Social Psychology of Education (2025) 28:136
https://doi.org/10.1007/s11218-025-10096-8

Testing the effect of agreement and discrepancy between teachers' and students' reported interpersonal behaviors on students' motivation: a response surface analysis

Nadia Leroy[1,2]

Received: 15 May 2024 / Accepted: 16 June 2025

Abstract

Perceptions of teachers' interpersonal behaviors are known to influence students' motivation and perceived competence, yet it remains unclear how agreement or discrepancy between students' and teachers' perceptions affects these outcomes. This study involved 30 teachers (24 females; M_{age} = 47.25, SD_{age} = 8.90) and 1,062 6th-grade students (529 females; M_{age} = 11.15, SD_{age} = 0.49) from 47 classes, using a multilevel design. Drawing on self-determination theory, polynomial regression and response surface analysis were conducted to assess how congruence and discrepancy in perceived need-supportive behaviors related to students' motivation and competence in mathematics. Results showed that when teachers and students agreed on interpersonal behaviors, boys' autonomous motivation and girls' perceived competence increased, while amotivation decreased for both groups, with a non-linear effect observed for girls' amotivation. In cases where teachers overestimated their supportive behaviors relative to students' reports, both boys' and girls' autonomous motivation and perceived competence declined, and boys' external motivation increased. These findings underscore the importance of perceptual agreement in teacher-student interactions and suggest that interventions grounded in self-determination theory may help improve motivation and educational outcomes.

Keywords Self-determination theory · Classroom dynamics · Multilevel polynomial regression · Response surface methodology

✉ Nadia Leroy
nadia.leroy@univ-grenoble-alpes.fr

[1] Laboratoire de Recherche sur les Apprentissages en Contexte, Université Grenoble Alpes, 1251 Avenue Centrale CS 40700, 38058 Grenoble Cedex, France

[2] UGA - UFR SHS - Bâtiment Michel Dubois– LaRAC, Grenoble Cedex 9, CS 40700 - 38058, France

Published online: 01 July 2025

1 Introduction

Understanding what motivates students in the classroom remains a central concern in educational psychology. Self-Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000) provides a well-established framework to explain how social contexts support or undermine students' motivation by satisfying or frustrating their basic psychological needs for autonomy, competence, and relatedness. When students perceive their teachers as need-supportive—providing choices, encouragement, and respectful communication—they are more likely to experience autonomous motivation and a stronger sense of competence, particularly in cognitively demanding subjects like mathematics (Reeve, 2009; Vansteenkiste et al., 2020).

While most studies in the field of students' motivation have relied on students' self-reports of teacher behaviors, less is known about how alignment—or misalignment—between teachers' and students' perspectives influences motivation. This is an important gap, as research shows that teachers' self-perceptions often diverge from those of their students (Doumen et al., 2009; Bardach et al., 2018), and such discrepancies may reflect meaningful differences in how classroom interactions are experienced and interpreted (Jussim et al., 1996; Rocchi & Pelletier, 2017).

Drawing from SDT, we argue that agreement between teacher- and student-reported interpersonal behaviors is not only a methodological concern but also a psychologically meaningful variable. Agreement may signal a shared understanding of the classroom climate, whereas discrepancies—particularly when teachers overestimate their support—may result in students' needs being unmet, leading to decreased motivation and perceived competence. Conversely, when students perceive more support than teachers report, motivational outcomes may be more favorable, as students feel more autonomy and connection than teachers are aware of.

Mathematics classrooms provide a compelling context to explore the effects of (mis)alignment in teacher- and student-reported interpersonal behaviors on students' motivation and perceived competence. Math instruction often emphasizes structure and evaluation, which can obscure students' sense of autonomy and lead to perceptual mismatches (Jang et al., 2010). Moreover, well-documented gender differences in math-related anxiety, self-concept, and motivation (Eccles & Wigfield, 2002; Stoet & Geary, 2012) suggest that boys and girls may interpret the same teacher behaviors differently, further complicating alignment.

To address these complex relationships, we employed Response Surface Analysis (RSA)—a method that overcomes the limitations of traditional discrepancy scores by modeling both the level and direction of agreement/disagreement between two sources. This method allows us to test whether congruence at high levels of perceived support is more beneficial than congruence at low levels, and whether the effects of discrepancy differ depending on whether the teacher or the student reports higher levels of support (Humberg et al., 2019).

Figure 1 presents our conceptual model: students' motivation and perceived competence are expected to vary as a function of the agreement and discrepancy between teacher-reported and student-perceived need-supportive interpersonal behaviors, with separate response surfaces modeled for boys and girls. This model integrates theoretical constructs from SDT with empirical patterns of (mis)alignment in the

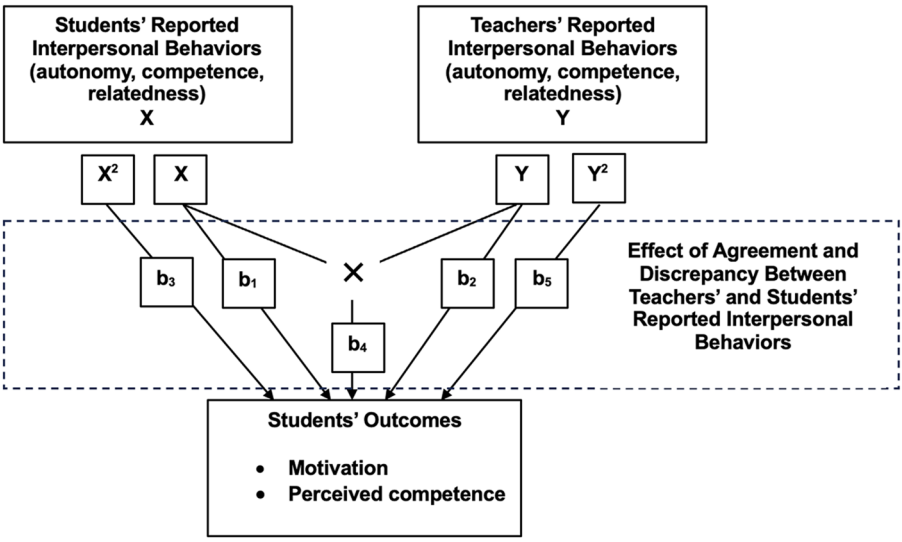

Fig. 1 Conceptual model of agreement, discrepancy, and their impact on students' motivation and outcomes this figure illustrates the relationship between teacher-reported and student-perceived need-supportive interpersonal behaviors (autonomy, competence, and relatedness) emphasizing the dynamics of agreement and discrepancy in relation to students' motivation, and perceived competence

classroom, and it highlights the centrality of both perspectives in understanding motivational processes.

1.1 Self-Determination theory and the role of need-supportive behaviors

SDT emphasizes the importance of autonomy, competence, and relatedness in fostering intrinsic motivation and engagement. These needs are universal and critical for optimal functioning, regardless of cultural or contextual variations (Deci & Ryan, 2000; Vansteenkiste et al., 2020). Autonomy refers to the need to feel volitional and authentic in one's actions. When students perceive their autonomy as supported—such as through meaningful choices or acknowledgment of their perspectives—they are more likely to experience engagement and satisfaction in learning activities. Conversely, when autonomy is thwarted, students often feel coerced or controlled, leading to diminished intrinsic motivation and disengagement.

Competence reflects the need to feel effective and capable in one's interactions with the environment. Students experience competence when they perceive progress in their learning, receive constructive feedback, and successfully navigate challenges. Conversely, frustration of competence needs—such as through repeated failures or unclear expectations—can result in feelings of inadequacy and helplessness, which undermine persistence and engagement (Deci & Ryan, 2002; Vansteenkiste & Ryan, 2013).

Relatedness involves the need to feel connected, valued, and supported by others. When students perceive that their teachers care about them and respect their perspectives, they are more likely to feel a sense of belonging, which fosters engagement

and resilience. Conversely, unmet relatedness needs, such as feelings of isolation or neglect, can lead to emotional disengagement and academic withdrawal (Skinner & Pitzer, 2012; Baumeister & Leary, 1995).

Teachers' need-supportive interpersonal behaviors are critical for fulfilling these psychological needs. These behaviors include autonomy-supportive practices such as providing meaningful choices, encouraging self-expression, and offering rationales for tasks. Competence-supportive behaviors involve setting clear expectations, providing constructive feedback, and designing mastery-oriented activities that build students' confidence and skills. Relatedness-supportive behaviors emphasize care, empathy, and respect, fostering positive relationships and a sense of belonging within the classroom (Reeve, 2009; Deci & Ryan, 2000).

1.2 The role of mathematics and gender in teacher-student perceptual discrepancies

While much of this research focuses on students' perceptions of teachers' behaviors, relatively little attention has been given to teachers' self-perceptions and how these align—or fail to align—with students' views. This misalignment can have significant implications for understanding teacher-student dynamics. Mathematics, in particular, is known for its high cognitive demands, frequent assessment practices, and structured instructional approaches, making it a particularly relevant context for studying teacher-student perceptual discrepancies. Research suggests that students' perceived competence in mathematics plays a crucial role in shaping their motivation and engagement (Eccles & Wigfield, 2002; Marsh & Martin, 2011). However, mathematics instruction often relies on explicit guidance and well-structured learning sequences, which may lead students to perceive lower autonomy, even when teachers believe they are providing sufficient support (Jang et al., 2010). Furthermore, mathematics is a domain where students frequently experience anxiety, which can further influence their perceptions of teacher behaviors (Ashcraft & Krause, 2007; Hembree, 1990). These contextual characteristics suggest that discrepancies between teachers' self-perceptions of their instructional behaviors and students' perceptions of need-support may be particularly pronounced in mathematics classrooms, where rigid instructional structures and assessment pressures can shape differing views on support, autonomy, and competence-building practices (Jang et al., 2010). Given these challenges, mathematics classrooms provide a unique setting in which discrepancies between teachers' and students' perceptions of need-supportive behaviors may be particularly pronounced.

