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Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction

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Abstract

This article investigates teacher enthusiasm and how it relates to instructional behaviours. We distinguished teachers' enthusiasm for the subject matter of mathematics from their enthusiasm for teaching mathematics. A total of 323 teachers and their 9th-grade classes participated in the study. Questionnaires were used to assess teachers' enthusiasm and instructional behaviours from both the teacher and the student perspective. Structural equation modelling revealed that teachers who were more enthusiastic about teaching showed higher quality instructional behaviour—both self-reported and student-rated. By contrast, enthusiasm for mathematics as a subject matter predicted teachers' self-reports, but not students' ratings, of instructional behaviour.

Keywords: Enthusiasm; Instructional quality; Teacher motivation; Mathematics

1. Introduction

Students and the general public often identify enthusiasm as one of the defining characteristics of a good teacher (Witcher, Onwuegbuzie, & Minor, 2001). Likewise, many research overviews of effective teaching feature ''teacher enthusiasm'' as a key aspect of instructional quality (Shuell, 1996; Walberg & Paik, 2000). From a conceptual point of view, however, there is no single, widely accepted definition of the concept of enthusiasm. A review of the literature reveals that teacher enthusiasm is frequently regarded as a feature of instruction rather than as a personal characteristic of the teacher. At the same time, the target of enthusiasm—i.e., what exactly teachers are expected to be enthusiastic about—is not made explicit. Moreover, there has been surprisingly little empirical research on the dimensions, causes and consequences of teachers' enthusiasm. This study aimed to take the first steps to close these theoretical and empirical gaps.

In everyday language, the word ''enthusiasm'' describes the enjoyment and excitement that people experience when engaged in certain tasks. Drawing on motivation theories that aim at explaining engagement in tasks, such as interest theory (Krapp, 2002) and self-determination theory (Deci & Ryan, 2002), we argue that enthusiasm can be conceptualized as a relatively stable affective disposition that may be seen as an integral part of teachers'

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motivation (Eccles & Wigfield, 2002; Pekrun, 2006; Pintrich, 2003a, 2003b). Enthusiasm as a manifestation of intrinsic motivation may promote teachers' active involvement in their work and is likely reflected in high quality instructional behaviour. We present empirical data drawn from a teacher and student survey, assess differences in teacher enthusiasm, and examine whether these differences are reflected in teachers' instructional behaviours (namely classroom management, use of cognitively stimulating methods, provision of social support for students). On the theoretical level, we advocate a differentiated approach that distinguishes between enthusiasm for teaching as an activity and enthusiasm for the subject taught, because both aspects have specific manifestations in the classroom.

1.1. Enthusiasm as an instructional strategy

Ever since Brophy and Good (1986) identified "teacher enthusiasm" as one of the core teacher qualities in their seminal overview of effective teaching, the term has been used to describe a particular effective mode of delivering information to students (Shuell, 1996; Walberg & Paik, 2000). The concept of teacher enthusiasm has since been investigated in a number of studies, both within the framework of instructional quality in the classroom and beyond (e.g., teacher evaluation research, research on intrinsic motivation). Since these approaches are embedded in specific theoretical and methodological frameworks, conceptualizations and operationalizations of "enthusiasm" vary considerably.

In instructional quality research, teacher enthusiasm is often viewed as the teacher's capacity to transport the importance and intrinsic value of learning or of the content to be learned to students (Patrick, Turner, Meyer, & Midgley, 2003; Turner et al., 2002). Consequently, teacher enthusiasm is usually inferred from observations of teachers' instructional behaviours, such as remarking on the value of the learning material or expressing their own interest in the matter (Patrick et al., 2003). This type of enthusiastic instructional behaviour seems to foster active learning and student engagement (Patrick et al., 2003; Turner et al., 2002).

Similar findings are reported from teacher evaluation research, in which—typically within the context of university course evaluations—students are asked to rate their instructor's enthusiasm, often on questionnaire items that tap the instructor's expressiveness and energy level; for example, "…the instructor was very enthusiastic/apparently bored" (Jackson et al., 1999), or "…spoke with expressiveness" (Marsh, 1994). This student-rated instructor enthusiasm is positively correlated with other student-rated features of effective teaching (e.g., structuredness and comprehensibility) and with students' ratings of their own learning and progress in class (Jackson et al., 1999; Marsh, 1994). In view of these findings, teacher enthusiasm—or, more specifically, teacher expressiveness—is sometimes seen as a potential source of biased student ratings. Although the evidence is mixed, the "Dr. Fox effect" describes the tendency for more expressive teachers to be given more positive student ratings, irrespective of their actual teaching qualities (Marsh & Ware, 1982; Williams & Ware, 1977).

