Teacher experience (γ_{41})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{42})					**0.16**	**0.11**
Class beginning-of-year achievement (γ_{43})					**−0.01**	**0.01**
Involvement RRG						
Intercept (γ_{50})			−0.33***	0.06	**−0.33*** **	**0.06**
Teacher experience (γ_{51})					**0.02***	**0.01**
Teacher autonomous motivation (γ_{52})					**−0.18**	**0.11**
Class beginning-of-year achievement (γ_{53})					**−0.00**	**0.01**
Random components (variance)						
Intercept (τ_{00})	0.02*		0.03***		**0.01*** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support RRG slope (τ_{22})			0.02		**0.01**	
Structure RRG slope (τ_{33})			0.04		**0.01**	
Involvement RRG slope (τ_{44})			0.04		**0.01**	
Variance within classes (σ^2)	0.62		0.43		**0.43**	
Model deviance	1383.31		1211.65		**1182.72**	
Number of parameters estimated	3		22		**34**	

Note. Sex was coded 0 = male and 1 = female. RRG = relative rating gap. **Bolds** are the values for the superior model. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Full Model

In the full model, teacher autonomous motivation was related positively to students' autonomy ($\gamma_{02} = 0.19$, $p < .05$). After adding the Level 2 predictors, the structure RRG coefficient changed from being non-significant ($\gamma_{50} = -0.13$, $p = .07$) to significant ($\gamma_{50} = -0.18$, $p = .01$). It indicates that students with teachers who overestimated their structure tended to feel less competent than did students with teachers who underestimated their use of structure.

As a predictor for the slope for RRG for involvement (β_{5j}), an increase in teacher experience changed the effect of involvement on student perceived competence ($\gamma_{51} = 0.02$, $p < .05$; see Table 13). As shown in Figure 4, Students' competence was not changed significantly when students are with experienced teachers regardless of the teachers overestimate or underestimate involvement. However, students' competence with inexperienced teachers decreases as the teachers overestimate their involvement.

The Level 2 predictors explained an additional 66.7% of the between-class variances in student perceived competence over the Level 1 model. The deviance statistics showed that the full model was statistically different from the Level 1 model ($\chi^2(12) = 28.93$, $p < .01$). Therefore, the full model is more appropriate than the Level 1 model.