Gender is another key factor that may influence teacher-student perceptual discrepancies, as research suggests that boys and girls interpret and respond to need-supportive teaching practices differently. Since mathematics is a subject where gender differences in motivation, self-efficacy, and anxiety are well-documented, it is essential to consider how these disparities affect students' perceptions of teacher support and the extent to which their views align with or diverge from those of their teachers.

Gender differences significantly shape how students perceive teacher support and experience motivation in the classroom. Research indicates that boys and girls may

interpret teacher behaviors differently, particularly concerning autonomy support, competence support, and controlling behaviors. While girls tend to report higher perceived competence when they receive strong teacher support, boys appear more sensitive to the level of autonomy granted by their teachers (Deci & Ryan, 2000; Vallerand et al., 1997; Wang et al., 2015). These distinctions are particularly relevant in mathematics education, where gender disparities in motivation, self-concept, and engagement have been widely documented. Despite performing equally well, girls frequently report lower self-efficacy and higher levels of anxiety in mathematics compared to boys (Eccles & Wigfield, 2002; Gunderson et al., 2012; Stoet & Geary, 2012). Such factors shape how students interpret teacher feedback and perceive need-supportive behaviors, potentially leading to differential effects of teacher-student agreement or discrepancy on motivation. Moreover, boys and girls may experience different expectations from teachers and parents, which can influence their perception of support in the learning process (Meece et al., 2006). Given these variations, it is important to assess whether teacher-student perceptual alignment impacts boys and girls differently. By incorporating gender into the analysis, this study aims to determine whether certain types of need-supportive behaviors benefit one gender more than the other, particularly in mathematics classrooms, where instructional support and motivation play a crucial role in academic engagement and success.

1.3 Perceptual discrepancy as a motivational construct

Traditional research on teacher-student interactions often assumes alignment between teachers' self-perceptions and students' evaluations. However, evidence suggests that discrepancies between these perspectives are common and may significantly affect classroom dynamics and student outcomes (Skinner & Belmont, 1993). Teachers may overestimate or underestimate their behaviors relative to how students perceive them. These discrepancies can lead to misalignment in relational expectations, potentially affecting students' motivation and engagement (Hughes et al., 1999; Jussim et al., 1996).

Research has shown that discrepancies in teacher-student perceptions are not simply measurement errors but reflect meaningful differences in how behaviors are interpreted and experienced (Bardach et al., 2018; Rodrigues et al., 2021). For example, weak correlations between teachers' and students' evaluations of relatedness suggest that students and teachers may have fundamentally different understandings of what constitutes a supportive relationship (Doumen et al., 2009; Hughes et al., 1999). These differences may be influenced by contextual factors, individual biases, or communication gaps, all of which can shape classroom dynamics (Kluger & DeNisi, 1996; Murray & Greenberg, 2001). Understanding these discrepancies is crucial for developing interventions that enhance teacher-student alignment and improve educational outcomes.

Several frameworks provide insights into teacher-student discrepancies. Pianta's teacher-student relationship framework (1999) emphasizes the quality of relational dynamics, focusing on dimensions such as closeness, conflict, and dependency. This framework has demonstrated the importance of supportive teacher-student relationships for fostering students' social-emotional and academic development. However,

its emphasis on global relational quality limits its ability to address the specific mechanisms driving motivation. Hoza's concept of illusory bias (2002) examines discrepancies between self-perceptions and external evaluations. This framework provides valuable insights into how individuals, including teachers, may overestimate or underestimate their behaviors. While this perspective highlights perceptual accuracy, it focuses less on the motivational or developmental consequences of these discrepancies. In contrast, SDT offers a more comprehensive framework for understanding how teacher behaviors influence students' psychological needs. By examining the functional consequences of alignment and misalignment, SDT provides unique insights into how discrepancies in teacher-student perceptions affect motivation, engagement, and learning outcomes (Deci & Ryan, 2002).

1.4 Toward a more nuanced analysis: the use of response surface analysis

Traditional methods for analyzing discrepancies, such as difference scores or residual scores, have been widely used to investigate the effects of perceptual misalignment on outcomes (Kenny et al., 2006). These methods, while intuitive, present significant limitations. Difference scores fail to disentangle the contributions of individual components to the variance explained, impose untested constraints, and overlook the directionality of discrepancies (Blanton et al., 2006; Edwards, 2001). For instance, they equate discrepancies at high and low levels of agreement (e.g., 5–4 = 1 and 2–1 = 1), ignoring their potentially distinct psychological consequences. To address these issues, we employed Response Surface Analysis (RSA)—a method that enables the modeling of both the level and the direction of congruence and discrepancy between two reports. RSA offers a more nuanced examination of how student outcomes vary as a function of teacher-student alignment, and whether certain types of discrepancy (e.g., teacher overestimation) are more detrimental than others (Humberg et al., 2019). A comprehensive explanation of the response surface analysis method, including detailed equations, statistical interpretations, and graphical representations, is provided in the supplementary material, offering an in-depth discussion of the theoretical and methodological framework applied in this study.

1.5 Study objective and conceptual model

Despite the growing body of research on teacher-student interactions, little is known about the motivational consequences of perceptual (mis)alignment in mathematics education. This study aims to fill that gap by examining how agreement and discrepancy between teacher-reported and student-perceived need-supportive interpersonal behaviors relate to students' motivation and perceived competence in mathematics. Figure 2 presents our conceptual model. We propose that students' motivational outcomes (autonomous motivation, controlled motivation, perceived competence) vary as a function of both the level and the direction of teacher-student alignment, with potential moderation by gender. This framework integrates SDT, perceptual accuracy research, and RSA to offer a multidimensional understanding of classroom motivational dynamics.

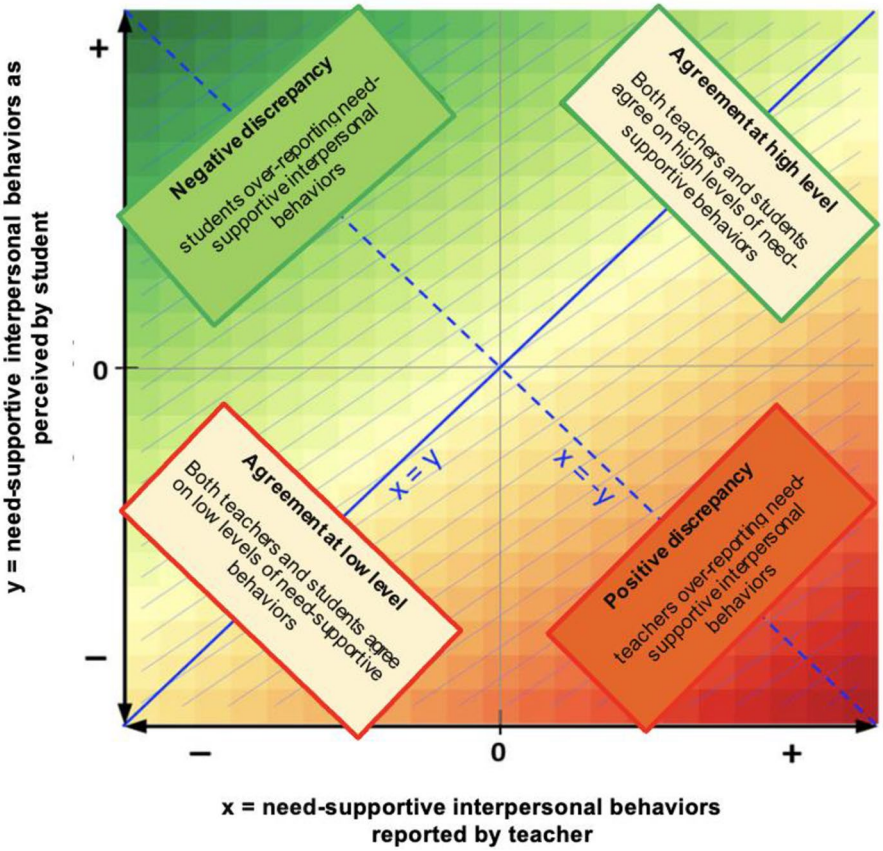

Fig. 2 Teacher-student perception dynamics: agreement and discrepancy in need-supportive behaviors this figure illustrates the relationship between teacher-reported and student-reported perceptions of need-supportive interpersonal behaviors, emphasizing the dynamics of agreement and discrepancy

2 Research questions and hypotheses

This study investigates the dynamics of agreement and discrepancy between teachers' self-reported need-supportive interpersonal behaviors and students' perceptions of these behaviors. To guide the investigation, the study addresses two primary research questions:

Research Question 1 (RQ1): What is the distribution and frequency of agreement and discrepancy patterns (high agreement, low agreement, positive discrepancy, and negative discrepancy) between teachers' reports and students' perceptions of need-supportive behaviors?

Research Question 2 (RQ2): What is the role of agreement and discrepancy patterns in shaping students' motivation and perceived competence, as analyzed using Response Surface Analysis (RSA)?

Three hypotheses are proposed:

H1: Higher agreement between teachers' and students' perceptions of need-supportive interpersonal behaviors (both teachers and students reporting high support, X = Y, top right quadrant) will be associated with greater autonomous motivation and perceived competence, and lower amotivation and external regulation.

H2: When teachers over-report their need-supportive behaviors compared to students' perceptions (positive discrepancy), students will exhibit lower autonomous motivation and perceived competence, alongside higher controlled motivation and amotivation; when students over-report support (negative discrepancy), more favorable motivation patterns are expected.

H3: Negative discrepancy (students over-reporting support) will be associated with greater autonomous motivation and perceived competence than high agreement, while amotivation will be lower in negative discrepancy contexts.