Finally, a small number of experimental studies have investigated the effect of different levels of instructor enthusiasm on students' motivations and learning behaviours, typically by having lecturers display different levels of expressiveness in controlled instructional settings. Often drawing on the concept of intrinsic motivation, these studies show that teachers who display high levels of enthusiasm or intrinsic motivation to teach seem to exert a positive effect on students' own motivation (Brigham, Scruggs, & Mastropieri, 1992; McKinney, Robertson, Gilmore, Ford, & Larkins, 1984; Patrick, Hisley, & Kempler, 2000), an effect sometimes labelled "emotional contagion" (Hsee, Hatfield, & Carlson, 1990).

This brief overview of research shows that teachers' displays of enthusiasm are broadly considered an important feature of the teaching/learning process. With its focus on the instructional process, however, prior research has highlighted teachers' overt instructional behaviour, and rarely discussed factors that may enable them to show these motivating and effective instructional behaviours. Recently, Long and Hoy (2006) argued that teachers' own motivational orientations may prompt them to display high quality instructional behaviours: "…teachers who richly invest themselves in forming complex attachments to their content area and unashamedly share those interests with their students are effective, empowered, and energizing instructors" (p. 312). Similarly, Pelletier, Legault, and Séguin-Lévesque (2002) found that teachers who reported high levels of self-determined motivation reported teaching in a particularly motivating way (operationalized by autonomy-supporting behaviours). In addition to describing teacher enthusiasm as an instructional feature, it may thus be worth examining whether teacher enthusiasm is a personal disposition that varies across teachers.

1.2. Enthusiasm as a personal disposition

The idea that teachers' motivational characteristics can explain differences in their instructional behaviour echoes core assumptions of psychological motivation theories. Motivation, as an antecedent of behaviour, is assumed to provide the energy, direction and quality of goal-directed behaviour (Ford, 1992; Pintrich, 2003b; Schutz, Hong, Cross, & Osbon, 2006), and it is thought that differences in people's goals, emotions, beliefs and values predict differential behaviour and engagement (Eccles & Wigfield, 2002; Ford, 1992; Linnenbrink, 2006; Pintrich, 2003b; Schutz et al., 2006). Enthusiasm, as a disposition that varies between teachers, may therefore be seen as an affective component of teacher motivation. It represents *a trait-like, habitual, recurring emotion* (Pekrun, 2006)—more specifically, it reflects *the degree of enjoyment, excitement and pleasure that teachers typically experience in their professional activities*.

This definition puts teacher enthusiasm conceptually very close to the construct of individual interest (Krapp, 2002; Renninger, 2000), a stable orientation taking the form of a specific relationship between a person and an object that is most often characterized by two components, namely feelings of personal relevance (value commitment) and positive emotions. Recently, Long and Hoy (2006) applied the concept of individual interest to describe effective teachers, arguing that high levels of teacher interest may lead to effortful and persistent behaviour. From our point of view, two distinctions need to be drawn between the constructs of individual interest and enthusiasm. First, enthusiasm, as an affective disposition, pertains only to the affective component, whereas the construct of interest also encompasses cognitive aspects. Second, the construct of interest is generally used to describe interest in certain topics or subjects (Renninger, 2000). It seems reasonable to assume that teachers who enjoy their subject may be motivated to read up on related topics or engage in related activities, thus acquiring more domain-specific knowledge, which can then be conveyed to their students (Long & Hoy, 2006). However, teaching requires more than the mere accumulation of knowledge—the knowledge acquired must be successfully communicated to students. This interaction, which forms the core of the teaching profession, may not be adequately addressed by the concept of domain-specific individual interest. It thus seems reasonable to draw a theoretical distinction between *topic*-related and *activity*-related enthusiasm. Given the cliché of the highly knowledgeable, but pedagogically untalented, mathematics or science teacher who is fascinated by the subject of instruction, but would prefer not to have to interact with students, the topic- vs. activity-specific distinction seems particularly applicable to teaching (see also Shulman, 1987).

