



Student emotions in class: The relative importance of teachers and their interpersonal relations with students[☆]



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ABSTRACT

This study highlights the importance of teachers in relation to the emotions students experience in class. First, in line with the work of Kenny, we argue that the specific relationship that evolves between teachers and students drives students' emotional experiences. We decompose variability in student emotions not only into the commonly investigated student and teacher facets but also into facets representing specific pairings of teachers with classes and students (so-called relationship effects). Second, using interpersonal theory, we assess the degree to which the interpersonal quality of teaching accounts for variability in student emotions. Cross-classified multilevel modelling of 8042 student ratings ($N = 1668$ secondary school students, $M_{age} = 14.94$) of 91 teachers indicated that a considerable amount of variability that is usually assigned to the student level may be due to relationship effects involving teachers. Furthermore, the way that teachers interpersonally relate to their students is highly predictive of student emotions. In sum, teachers may be even more important for student emotions than previous research has indicated.

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1. Introduction

Emotions are an important student outcome but they also affect motivation for learning, self-regulation, lifelong learning skills and academic achievement (Mega, Ronconi, & De Beni, 2014; Pekrun, Goetz, Titz, & Perry, 2002). Studies consider the social environment a major source of emotions in everyday life (Baumeister & Leary, 1995; Keltner, Van Kleef, Chen, & Kraus, 2008) and in academic settings (Martin & Dowson, 2009; Pekrun & Perry, 2014; Pekrun, Elliot, & Maier, 2006). In classrooms, teachers are the focal point of many social exchanges, and they are the professionals whose task is to organize the (social) classroom environment. This study used two ways to gauge the importance of teachers and their interpersonal relations with students for student emotions in class.

First, in line with the conceptual and empirical work of Kenny and colleagues (Kenny, 1994; Kenny, Kashy, & Cook, 2006), we argue that in addition to the teacher and the student themselves, the specific relationship that evolves between them drives students' emotional experiences. Thus, beyond the trait-like or stable influences of teacher and student characteristics, the specific adjustment between a teacher and a student may cause students to report, for example, more or less enjoyment or anxiety. We examined the relative importance of these so-called *relationship effects* for student emotions. To do so, we extended current modelling of classroom (social) environments (e.g., Becker, Goetz, Morger, & Ranellucci, 2014; Goetz, Lüdtke, Nett, Keller, & Lipnevich, 2013; Marsh, Martin, & Cheng, 2008) with cross-classified multilevel modelling (Fielding & Goldstein, 2006).

Second, because interpersonal processes and emotions are intertwined (Fischer & Van Kleef, 2010; Keltner et al., 2008), we applied interpersonal theory (Horowitz & Strack, 2010) and its adaptation to the educational context (Wubbels, Créton, & Hooymayers, 1985; Wubbels et al., 2014). We estimated the extent to which students' emotional variability can be explained by

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how students perceive their teachers' interpersonal agency (i.e., power or social influence) and communion (i.e., affection or warmth). Teacher behaviours that support agency include generally taking the lead in class, talking with a relatively loud voice and an up-right posture while lecturing. In contrast, behaving in an uncertain way or exhibiting weak discipline in class reduce teacher interpersonal agency. Behaviours that support communion include being generally friendly and responsive to student needs, whereas punishing students or using sarcasm and making fun of students decrease teacher communion (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

Thus, based on a more fine-grained modelling approach (i.e., decomposition of variance), we aimed to gain a clearer understanding of the relative importance of teachers for student emotions. We aimed at explaining variability in students' emotions through students' interpersonal perceptions of their teachers.

1.1. Facets of the classroom social environment and student emotions

Multiple studies have reported the relative importance of facets of the classroom environment, such as students, teachers and classes, for variability in student emotions (Ahmed, Werf, Minnaert, & Kuyper, 2010; Becker et al., 2014; den Brok, Levy, Brekelmans, & Wubbels, 2005; Frenzel, Pekrun, & Goetz, 2007; Goetz et al., 2013; Goetz, Frenzel, Luedtke, & Hall, 2011; Marsh et al., 2008). In line with the conceptual and empirical work of Kenny and colleagues (e.g., Kenny, 1994; Kenny et al., 2006), we argue that in addition to these frequently examined facets or levels of the classroom environment, additional facets should be considered to fully understand the teacher's role in student emotions. Because people (teachers and students) develop an interaction history, behaviour and perceptions become increasingly interdependent and unique to the persons involved (Kenny et al., 2006), representing specific adjustment between interaction partners. Kenny showed that pairings of specific people, or so-called *relationship effects*, are potent sources of variability in constructs reflecting social and interpersonal processes. For example, a teacher may be able to elicit enjoyment from certain classes and particularly from certain students but not from all classes or from all students alike. Therefore, we expected that the role of the teacher in student emotions could be further clarified by studying these pairings or relationship effects. To date, the study of these effects and, in particular, teacher-class and teacher-student pairings is rather uncommon in educational research (cf. Fielding & Goldstein, 2006). Thinking along these lines, however, has become quite common in other social science research. For example, Cook (2001) showed that parental control is not only a function of parenting style or child temperament, but also of the specific adjustment of parent and child. Quick and Lakey's study (2017) indicated that sensation seeking in social situations is to a large degree dependent on the specific adjustment of people, next to more stable personality traits.

1.1.1. Modelling the classroom social environment

When determining the relative importance of facets of the classroom environment for students' emotional variability, most studies (e.g., Becker et al., 2014; den Brok et al., 2005; Frenzel et al., 2007) have applied a "classical" multilevel structure with students purely nested in classes and classes purely nested in teachers. Such a structure is depicted in the upper panel of Fig. 1. When just one class per teacher is sampled, the teacher and class levels are completely confounded or identical, and class contributions to student emotions cannot be distinguished from teacher contributions. In this situation, only two levels of the classroom social environment are modelled (the student and a combined teacher-

class level). Confounded levels may lead to incorrect variance estimates (Fielding & Goldstein, 2006) and, consequently, to inaccurate estimations of the relative importance of teachers for students' emotional experiences in class.

It can be argued that in many samples, more than just the teacher and class levels are confounded. The pairing of specific teachers with specific classes and the pairing of teachers with specific students also represent levels or facets of the classroom environment that may contribute to variability in student emotions.

The lower panel of Fig. 1 depicts a sample structure that includes these additional pairing levels. Teachers teach multiple classes, and students are taught by multiple teachers. As Fig. 1 shows, students attend different classes for different subjects, and the class level cannot be distinguished from the teacher-class level. Further, because each teacher-class pairing belongs to only one teacher, teacher-class pairings are purely nested within teachers. Thus, as depicted in the lower panel of Fig. 1, student perceptions (e.g., questionnaires or the teacher-student pairings) are nested within more than one higher-level unit. This is called a *cross-classification* (Fielding & Goldstein, 2006; Raudenbush & Bryk, 2002). The teacher-class level represents the average rating of all students from a specific class for a specific teacher, and the teacher-student level represents a rating of a student for a specific teacher. Likewise, the teacher level represents the average of all students who rated a teacher, the class level represents the average rating of all students from a specific class for all teachers the class rated, and the student level represents the average of all ratings of one student for several teachers.

Technically, a teacher-student pairing (or teacher-class pairing) resembles an interaction term (Raudenbush & Bryk, 2002). Thus, for students and teachers a cross-classification can be conceptualised as a table in which the rows are teachers and the columns are students. A random interaction effect (e.g., the teacher-student level) is "the deviation of the cell mean from that predicted by the grand mean and the two main effects" (Raudenbush & Bryk, 2002, p. 377). The main effects in our example are the student and the teacher, and the deviation of the cell mean represents the specific adjustment between a teacher and a student (reminiscent of a so-called relationship effect; Kenny, 1994; Kenny et al., 2006). In a situation where students have several subjects in the same classroom group (note that this situation is not depicted in Fig. 1), also the teacher-class level is cross-classified by teacher and class.