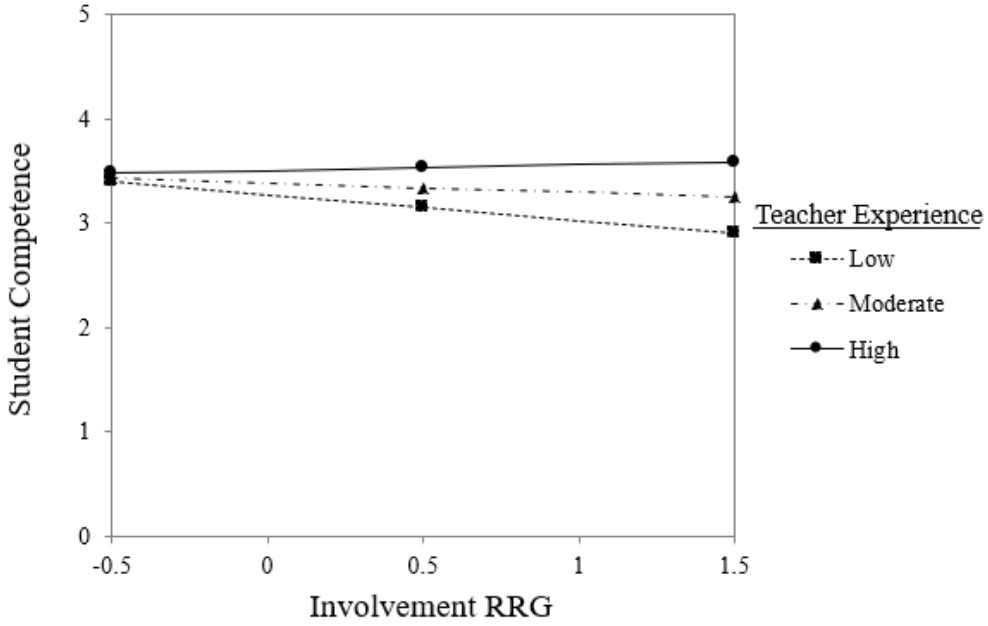

Figure 4. Graph of the moderating effect of teacher experience on the relation between the RRG for involvement and student competence using unstandardized scores. For teacher experience, low is 1SD below the mean, moderate is the mean, and high is 1SD above the mean. RRG = relative rating gap.

Student Perceived Relatedness

Level 1 Model

In the Level 1 model (see Table 14), overall students' mean perceived relatedness was 3.35 (γ_{00}). Students' beginning-of-year achievement was related positively to students' relatedness. With a one-point increase in students' beginning-of-year achievement, their perceived relatedness increased by 0.01 points ($p < .001$).

The relation between RRG for involvement and student relatedness was negative ($\gamma_{50} = -0.42$, $p < .001$). For every point increase in the involvement RRG, it is expected that students' relatedness would decrease by 0.42 points. That is, as teachers' ratings of involvement exceeded their students' ratings, students' perceived relatedness decreased. However, the RRG for autonomy support and structure did not predict students' relatedness. By adding the Level 1 predictors, 29.3% of the within-class variance in student relatedness was explained.

Full Model

In the full model, teacher autonomous motivation had both a main effect and a moderating effect. For every point increase in teacher autonomous motivation, student perceived relatedness increased by 0.32 points ($\gamma_{02} = 0.32$, $p < .001$).

As a predictor for the slope for RRG for autonomy support (β_{3j}), an increase in teacher autonomous motivation changed the direction of the association between involvement and student relatedness ($\gamma_{51} = -0.29$, $p < .05$; see Figure 3). This result demonstrates that students' relatedness decreased as teacher overestimated their autonomy support, and high, compared to low, teacher autonomous motivation increased the negative relation between the autonomy support RRG and student relatedness.

Adding the Level 2 predictors explained an additional 75% of the between- and 2.44% of the within-class variance in student relatedness over the Level 1 model. Deviance statistics showed that the full model was statistically different from the Level 1 model ($\chi^2(12) = 37.72$, $p < .001$). Therefore, the full model is supported.

Table 14. *Parameter Estimates for the RRG in Need-Supportive Practices and Student Perceived Relatedness*

Variable	Unconditional		Level 1 model		Full model	
	Estimate	SE	Estimate	SE	Estimate	SE
Fixed effects						
Intercept (γ_{00})	3.50***	0.04	3.35***	0.10	**3.32*** **	**0.10**
Teacher experience (γ_{01})					**0.00**	**0.00**
Teacher autonomous motivation (γ_{02})					**0.32*** **	**0.08**
Class beginning-of-year achievement (γ_{03})					**−0.00**	**0.01**
Sex						
Intercept (γ_{10})			0.08	0.06	**0.08**	**0.05**
Beginning-of-year achievement						
Intercept (γ_{20})			0.01***	0.00	**0.01*** **	**0.00**
Autonomy support RRG						
Intercept (γ_{30})			0.00	0.07	**0.05**	**0.07**
Teacher experience (γ_{31})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{32})					**−0.29***	**0.12**
Class beginning-of-year achievement (γ_{33})					**0.01**	**0.01**
Structure RRG						
Intercept (γ_{40})			0.01	0.06	**−0.05**	**0.06**
Teacher experience (γ_{41})					**0.00**	**0.01**
Teacher autonomous motivation (γ_{42})					**0.19**	**0.10**
Class beginning-of-year achievement (γ_{43})					**−0.00**	**0.01**
Involvement RRG						
Intercept (γ_{50})			−0.42***	0.07	**−0.43*** **	**0.06**
Teacher experience (γ_{51})					**0.01**	**0.01**
Teacher autonomous motivation (γ_{52})					**−0.12**	**0.12**
Class beginning-of-year achievement (γ_{53})					**−0.01**	**0.01**
Random components (variance)						
Intercept (τ_{00})	0.02**		0.04***		**0.01*** **	
Beginning-of-year achievement (τ_{11})			0.00		**0.00**	
Autonomy support RRG slope (τ_{22})			0.02		**0.02**	
Structure RRG slope (τ_{33})			0.01		**0.01**	
Involvement RRG slope (τ_{44})			0.04		**0.04**	
Variance within classes (σ^2)	0.58		0.41		**0.40**	
Model deviance	1341.37		1188.07		**1150.35**	
Number of parameters estimated	3		22		**31**	