With its emphasis on positive emotional experiences, the construct of enthusiasm is also conceptually close to the construct of intrinsic motivation, i.e., the disposition to pursue an activity for the satisfaction inherent in it rather than for the expected external consequences (Deci & Ryan, 2002). Both constructs describe positive emotional experiences achieved while engaging in an activity; however, whereas enthusiasm describes only the affective experience itself, the construct of intrinsic motivation implies that this affective experience is the ultimate reason for behaviour (Eccles & Wigfield, 2002). Teachers, like other employees, tend not to work purely because they enjoy it; at least some of their reasons for engaging are usually extrinsic (Pelletier et al., 2002). Enthusiasm as an affective disposition marked by habitual positive emotions may thus be seen as a manifestation of intrinsic motivation, but may also occur when teachers are extrinsically motivated.

1.3. Instructional quality and enthusiasm

Instructional quality is defined as creating challenging and adaptive learning situations, as well as carefully guiding students through the learning process (Baumert et al., 2004; Brophy, 1999; Collins, Greeno, & Resnick, 2001; Shuell, 1996, 2001). Within this theoretical framework, successful teachers can be described as performing well on at least three aspects of instructional behaviour. First, they succeed in establishing a well-structured environment characterized by low disturbance levels and efficient use of time (classroom management, Emmer & Stough, 2001). Second, they offer students high-level cognitive activities that enable them to develop new insights and understandings based on their former knowledge or preconceptions. From an organizational point of view, this cognitive activation can be facilitated by selecting tasks that draw on students' prior knowledge and experience, and by considering different approaches to a task as well as students' (mis)conceptions in whole-class discussions (Kunter & Baumert, 2006; Turner et al., 1998). It is crucial that these learning opportunities are attuned to students' levels of understanding, that they stimulate students' own thought processes, and that they leave students room to evaluate their own learning outcomes, a process that Stefanou, Perencevich, DiCintio, and Turner (2004) have called "cognitive autonomy support". Third, effective teachers create a supportive social environment in which students receive personal guidance and feel personally valued (Ryan & Powelson, 1991).

Indirect support for a positive association between teacher enthusiasm and instructional quality can be drawn from studies on teaching effectiveness, which typically report positive associations between student ratings of their instructor's motivation, on the one hand, and teaching skills, on the other (Jackson et al., 1999; Marsh, 1994). Because these findings are based on student observations alone, however, there is no way of knowing whether student perceptions of teacher motivation coincide with the motivation experienced by the teachers themselves. Similarly, in studies based solely on teacher self-reports (Long & Hoy, 2006; Pelletier et al., 2002), correlations between reported motivation and reported instructional behaviours may be inflated due to a positive (or negative) self-perception bias. In the present study, we used both teacher self-reports and student ratings to assess teachers' enthusiasm and instructional behaviours, thus avoiding the inflated correlations that may result from the use of a single informant.

1.4. Aims and hypotheses

Open questions in the study of teacher enthusiasm concern the conceptualization of the construct, methodological approaches to its measurement, and its relevance to actual classroom behaviours. In the present study, we examined the salience of teacher enthusiasm as an affective disposition in classroom situations by reference to mathematics teachers' self-reports and student data.

Specifically, we first expected two aspects of mathematics teachers' enthusiasm to be distinguishable, namely enthusiasm for mathematics and enthusiasm for teaching (hypothesis 1). Second, to establish the two aspects of enthusiasm as dispositional characteristics reflecting trait-like dimensions of teacher motivation, we examined their relationships with other indicators of teacher motivation. We expected both aspects to be related to, but different from, teachers' general job satisfaction (Van Horn, Taris, Schaufeli, & Schreurs, 2004) and to be correlated with students' ratings of their teachers' enthusiasm (hypothesis 2). Third, we expected enthusiasm to be associated with high quality teaching, and we expected enthusiastic teachers to show more attentive and involved behaviour during lessons, as indicated by higher levels of monitoring students' behaviours, promoting students' cognitive autonomy, and social support for students (hypothesis 3). To find out whether teacher enthusiasm was relevant to both teachers and students, we sought to assess instructional quality from both the teachers' and the students' perspective. Fourth, we expected to find differential associations between teachers' enthusiasm and their instruction when different indicators of instructional quality (i.e., teacher and student ratings) were compared. Specifically, we expected the correlations between teacher enthusiasm and teachers' self-reports of instruction to be higher than the correlations between teacher enthusiasm and students' ratings of instruction (hypothesis 4).