1.1.2. Variance decomposition of student emotions

The available studies on student emotions (sections 1.1 and 1.1.1) vary in terms of the applied measures and in terms of what levels were considered. Hence, broad ranges of variability at the different levels of the classroom environment have been found. For example, between 13% and 86% of the variance in enjoyment and between 8% and 71% of the variance in anxiety have been ascribed to the student level. Between teachers, student emotions vary to a lesser extent: approximately 10% for enjoyment and below 5% for anxiety (Ahmed et al., 2010; Becker et al., 2014; den Brok et al., 2005; Goetz et al., 2013; Marsh et al., 2008). There is also some evidence that classes contribute to students' emotional variability. For example, Frenzel et al. (2007) showed that students in classes with more boys reported relatively less enjoyment and more anxiety. Overall, however, less than 5% of the variability in student emotions has been ascribed to the class level (den Brok et al., 2005; Marsh et al., 2008).

To obtain a clearer estimate of the relative importance of teachers for student emotions, the present investigation examined relationship effects involving the teacher. These effects highlight the adjustment of a teacher with a specific class or student and are

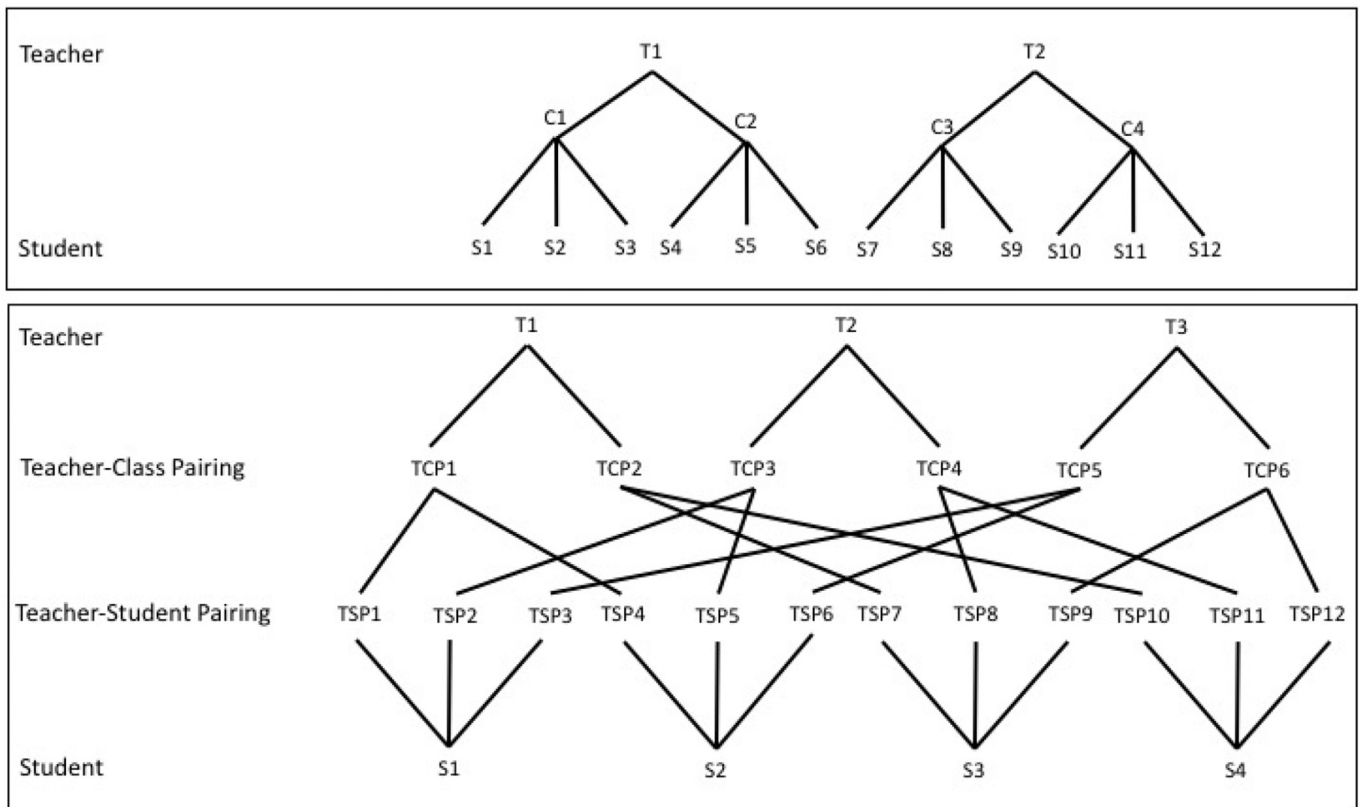


Fig. 1. On top, a 'classical' sample structure is depicted with students completely nested in classes, which are on their turn completely nested in teachers. Below, a for many educational settings more realistic cross-classified structure is depicted, in which teachers teach multiple classes, and students are taught by multiple teachers. The Teacher-Student Pairing level represents single observations or questionnaires. All four depicted levels in the lower panel are potential sources of variability in student emotions.

reflected in the teacher-class and teacher-student levels (see lower panel Fig. 1). An inspection of these effects makes it possible to gauge the degree to which a teacher may elicit more enjoyment or anxiety in a specific student or class than in others. Moreover, this approach facilitates the examination of a possible over- or underestimation of teacher and student effects in earlier studies, in which levels of the classroom environment were confounded.

1.2. Students' interpersonal perceptions of their teacher as an antecedent of student emotions

In addition to examining relationship effects involving the teacher (i.e., variance decomposition), the present study focused on the extent to which interpersonal processes involving the teacher can explain variability in student emotions.

Interpersonal processes and emotions are intertwined (Fischer & Van Kleef, 2010; Keltner et al., 2008). One dominant approach in psychological research is to conceptualise emotions as informing interpersonal processes (e.g., Frijda's (1986) social-functional approach to emotions). Other studies view emotional and interpersonal processes as reciprocal in nature. For example, Keltner et al. (2008) described interpersonal power as a social interaction heuristic: in dyadic exchanges, power prioritises emotions of high-power individuals, meaning that low-power individuals tend to emulate these emotions. In their review, Baumeister and Leary (1995) highlighted how emotional reactions directly follow belongingness in interpersonal relationships. The reinforcement of a social bond induces positive affect and enjoyment, whereas anxiety is related to damaged social bonds and exclusion. Also in the classroom, interpersonal processes are potentially an important

predictor of students' emotional experiences.

Interpersonal theory conceptualises the quality of interpersonal processes in an integrated way (Horowitz & Strack, 2010). According to this theory, all behaviour that people exhibit in the presence of others entails an interpersonal message representing a specific blend of agency (i.e., power, social influence) and communion (i.e., affection, warmth). Wubbels et al. (1985) adopted interpersonal theory to characterise how teachers relate to students in class. The current investigation examined the predictive value of students' perceptions of their teachers' interpersonal agency and communion for student emotions.

How can general findings regarding the association between interpersonal and emotional processes be translated to classrooms? For example, den Brok et al. (2005) indicated that highly agentic teachers who are also perceived as conveying relatively high levels of communion induce more pleasant emotions in students than low-agentic teachers do. A possible explanation is that students less readily emulate such a teacher's positive affect. Likewise, highly agentic teachers who are perceived as conveying little communion may induce relatively high levels of anxiety because students shift towards the negative affect associated with low communion.