Note. Sex was coded 0 = male and 1 = female. RRG = relative rating gap. **Bolds** are the values for the superior model. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

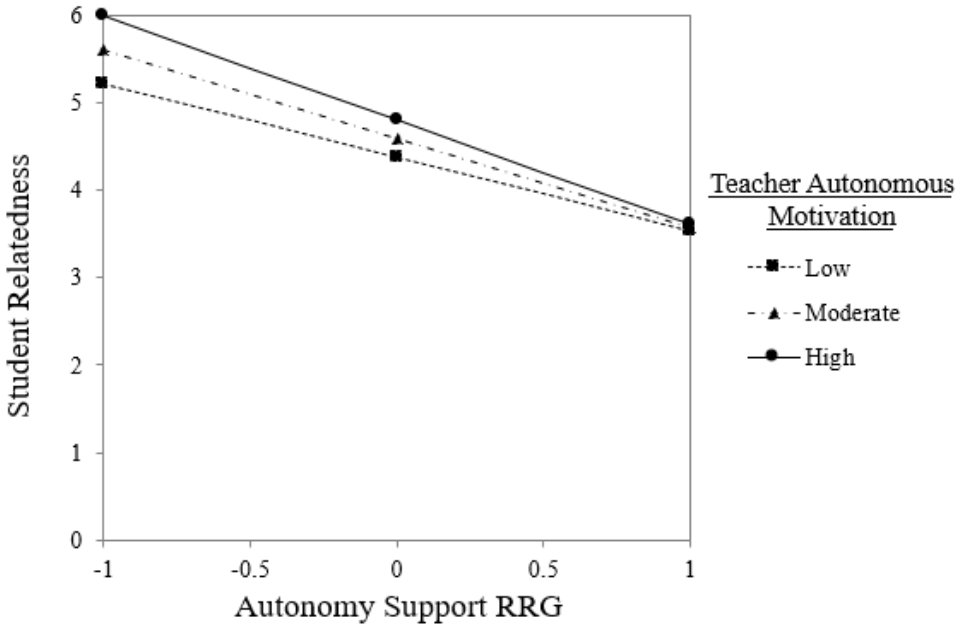

Figure 5. Graph of the moderating effect of teacher autonomous motivation on the relation between the RRG for involvement and student relatedness using unstandardized scores. For teacher autonomous motivation, low is 1SD below the mean, moderate is the mean, and high is 1SD above the mean. RRG = relative rating gap.

Student End-of-semester Achievement

Level 1 Model

Table 15 demonstrates the results of the HLM analyses for student end-of-semester achievement. In this model, the overall mean score for students' end-of-semester achievement was 80.53 (γ_{00}) after controlling students' sex and beginning-of-year achievement. With a one-point increase in students' beginning-of-year achievement, their end-of-semester achievement was higher by 0.88 points ($p < .001$). Similar to the parallel ARG model, none of the three need-supportive practices RRG was related to end-of-semester achievement. Because there were no significant relations with RRG for need-supportive practices in the Level 1 model, I did not test the full model.