3 Method

3.1 Study design

Following the classification proposed by Sánchez-Martín et al. (2024), our study employs an observational analytical design with a multilevel structure, using a longitudinal approach to examine the relationship between teachers' and students' perceptions of need-supportive behaviors and students' motivation. Data were collected at two points during the school year: Time 1 (end of the first quarter, December) and Time 2 (end of the school year, June). The design aimed to examine the alignment (agreement and discrepancy) between teacher-reported and student-perceived need-supportive behaviors and their effects on students' motivation and perceived competence.

3.2 Participants

Practical constraints such as time and access to schools led to a final sample size of 1,062 middle school students distributed across 47 classes in the 6th grade. The sample consisted of students aged 10 to 12 years. The gender distribution was balanced, with 50.2% girls and 49.8% boys. Academic progression varied, with 76% of students progressing "on time," 18% repeating a grade, and 4% skipping a grade (no information was available for the remaining students). The sample represented diverse socioeconomic backgrounds, with 17% of fathers employed in executive or higher-level intellectual professions, 20% in intermediate professions, 14% as craftsmen, traders, or business owners, 0.2% farmers, 3.5% employees, 15% workers, and 5% unemployed (no information was available for 25.6%). All schools were public, with student populations ranging from 220 to 717. Approximately 33% of the schools were located in Priority Education Zones, which are areas characterized by higher levels of socio-economic disadvantage. These zones receive additional resources and support to address educational inequalities and improve outcomes for students from disadvantaged backgrounds. The participating mathematics teachers ($N = 30$) were predominantly women (80%) and aged between 27 and 59 years ($M = 47.25$,

SD = 8.9). Their teaching experience averaged 22.10 years (*SD* = 10.96). These demographic characteristics align with the general population of French teachers (RESRS, 2022).

3.3 Procedure

The study was conducted in collaboration with 15 school principals, who were initially contacted to obtain permission for data collection. The research objectives were explained in detail to the principals, and their approval was secured before proceeding. Teachers, students, and their parents were subsequently informed about the aims of the study. Written informed consent was obtained from all participants, ensuring ethical compliance. To maintain confidentiality, anonymized codes were assigned to each participant. Data collection was carried out at two distinct time points during the school year. At Time 1 (December), students completed a questionnaire designed to assess their perceptions of their teachers' need-supportive behaviors. Simultaneously, teachers completed a parallel questionnaire to evaluate their own supportive motivational styles during mathematics instruction. This timing was chosen to allow both students and teachers to accumulate sufficient classroom experiences to provide informed and meaningful assessments of these behaviors. At Time 2 (June), students completed additional questionnaires aimed at measuring their motivation and perceived competence.

3.4 Measures

All instruments were administered in French, following a thorough translation-back translation procedure (Harkness & Schoua-Glusberg, 1998). Respondents were asked to indicate the extent to which they agreed with each statement on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4.1 Students-perceived and teachers-reported need-supportive interpersonal behaviors

A French-translated version of the Learning Climate Questionnaire (LCQ) was used to measure the teacher's need-supportive interpersonal behaviors from both students' and teachers' perception. This instrument has been validated and used in several studies (e.g., Black & Deci, 2000; Williams & Deci, 1996). The first subscale, aimed at assessing autonomy-supportive behaviors, comprised four items gauging whether the teacher enabled students to feel like the initiators of their own actions (e.g., In class, my teacher allows me to choose certain things, like exercises to do, etc.). The second subscale assessed competence-supportive behaviors and included items related to how teachers enabled their students to feel capable of effectively completing tasks in class (e.g., What my teacher tells me increases my confidence in class). The third subscale measured relatedness-supportive behaviors and included items evaluating the opportunities provided to students to establish relationships with others and feel emotionally connected to their teacher (e.g., I feel that my teacher understands me). We aggregated scores from each of these three subscales to obtain an overall indica-

tor of the need-supportive interpersonal behaviors as reported by students (ω = 0.88). Since we also needed a commensurable measure to evaluate the need-supportive interpersonal behaviors as reported by teachers, we slightly adapted the instructions so that the item wording referred to the teachers' perception of the need-supportive interpersonal behaviors they adopted in their class, incorporating the three dimensions of need-support (e.g., In class, I allow my students to choose certain things, like exercises to do, etc.; In class, when I talk to my students, I ensure that what I say reinforces their self-confidence in the subject matter; In class, I try to put myself in my students' shoes to better understand them). We aggregated scores from the three subscales to represent the need-supportive interpersonal behaviors as reported by teachers (ω = 0.82).

3.4.2 Students' motivation

Students' motivation was assessed using an adapted version of the Self-Regulated Questionnaire - Academic (SRQ-A) developed by Ryan and Connell (1989). Several questions were asked about the reasons why students adopt different kinds of behaviors in class in three main domains: "Why I do my homework," "Why I work in class," and "Why I try to do well in math class." Multiple-choice response options were provided corresponding to different motivational regulations: external regulation (e.g., because I have been promised rewards if I do well), introjected regulation (e.g., because I would feel bad if I did not do well), identified regulation (e.g., because it's important to me), and intrinsic motivation (e.g., because I enjoy doing my math work). Additional items were integrated to assess amotivation (e.g., honestly, I don't know why I should do my math homework, I really feel like I'm wasting my time). The SRQ-A has been widely used in the educational field, and its validity and reliability have been tested and demonstrated to be strong (Grolnick & Ryan, 1989; Ryan & Deci, 2000). In the current study, the subscales demonstrated very good levels of reliability. ($\omega_{intrinsic} = 0.87$; $\omega_{identified} = 0.86$; $\omega_{introjected} = 0.81$; $\omega_{external} = 0.81$; $\omega_{amotivation} = 0.88$).

3.4.3 Students' perceived competence

To assess students' perceived competence, we used the Self-Description Questionnaire II (SDQ II) developed by Marsh (1992), which is an instrument designed to evaluate self-concept among adolescents. Research has shown the good psychometric properties of the SDQII (e.g., Guérin et al., 2003). For the purposes of the study, only the ten items aimed at evaluating self-concept in mathematics were retained (e.g., "I do well in mathematics"; "I get good grades in mathematics"). The scale demonstrated a very high level of reliability (ω = 0.89).

3.5 Data analytical strategy

All analyses were conducted using R statistical software version 4.3.1 (R Development Core Team, 2022), along with the lme4 (Bates et al., 2015) and RSA (Schönbrodt, 2015) packages. A post hoc power analysis was conducted to evaluate the

adequacy of the sample size used in this study. With five predictors, a sample size of 1062, and an effect size of $f^2 = 0.35$ (considered large according to Cohen's conventions), the power of the analysis was found to be 1.0.

A logistic regression model was fitted to predict missingness in the dataset based on several observed variables, including various measures of student motivation and teacher support. The model results indicated that none of the predictors were significantly associated with the missing data, suggesting that the missing data is likely Missing Completely at Random (MCAR). Therefore, we applied listwise deletion for handling missing data, excluding any observations with missing values in the variables included in the analysis, which ensured that only complete cases were used to fit the mixed-effects model. Multilevel response surface analysis was based on the R script written by Nestler et al. (2019), available on the OSF website: https://osf.io/d9syw/.

To obtain unbiased estimates of fixed effects (Preacher et al., 2006), student-perceived need-supportive interpersonal behaviors was centered on the group mean, and teacher-reported need-supportive interpersonal behaviors was centered on the grand mean. The calculation of squared and interaction terms was also based on centered variables. Thus, centered variables, their squared terms, and their interaction terms were used to predict the outcome variables, including motivation and perceived competence. Additionally, to facilitate interpretation and limit multicollinearity (Marsh et al., 2012), we standardized teachers' reported need-supportive interpersonal behaviors before analysis. We used Full Information Maximum Likelihood (FIML) estimation.

4 Results

4.1 Preliminary analyses

Possible issues of multicollinearity were examined using the variance inflation factor (VIF), with scores below 5 considered acceptable. In this study, VIF scores ranged from 1.00 to 1.30. Normal distributions were assessed by examining estimates of skewness and kurtosis, with acceptable normality considered using thresholds of -2 to +2 and −7 to +7. Skewness and kurtosis values fell within an acceptable range for all variables. Descriptive statistics, internal consistency, and bivariate correlations are presented in Table 1.

The perceived competence is higher in boys than in girls ($t(994) = 6.23$; $p < .001$), as is the case for intrinsic regulation ($t(992) = 2.62$; $p = .009$), external regulation ($t(995) = 4.07$; $p < .001$), and amotivation ($t(1033) = 1.97$; $p = .05$). However, no significant difference was found in identified regulation ($t(995) = -0.005$; $p = .99$) or introjected regulation ($t(1017) = 0.95$; $p = .34$). Independent samples equivalence tests (Lakens, 2017) concluded equivalence of scores between girls and boys for identified regulation ($t(995) = -6.99$; $p < .001$) and introjected regulation ($t(1017) = -7.56$; $p < .001$). Regarding the perceived motivational style, there was no significant difference in perceived support between girls and boys $t(1006) = 0.49$, $p = .62$, nor in reported support between male and female teachers $t(45) = 0.27$, $p = .79$. Equiva-