The application of interpersonal theory to earlier studies linking teaching and student emotions provides a framework to describe the expected effects of interpersonal processes in the classroom. In the educational context, Pekrun and colleagues (Pekrun et al., 2006; Pekrun & Perry, 2014) suggested that autonomy support, communicated achievement expectancies, and the type of feedback are antecedents of students' emotions. As interpersonal theory postulates, these teaching constructs can be interpersonally

framed: they all convey a certain degree of teacher agency and communion (e.g., providing normative rather than internally referenced feedback may be perceived as unfriendly or low on communion), and they all exert their effect in interaction between the teacher and the student (Wubbels et al., 2014). Studies have shown that students who perceive their teachers as enthusiastic, as positively reinforcing achievement (Becker et al., 2014; Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009; Goetz, Pekrun, Hall, & Haag, 2006; Goetz et al., 2013), and as monitoring and being clear (Kunter, Baumert, & Köller, 2007) (i.e., high in both agency and communion) experience relatively more pleasant emotions. Unpleasant student emotions such as anxiety are more frequently experienced when students perceive their teacher as punishing (Frenzel et al., 2007), pressuring achievement (Goetz, Pekrun et al., 2006) (i.e., high in agency and low on communion), or anxious (Becker et al., 2014) (i.e., relatively low in both interpersonal dimensions).

The current study used teacher agency and communion as perceived by students to explain variability in student emotions. In line with what was discussed in section 1.1.1, per level of the classroom social environment, different aggregates of the two interpersonal dimensions can be calculated. In line with Kenny (1994) we conceive these aggregates as possible interpersonal effects per level:

Teacher effect: Agency and communion aggregated per teacher, representing teachers' general interpersonal style or trait (Brekemans, 1989; Levy, Wubbels, den Brok, & Brekemans, 2003). Variance in this aggregate would indicate for example that some teachers are in general more agentic in class than others.

Class effect: Per class aggregated agency and communion would represent how teachers are perceived in similar ways by a class. If classes had such a tendency (i.e., a high intraclass correlation (ICC) over class-mean ratings), this aggregate might indicate how classes consistently trigger different levels of teacher agency and communion because classes may consistently differ, for example, in cooperativeness (i.e., being a "difficult" class). A non-cooperative class might consistently trigger strict behaviour in all teachers that teach this class, resulting in consistently negative communion ratings and high agency ratings for all teachers.

Teacher-class relationship: Per teacher-class pairing aggregated agency and communion represent interpersonal teacher-class adjustment. Brekemans (1989) showed that, in particular, teacher communion depends on specific teacher-class pairings. Thus, next to possible class and teacher effects, teachers show more or less communion with specific classes.

Student effect: Per student averaged agency and communion captures how students perceive their teachers similarly. If ICCs would indicate such a consistent tendency in students' ratings, this would either indicate a rater bias ('all teachers are nice') or, alternatively, that students consistently trigger certain interpersonal behaviour of their teachers (e.g., all teachers are particularly friendly with this student). In our study, the student effect closely resembles perceiver effects as defined in Kenny's Social Relations Model (SRM; 1994), whereas teacher traits as described above resemble so-called target effects.

Teacher-student relationship: When controlling for the other facets (i.e., with the variance of the other levels partialled out), unaggregated student perceptions of teacher agency and communion most closely resemble teacher-student relationships or the specific adjustment of a teacher with a specific student. This aggregate describes the part of a student rating that is unique to a specific teacher-student pairing. It describes the degree to which a student perceives teacher agency and communion over and above stable teacher, class and student effects and over and above a teacher-class adjustment.

1.3. The present study

The overall aim of the current study was to gauge the importance of teachers for emotions students experience in class. First, we decomposed variance in student emotions to learn more about the importance of relationship effects for student emotions, which represent the specific adjustment between teachers and classes and teachers and students for students' emotions. Second, we estimated the extent to which variability in student emotions can be explained by how students perceive their teachers interpersonally. The current study focussed on enjoyment and anxiety. They represent the most often investigated pleasant and unpleasant emotions at school and show very clear relationships with academic achievement (e.g., Pekrun et al., 2017, in press). Further, they are in the tradition of "positive psychology" (e.g., Seligman & Csikszentmihalyi, 2000) and test anxiety research (e.g., Zeidner, 1998), respectively because these emotions are conceived as the most important pleasant and unpleasant emotions students experience in class. The specific research questions were as follows.

- 1) In addition to class and student, what is the relative importance of the teacher and of relationship effects involving the teacher for student emotions in class?
- 2) How do students' perceptions of interpersonal teacher agency and communion, in terms of aggregates representing the different facets of the classroom social environment, relate to student enjoyment and anxiety?

Regarding the first question and based on Kenny et al. (2006), we expected that the importance of a teacher for student emotions would also be reflected in levels capturing pairings of teachers with classes and pairings of teachers with students. For variables such as liking, Kenny et al. report that approximately 25% of the variance typically resides at the level of specific pairings of people. Studies that decomposed variance in enjoyment and anxiety but disregarded such specific pairings found that up to approximately 85% of the variance in enjoyment and anxiety was located at the student level (Ahmed et al., 2010; Becker et al., 2014; den Brok et al., 2005; Goetz et al., 2013; Marsh et al., 2008). Because variance due to specific pairings of teachers with students is represented at the student level when not explicitly modelled (Fielding & Goldstein, 2006) we expected to find (considerably) smaller variance components at the student level as compared to earlier studies. This would indicate that earlier studies probably overestimated the variance at the student level and thereby underestimated the relative importance of teachers for student emotions.

Regarding our second question, we expected that teacher agency would positively relate to student enjoyment and that communion would positively relate to student enjoyment. We further expected that communion would be negatively associated with anxiety (compare Becker et al., 2014; Goetz, Pekrun et al., 2006; Goetz et al., 2013; Frenzel et al., 2009). As earlier studies have indicated that anxiety is less strongly associated with the classroom environment than enjoyment (e.g., Frenzel et al., 2007; Marsh et al., 2008; Pekrun & Perry, 2014), we expected that teacher agency and communion would explain less variance in anxiety. Overall, we expected that communion would distinguish more between student emotions than agency (den Brok et al., 2005; Wubbels et al., 2006). Next to testing interaction terms, we explored the joint effect of student perceptions of teacher agency and communion by examining specific combinations of these two dimensions as they are represented in teachers' interpersonal profiles (Wubbels et al., 2006).

2. Method

2.1. Participants and procedure

The sample consisted of 1668 students (48% girls, $M_{age} = 14.94$ years, $SD = 1.44$) from one large secondary school in the Netherlands. Ninety-two percent of them were born in the Netherlands, closely reflecting the national school average of 89% (CBS, 2014). These students rated 91 teachers (53% female) with an average teaching experience of 15.39 years ($SD = 11.24$). Each teacher was rated by 4.23 classes on average ($SD = 2.34$); 381 unique teacher-class pairings occurred, each involving 20.78 students on average ($SD = 5.37$). A student rated 4.70 teachers on average ($SD = 2.83$), resulting in 8042 completed ratings or teacher-student pairings. In the Netherlands, secondary education entails three different ability tracks (pre-vocational, senior general secondary, and pre-university), and students were approximately equally divided across these tracks. Students who were engaged in final exams at the time of data collection did not participate. In the Netherlands, students in the lower grades typically remain in the same class for each subject (60% in the present sample), and students in the upper grades attend their lessons in subject specific groups.

Questionnaires were completed during regular classroom lessons. It was clarified that participation was optional for students and teachers and that questionnaires would be treated confidentially. Teachers brought questionnaires to class and in every class a student was appointed to hand-out and take in the questionnaires, put them in an envelope, and subsequently seal the envelope without interference of the teacher. The response rate at the teacher level was 77%. As not all teachers administered questionnaires in all their classes, the response rate at the teacher-class level was somewhat lower, at 68%. A few student questionnaires (2.68%) were omitted from the analyses due to large portions of incomplete data.