Table 15. *Parameter Estimates for the RRG in Need-Supportive Practices and Student Achievement*

	Unconditional		Level 1 model	
Variable	Estimate	SE	Estimate	SE
Fixed effects				
Intercept (γ_{00})	81.82***	0.94	80.25***	1.49
Sex				
Intercept (γ_{10})			0.44	0.73
Beginning-of-year achievement				
Intercept (γ_{20})			0.88***	0.06
Autonomy support RRG				
Intercept (γ_{30})			1.71	1.16
Structure RRG				
Intercept (γ_{40})			−1.25	1.20
Involvement RRG				
Intercept (γ_{50})			−1.27	1.22
Random components (variance)				
Intercept (τ_{00})	12.19***		22.49***	
Beginning-of-year achievement (τ_{11})			0.08***	
Autonomy support RRG slope (τ_{22})			9.76	
Structure RRG slope (τ_{33})			11.04	
Involvement RRG slope (τ_{44})			19.92*	
Variance within classes (σ^2)	247.68		70.78	
Model deviance	4868.80		4242.20	
Number of parameters estimated	3		22	

Note. Sex was coded 0 = male and 1 = female. RRG = relative rating gap. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

CHAPTER 5. DISCUSSION

In this study, I examined: (1) differences among teachers' and students' agreement about teachers' need-supportive practices, (2) associations between teacher-student agreement about need-supportive practices and student motivation and achievement, and (3) teacher and student factors that may moderate the relations between teacher-student perception gaps and student motivation and achievement.

The findings from the present study contribute to research and theory in the following ways. First, the findings support results from other studies by indicating general discrepancies between teachers' and students' perceptions of teachers' need-supportive practices. Second, they indicate that student motivation varies depending on the difference between teachers' and students' perceptions of need-supportive practices; larger discrepancies are related to lower student motivation and need satisfaction. Third, the findings identify moderating roles of teacher motivation and experience on the relations between teacher-student perception gaps and student motivation and need satisfaction. Finally, the results indicate that the RRG is more sensitive to identifying links with students' motivational beliefs than is the ARG.

Differences in Teacher-Student Perceptions Across Need-Supportive Practices

The results showed that the size of the difference between teachers' and students' perceptions of teacher practices varies depending on the type of need-supportive practices considered. Regardless of whether the rating gap was absolute or relative, there was less discrepancy between teaches' and students' perceptions of structure practices than there was for autonomy support or involvement. In other words, students' perceptions of their teacher's use of structure were more similar to the teacher's own perceptions compared to judgments about teacher autonomy support or involvement. This finding is consistent with previous studies that show variability in teacher-student agreement across different teaching practices (Bardach et al., 2018; Kunter & Baumert, 2006). Specifically, teaching practices that are relatively objective and easy to observe tend to have more agreement than do practices that are more subjective and require interpreting. In the present study, items measuring teacher structure ask about the teacher setting clear goals and providing students with specific directions (e.g., "my teacher shows me

how to solve problems for myself" and "my teacher doesn't tell me what he/she expects of me in class [reversed]"). These practices involve behaviors that are observable and relatively objective. By contrast, many of the items in the measures of autonomy support (e.g., "my teacher listens to my opinion") and involvement (e.g., "my teacher likes me") require students to interpret teachers' subjective behavior, making it less likely that teachers and students to agree.

Also, given that involvement relative rating gap was significantly higher than autonomy support and structure relative rating gap, teachers tend to overestimate their involvement practices than autonomy support and structure. It indicates that involvement gaps may be the most influential factor on students' outcomes.