Table 1 Means, standard deviations, and correlations with confidence intervals

Variables	M	SD	1	2	3	4	5	6	7
1. STU	2.95 (2.98)	0.84 (0.87)							
2. PC	3.08 (3.47)	0.97 (1.00)	0.31**						
			[0.25, 0.36]						
3. INTRINS	2.80 (2.97)	1.01 (1.06)	0.41**	0.60**					
			[0.36, 0.46]	[0.56, 0.64]					
4. IDENT	3.44 (3.44)	1.13 (1.13)	0.35**	0.45**	0.76**				
			[0.29, 0.40]	[0.40, 0.50]	[0.74, 0.79]				
5. INTROJ	3.17 (3.23)	0.92 (0.96)	0.18**	0.10**	0.22**	0.22**			
			[0.12, 0.24]	[0.03, 0.16]	[0.15, 0.28]	[0.16, 0.28]			
6. EXT	2.64 (2.89)	0.98 (0.97)	−0.11**	−0.24**	−0.19**	−0.15**	0.16**		
			[-0.17, −0.05]	[-0.30, −0.18]	[-0.25, −0.13]	[-0.21, −0.09]	[0.10, 0.22]		
7. AMOT	2.38 (2.59)	1.59 (1.88)	−0.27**	−0.46**	−0.56**	−0.60**	−0.07*	0.33**	
			[-0.32, −0.21]	[-0.51, −0.41]	[-0.60, −0.52]	[-0.64, −0.56]	[-0.13, −0.01]	[0.27, 0.38]	
8. TEACH	4.02 (4.06)	0.41 (0.30)	0.02	−0.25	-0.06	-0.17	-0.18	0.14	0.07
			[-0.36, 0.39]	[-0.56, 0.06]	[-0.40, 0.28]	[-0.50, 0.16]	[-0.44, 0.08]	[-0.08, 0.36]	[-0.38, 0.51]

Note. M and SD represent the mean and standard deviation for girls, with values in parentheses for boys. Confidence intervals are shown in brackets. STU = Students-Perceived Need-Supportive Interpersonal Behaviors. PC = Perceived Competence. INTRINS = Intrinsic regulation. IDENT = Identified regulation. INTROJ = Introjected regulation. EXT = External regulation. AMOT = Amotivation. TEACH = Teachers-Reported Need-Supportive Interpersonal Behaviors. Coefficients listed for the TEACH row correspond to coefficients obtained from simple multilevel regression modeling. *p<.05. **p<.01

lence tests concluded equivalence of scores between girls and boys ($t(1006) = -8.77$; $p<.001$) and between male and female teachers ($t(19.1) = -3.97$; $p<.001$).

The students' perceived need-supportive interpersonal behaviors was positively and significantly correlated with perceived competence $r(955)=0.31$, $p<.001$, intrinsic regulation $r(955)=0.41$, $p<.001$, identified regulation $r(955)=0.35$, $p<.001$, and introjected regulation $r(978)=0.18$, $p<.001$. However, it was negatively correlated with external regulation $r(955)=-0.11$, $p<.001$, and with amotivation $r(1009)=-0.26$, $p<.001$.The linear relationship between the students' perceived need-supportive interpersonal behaviors and the teachers' reported need-supportive interpersonal behaviors was non-significant ($b=0.02$, $p=.93$). Similarly, there was no linear relationship between the teachers' reported need-supportive interpersonal behaviors and intrinsic regulation ($b = -0.06$, $p=.72$), identified regulation ($b = -0.17$, $p=.34$), introjected regulation ($b = -0.18$, $p=.19$), external regulation ($b=0.14$, $p=.21$), amotivation ($b=0.07$, $p=.77$), and students' perceived competence ($b = -0.25$, $p=.13$).

4.2 Frequencies of agreement and discrepancy in need-supportive interpersonal behaviors

Discrepancies were identified using a 10% threshold, as suggested by Shanock et al. (2010). All need-supportive interpersonal behavior scores were standardized to z-scores ($M=0$; $SD=1$), and students' scores were subtracted from teachers' scores, given that students' perceptions are often considered the most accurate reflection of teachers' behaviors. The analysis involved calculating: (i) the percentage of behaviors in agreement, defined as scores within ± 0.5 standard deviations of each other, (ii) the percentage of over-reported behaviors, where teachers' scores exceeded students' perceptions by 0.5 standard deviations, and (iii) the percentage of under-reported behaviors, where teachers' scores were lower than students' perceptions by 0.5 standard deviations. This approach, based on the commonly accepted criterion of a half-standard deviation (Shanock et al., 2010), provided a reliable means to identify significant discrepancies and patterns of agreement between teacher and student perceptions of need-supportive behaviors. The average rates of predictor agreement and discrepancy show a distribution in which 75% of students-perceived and teachers-reported need-supportive interpersonal behaviors were discrepant. Specifically, in 50% of the sample, teachers tend to over-report their need-supportive interpersonal behaviors. For the last 25%, teachers tend to under-report their need-supportive interpersonal behaviors. The remaining quarter represented a situation of agreement between students and teachers. These findings imply that discrepancy between teachers' report and students' perceptions of need-supportive interpersonal behaviors occur frequently enough to warrant analyzing the level of agreement and discrepancy in the data with response surface analyses.

4.3 Multilevel polynomial regression models

Following Hox's recommendations (2010), the first step involved estimating empty models to determine the amount of variance at each level of the data structure. The

Table 2 Multilevel models and response surface parameters for girls and boys

	Model A: Intrinsic Regulation		Model B: Identified Regulation		Model C: Introjected Regulation		Model D: External Regulation		Model E: Amotivation		Model F: Perceived Competence	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
	A1	A2	B1	B2	C1	C1	D1	D2	E1	E2	F1	F2
Fixed Effects												
Intercept	2.82*** (0.11)	2.75*** (0.10)	3.62*** (0.12)	3.24*** (0.11)	3.26*** (0.09)	3.15*** (0.11)	2.60*** (0.10)	2.86*** (0.09)	2.28*** (0.15)	2.82*** (0.20)	3.15*** (0.09)	3.50*** (0.11)
	[2.59, 3.05]	[2.54, 2.96]	[3.39, 3.87]	[3.02, 3.47]	[3.08, 3.44]	[2.94, 3.36]	[2.41, 2.80]	[2.67, 3.07]	[1.97, 2.59]	[2.49, 3.22]	[2.97, 3.34]	[3.28, 3.73]
STU	0.56*** (0.09)	0.69*** (0.10)	0.60*** (0.11)	0.60*** (0.11)	0.20* (0.09)	0.40*** (0.09)	−0.29** (0.10)	−0.17† (0.09)	−0.79***(0.16)	−0.89***(0.18)	0.45*** (0.10)	0.45*** (0.10)
	[0.38, 0.75]	[0.51, 0.89]	[0.38, 0.82]	[0.39, 0.81]	[0.01, 0.39]	[0.22, 0.59]	[-0.49, −0.09]	[-0.38, 0.01]	[-1.09, -0.48]	[-1.25, -0.54]	[0.25, 0.65]	[0.26, 0.64]
TEACH	0.06 (0.06)	0.21 (0.22)	−0.32 (0.24)	0.04 (0.23)	−0.19 (0.18)	−0.18 (0.22)	0.03 (0.20)	0.41† (0.21)	−0.12 (0.32)	−0.39 (0.42)	−0.05 (0.18)	−0.30 (0.23)
	[-0.59, 0.33]	[-0.22, 0.64]	[-0.80, 0.16]	[-0.42, 0.51]	[-0.56, 0.17]	[-0.63, 0.27]	[-0.37, 0.43]	[-0.01, 0.81]	[-0.75, 0.51]	[-1.23, 0.44]	[-0.42, -0.31]	[-0.78, 0.16]
STU^2	−0.17 (0.27)	0.06 (0.05)	−0.05 (0.07)	0.02 (0.06)	−0.08 (0.06)	0.06 (0.05)	0.08 (0.06)	0.05 (0.05)	0.14 (0.09)	0.05 (0.09)	−0.04 (0.06)	0.04 (0.05)
	[-0.05, 0.17]	[-0.04, 0.16]	[-0.19, 0.07]	[-0.09, 0.14]	[-0.19, 0.03]	[-0.04, 0.16]	[-0.49, -0.08]	[-0.06, 0.15]	[-0.04, 0.32]	[-0.15, 0.24]	[-0.16, 0.08]	[-0.07, 0.14]
STU*TEACH	−0.15 (0.16)	−0.40** (0.14)	−0.11 (0.19)	−0.35* (0.16)	−0.08 (0.16)	−0.28* (0.14)	0.21 (0.17)	0.12 (0.14)	0.42 (0.27)	0.65* (0.27)	−0.18 (0.17)	−0.21 (0.14)
	[-0.47, -0.17]	[-0.68, -0.12]	[-0.49, 0.26]	[-0.67, -0.03]	[-0.41, 0.24]	[-0.56, -0.01]	[-0.12, 0.55]	[-0.16, 0.41]	[-0.10, 0.94]	[0.13, 1.18]	[-0.51,0.15]	[-0.50,0.07]
$TEACH^2$	0.03 (0.30)	−0.07 (0.23)	−0.18 (0.28)	0.15 (0.25)	0.14 (0.21)	0.19 (0.24)	0.24 (0.23)	−0.49* (0.22)	0.31 (0.237)	0.18 (0.45)	−0.17 (0.21)	0.05 (0.25)
	[-0.71, 0.37]	[-0.52, 0.39]	[-0.75, 0.38]	[-0.34, 0.65]	[-0.29, 0.55]	[-0.29, 0.68]	[-0.23, 0.71]	[-0.93, -0.05]	[-0.41, 1.05]	[-0.71, 1.08]	[-0.60, 0.26]	[-0.46, 0.57]
Random Effects												

Table 2 (continued)