2.2. Measures

2.2.1. Student enjoyment and anxiety

Enjoyment and anxiety were measured using a Dutch translation of these two scales of the Academic Emotions Questionnaire and were viewed as two discrete emotions (Ahmed, van der Werf, Kuyper, & Minnaert, 2013; Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). Both emotions were measured with four items consisting of a five-point Likert scale bounded by “strongly disagree” and “strongly agree”. The stem for the items was, “During the lesson of this teacher ...”. An example item for enjoyment was, “... I enjoy

myself”, and an example for anxiety was, “... I feel nervous”. Both scales were internally consistent at the individual ratings level; $\alpha_{enjoyment} = 0.81$, $\alpha_{anxiety} = 0.76$. CFA showed that a two-factor model fit the data well; $\chi^2(19) = 905.35$, $p < 0.001$, CFI = 0.96, TLI = 0.94, RMSEA = 0.08. Enjoyment and anxiety correlated negatively (zero-order $r = -0.27$, $p < 0.001$) (see Table 1).

2.2.2. Teacher agency and communion

In interpersonal theory, agency and communion are viewed as two theoretically independent dimensions underlying human behaviour exhibited in the vicinity of others and people's perceptions of each other (Horowitz & Strack, 2010). Students' perceptions of teacher agency and communion were addressed with a 16-item version of the Questionnaire on Teacher Interaction (QTI; Wubbels et al., 2006), and items were rated on a five-point Likert scale bounded by “never” and “always”. Because a circumplex structure underlies the QTI (den Brok, Brekelmans, & Wubbels, 2006), scores are calculated by weighting each item separately for the agency dimension and the communion dimension. For example, “This teacher is strict” is more heavily weighted for agency, whereas “This teacher is patient” is more heavily weighted for communion. The internal consistency at the rating level was good, $\alpha_{agency} = 0.70$, $\alpha_{communion} = 0.87$. Validity (the circular ordering and spacing of the 16 QTI items) was evaluated using CircE (Grassi, Luccio, & Fo Blas, 2010) and was deemed acceptable, $\chi^2(28) = 30880.36$, $p < 0.001$, CFI = 0.99, TLI = 0.99, RMSEA = 0.44. The zero-order correlation between agency and communion indicated a weak association, $r = 0.21$, $p < 0.001$ (see Table 1).

2.2.3. Background variables

Analyses were controlled for student achievement (Mega et al., 2014), age (Carstensen et al., 2011; Marsh et al., 2008), and gender (Frenzel et al., 2007; Marsh et al., 2008). Achievement was measured at the teacher-student level by self-reported grades (see Table 1).

2.3. Strategy of analysis

IBM SPSS version 22 was used because programming cross-classified models is relatively easy in SPSS (Kenny, 2007; syntax included in Appendix 1). To answer the first research question, we tested cross-classified variance component models to estimate the amount of variance in student enjoyment and anxiety, separately in two models. In the Dutch educational system, students in the lower grades of secondary school stay within the same class for all their subjects. Therefore, using the lower grade data only, we first tested a model in which students were purely nested within classes,

Table 1
Descriptives and zero-order correlations among measures at the teacher-student level.

	M	SD	1	2	3	4	5	6	7
Interpersonal perceptions ^a									
1. Agency	0.50	0.63	–						
2. Communion	0.75	0.88	0.20***	–					
Emotions ^b									
3. Enjoyment	3.08	0.95	0.26***	0.65***	–				
4. Anxiety	1.69	0.80	0.02	–0.40***	–0.27***	–			
Background variables									
5. Achievement ^c	6.81	1.15	0.02	0.17***	0.21***	–0.22***	–		
6. Gender ^d	–	–	–0.00	–0.01	–0.06***	0.07***	0.02	–	
7. Age (years)	14.88	1.42	–0.08***	0.05***	–0.06***	–0.04**	–0.09***	0.02	–

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

^a Range –2.6–2.6.

^b Range 1–5.

^c Range 5–10.

^d 0 = boys, 1 = girls.

Table 2

Enjoyment: Cross-classified variance component model (M1) and conditional models including teacher interpersonal agency and communion (M2) and background variables (M3).

	M1	M2	M3
Fixed effects			
	<i>B (SE)</i>	<i>B (SE)</i>	<i>B (SE)</i>
Intercept		3.07 (0.02)***	3.25 (0.04)***
Teacher-student level			
Agency		0.22 (0.02)***	0.22 (0.02)***
Communion		0.66 (0.01)***	0.66 (0.01)***
AG × COM		0.10 (0.02)***	0.11 (0.02)***
Achievement			0.09 (0.01)***
Student level			
Gender			−0.11 (0.02)***
Age			−0.00 (0.00)*** ^a
Teacher-class level			
Communion		0.68 (0.03)***	0.66 (0.03)***
Teacher level			
Agency		0.25 (0.05)***	0.24 (0.05)***
Communion		0.71 (0.04)***	0.69 (0.03)***
AG × COM		0.23 (0.08)***	0.20 (0.08)***
Random parameters			
	<i>SS (SE)</i>	<i>SS (SE)</i>	<i>SS (SE)</i>
σ^2_e (teacher-student)	0.42 (0.01) ***	0.29 (0.01)***	0.28 (0.01)***
σ^2_{u0} (student)	0.21 (0.01) ***	0.16 (0.01)***	0.16 (0.01)***
σ^2_{v0} (teacher-class)	0.08 (0.01) ***	0.02 (0.00)***	0.02 (0.00)***
σ^2_{w0} (teacher)	0.17 (0.03) ***	0.02 (0.01)***	0.02 (0.00)***
Explained variance			
R^2 teacher-student		32%	33%
R^2 student		27%	27%
R^2 teacher-class		80%	80%
R^2 teacher		88%	88%
Total R^2		45%	46%
−2*log likelihood	17974.71	14796.71	14280.09

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

^a Unrounded value = −0.003 (0.001).

teacher-student pairings were nested within a cross-classification of students and teacher-class pairings, and teacher-class pairings were nested within a cross-classification of classes and teachers. Student enjoyment and anxiety varied minimally across classes (3% for enjoyment and 1% for anxiety); this variance was not significant when applying a 1% significance level (enjoyment: $p = 0.026$; anxiety: $p = 0.081$). Omitting the class level resulted in an only slightly poorer fit (enjoyment: $\Delta\chi^2(1) = 7.40$, $p = 0.003$; anxiety: $\Delta\chi^2(1) = 9.58$, $p = 0.001$). Substantively, this indicated that in the lower grades, the class level was not a relevant source of variability in student emotions. Therefore, to be able to work with a more parsimonious model and to gain statistical power to test our hypotheses, we continued without the class level. This made it possible to combine the data from the lower and upper grades in further analyses (as is presented in the lower panel in Fig. 1). The variance components (see M1 in Table 2 and Table 3) were used to describe the relative importance of teachers for student emotions (i.e., proportions of variance in student emotions and ICCs; Raudenbush & Bryk, 2002).

To answer the second question, teacher agency and communion predictors were added (M2). First, the substantive relevance of each aggregate was evaluated by calculating ICCs and the ICC2 or λ (Snijders & Bosker, 2012). An ICC2 clearly below 0.60 was taken as an indication that it was not valid to further concern a given aggregate in the analysis (Lüdtke, Robitzsch, Trautwein, & Kunter, 2009). Based on this analysis (see Table 4 and section 3.3), agency was entered as predictor at only the teacher-student and teacher levels. Communion was entered as a predictor at the teacher-student, teacher-class, and teacher levels. To gauge the effect of specific blends of teacher agency and communion interaction terms

Table 3

Anxiety: Cross-classified variance component model (M1) and conditional models including teacher interpersonal agency and communion (M2) and background variables (M3).