Associations of Differences Between Teachers' and Students' Perceptions and Student Outcomes

This study showed that agreement between teachers and students about the teacher's need-supportive practices is related to students' motivation and related beliefs. It is the only study that investigated how both the absolute and relative perception gaps about need-supportive practices are related to students' outcomes. The general finding that smaller teacher-student rating gaps are related to greater student motivation and need satisfaction is consistent with Rocchi and Pelletier's (2018) study in the sports domain. Specifically, they found that the relative rating gaps between coaches' and female athletes' perceptions of need-supporting coaching are associated negatively with the athletes' need satisfaction.

Importantly, differences between teacher and student perceptions of teacher involvement practices are particularly relevant for students' motivation, regardless of whether the gap is conceptualized in absolute or relative terms. This finding is consistent with Skinner and Belmont's (1993) study showing that teacher involvement is aligned with not only students' perceptions of teacher involvement, but also with teacher autonomy support and structure. That is, teacher involvement appears to be central to meeting all three psychological needs.

The significance of building positive teacher-student relationships (the essential practice of involvement) has been emphasized within various contexts (den Brok et al, 2010; Hughes, 2012; Wubbels & Brekelmans, 2005). For example, teacher-student relationships are related positively to student engagement (Martin & Collie, 2019), achievement (Roorda et al., 2011), and peer acceptance (Hughes & Kwok, 2006). However, within SDT involvement has received

considerably less attention than autonomy support or structure (Sparks et al., 2016). Therefore, the present study's findings suggest that SDT researchers should pay more attention to teacher involvement.

The absolute difference between teachers' and students' perceptions of teacher involvement is related negatively to students' autonomous motivation, and perceived competence and relatedness. In other words, when students' views of their teacher's involvement are more congruent with the teacher's self-perception, students' autonomous motivation, perceived competence, and relatedness are greater. The finding supports the argument that wide differences of opinion between teachers and students about the extent of teacher need-supportive practices are detrimental to students' motivation. It also suggests that efforts to reduce disparities between teachers' and students' perception gaps may be beneficial for students.

Unexpectedly, the relation between the absolute teacher-student rating gap for autonomy support and student relatedness was positive. That is, with greater differences between teachers' and students' perceptions of teacher autonomy support, students perceived greater relatedness. The result that students interpret teacher autonomy support differently depending on their level of relatedness satisfaction may be related to Zhou and her colleagues' (2012) finding involving Chinese students' perceptions of teacher control and autonomy support. Specifically, they found some teacher practices that are viewed by Western students as controlling are evaluated by Chinese students as less controlling and even as showing caring and encouragement. Therefore, Korean students may consider some teacher control (i.e., the opposite of autonomy support) as showing the teacher's concerns and affection, similar to how they were perceived by Chinese students in Zhou et al.'s study. However, further investigation of connections between students' perceptions of teacher autonomy support and relatedness satisfaction is needed.

When teachers overestimate their use of involvement-related practices, relative to their students' estimates, students' autonomous motivation and perceived autonomy, competence, and relatedness suffers. Furthermore, the RRG for structure is also related negatively to students' autonomous motivation and perceived competence. That is, when teachers overestimate their use of structure-related practices, their students tend to be less autonomously motivated and view their competence less favorably compared to those with underestimating or congruent teachers. Similarly, students with teachers who overestimate their use of autonomy supportive practices, relative to students' judgements, tend to view themselves as having lower autonomy compared to

students with teachers who underestimate their autonomy support. It may be that many teachers do not recognize the extent to which their need-supportive practices need to be utilized and evident to students in order to adequately meet students' psychological needs. Without this recognition, therefore, these teachers may believe they are doing enough despite not meeting students' needs satisfactorily or fully supporting autonomous motivation.

The dual consideration of the RRG and the AGR showed that the RRG was the more sensitive and important in explaining differences in student motivation and need satisfaction. Therefore, it appears better for researchers who are interested in understanding differences between teachers' and students' perceptions of instructional practices to use the RRG rather than the ARG.