	Model A: Intrinsic Regulation		Model B: Identified Regulation		Model C: Introjected Regulation		Model D: External Regulation		Model E: Amotivation		Model F: Perceived Competence	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Intercept Level 1	0.72 (0.84)	0.83 (0.90)	0.97 (0.98)	1.04 (1.02)	0.79 (0.89)	0.77 (0.88)	0.86 (0.93)	0.84 (0.92)	2.12 (1.46)	2.95 (1.72)	0.83 (0.91)	0.77 (0.88)
Intercept Level 2	0.12 (0.34)	0.06 (0.25)	0.11 (0.33)	0.06 (0.25)	0.03 (0.18)	0.09 (0.29)	0.05 (0.23)	0.05 (0.22)	0.14 (0.37)	0.27 (0.52)	0.03 (0.18)	0.10 (0.32)
ICC	18.8%	14.4%	14.9%	11.4%	5.3%	13.1%	4.2%	7.6%	7.6%	11.8%	10.1%	20.1%
R^2	0.18	0.21	0.16	0.13	0.015	0.06	0.04	0.05	0.10	0.09	0.08	0.14
Response Surface Parameters												
a_1	0.44 (0.24)	0.91** (0.27)	0.28 (0.26)	0.65* (0.29)	0.01 (0.19)	0.22 (0.27)	−0.26 (0.22)	0.23 (0.26)	−0.91** (0.34)	-1.29 *(0.51)	0.39* (0.20)	−0.15 (0.28)
a_2	−0.25 (0.28)	−0.40 (0.31)	−0.35 (0.30)	−0.18 (0.33)	−0.03 (0.22)	−0.03 (0.31)	0.37 (0.25)	−0.33 (0.29)	0.88* (0.39)	0.88 (0.58)	−0.39 (0.23)	−0.13 (0.32)
a_3	0.70** (0.25)	0.49* (0.20)	0.92** (0.27)	0.55* (0.22)	0.39 (0.21)	0.58** (0.21)	−0.32(0.23)	−0.59** (0.19)	−0.68 (0.36)	−0.49 (0.39)	0.51*(0.21)	0.75***(0.22)
a_4	0.04 (0.36)	0.39 (0.24)	−0.12 (0.39)	0.52* (0.26)	0.14 (0.32)	0.54* (0.26)	−0.06 (0.34)	−0.57* (0.23)	0.04 (0.37)	−0.42 (0.48)	−0.02 (0.32)	0.30 (0.26)

Note. STU = Students-Perceived Need-Supportive Interpersonal Behaviors; TEACH = Teachers-Reported Need-Supportive Interpersonal Behaviors; STU*TEACH = interaction term between STU and TEACH; STU^2 = quadratic term of STU; $TEACH^2$ = quadratic term of TEACH; R^2 refers to the percentage of variance explained in the dependent variable; b_1 to b_5 are the unstandardized regression coefficients with 95% confidence intervals in brackets and standard errors in parentheses. R^2 refers to the percentage of variance explained in the dependent variable. † $p<.10$. *$p<.05$. **$p<.01$. ***$p<.001$

intra-class correlation (ICC) values, which quantify the proportion of variance at level 2, are presented in Table 2. While there is no strict rule, it is commonly accepted that ICC values greater than 0.10 justify a multilevel analysis aimed at explaining level 2 variance. However, in this analysis, we estimated multilevel models for all outcome variables, even those with an ICC below 0.10, as our goal was not to model level 2 variance but to produce unbiased estimates for regression coefficients as they are derived to estimate the response surface parameters. First student-perceived need-supportive interpersonal behaviors are significantly related to all variables, for both boys and girls, in line with the expected relationships. The more girls and boys perceived need-supportive behaviors from their math teachers, the stronger the intrinsic regulation (b_1=0.56, SE=0.09, p<.001 for girls and b_1=0.69, SE=0.10, p<.001 for boys) and identified regulation (b_1=0.60, SE=0.11, p<.001 for girls and for boys) and the stronger their perceived competence (b_1=0.45, SE=0.10, p<.001 for girls and for boys). Conversely, students-perceived need-supportive behaviors were negatively related to external regulation (b_1=−0.29, SE=0.10, p=.004 for girls and b_1=−0.17, SE=0.09, p=.06 for boys) and to amotivation (b_1=−0.79, SE=0.16, p<.001 for girls and b_1=−0.89, SE=0.18, p<.001 for boys). Introjected regulation is positively related to students-perceived need-supportive behaviors (b_1=0.20, SE=0.09, p=.03 for girls and b_1=0.40, SE=0.09, p<.001 for boys).

Regarding the teachers' reported need-supportive behaviors, there is no statistically significant relationship with outcome variables in the girls' group. However, among boys, the teachers-reported need-supportive behaviors negatively moderate the positive relationship between the students-perceived need-supportive behaviors and intrinsic regulation. (b_4=−0.40, SE=0.14, p=.005), identified regulation (b_4=−0.35, SE=0.16, p=.03), and introjected regulation (b_4=−0.28, SE=0.14, p=.04). An inverse relationship pattern is observed concerning amotivation, as in this case, teachers' reported need-supportive behaviors positively moderate the negative relationship between amotivation and students' perceived need-supportive behaviors. (b_4=0.65, SE=0.27, p=.01). Finally, in the external regulation regression model, the coefficient associated with the quadratic term of teachers' reported need-supportive behaviors are also statistically significant. (b_4=−0.49, SE=0.22, p=.03), indicating the presence of a nonlinear relationship between these two variables.

4.4 Response surface analysis

We then examined the test associated with the different response surface parameters produced for each dependent variable. Positive and statistically significant values for parameter a_1 indicate that when students-perceived and teachers-reported need-supportive interpersonal behaviors are in agreement, the outcome variable increases as both levels of students-perceived and teachers-reported need-supportive interpersonal behaviors increase. This is the case for girls' perceived competence (a_1=0.39, SE=0.20, p=.05) as well as intrinsic regulation (a_1=0.91, SE=0.27, p=.001) and identified regulation for boys (a_1=0.65, SE=0.29, p=.03). However, as the level of agreement increases, the level of amotivation decreases for both girls (a_1=−0.91, SE=0.34, p=.008) and boys (a_1 = -1.29, SE=0.51, p=.01). It is noteworthy that for girls' amotivation, the positive and statistically significant value of the surface param-

eter a_2 (a_2=0.88, SE=0.39, p=.02) suggests that the negative relationship between the level of agreement and amotivation changes sign for higher levels of agreement. These slope values along the line of congruence partially confirm hypothesis H1 regarding the effect of agreement level.

Furthermore, the response surface parameter a_3 was positive and statistically significant supporting that the direction of discrepancy between students-perceived and teachers-reported need-supportive interpersonal behaviors were meaningful for students' motivation and perceived competence. Specifically, a significant positive a_3 indicates that intrinsic regulation (a_3=0.70, SE=0.25, p=.006 for girls and a_3=0.49, SE=0.20, p=.01 for boys), identified regulation (a_3=0.92, SE=0.27, p<.001 for girls and a_3=0.55, SE=0.22, p=.01 for boys), and perceived competence (a_3=0.51, SE=0.21, p=.02 for girls and a_3=0.75, SE=0.22, p<.001 for boys) are higher when the discrepancy is such that students' perception of need-supportive interpersonal behaviors are higher than teachers' rated need-supportive interpersonal behaviors. Additionally, for boys' identified regulation, the level increases more sharply as the degree of the discrepancy increases (a_4=0.52, SE=0.26, p=.05). This positive effect of discrepancy in direction of students over-reporting need-supportive interpersonal behaviors (a_3=0.58, SE=0.21, p=.006) on boys' introjected regulation strengthens as the degree of discrepancy increases (a_4=0.54, SE=0.26, p=.04). An inverse relationship pattern is observed for boys' external regulation as the effect of discrepancy in direction of students over-reporting need-supportive interpersonal behaviors is negative (a_3=−0.59, SE=0.19, p=.002), and this negative effect strengthens as the degree of discrepancy in direction of students over-reporting need-supportive interpersonal behaviors increases (a_4=−0.57, SE=0.23, p=.01).

Direct observation of the three-dimensional response surface plots presented in Fig. 3 finally confirms hypotheses H3a and H3b. For intrinsic and identified regulations, as well as perceived competence, the response surfaces are higher in the situation of discrepancy in the direction of students' over-reporting need-supportive interpersonal behaviors than in the situation of agreement between teachers and students' reports at a high level. Conversely, external regulation, as well as girls' and boys' amotivation, are lower in the situation of discrepancy in the direction of students' over-reporting than in the situation of agreement at a high level. However, concerning boys' introjected regulation, a higher level is observed in the situation of discrepancy in the direction of students' over-reporting than in the situation of agreement at a high level.

5 Discussion

Guided by Self-Determination Theory (SDT; Deci & Ryan, 1985, 2000), this study examined how agreement and discrepancy between teacher- and student-reported need-supportive interpersonal behaviors influence students' motivation and perceived competence in mathematics. As emphasized in the introduction, SDT posits that students' motivation is fostered when their basic psychological needs for autonomy, competence, and relatedness are satisfied. The current findings contribute to this framework by demonstrating that perceptual alignment between teachers and