	M1	M2	M3
Fixed effects			
	<i>B (SE)</i>	<i>B (SE)</i>	<i>B (SE)</i>
Intercept		1.72 (0.02)***	1.57 (0.05)***
Teacher-student level			
Agency		−0.00 (0.02)	0.00 (0.02)
Communion		−0.37 (0.01)***	−0.36 (0.01)***
AG × COM		0.04 (0.02)	0.04 (0.02)
Achievement			−0.11 (0.01)***
Student level			
Gender			0.10 (0.03)***
Age			−0.00 (0.00)
Teacher-class level			
Communion		−0.25 (0.05)***	−0.20 (0.03)***
Teacher level			
Agency		0.25 (0.05)***	0.23 (0.05)***
Communion		−0.45 (0.04)***	−0.43 (0.03)***
AG × COM		−0.24 (0.08)***	−0.25 (0.08)***
Random parameters			
	<i>SS (SE)</i>	<i>SS (SE)</i>	<i>SS (SE)</i>
σ^2_e (teacher-student)	0.34 (0.01) ***	0.31 (0.01)***	0.30 (0.01)***
σ^2_{u0} (student)	0.22 (0.01) ***	0.19 (0.01)***	0.18 (0.01)***
σ^2_{v0} (teacher-class)	0.02 (0.00) ***	0.01 (0.00)***	0.01 (0.00)***
σ^2_{w0} (teacher)	0.10 (0.02) ***	0.03 (0.01)***	0.02 (0.01)***
Explained variance			
R^2 teacher-student		10%	14%
R^2 student		13%	15%
R^2 teacher-class		35%	30%
R^2 teacher		70%	74%
Total R^2		20%	23%
−2*log likelihood	16356.06	15403.49	14778.68

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

were added and predictions for specific combinations of agency and communion as reflected in interpersonal teacher profiles (Wubbels et al., 2006) were calculated based on M2. The last model (M3) controlled the analysis for student background variables.

Aggregates of agency and communion are climate constructs; that is, higher-level aggregates were conceptualised as “influencing” lower-level scores of agency and communion (Marsh et al., 2012). Representing this properly requires cluster-mean centring at the lower levels (Lüdtke et al., 2009; Marsh et al., 2012). Cluster-mean-centred teacher-student scores represented the deviation from the agency and communion mean of all teacher-student pairings clustered within one teacher-class pairing. Cluster-mean-centred teacher-class scores reflected the deviation from the mean of all teacher-class scores clustered within one teacher. Measures at the highest level, the teacher level, were grand-mean centred. The background variables of age and achievement were also grand-mean centred as they represent contextual rather than climate constructs. Gender was not centred.

3. Results

3.1. Preliminary analyses

Residual terms at all levels in the variance component model (M1) and the final model (M3) were inspected (Hox, 2010). Assumptions of multivariate normality and linearity were met, and no prominent multivariate outliers were detected. Table 1 presents an overview of descriptives and zero-order correlations among the variables. Student-perceived teacher agency showed a weak to moderate positive association with enjoyment ($r = 0.26$; $p < 0.001$), and communion showed a strong positive association ($r = 0.65$;

Table 4
Intraclass correlations for agency and communion.

Level	Agency		Communion	
	ICC1	λ /ICC2	ICC1	λ /ICC2
Student	0.08	0.29	0.12	0.39
Teacher-class	0.04	0.48	0.18	0.82
Teacher	0.43	0.98	0.34	0.98
Class ^a	0.01	0.04	0.02	0.08

^a The class level computation was based on the lower grade data only; see sections 1.1 and 2.1.

$p < 0.001$). In addition, communion showed a moderate negative association with anxiety ($r = -0.40$; $p < 0.001$). Agency and anxiety were not correlated.

3.2. Variance decomposition of student enjoyment and anxiety

The proportions of variance in student emotions at the different levels (ICC1) were derived from variance component models (M1; Tables 2 and 3). Note that, as is the case in models that are not cross-classified, the sum of all variances represents the total variance. Twenty-four percent of the variance in enjoyment was situated at the student level, 9% at the teacher-class level, and 19% at the teacher level. The remaining 47% was located at the teacher-student level, including lesson-specific variance and measurement error. The results of studies reporting repeated measures of emotions within the same teacher-student pairing (Ahmed et al., 2010; Bieg, Goetz, & Lipnevich, 2014) suggests that at least 30% of the variance on this level may be attributed to teacher-student pairings. For the current analysis, this would mean that variance at the teacher-student level can be estimated at approximately 15%. Of the variance in anxiety, 32% was situated at the student level, 3% was at the teacher-class level, and 15% was at the teacher level. The remaining 51% was located at the teacher-student level, of which approximately 17% can probably be allocated to specific teacher-student pairings.

In sum and in line with our expectations, the results of this variance decomposition showed that there are considerable relationship effects present in the emotions students experience in class.

3.3. Teacher agency and communion as predictors of student emotion

(Aggregates of) student perceived agency and communion (see section 1.2) were added as predictors to assess the relevance of interpersonal processes involving the teacher for student emotions. Given the relevance of the aggregates for the current analysis (as indicated by the λ or ICC2, see Table 4), and the assumed predictive power (Lüdtke et al., 2009; Snijders & Bosker, 2012), the aggregates of teacher communion at the teacher and teacher-class level and the aggregates of teacher agency at the teacher level were included in the further analyses.

The low ICCs in Table 4 for class and student illustrate that there was only a weak (students) or no tendency (classes) to perceive teachers in similar ways (i.e., there was no rater bias for teacher agency and communion). These effects were therefore not included in the further analyses.

3.3.1. Enjoyment

Including agency and communion as predictors (M2, Table 2) enhanced the model fit considerably, $\Delta\chi^2(5) = 3178.00$, $p < 0.001$. As expected, communion was significantly and positively related to enjoyment at the teacher-student, teacher-class, and teacher level.

Also agency was significantly and positively related to enjoyment, but only at the teacher-student and teacher level. Taking all levels together, agency and communion accounted for 45% of the variance in student enjoyment (a medium to large sized effect). Especially at the teacher and teacher-class levels, interpersonal measures accounted for a considerable amount of variance in student enjoyment: 88% and 80%, respectively.

The inclusion of student achievement, gender, and age (M3) further improved the model fit, $\Delta\chi^2(3) = 515.98$, $p < 0.001$. High achievers, boys, and younger students experienced slightly more enjoyment than low achievers, girls, and older students, respectively. Only an extra 1% of variance was explained, however, and the regression coefficients of agency and communion only changed marginally (see Table 2).

As expected, communion predicted student enjoyment more strongly than agency did. Statistically significant interaction terms between agency and communion indicated that the effect of one of the interpersonal dimensions was moderated to some degree by the other dimension. To get a better idea of the effect of specific combinations of teacher agency and communion, and because teacher behaviour can be described in terms of a blend of agency and communion, we related enjoyment to typical blends (i.e., teacher profiles) that can be distinguished among Western teachers (Brekemans, 1989; Wubbels et al., 2006). For students of so-called tolerant/authoritative teachers (approximately 10% of the Dutch teacher population; Brekemans, 1989; Wubbels et al., 2006), who are characterised by relatively high agency (0.34) and high communion (1.33), our model predicted the highest student enjoyment. Compared to the average teacher in our sample, the effect was comparable to a small to medium-sized effect ($d = 0.43$). For students of so-called uncertain/aggressive teachers (approximately 7% of Dutch teachers), who are characterised by relatively low levels of agency (-0.16) and communion (-0.34), our model predicted the lowest enjoyment scores ($d = -0.87$; comparable to a large effect).

In sum, teacher agency and communion were rather strongly associated with students' enjoyment in class. As anticipated, communion especially predicted variability in enjoyment, but agency could also explain some of the variance.

3.3.2. Anxiety

For anxiety, including agency and communion (M2, Table 3) resulted in a considerably better fit, $\Delta\chi^2(5) = 952.57$, $p < 0.001$. Communion at the teacher-student, teacher-class, and teacher level was significantly negatively related to student anxiety. Agency at the teacher level was significantly positively related to student anxiety. Agency and communion accounted for 20% of the total variance in student anxiety and as much as 70% of the variance in student anxiety at the teacher level.