Interestingly, students' achievement was not related to either the AGR or RRG for any of the need-supportive practices. Taylor and Ntoumanis (2007) argued that student achievement may be too far from need-supportive practices to be affected. However, the premise that need-supportive practices satisfy students' psychological needs, which promotes their autonomous motivation and fosters achievement, is central to SDT (Ryan & Deci, 2017, 2020). Consistent with that premise, other research indicates significant associations between teacher need support and student achievement (Ahn et al., 2021). The non-significant associations in the present study may be explained by the large correlation between achievement at the beginning of the year and end of the semester, leaving little variance to be explained by differences in teacher-student perceptions. It may take longer than a semester for achievement to be affected through the process just outlined (need support → need satisfaction → autonomous motivation → achievement). For example, intervention research found that increased teacher autonomy support at the beginning of the year affected student achievement at the end of the year (e.g., Cheon & Reeve, 2013; Cheon et al., 2020; Ulstrad et al., 2018). Therefore, in the present study, teacher-student perception gaps of need-supportive practices may have been related to end of year achievement; unfortunately, these data were not collected.

Moderating Effects of Teacher Autonomous Motivation and Teacher Experience

This study examined potential teacher and student moderators in the relations between perception gaps and student outcomes. Among teacher and student factors, teacher autonomous motivation moderated the relations between the involvement ARG and student relatedness, and

between the autonomy support RRG and student relatedness. The results showed that, as the involvement perception gap increased or as teachers overestimated their autonomy support, students with autonomously motivated teachers had considerably lower relatedness compared to students with less autonomously motivated teachers. It may indicate the significance of the consonance of teacher autonomous motivation with their need-supportive practices. Generally, autonomously motivated teachers provide need-supportive practices (Ahn et al., 2021). However, when teachers assess themselves as being autonomously motivated for teaching, if their perceptions of instruction are not congruent with what their students think, this mismatch appears to be more detrimental to students than when teachers assess themselves as less autonomously motivated for teaching.

Teacher experience also moderated the relation between the involvement RRG and students' perceived competence. Students' competence perceptions did not differ significantly when they were taught by experienced teachers, regardless of whether teachers overestimated or underestimated their involvement. However, with inexperienced teachers, students' perceived competence was lower as the teachers overestimated their involvement. It may be that experienced teachers know how to complement students' competence over involvement gaps owing to their instructional expertise. However, inexperienced teachers may not know well how to complement the deficit of rating gaps because of their relatively short experience of practical classrooms.

Direction and Magnitude of Teacher-Student Rating Gaps

The current study considered both the absolute and relative rating gaps between teacher and student perceptions on three need-supportive practices. The results using both the involvement ARG and RRG descriptive statistics and HLM indicate that the RRG, and not the ARG, may be the driving force in affecting student outcomes. For example, the effect of the involvement rating gap on relatedness was −.35 for the ARG and −.43 for the RRG, but the mean involvement rating gap was 1.13 for ARG and.59 for RRG. That is, the involvement RRG had a larger effect and a smaller mean compared to the involvement ARG, therefore the RRG is likely to be a more important predictor than the ARG.

However, the ARG and RRG provide different information. The ARG indicates whether or not the gaps between students' and teachers' perceptions are influential for student outcomes,

however the RRG tells if the rating gaps matter and whether there are differences between teachers' overestimation and underestimation. Therefore, it is useful to examine both approaches when conceptualizing and measuring differences between teachers' and students' perceptions of teachers' practices.

Implications

According to the present study, when teaching practices are observable, explicit, and relatively objective, students' perceptions tend to be more congruent with teachers' perceptions than are less observable, implicit, and relatively subjective practices. Given that observable and relatively objective teaching practices are easiest to agree on, it may be useful for researchers to develop concrete items to measure teaching practices.