2. Method

2.1. Design

The data reported are from the COACTIV (Professional Competence of Teachers, Cognitively Activating Instruction, and the Development of Students' Mathematical Literacy) study, a large-scale study on secondary school mathematics teaching that was embedded in the German extension to the 2003 cycle of the Programme for International Student Assessment (PISA 2003) by the Organization for Economic Cooperation and Development (OECD). The international PISA 2003 design was extended in several ways in Germany. For the present study, a representative sample of 387 intact 9th-grade mathematics classes was drawn, and their mathematics teachers were administered an extensive set of questionnaires and assessments. This design allowed teachers' enthusiasm and instructional behaviour to be linked with the corresponding student data.

2.2. Sample

The teacher sample consisted of 323 mathematics teachers (57% male) aged 25–64 years ($M = 47.6$ years, $SD = 9.0$). The length of their teaching experience ranged from 1 to 41 years ($M = 21.3$ years, $SD = 10.5$). Almost all teachers (97%) had passed the state examination mandated by the German teacher education system, with 87% majoring in mathematics. The teachers were employed in 179 schools from all tracks of the German secondary system: 22.3% in lower track schools (Hauptschulen), 10.2% in multitrack schools (Schulen mit mehreren Bildungsgängen), 25.7% in intermediate track schools (Realschulen), 9.9% in comprehensive schools (Gesamtschulen) and 31.9% in academic track schools (Gymnasien). All participating teachers taught mathematics to one of the 9th-grade classes in the PISA 2003 sample. Of the 94% of teachers from the original PISA classes who participated in the teacher survey ($N = 351$), we excluded those who provided no data on the enthusiasm items ($N = 23$) and/or those for whom less than five students provided data ($N = 9$). Owing to overlap between these two groups, a total of 28 teachers were excluded, giving a sample of 323 teachers. This sample did not differ from the original class sample in terms of student achievement or students' social background.

The student sample consisted of 323 classes with 3961 students. Because a within-class rotation of different questionnaires was used, the ratings are based on an average of 12 students per teacher (range 6–18 students). The mean age of the students was 15.8 years (SD = .7), with 52% girls. 91% of the students were born in Germany, 92% spoke German at home.

2.3. Measures

Table 1 provides an overview of all measures, including descriptive data. In order to give an illustrative overview, the descriptive statistics are based on manifest scales that were formed by averaging the respective scale items. The scales thus reflect the original item metric. All questionnaire items were rated on a 4-point Likert-type scale ranging from 1 = strongly disagree to 4 = strongly agree.

2.3.1. Teacher enthusiasm questionnaire

Four items of the teacher motivation questionnaire, which was constructed specifically for the COACTIV study, measured teacher enthusiasm. The items were based on an existing teaching effectiveness questionnaire (Marsh & Ware, 1982) and focused on two factors: *Teachers' enthusiasm for mathematics* (e.g., "I am still enthusiastic about the subject of mathematics") and *Teachers' enthusiasm for teaching mathematics* (e.g., "I really enjoy teaching mathematics in this class"). Confirmatory factor analyses were used to confirm the two-factor structure of the enthusiasm scale (see Table 2). The appropriateness of the two-factor model was evaluated and compared with that of a single-factor model. The two models could not be compared directly using the χ^2 goodness-of-fit test, because both had the same degrees of freedom (df = 2). Instead, the Bayesian Information Criteria (BIC) was used for model comparison, with a smaller value indicating a better fit. The comparison of the indices of the two models favoured the two-factor model, $\chi^2(2, N = 323) = 3.899$, $p < .05$, CFI = .994, RMSEA .011, $SRMR_{between} = .019$, BIC = 2250.899, over the single-factor model, $\chi^2(2, N = 323) = 56.204$, $p < .05$, CFI = .816, RMSEA .061, $SRMR_{between} = .145$, BIC = 2338.583. The intercorrelation between the two factors was $r = .34$ (latent factor correlation; $p < .05$),