Again, including the student background variables improved the model fit, $\Delta\chi^2(3) = 624.81$, $p < 0.001$, although age was unrelated to anxiety. Lower-achieving students and girls experienced slightly more anxiety than did high achievers and boys, respectively. Again, the additional explained variance was small (3%), and the regression coefficients of agency and communion changed less than 1%.

In sum, also for anxiety communion was the more important predictor. The standardized effect of communion at the teacher level was -0.32 and 0.17 for agency. A statistically significant interaction between agency and communion at the teacher level indicated that, in line with interpersonal theory, the effect of agency and communion depended, to some degree, on each other. When tested separately, adding the interaction terms resulted however in only a very marginally better model fit.

For students of tolerant/authoritative teachers, our model predicted the lowest anxiety scores ($d = -0.39$; resembling a small to

medium-sized effect). For students of repressive teachers (approximately 7% of the Dutch teacher population), who are characterised by high agency (0.66) and low communion (−0.27), our model predicted the highest anxiety scores ($d = 0.66$, resembling a medium- to large-sized effect).

4. Discussion

The social environment is a major source of emotions both in everyday life and in academic settings (Baumeister & Leary, 1995; Martin & Dowson, 2009). In classrooms, teachers are the focal point of many social exchanges and are the professionals who organize classroom processes. This study further investigated the importance of the teacher for student emotions experienced in class in two ways. First, we focussed on the relative importance of a specific adjustment of teachers with classes and students in addition to the classically modelled teacher and student effects. Second, we estimated the extent to which students' emotional variability can be explained by interpersonal processes involving the teacher. Overall, our findings suggest that teachers may be even more important for student emotions than has previously been assumed.

First, our results suggest that a substantial part of the variability in emotions usually ascribed to between-student differences (Ahmed et al., 2010; Becker et al., 2014; den Brok et al., 2005; Frenzel et al., 2007; Goetz et al., 2013; Goetz et al., 2011; Marsh et al., 2008) does, in fact, involve teachers. Our cross-classified multilevel models explicitly highlighted specific teacher adjustment by modelling *pairings* of teachers with students and classes in addition to the usually examined teacher, class and student levels.

The second important finding was that student perceptions of teacher agency (interpersonal dominance or influence) and communion (warmth or interpersonal proximity) mattered for student emotions. Agency and communion accounted for 45% of the total variance in student enjoyment and for 20% in anxiety. As expected, teacher communion predicted student emotions particularly via teachers' adjustment to specific classes and students; specifically with regard to anxiety, teacher agency functioned more as a relatively stable teacher trait.

4.1. Variability in student emotions due to teacher-student and teacher-class adjustment

In previous studies, levels of the classroom social environment were often confounded, which made it difficult to accurately specify the relative importance of teachers for students' emotional experiences. For example, the teacher-student level, representing the degree of adjustment between teachers and specific students, was often confounded with the student level, and the teacher-class level, representing the adjustment of teachers with specific classes, was confounded with the class and teacher levels (Ahmed et al., 2010; Becker et al., 2014; den Brok et al., 2005; Frenzel et al., 2007; Goetz et al., 2013; Goetz et al., 2011; Marsh et al., 2008). For instance, Frenzel et al. (2007) concluded that 13% of the variability in students' mathematics-related enjoyment and 5% of the variability in anxiety were due to teacher and class, with the remainder residing at the student level including error. Because the teacher-class and teacher level were not differentiated from the class level in their sample, the actual emotional variability across classes and across students was probably smaller, leading to a biased evaluation of the relative importance of teachers for student emotions. In the current sample, using cross-classified multilevel modelling including the teacher-class and teacher-student levels, student emotions varied little across classes. Similarly, by extracting the teacher-student level from the student level, our estimates of emotional variability between individual students, especially in

enjoyment, are considerably smaller (in comparison to some studies approximately two-thirds) than those reported in earlier studies (Ahmed et al., 2010; den Brok et al., 2005; Marsh et al., 2008). In contrast to earlier studies, our results suggest that the facets of the classroom environment involving the teacher (i.e., teachers, teacher-class pairings, and teacher-student pairings) are more important for variability in student emotions than individual student characteristics (i.e., the student level).

In our study, variance in student enjoyment and anxiety situated at the teacher and teacher-class levels was up to three times larger than that in earlier research (den Brok et al., 2005; Frenzel et al., 2007; Marsh et al., 2008). Because the number of classes per teacher was more than two times larger than in previous studies, estimates in the present study are likely to be more reliable, and because this study modelled a more precise level structure, they are probably more accurate. In the present study, however, emotion items were tied to classroom settings involving a specific teacher (e.g., "I enjoy the lessons of this teacher"), whereas other studies (den Brok et al., 2005; Frenzel et al., 2007; Marsh et al., 2008) put more emphasis on the subject (e.g., "I look forward to mathematics class"), which may have affected variance estimates.

Finally, anxiety varied more between students than enjoyment. This is in line with cumulative evidence that anxiety is more situation and teacher-transcending than other emotions (e.g., Goetz, Frenzel, Pekrun, & Hall, 2006; Gogol, Brunner, Martin, Preckel, & Goetz, 2017; Green, Martin, & Marsh, 2007). In other words, anxiety may be a more trait like (i.e., habitual) emotion as compared to other emotions (compare Sarason & Sarason, 1990).

4.2. Teacher agency and communion

We investigated the extent to which student perceptions of teacher agency and communion and their aggregates accounted for variance in student emotions. The rather substantial total amount of explained variance suggests that interpersonal processes involving teachers play a crucial role in student emotions (Becker et al., 2014; Frenzel et al., 2009; Goetz et al., 2013). Teacher communion accounted for considerable parts of emotional variability tied to specific teacher-student and teacher-class pairings (representing relationship effects or teacher adjustment with classes and students), showing that emotions are a matter of interpersonal synergy or "click" of teachers with classes and especially students. Agency, interestingly and in contrast, affected student anxiety only via relatively stable teacher traits (i.e., affecting all students in a rather similar way) instead through a specific adjustment or relationship effect. Enjoyment, however, was next to trait like teacher agency also affected by the teacher agency levels in that applied to specific teacher-student dyads only. In sum, our results regarding the relevance of the specific interpersonal adjustment between teacher and student, represent a new finding which underpins the importance of teachers and their interpersonal behaviour for student emotions. Statistically significant interactions between the two interpersonal dimensions indicated that, to some degree, these dimensions moderate each other's effect.

In our study, relatively higher interpersonal teacher communion was clearly associated with lower anxiety and higher student enjoyment. As expected, agency was related more ambiguously to student emotions. Specific blends of agency and communion mattered. Based on the model predictions, the highest enjoyment levels and lowest anxiety levels can be expected for students of tolerant/authoritative teachers (Wubbels et al., 2006), who are characterised by relatively high teacher agency and communion. When compared to the average teacher in our sample, the effects resembled a small to medium-sized effect. The most negative emotional outcomes were predicted for the students of uncertain/aggressive teachers

(relatively low levels of agency and communion) and repressive teachers (high agency and low communion). Comparing these profiles to the average teacher of our sample yielded medium to large effects, indicating that interpersonal teacher behaviour has the potential to seriously impact students' emotions.

4.3. Limitations and future research

We acknowledge that student emotions may have a reciprocal relationship with what teachers do in class (e.g., Anderson & Guerrero, 1998; van Kleef, De Dreu, & Manstead, 2010). We mainly elaborated on the hypothetical influence of interpersonal teacher behaviour on student emotions because teachers are the professionals in the classroom and are, ideally, the agents of change regarding the general organisation of (social) classroom processes. Therefore, insight into what teachers can do to enhance positive student experiences is critical. Our findings indicate that the potential for teacher influence on student emotions may be larger than has previously been assumed. Future research needs to focus on investigating causality and reciprocity between teacher behaviour and student emotions.