Another implication relates to increasing students' autonomous motivation and satisfaction of their autonomy, competence, and relatedness needs. The results suggest that decreasing the teacher-student perception gaps on need-supportive practices may promote students' autonomous motivation and satisfaction of their psychological needs. In particular, teacher-student involvement gaps, regardless of absolute or relative, were the most important factor related to students' outcomes. Therefore, teachers should focus on how to build a positive teacher and student relationships. Some intervention programs (Bosman et al., 2021; Murray & Malmgren, 2005) may inform efforts to build positive relationship with students. For example, Murray and Malmgren (2005) tested their teacher-student intervention program and the results showed that, as the positive relationship between teacher and students increased, students' social, emotional, academic adjustment also increased. Their intervention involved teachers meeting with individual students regularly, setting students' goals (not necessarily academic goals) together, assisting students' goal achievement, providing praise, and writing journals for each student. This kind of program may be employed via teacher workshop or professional development training, where teachers learn about these practices, and it may reduce the discrepancies between teachers' and students' perceptions of teachers' practices.

The results of the present study also have potential to inform researchers' decisions about collecting data on teachers' instructional practices. Given that there are the differences between teacher and student perceptions of teaching practices and the least perception gap is the most beneficial to student motivation and need satisfaction, it is important to consider both teacher and

student perceptions. Although previous studies indicate that student perceptions of teachers' instructional practices predict students' motivation more accurately than teacher perceptions do (Kunter & Baumert, 2006), the present study indicates that it is useful to consider the perceptions of both. Understanding implications of differences between teachers' and students' perceptions for some practices may lead to greater efforts to align perceptions.

Limitations and Future Directions

The present study used quantitative measures to collect teacher and student perceptions of need-supportive practices. Even though I found that teachers and students tended to hold different views about the teacher's need-supportive practices, details of exactly how they differ are not clear. Therefore, it may be useful to examine how both students and teachers perceive and interpret need-supportive practices qualitatively. For example, asking students to explain qualitatively why, in detail, they gave specific ratings to their teacher and to give concrete examples of teacher behaviors may be useful, similar to the method used by Patrick and Ryan (2008) to examine students' judgements of their teacher's mastery-promoting practices. Similar open-ended questions could also be asked of teachers. Triangulating students' and teachers' reasoning behind their evaluation of need-supportive practices may provide information necessary to reduce the perceptions gaps between teachers and students.

Another limitation of the current study is that the data were cross-sectional and therefore, I could not test causality of the relations. It would be interesting to longitudinally examine changes in teacher-student absolute or relative rating gaps and, if the rating gap changes, consider how it affects students' autonomous motivation and need satisfaction.

Finally, in the current study, teacher perceptions of need-supportive practices within the classroom generally were measured. However, teachers' expectations for individual students differ, and these expectations influence how teachers interact with students individually (Hornstra et al., 2018), therefore it may be interesting to consider teachers' perceptions of the autonomy support, structure, and involvement they provide to individual students.

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APPENDIX.

Teacher and Student Survey Questionnaire

* All items scored on a 5-point scale

(1 = strongly disagree; 2 = disagree; 3 = undecided; 4 = agree; 5 = strongly agree)

[+] Item was deleted after checking validity and reliability

Student Report of Teacher Need Support:

Teacher as Social Context Questionnaire (TASCQ-S; Belmont et al., 1992)

In my math class…

Autonomy Support

1. It seems like my teacher is always telling me what to do (R). [+]
2. My teacher doesn't listen to my opinion (R).
3. My teacher doesn't give me much choice about how I do my schoolwork (R).
4. My teacher is always getting on my case about schoolwork (R). [+]
5. My teacher doesn't explain why what I do in school is important to me (R).
6. My teacher gives me a lot of choices about how I do my schoolwork.
7. My teacher listens to my ideas.
8. My teacher talks about how I can use the things we learn in school.