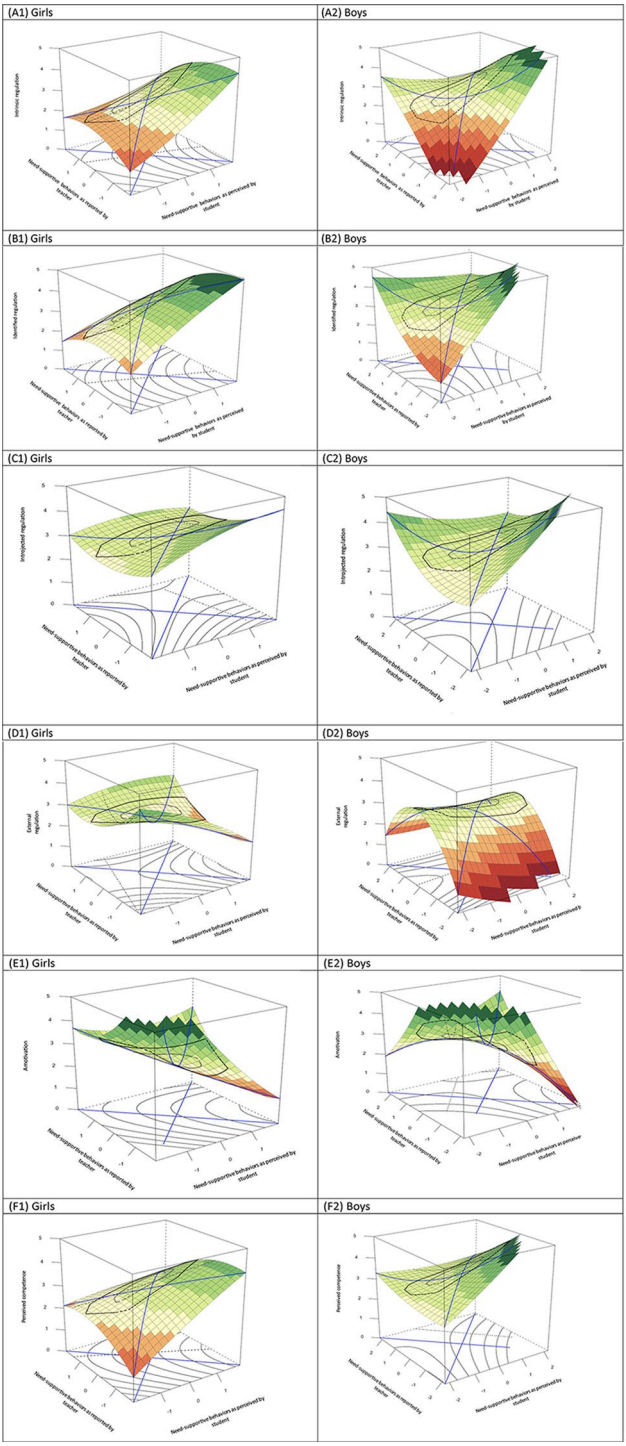

Fig. 3 Response Surface Plots for Intrinsic Regulation, Identified Regulation, Introjected Regulation, External Regulation, Amotivation, and Perceived Competence for Boys and Girls Response surface plots for intrinsic regulation (**A1-A2**), identified regulation (**B1-B2**), introjected regulation (**C1-C2**), external regulation (**D1-D2**), amotivation (**E1-E2**), and perceived competence (**F1-F2**) are presented for both girls and boys. The subfigures illustrate the effects of agreement and discrepancy in teacher-student interactions on motivation and perceived competence

students may serve as a contextual signal indicating whether these needs are being met or frustrated, thereby shaping students' autonomous motivation, controlled motivation, and competence beliefs. To address these research questions, we employed multilevel polynomial regression combined with response surface analysis (RSA), allowing us to simultaneously assess the joint effects of both students' and teachers' perceptions and visualize these effects using three-dimensional plots. This analytical approach, which remains underutilized in social psychology, enabled us to capture both linear and non-linear patterns of association while accounting for the nested structure of the data.

5.1 Distribution and frequency of agreement and discrepancy patterns

To address RQ1, we examined the distribution and frequency of agreement and discrepancy patterns between teachers' reports and students' perceptions of need-supportive interpersonal behaviors. The results revealed four distinct patterns: high agreement, low agreement, positive discrepancy (teachers over-reporting need-support), and negative discrepancy (students over-reporting need-support). High agreement accounted for 25% of cases, with low agreement making up another 25%. Notably, positive discrepancy was observed in 50% of cases, consistent with research suggesting that individuals in authority roles, such as teachers or coaches, often overestimate their positive behaviors (Rocchi & Pelletier, 2017). These discrepancies are not merely artifacts of measurement error but reflect meaningful psychological and social processes. For instance, the "better-than-average" phenomenon (Alicke & Govorun, 2005) highlights how individuals tend to view their own behaviors more favorably than others might.

These findings emphasize the importance of considering discrepancies as more than measurement limitations, as they can provide valuable insights into classroom dynamics and interpersonal relationships. Moving beyond one-way perspectives, it is essential to consider both teachers' and students' reports to fully capture the nuances of need-supportive interpersonal behaviors. Factors driving these discrepancies may include psychological need satisfaction among teachers, external pressures such as curriculum demands, challenges in managing diverse student needs, or inadequate recognition and support from superiors (Pelletier et al., 2002). Additionally, the role of context-specific challenges, such as teaching mathematics—a subject often perceived as inherently more abstract and challenging—may amplify these discrepancies, influencing both teachers' self-perceptions and students' assessments of their behaviors.

These results underscore the need to account for over-reporting and under-reporting when conducting self-reported studies on interpersonal behaviors, as both can significantly impact the validity and reliability of findings. For example, over-reporting by teachers could stem from a desire to align with professional standards or to present themselves favorably, while under-reporting may reflect a lack of confidence or heightened awareness of their shortcomings. Exploring these discrepancies further could elucidate why some teachers exaggerate, underestimate, or accurately report their interpersonal behaviors, offering deeper insights into the social and psychological factors influencing teacher-student interactions. Such investigations would

not only advance theoretical understanding but also provide practical strategies for improving alignment in teacher-student perceptions, thereby fostering more effective and supportive classroom environments.

The instructional context of mathematics may partly explain the discrepancies observed between teachers' and students' perceptions of need-supportive behaviors. Given that mathematics instruction is often highly structured, teachers may perceive themselves as providing sufficient autonomy support, whereas students—accustomed to guided instruction—may interpret the same behaviors as controlling. Additionally, prior research highlights the importance of perceived competence in mathematics for student engagement (Eccles & Wigfield, 2002), suggesting that students with lower confidence in their abilities may be more sensitive to discrepancies in perceived teacher support.

5.2 Relationships between agreement and discrepancy patterns and students' motivation and perceived competence

To address RQ2, we examined the relationships between agreement and discrepancy patterns in teachers' self-reported and students' perceived need-supportive interpersonal behaviors, and their associations with students' motivation and perceived competence. Using multilevel polynomial regression modeling and Response Surface Analysis (RSA), the findings indicated that perceptual alignment between teachers and students was positively related to intrinsic and identified motivation, as well as perceived competence, while being negatively related to external regulation and amotivation. These results are consistent with prior research emphasizing the benefits of perceptual alignment in leader-subordinate dynamics (Cable & DeRue, 2002; Edwards, 2008; Kristof-Brown et al., 2005; Kristof-Brown & Guay, 2011).

The analysis also revealed complex, non-linear relationships. For instance, among girls, higher levels of alignment were unexpectedly associated with increased amotivation, possibly reflecting heightened social pressure or a desire to conform when agreement reaches very high levels. This suggests that while alignment is generally beneficial, excessive convergence may at times produce unintended negative effects. Among boys, higher alignment was consistently associated with greater intrinsic and identified motivation, and lower external regulation and amotivation, pointing to potential gender differences in how alignment interacts with motivational processes.

Regarding discrepancies, both the direction and magnitude of misalignment appeared to be critical. Negative discrepancies—where students reported perceiving more support than teachers—were linked to higher autonomous motivation and perceived competence in both boys and girls. In contrast, positive discrepancies—where teachers reported higher support than students—were associated with lower intrinsic and identified motivation, weaker perceived competence, and higher external regulation, especially for boys. These findings align with prior evidence suggesting that overestimation of supportive behaviors by authority figures may undermine relational and motivational outcomes (Rocchi & Pelletier, 2017).

RSA further illuminated the role of discrepancy magnitude, showing that larger discrepancies had stronger associations with boys' identified, introjected, and external regulations. Interestingly, while high alignment was generally linked to positive

outcomes, situations in which students over-reported need-supportive behaviors yielded even more favorable associations with intrinsic motivation, identified regulation, and perceived competence compared to perfect alignment. This suggests that certain forms of misalignment—specifically when students perceive greater support than teachers acknowledge—may still foster enhanced motivation and competence.

Overall, these findings emphasize that discrepancies between teachers' and students' perceptions are not mere methodological artifacts but reflect meaningful psychological and social dynamics. Such misalignments may result from differences in interpretation shaped by contextual factors, interpersonal experiences, and individual expectations. For example, the distinctive features of mathematics instruction—often characterized by structure and evaluation—may increase the likelihood of perceptual mismatches, placing greater pressure on both teachers and students.

By conceptualizing both agreement and discrepancy as psychologically meaningful constructs, this study offers novel insights into how perceptual alignment relates to teacher-student dynamics and student motivation. These results carry important implications for teacher training programs, highlighting the value of fostering teacher awareness of students' subjective experiences and promoting open communication to reduce perceptual gaps. Encouraging teachers to actively seek student feedback may help cultivate more supportive and motivating classroom climates. Future research should further explore these processes, with particular attention to contextual and gendered factors influencing the direction and magnitude of perceptual discrepancies in educational settings.

Finally, these patterns are consistent with Self-Determination Theory, which emphasizes that students' motivational quality depends on the extent to which their psychological needs are satisfied. High agreement may reflect effective need-supportive teaching, while discrepancies—particularly when teachers overestimate their support—may indicate unrecognized need frustration from the students' perspective, contributing to decreased intrinsic motivation and competence beliefs. Conversely, when students perceive more support than teachers report, this may reflect enhanced experiences of autonomy, competence, or relatedness that are not fully recognized by teachers. Overall, the present study extends the SDT framework by demonstrating that teacher-student perceptual agreement functions as a meaningful indicator of psychological need satisfaction in the classroom, with direct consequences for students' motivational profiles and perceived competence.

5.3 Implications for future research

This study offers valuable insights into the dynamics of agreement and discrepancy between teachers' self-reported need-supportive behaviors and students' perceptions, highlighting their influence on students' motivation and perceived competence. Future research could build upon these findings by exploring several avenues to deepen our understanding of these dynamics.

First, expanding the sample size at the class level would help provide more stable correlations and more precise estimates, especially when investigating complex interactions within educational settings. While this study provides a cross-sectional examination of teacher-student perceptual agreement and discrepancy, future research

should investigate how these perceptions evolve over time. Existing research suggests that students' motivation and perceived competence fluctuate throughout the academic year, and teacher-student relationships may strengthen or weaken as classroom interactions accumulate (Roorda et al., 2011; Skinner & Belmont, 1993). Longitudinal studies in educational psychology indicate that perceived autonomy support and need satisfaction are dynamic rather than static (Jang et al., 2016), suggesting that discrepancies between teacher and student perceptions of support could also shift over time. Additionally, studies on teacher effectiveness have shown that instructional practices adapt in response to classroom needs, further reinforcing the potential for evolving perceptual alignment (Hafen et al., 2015). Investigating teacher-student perceptual discrepancies across multiple time points could provide deeper insights into whether and how such misalignments persist, intensify, or diminish over time, contributing to a more nuanced understanding of their impact on student motivation and learning outcomes."