Further, because we assessed student emotions at one occasion per teacher only, we could not distinguish measurement error and time specific (i.e., more situational) variance from the teacher-student level. If the estimates for time dependent effects on emotions obtained by Ahmed et al. (2010) and Bieg et al. (2014) apply to our sample, it can however be expected that of the variance we found at the teacher-student level (about 50% of the total variance), approximately 30% is truly due to teacher-student pairings and their specific adjustment to each other. Consequently, 20% would then be due to time-dependent variance and measurement error. Future research needs to verify this.

Another open question is to what degree students' interpersonal perceptions of their teacher overlap with liking or disliking of specific school subjects. Several studies have shown that enthusiastic teachers who positively reinforce achievement (Becker et al., 2014; Frenzel et al., 2009; Goetz, Frenzel et al., 2006, 2013), who monitor students and are clear in their communication (Kunter et al., 2007) (i.e., high in both agency and communion) have students who experience relatively more pleasant and less unpleasant emotions. It therefore is fair to assume that such teacher behaviour can buffer, for example, math anxiety. Note that the current study focussed emotion items on lessons as provided by a specific teacher rather than focussed on specific subjects.

Our findings showed that cross-classified designs, in which specific pairings of teachers with students and classes are considered, are informative when relating student outcomes to classroom environments. Moreover, the cross-classified structure, in which a student encounters several teachers, provides ecological validity as this structure is rather common to secondary education. In line with Nurmi's (2012) call for a more precise conceptualisation of instruction, cross-classified designs allow for a more specific investigation of the sources of variability in students' classroom experiences and outcomes. Although we believe such an approach is worthwhile and sometimes necessary, we certainly do not want to suggest that it is the best choice in most contexts and studies. The application of cross-classified multilevel modelling is still in its infancy, as illustrated by the restricted possibilities of many statistical software packages. Although some authors describe cross-classified analyses (e.g., Beretvas, 2008; Kenny, 2007), more guidelines on how to model complex cross-classified data in education are needed. IBM SPSS version 22 is rather versatile when fitting cross-classified models, but it requires some computational power.

Finally, it should be noted that our data represent one large school. Although variance in student emotions and students' interpersonal perceptions is commonly rather small at the school level (below 5%, e.g., Marsh et al., 2008; OECD, 2013; Wubbels et al., 2006), this may have affected our estimates (i.e., some of the teacher variance may have been in fact school-level variance).

4.4. Conclusion and implications

Overall, our results are in line with the notion that teachers can be most effective when they act as 'warm demanders' (Woolfolk-Hoy & Weinstein, 2006) or, with other words, when they convey relatively high levels of interpersonal agency and communion in class. Our findings further suggest that teachers' potential to impact emotions in class has probably been underestimated in research so far. (Pleasant) emotions are not only associated with teacher trait-like characteristics and students' dispositions (i.e., stable differences between teachers and between students) but also depend on how teachers adjust their teaching to specific students and classes. The level of agency and communion, as reflected in teachers' general teaching practices as well as in their contact with specific students, has the clear potential to affect academic achievement via student emotions too (Mega et al., 2014; Pekrun et al., 2002). Our results suggest that interventions which target this specific adjustment of teachers with classes and of teachers with students, may be more worthwhile than, for example, interventions focusing on individual teachers and their general practices or interventions targeting individual students only.

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Appendix 1. SPSS syntax

SPSS Syntax for the variance component model including the class level, based on Kenny (2007) and Beretvas (2008). Note that SPSS automatically takes hierarchical nesting structures (e.g., of students within classes or teacher-student pairings within students and teacher-class pairings) into account.

```
mixed enjoyment
/print = g solution testcov
/RANDOM = intercept | subject (student)
/RANDOM = intercept | subject (teacher)
/RANDOM = intercept | subject (class)
/RANDOM = intercept | subject (teacher-class).
```

SPSS Syntax for Model 1:

```
mixed enjoyment
/print = g solution testcov
/RANDOM = intercept | subject (student)
/RANDOM = intercept | subject (teacher)
/RANDOM = intercept | subject (teacher-class).
```

References

- Ahmed, W., van der Werf, G., Kuyper, H., & Minnaert, A. (2013). Emotions, self-regulated learning, and achievement in mathematics: A growth curve analysis. *Journal of Educational Psychology, 105*(1), 150–161. <http://dx.doi.org/10.1037/a0030160>.