Structure

1. Every time I do something wrong, my teacher acts differently (R). [+]
2. My teacher shows me how to solve problems for myself.
3. My teacher keeps changing how he/she acts towards me (R). [+]
4. My teacher doesn't make it clear what he/she expects of me in class (R). [+]
5. My teacher doesn't tell me what he/she expects of me in class (R).
6. My teacher makes sure I understand before he/she goes on.
7. If I can't solve a problem, my teacher shows me different ways to try to.
8. My teacher checks to see if I'm ready before he/she starts a new topic.

Involvement

1. My teacher likes me.
2. My teacher knows me well.
3. My teacher really cares about me.

4. My teacher just doesn't understand me (R).
5. My teacher spends time with me.
6. My teacher talks with me.
7. I can't depend on my teacher for important things (R).
8. I can't count on my teacher when I need him/her (R). [+]

Teacher Report of Their Need Supportive Practices:

Teacher as Social Context Questionnaire (TASCQ-T; Belmont et al., 1992)

In my math class…

Autonomy Support

1. When it comes to assignments, I'm always having to tell these students what to do(R). [+]
2. I can't let these students do things their own way (R).
3. It's better not to give too many choices to these students (R).
4. I find myself telling these students every step to make when it comes to school work(R). [+]
5. It is difficult to explain to these students why what we do in school is important (R).
6. I try to give these students a lot of choices about classroom assignments.
7. I let these students make a lot of their own decisions regarding school work.
8. I encourage these students to think about how schoolwork can be useful to them.

Structure

1. I find it hard to be consistent with these students (R). [+]
2. I show these students different ways to solve problems.
3. I change the rules about school work for these students (R). [+]
4. Sometimes I feel I don't make my expectations clear to these students (R). [+]
5. I talk with these students about my expectations for them.
6. When these students don't understand something, I explain it a lot of different ways.
7. When these students don't comprehend the material, I take a different approach.
8. It's hard to know when these students are ready to go on to new material (R).

Involvement

1. These students are easy to like.
2. I know these students well.

3. When these students do not do as well as they can, I can make time to help them find ways to do better.
4. I don't understand these students very well (R).
5. I spend time with these students.
6. I talk with these students.
7. These students can count on me to be there for them.
8. Sometimes I feel like I can't be there for these students when they need me (R). +

Motivation:

Teacher Self-determination (Taylor & Ntoumanis, 2007)

I teach my class math because…

Autonomous Motivation

1. teaching this class is fun.
2. I feel good when I am teaching this class.
3. I think that teaching this class is pleasurable.
4. I think that teaching this class is interesting.
5. I am doing it for my own good.
6. I believe teaching this class is important for me.
7. I think teaching this class is good for me.
8. it is my personal decision. +

Korean Academic Self-Regulation Questionnaire (K-SRQ-A; A. Y. Kim, 2002)

I study math because …

Autonomous Motivation

1. I enjoy answering challenging questions.
2. It's fun.
3. I like to think about new questions.
4. I enjoy studying math.
5. I enjoy working out the answers to math problems.
6. I want to learn about new things.
7. It helps me to understand difficult concepts.

8. I believe it is valuable to accumulate knowledge.
9. I find out if I'm right or wrong.
10. It helps me to understand the lesson contents.

Student Perceptions of Basic Psychological Need Satisfaction:

Korean Basic Psychological Needs Scale (K-BPNS; Lee & Kim, 2008)

In my math class …

Autonomy

1. I feel pressured from others (R).
2. I frequently have to do what I am told (R).
3. I'm not allowed to choose the way to do activities (R).
4. I feel that I am free to decide for myself how to work in math class. +
5. I generally feel free to express my ideas and opinions.

Competence

1. I feel that I am very effective.
2. People I know tell me I am good at math.
3. Most days I feel a sense of accomplishment from what I do.
4. I feel like I am capable more than others are.
5. I feel like I can teach what I know to others well.

Relatedness

1. I feel that people care about me.
2. I really like the people I interact with.
3. People around me and I generally help each other.
4. The people I interact with do not seem to like me much (R).
5. People around me and I generally share our feelings with each other.