Another promising avenue for future research involves exploring the role of gender in shaping teacher-student interactions. Given the gender imbalance in our teacher sample, future studies could investigate how teacher and student gender may influence the discrepancies in perceptions, particularly in educational settings where gender dynamics play a significant role in classroom interactions. Research in organizational psychology has suggested that female leaders tend to have fewer discrepancies in their self-reports compared to subordinates, so this is an area worth exploring in greater depth.

Furthermore, while this study focused on mathematics, future research could extend these findings to other academic subjects, each with its own unique set of challenges. Exploring subject-specific variations in teacher-student perceptual alignment could provide valuable insights for tailoring pedagogical strategies to different academic disciplines. Understanding how the subject matter itself influences teacher-student perceptions could provide important insights into how specific challenges in teaching various content areas shape teacher behaviors and student motivation.

Finally, exploring contextual factors such as shared gender, race, or interest in the subject matter may offer valuable perspectives on teacher-student relationships. Students may feel more connected to teachers with whom they share certain characteristics, and this connection could significantly influence their motivation and engagement. Future research should further explore these factors to gain a deeper understanding of how teacher-student relationships are shaped and how they influence motivation in the classroom.

5.4 Implications for practice

From a practical perspective, the findings of this study suggest several implications for teacher training and intervention programs. Specifically, discrepancies in teachers' self-reports and students' perceptions of need-supportive behaviors can negatively affect student motivation and perceived competence. Teachers should be made aware of how their behaviors are perceived by students, and training programs should emphasize the importance of aligning teachers' perceptions with students' experiences. To improve teachers' awareness of how their behaviors are perceived by

students, training programs should integrate structured reflection exercises, such as video-based self-evaluations or role-playing activities, where teachers compare their self-assessments with student feedback (Sherin & van Es, 2009). Providing teachers with opportunities to observe their own interactions with students, such as through video recordings, can enhance self-awareness and encourage more need-supportive practices. Engaging in this type of reflection allows teachers to identify potential discrepancies between their intended behaviors and students' experiences, fostering greater sensitivity to student needs.

Additionally, incorporating student feedback mechanisms can provide teachers with valuable insights into how their behaviors are received in the classroom. Structured classroom surveys focusing on perceived autonomy support, competence support, and teacher responsiveness offer concrete data that teachers can use to adjust their instructional strategies accordingly (Ryan & Deci, 2017). Encouraging teachers to solicit student feedback regularly can help create a more dynamic and responsive learning environment, where teachers refine their approaches based on students' evolving needs.

A further refinement in teacher training is the use of dual-perspective classroom observations, where both teachers and students independently evaluate the same lesson. After the lesson, they can compare perspectives, identifying areas of alignment and misalignment in perceived support. This approach has been effective in helping teachers recognize unintended controlling behaviors that may reduce student motivation (Reeve, 2009). By creating structured opportunities for teachers and students to discuss their perceptions, schools can promote a shared understanding of effective teaching practices.

Finally, the development of mentorship and coaching programs can support teachers in refining their instructional approaches. Schools and teacher preparation programs could introduce mentorship initiatives where experienced educators guide new teachers in aligning their instructional intentions with student experiences. Collaborative discussions based on student feedback can help teachers refine their ability to anticipate and adjust their teaching behaviors to better meet student needs. Providing teachers with structured opportunities to reflect on student perceptions and integrate feedback into their practice can enhance classroom engagement and learning outcomes.

By implementing these strategies in teacher education and professional development programs, schools can foster a culture of continuous learning and adaptation, ensuring that teachers remain attuned to student needs. Encouraging teachers to engage in structured reflection, seek feedback, and adopt a student-centered perspective can contribute to more supportive and effective learning environments, ultimately benefiting both teachers and students.

5.5 Limitations and future research

This study provides valuable insights into teacher-student dynamics, yet several limitations should be addressed in future research. First, the relatively small sample size at the class level may have contributed to unstable correlations and the potential over-

estimation of significant effects. Larger, more representative sample sizes are essential to ensure more reliable results and to enhance the generalizability of the findings.

Additionally, the study used a single assessment of teachers' need-supportive behaviors. While previous research shows moderate temporal consistency in such assessments (Curby et al., 2011; Hamre et al., 2009), future research using a repeated measures design would offer greater insights into how these behaviors evolve over time. By collecting data at multiple time points, researchers could examine how the dynamics of agreement and discrepancy between teachers' and students' perceptions develop and influence students' motivation and competence over the course of a school year.

Another limitation is the gender imbalance in the teacher sample, with only six male teachers, which restricts our ability to examine potential gender-related differences in teacher-student interactions. Given that female leaders tend to show fewer discrepancies in their self-reports compared to their subordinates (Eagly, 2005), future studies should investigate whether teacher and student gender plays a role in shaping discrepancies in perceptions.

This study focused exclusively on mathematics, a subject with unique challenges, such as its abstract nature and emphasis on problem-solving. Future research should extend these findings to other subjects to assess whether the dynamics observed in mathematics generalize to different academic domains. Exploring how the specific challenges of teaching various subjects interact with teacher-student perceptions and influence student motivation could provide a more comprehensive understanding of the impact of need-supportive behaviors across disciplines.

Moreover, this study did not account for contextual factors such as shared gender, race, or interest in the subject matter, which could significantly impact the teacher-student relationship. Research suggests that students may feel more connected to teachers who share similar characteristics, which can influence motivation and engagement (Cheryan et al., 2009). Future research should examine how these contextual factors shape teacher-student interactions and the resulting effects on student motivation.

6 Conclusion

This study provides valuable insights into the complex dynamics of teacher-student interactions, specifically focusing on the relationship between teachers' self-reported need-supportive behaviors and students' perceptions of these behaviors. By examining the agreement and discrepancies between these perspectives, the research contributes to understanding how these factors influence students' motivation and perceived competence. This work highlights the importance of considering both teachers' self-reports and students' perceptions in the study of teacher-student dynamics, as discrepancies in these perceptions may significantly affect student outcomes. It introduces a novel application of polynomial regression and RSA to analyze the interactions between teacher and student perceptions. RSA, a sophisticated statistical tool, allows for a nuanced exploration of both linear and non-linear relationships, deepening our understanding of how perceptual alignment—or the lack thereof—affects

student motivation and engagement. Recognizing the importance of multi-informant discrepancies in teacher-student interactions, this study advocates for the necessity of considering both teachers' and students' perspectives when identifying conditions conducive to students' motivation and well-being in the classroom. The study also highlights that teachers' and students' perceptions of interpersonal behaviors do not always coincide, underscoring the need for more refined methods to assess these relationships. Teachers must be made aware of how their behaviors are perceived by students, and training programs should focus on helping teachers align their self-perceptions with those of their students. This alignment can foster a more supportive and motivating classroom environment, ultimately benefiting both teacher effectiveness and student motivation. By reflecting on the findings of this study and considering the implications for teacher practice and future research, we aim to advance our understanding of how teacher-student dynamics shape educational outcomes and contribute to more effective teaching strategies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11218-025-10096-8.

Data availability The study design and analysis plans were not preregistered. The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Declarations

Conflicts of interest We have no conflicts of interest to disclose

References

Alicke, M. D., & Govorun, O. (2005). The better-than-average effect. In M. D. Alicke, D. A. Dunning, & J. I. Krueger (Eds.), *The self in social judgment* (pp. 85–106). Psychology.

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review*, *14*(2), 243–248. https://doi.org/10.3758/BF03194059

Bardach, L., Khajavy, G. H., Hamedi, S. M., Schober, B., & Lüftenegger, M. (2018). Student-teacher agreement on classroom goal structures and potential predictors. *Teaching and Teacher Education*, *74*, 249–260. https://doi.org/10.1016/j.tate.2018.05.010

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1). https://doi.org/10.18637/jss.v067.i01

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*(6), 740–756. https://doi.org/10.1002/1098-237X(200011)84:6%2c740::AID-SCE4%2e3.0.CO;2-3

Blanton, H., Jaccard, J., Gonzales, P. M., & Christie, C. (2006). Decoding the implicit association test: Implications for criterion prediction. *Journal of Experimental Social Psychology*, *42*, 192–212. https://doi.org/10.1016/j.jesp.2005.07.003

Cable, D. M., & DeRue, D. S. (2002). The convergent and discriminant validity of subjective fit perceptions. *Journal of Applied Psychology*, *87*(5), 875–884. https://doi.org/10.1037/0021-9010.87.5.875

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology*, *97*(6), 1045–1060. https://doi.org/10.1037/a0016239

Curby, T. W., Stuhlman, M., Grimm, K., Mashburn, A., Chomat-Mooney, L., Downer, J., Hamre, B., & Pianta, R. C. (2011). Within-day variability in the quality of classroom interactions during third and fifth grade. *The Elementary School Journal*, *112*(1), 16–37. https://doi.org/10.1086/660682

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and Self-determination in human behavior*. Springer Science & Business Media. https://doi.org/10.1007/978-1-4899-2271-7

Deci, E. L., & Ryan, R. M. (2000). The what and why of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (Eds.). (2002). *Handbook of self-determination research*. University of Rochester.