- Ahmed, W., Werf, G., Minnaert, A., & Kuyper, H. (2010). Students' daily emotions in the classroom: Intra-individual variability and appraisal correlates. *British Journal of Educational Psychology*, 80(4), 583–597. <http://dx.doi.org/10.1348/000709910X498544>.
- Anderson, P. A., & Guerrero, L. K. (1998). *Handbook of communication and emotion*. San Diego, CA: Academic Press.
- 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.
- Becker, E. S., Goetz, T., Morger, V., & Ranellucci, J. (2014). The importance of teachers' emotions and instructional behavior for their student emotions: An experience sampling analysis. *Teaching and Teacher Education*, 43, 15–26. <http://dx.doi.org/10.1016/j.tate.2014.05.002>.
- Beretvas, S. N. (2008). Cross-classified random effects models. In A. A. O'Connell, & D. B. McCoach (Eds.), *Multilevel modeling of educational data* (pp. 161–198). New York, NY: Information Age Publishing Inc.
- Bieg, M., Goetz, T., & Lipnevich, A. A. (2014). What students think they feel differs from what they really feel—academic self-concept moderates the discrepancy between students' trait and state emotional self-reports. *PLoS One*, 9(3). <http://dx.doi.org/10.1371/journal.pone.0092563>.
- Brekelmans, M. (1989). *Interpersoonlijk gedrag van docenten in de klas* (Doctoral dissertation). Utrecht, The Netherlands: Uitgeverij W.C.C.
- den Brok, P., Brekelmans, M., & Wubbels, T. (2006). Multilevel issues in research using students' perceptions of learning environments: The case of the questionnaire on teacher interaction. *Learning Environments Research*, 9(3), 199–213. <http://dx.doi.org/10.1007/s10984-006-9013-9>.
- den Brok, P., Levy, J., Brekelmans, M., & Wubbels, T. (2005). The effect of teacher interpersonal behaviour on students' subject-specific motivation. *The Journal of Classroom Interaction*, 40(2), 20–33.
- Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., et al. (2011). Emotional experience improves with age: Evidence based on over 10 years of experience sampling. *Psychology and Aging*, 26(1), 21–33. <http://dx.doi.org/10.1037/a0021285>.
- Centraal Bureau voor de Statistiek. (2014, May 14). *Bevolking; generatie, geslacht, leeftijd en herkomstgroepering*, 1 januari. Retrieved from: <http://statline.cbs.nl>.
- Cook, W. L. (2001). Interpersonal influence in family systems: A social relations model analysis. *Child Development*, 72(4), 1179–1197.
- Fielding, A., & Goldstein, H. (2006). *Cross-classified and multiple membership structures in multilevel models: An introduction and review* (Report No. 791). Retrieved from: <http://dera.ioe.ac.uk/6469/1/RR791.pdf>.
- Fischer, A. H., & Van Kleef, G. A. (2010). Where have all the people gone? A plea for including social interaction in emotion research. *Emotion Review*, 2(3), 208–211. <http://dx.doi.org/10.1177/1754073910361980>.
- Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. E. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology*, 101(3), 705–716. <http://dx.doi.org/10.1037/a0014695>.
- Frenzel, A. C., Pekrun, R., & Goetz, T. (2007). Perceived learning environment and students' emotional experiences: A multilevel analysis of mathematics classrooms. *Learning and Instruction*, 17(5), 478–493. <http://dx.doi.org/10.1016/j.learninstruc.2007.09.001>.
- Frijda, N. H. (1986). *The emotions*. Cambridge, England: Cambridge University Press.
- Goetz, T., Frenzel, A. C., Lüdtke, O., & Hall, (2011). Between-domain relations of academic emotions: Does having the same instructor make a difference? *The Journal of Experimental Education*, 79, 84–101.
- Goetz, T., Frenzel, A. C., Pekrun, R., & Hall, N. C. (2006). The domain specificity of academic emotional experiences. *The Journal of Experimental Education*, 75(1), 5–29.
- Goetz, T., Lüdtke, O., Nett, U. E., Keller, M. M., & Lipnevich, A. A. (2013). Characteristics of teaching and student emotions in the classroom: Investigating differences across domains. *Contemporary Educational Psychology*, 38(4), 383–394. <http://dx.doi.org/10.1016/j.cedpsych.2013.08.001>.
- Goetz, T., Pekrun, R., Hall, N., & Haag, L. (2006). Academic emotions from a social-cognitive perspective: Antecedents and domain specificity of students' affect in the context of Latin instruction. *British Journal of Educational Psychology*, 76(2), 289–308. <http://dx.doi.org/10.1348/000709905X42860>.
- Gogol, K., Brunner, M., Martin, R., Preckel, F., & Goetz, T. (2017). Affect and motivation within and between school subjects: Development and validation of an integrative structural model of academic self-concept, interest, and anxiety. *Contemporary Educational Psychology*, 49, 46–65.
- Grassi, M., Luccio, R., & Di Blas, L. (2010). CircE: An R implementation of Browne's circular stochastic process model. *Behavior Research Methods*, 42(1), 55–73. <http://dx.doi.org/10.3758/BRM.42.1.55>.
- Green, J., Martin, A. J., & Marsh, H. W. (2007). Motivation and engagement in English, mathematics and science high school subjects: Towards an understanding of multidimensional domain specificity. *Learning and Individual Differences*, 17(3), 269–279.
- Horowitz, L. M., & Strack, S. (2010). *Handbook of interpersonal psychology: Theory, research, assessment, and therapeutic interventions*. Hoboken, NY: John Wiley & Sons, Inc.
- Hox, J. (2010). *Multilevel analysis: Techniques and applications*. New York, NY: Routledge.
- Keltner, D., Van Kleef, G. A., Chen, S., & Kraus, M. W. (2008). A reciprocal influence model of social power: Emerging principles and lines of inquiry. *Advances in Experimental Social Psychology*, 40, 151–192. [http://dx.doi.org/10.1016/S0065-2601\(07\)00003-2](http://dx.doi.org/10.1016/S0065-2601(07)00003-2).
- Kenny, D. A. (1994). *Interpersonal perception: A social relations analysis*. New York, NY: Guilford Press.
- Kenny, D. A. (2007, April). Conventional multilevel modeling: SAS and SPSS. In *Paper presented at intergroup data as modeled using the social relations model conference*. Storrs, CT.
- Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. New York, NY: Guilford Press.
- van Kleef, G. A., De Dreu, C. K., & Manstead, A. S. (2010). An interpersonal approach to emotion in social decision making: The emotions as social information model. *Advances in Experimental Social Psychology*, 42, 45–96. [http://dx.doi.org/10.1016/S0065-2601\(10\)42002-X](http://dx.doi.org/10.1016/S0065-2601(10)42002-X).
- Kunter, M., Baumert, J., & Köller, O. (2007). Effective classroom management and the development of subject-related interest. *Learning and Instruction*, 17(5), 494–509. <http://dx.doi.org/10.1016/j.learninstruc.2007.09.002>.
- Levy, J., Wubbels, T., den Brok, P., & Brekelmans, M. (2003). Students' perceptions of interpersonal aspects of the learning environment. *Learning Environments Research*, 6(1), 5–36. <http://dx.doi.org/10.1023/A:1022967927037>.
- Lüdtke, O., Robitzsch, A., Trautwein, U., & Kunter, M. (2009). Assessing the impact of learning environments: How to use student ratings of classroom or school characteristics in multilevel modeling. *Contemporary Educational Psychology*, 34(2), 120–131. <http://dx.doi.org/10.1016/j.cedpsych.2008.12.001>.
- Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J., Abduljabbar, A. S., et al. (2012). Classroom climate and contextual effects: Conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist*, 47(2), 106–124. <http://dx.doi.org/10.1080/00461520.2012.670488>.
- Marsh, H. W., Martin, A. J., & Cheng, J. H. (2008). A multilevel perspective on gender in classroom motivation and climate: Potential benefits of male teachers for boys? *Journal of Educational Psychology*, 100(1), 78–95. <http://dx.doi.org/10.1037/0022-0663.100.1.78>.
- Martin, A. J., & Dowson, M. (2009). Interpersonal relationships, motivation, engagement, and achievement: Yields for theory, current issues, and educational practice. *Review of Educational Research*, 79(1), 327–365. <http://dx.doi.org/10.3102/0034654308325583>.
- Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology*, 106(1), 121–131. <http://dx.doi.org/10.1037/a0033546>.
- Nurmi, J. E. (2012). Students' characteristics and teacher-child relationships in instruction: A meta-analysis. *Characteristics and Teacher-Child Relationships in Instruction: A Meta-Analysis*. *Characteristics and Teacher-Child Relationships in Instruction: A Meta-Analysis*, 7(3), 177–197. <http://dx.doi.org/10.1016/j.edurev.2012.03.001>.
- OECD. (2013). *PISA 2012 results: Ready to learn: Students' engagement, drive and self-beliefs* (Vol. III). Paris: OECD Publishing.
- Pekrun, R., Elliot, A. J., & Maier, M. A. (2006). Achievement goals and discrete achievement emotions: A theoretical model and prospective test. *Journal of Educational Psychology*, 98(3), 583–597. <http://dx.doi.org/10.1037/0022-0663.98.3.583>.
- Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, 36(1), 36–48. <http://dx.doi.org/10.1016/j.cedpsych.2010.10.002>.
- Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of quantitative and qualitative research. *Educational Psychologist*, 37(2), 91–106. http://dx.doi.org/10.1207/S15326985EP3702_4.
- Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement emotions and adolescents' academic performance: Longitudinal models of developmental ordering. *Child Development*. <http://dx.doi.org/10.1111/cdev.12704> (in press).
- Pekrun, R., & Perry, R. P. (2014). Control-value theory of achievement emotions. In R. Pekrun, & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 120–141). New York, NY: Routledge.
- Quick, E., & Lakey, B. (2017). Social relations in sensation seeking and urgency: An SRM approach. *Personality and Individual Differences*, 111, 37–45.
- Raudenbush, S., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA: Sage Publications.
- Sarason, I. G., & Sarason, B. R. (1990). Test anxiety. In H. Leitenberg (Ed.), *Handbook*. Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, 55, 5–14.
- Snijders, T. A., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modelling*. London, England: Sage Publishers.
- Woolfolk-Hoy, A., & Weinstein, C. S. (2006). Student and teacher perspectives on classroom management. In C. Evertson, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (pp. 181–219). Mahwah, NJ: Lawrence Erlbaum Associates.
- Wubbels, T., Brekelmans, M., den Brok, P., & van Tartwijk, J. (2006). An interpersonal perspective on classroom management in secondary classrooms in The Netherlands. In C. M. Evertson, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (pp. 1161–1191). New York, NY: Lawrence Erlbaum Associates.
- Wubbels, T., Brekelmans, M., den Brok, P., Wijsman, L., Mainhard, T., & Van

- Tartwijk, J. (2014). Teacher-student relationships and classroom management. In E. T. Emmer, & E. J. Sabornie (Eds.), *Handbook of classroom management* (pp. 363–386). New York, NY: Routledge.
- Wubbels, T., Créton, H. A., & Hooymayers, H. P. (1985, April). Discipline problems of beginning teachers, interactional teacher behavior mapped out. In *Paper presented at the American educational research association annual meeting*. Chicago, IL.
- Zeidner, M. (1998). *Test anxiety: The state of the art*. New York, NY: Plenum Press.

Further Reading

- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159.