Doumen, S., Verschueren, K., Buyse, E., De Munter, S., Max, K., & Moens, L. (2009). Further examination of the convergent and discriminant validity of the student–teacher relationship scale. *Infant and Child Development*, *18*, 502–520. https://doi.org/10.1002/icd.635

Eagly, A. H. (2005). Achieving relational authenticity in leadership: Does gender matter? *The Leadership Quarterly*, *16*(3), 459–474. https://doi.org/10.1016/j.leaqua.2005.03.007

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*(1), 109–132. https://doi.org/10.1146/annurev.psych.53.100901.135153

Edwards, J. R. (2001). Ten difference score Myths. *Organizational Research Methods*, *4*, 265–287. https://doi.org/10.1177/109442810143005

Edwards, J. R. (2008). Person–environment fit in organizations: An assessment of theoretical progress. *The Academy of Management Annals*, *2*(1), 167–230. https://doi.org/10.1080/19416520802211503

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, *81*(2), 143–154. https://doi.org/10.1037/0022-0663.81.2.143

Guérin, F., Marsh, H. W., & Famose, J. P. (2003). Construct validation of the self-description questionnaire II with a French sample. *European Journal of Psychological Assessment*, *19*(2), 142–150. https://doi.org/10.1027/1015-5759.19.2.142

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles: A Journal of Research*, *66*(3–4), 153–166. https://doi.org/10.1007/s11199-011-9996-2

Hafen, C. A., Hamre, B., Allen, J. P., Bell, C., Gitomer, D., & Pianta, R. C. (2015). Teaching through interactions in secondary school classrooms: Revisiting the factor structure and practical application of the classroom assessment scoring system-secondary. *Journal of Early Adolescence*, *35*, 651–680. https://doi.org/10.1177/0272431614537117

Hamre, B. K., Pianta, R. C., & Chomat-Mooney, L. (2009). Conducting classroom observations in school-based research. In L. M. Dinella (Ed.), *Conducting science-based psychology research in schools* (pp. 79–105). American Psychological Association. https://doi.org/10.1037/11881-004

Harkness, J., & Schoua-Glusberg, A. (1998). Questionnaires in translation. In J. Harkness (Ed.), *Cross-Cultural survey equivalence, zentrum für umfragen, methoden und Analysen-ZUMA* (pp. 87–126). Mannheim.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, *21*(1), 33–46. https://doi.org/10.2307/749455

Hox, J. J. (2010). Multilevel analysis: Techniques and applications (2nd ed.). Routledge. https://doi.org/10.4324/9780203852279

Hoza, B., Pelham, W. E., Dobbs, J., Owens, J. S., & Pillow, D. R. (2002). Do boys with attention-deficit/hyperactivity disorder have positive illusory self-concepts? *Journal of Abnormal Psychology*, *111*(2), 268–278. https://doi.org/10.1037/0021-843X.111.2.268

Hughes, J. N., Cavell, T. A., & Jackson, T. (1999). Influence of the teacher–student relationship on childhood conduct problems: A prospective study. *Journal of Clinical Child Psychology*, *28*(2), 173–184. https://doi.org/10.1207/s15374424jccp2802_5

Humberg, S., Nestler, S., & Back, M. D. (2019). Response surface analysis in personality and social psychology: Checklist and clarifications for the case of congruence hypotheses. *Social Psychological and Personality Science*, *10*(3), 409–419. https://doi.org/10.1177/1948550618757600

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, *102*, 588–600. https://doi.org/10.1037/a0019682

Jang, H., Kim, E. J., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction*, *43*, 27–38. https://doi.org/10.1016/j.learninstruc.2016.01.002

Jussim, L., Eccles, J., & Madon, S. (1996). Social perception, social stereotypes, and teacher expectations: Accuracy and the quest for the powerful self-fulfilling prophecy. In M. P. Zanna (Ed.), *Advances in experimental social psychology*, Vol. 28, pp. 281–388). Academic Press. https://doi.org/10.1016/S0065-2601(08)60240-3

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. Guilford Press.

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*(2), 254–284. https://doi.org/10.1037/0033-2909.119.2.254

Kristof-Brown, A., & Guay, R. P. (2011). *Person–environment fit. In S. Zedeck (Ed.), APA handbook of industrial and organizational psychology, Vol. 3. Maintaining, expanding, and contracting the organization* (pp. 3–50). American Psychological Association. https://doi.org/10.1037/12171-001

Kristof-Brown, A. L., Zimmerman, R. D., & Johnson, E. C. (2005). Consequences of individual's fit at work: A meta-analysis of person-job, person-organization, person-group, and person-supervisor fit. *Personnel Psychology*, *58*(2), 281–342. https://doi.org/10.1111/j.1744-6570.2005.00672.x

Lakens, D. (2017). Equivalence tests: A practical primer for t tests, correlations, and meta-analyses. *Social Psychological and Personality Science*, *8*(4), 355–362. https://doi.org/10.1177/1948550617697177

Marsh, H. W. (1992). *The Self-Description Questionnaire (SDQ) I: A theoretical and empirical basis for the measurement of multiple dimensions of preadolescent self-concept: A test manual and research monograph*. University of Western Sydney.

Marsh, H. W., & Martin, A. J. (2011). Academic self-concept and academic achievement: Relations and causal ordering. *British Journal of Educational Psychology*, *81*(1), 59–77. https://doi.org/10.1348/000709910X503501

Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J. S., Abduljabbar, A. S., & Köller, O. (2012). Classroom climate and contextual effects: Conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist*, *47*(2), 106–124. https://doi.org/10.1080/00461520.2012.670488

Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, *44*(5), 351–373. https://doi.org/10.1016/j.jsp.2006.04.004

Murray, C., & Greenberg, M. T. (2001). Relationships with teachers and bonds with school: Social emotional adjustment correlates for children with and without disabilities. *Psychology in the Schools*, *38*(1), 25–41. https://doi.org/10.1002/1520-6807(200101)38:1%2c25::AID-PITS4%2e3.0.CO;2-C

Nestler, S., Humberg, S., & Schönbrodt, F. D. (2019). Multilevel response surface analysis. Retrieved from osf.io/jhyu9.

Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology*, *94*(1), 186–196. https://doi.org/10.1037/0022-0663.94.1.186

Pianta, R. C. (1999). *Enhancing relationships between children and teachers*. American Psychological Association. https://doi.org/10.1037/10314-000

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interactions in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics*, *31*(4), 437–448. https://doi.org/10.3102/10769986031004437

R Core Team (2022). *R: A language and environment for statistical computing. R Foundation for Statistical Computing*, Vienna, Austria. https://www.R-project.org/

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, *44*(3), 159–175. https://doi.org/10.1080/00461520903028990

Repères et références statistiques, édition 2022, DEPP.

Rocchi, M., & Pelletier, L. (2017). The antecedents of coaches' interpersonal behaviors: The role of the coaching context, coaches' psychological needs, and coaches' motivation. *Journal of Sport & Exercise Psychology*, *39*(6), 366–378. https://doi.org/10.1123/jsep.2016-0267

Rodrigues, F., Pelletier, L. G., Rocchi, M., Neiva, H. P., Teixeira, D. S., Cid, L., Silva, R. L., & Monteiro, D. (2021). Trainer-exerciser relationship: The congruency effect on exerciser psychological needs using response surface analysis. *Scandinavian Journal of Medicine & Science in Sports*, *31*(1), 226–241. https://doi.org/10.1111/sms.13825

Roorda, D. L., Koomen, H. M., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher-student relationships on students' school engagement and achievement: A Meta-Analytic approach. *Review of Educational Research*, *81*, 493–529. https://doi.org/10.3102/0034654311421793

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Sánchez-Martín, M., Gea, P., Aparicio, A. I. R., Navarro-Mateu, M., F., & Olmedo Moreno, E. M. (2024). A practical approach to quantitative research designs. *Espiral Cuadernos Del Profesorado*, *17*(35), 117–132. https://doi.org/10.25115/ecp.v17i35.9725

Schönbrodt, F. D. (2015). *RSA: An R package for response surface analysis (version 0.9.7*). Retrieved from http://cran.r-project.org/web/packages/RSA/index.html

Shanock, L. R., Baran, B. E., Gentry, W. A., Pattison, S. C., & Heggestad, E. D. (2010). Polynomial regression with response surface analysis: A powerful approach for examining moderation and overcoming limitations of difference scores. *Journal of Business and Psychology*, *25*(4), 543–554. https://doi.org/10.1007/s10869-010-9183-4

Sherin, M. G., & Van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, *60*, 20–37. https://doi.org/10.1177/0022487108328155

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, *85*(4), 571–581. https://doi.org/10.1037/0022-0663.85.4.571

Skinner, E. A., & Pitzer, J. R. (2012). Developmental dynamics of student engagement, coping, and everyday resilience. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 21–44). Springer Science+Business Media. https://doi.org/10.1007/978-1-4614-2018-7_2

Stoet, G., & Geary, D. C. (2012). Can stereotype threat explain the gender gap in mathematics performance and achievement? *Review of General Psychology*, *16*(1), 93–102. https://doi.org/10.1037/a0026617

Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout. *Journal of Personality and Social Psychology*, *72*(5), 1161–1176. https://doi.org/10.1037/0022-3514.72.5.1161

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, *23*(3), 263–280. https://doi.org/10.1037/a0032359

Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion*, *44*(1), 1–31. https://doi.org/10.1007/s11031-019-09818-1

Wang, M. T., Degol, J., & Ye, F. (2015). Math achievement is important, but task values are critical, too: Examining the intellectual and motivational factors leading to gender disparities in STEM careers. *Frontiers in Psychology*, *6*, 36. https://doi.org/10.3389/fpsyg.2015.00036

Williams, G. C., & Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology*, *70*(4), 767–779. https://doi.org/10.1037/0022-3514.70.4.767

Nadia Leroy is Associate Professor of Educational Psychology at Université GrenobleAlpes. Her research examines the developmental trajectories of motivation instudents and teachers, drawing on self-determination theory, achievement goal theory,and expectancy-value theory. She applies advanced quantitative methods suchas structural equation modeling, multilevel growth modeling, and response surfaceanalysis to study person-environment fit and its effects on academic and professionaloutcomes.