Table 1
Overview of measures and descriptive statistics

Measure	n	M	SD	ICC_1/ICC_2	Mean AD_M
Teacher dispositions					
Enthusiasm for mathematics	323	3.37	.49	–	–
Enthusiasm for teaching	323	2.89	.67	–	–
General job satisfaction	310	2.90	.72	–	–
Students' perceptions of teacher enthusiasm	323	3.10	.42	.19/.74	.66
Instructional behaviours					
Teacher self-reports					
Monitoring	323	3.16	.50	–	–
Cognitive autonomy support for students	319	2.91	.48	–	–
Social support for students	323	3.50	.45	–	–
Student ratings					
Monitoring	323	2.67	.41	.25/.80	.66
Cognitive challenge	323	2.85	.27	.09/.54	.69
Social support for students	323	2.58	.49	.27/.82	.70

ICC_1: proportion of variance between classes; ICC_2: reliability of class mean; Mean AD_M: mean average deviation index across all classes; – not applicable.

Table 2
Two-factor model of the teacher enthusiasm questionnaire: standardized factor loadings and residuals

Items	Enthusiasm for		Residuals
	Mathematics	Teaching	
I am still enthusiastic about the subject of mathematics	.73		.46
I find mathematics exciting and try to convey my enthusiasm to the students	.72		.47
I teach mathematics in this class with great enthusiasm		.86	.26
I really enjoy teaching mathematics in this class		.89	.22

indicating only a moderate association between enthusiasm for the subject of mathematics and enthusiasm for teaching mathematics in the class. The internal consistency for the manifest scales teachers' enthusiasm for mathematics and teachers' enthusiasm for teaching mathematics was Cronbach's $\alpha = .69$ and .86, respectively.

2.3.2. Teachers' instructional behaviours questionnaire

Teachers were asked how often they used various instructional methods. In the present investigation, we focused on three scales. First, as one aspect of good classroom management, the *monitoring* scale assessed the degree to which teachers try to prevent disruptions by being attentive to student behaviour (two items; e.g., ‘‘I notice immediately if one or more students aren't concentrating; I then immediately involve them in the lesson''). A second set of items tapped teachers' *cognitive autonomy support for students*, that is, involving students' ideas and errors in their instruction; for instance, letting students discover the inconsistencies in their solutions by themselves (five items; e.g., ‘‘I work on the basis of the students' suggestions and carry on with that working until the students notice that something doesn't add up''). A third set of items described teachers' provision of *social support for students* (four items; e.g., ‘‘I take care of my students if they have problems''). Confirmatory factor analysis confirmed that the theoretically proposed aspects of instructional behaviours could be reliably distinguished, $\chi^2(41,\ N = 323) = 93.648$, $p < .05$, CFI = .935, RMSEA = .013, $SRMR_{between} = .052$ (see also Table 3). The internal consistency for the manifest scales monitoring, cognitive autonomy support for students, and social support for students was Cronbach's $\alpha = .64$, .75, and .85, respectively.

2.3.3. Teachers' job satisfaction questionnaire

Six items assessed teachers' general job satisfaction (e.g., ‘‘If I had to choose again, I would still become a teacher''). Confirmatory factor analysis confirmed that they can reliably be subsumed under a single factor, $\chi^2(9,\ N = 323) = 44.633$, $p < .05$, CFI = .934, RMSEA = .024, $SRMR_{between} = .053$; all factor loadings were >.57; for the manifest scale, internal consistency was Cronbach's $\alpha = .87$.

2.3.4. Students' ratings of teachers' instructional behaviour questionnaire

The students in each class rated their teachers' behaviour on three sets of items. First, the items of the *monitoring* scale corresponded to those used in the teacher questionnaire and described the degree to which the teacher notices disruptive or inattentive student behaviour (three items; e.g., ‘‘In mathematics, our teacher immediately notices if we get distracted''). Second, students rated the degree of *cognitive challenge* they experience in mathematics instruction (three items; e.g., ‘‘Our mathematics teacher asks us to explain our thought processes thoroughly''). Note that the meaning of this scale differs slightly from that of the corresponding teacher scale, which taps cognitive autonomy. Findings reported by Kunter and Baumert (2006) indicate that teachers and students seem to perceive the dimension of cognitive challenge differently, with teachers reporting the *intended* cognitive autonomy, and students rating their subjective *experience* of cognitive challenge in the learning process. Third, again parallel to the teacher questionnaire, students rated the *social support for students* provided by their teacher (four items; e.g., ‘‘Our mathematics teacher always addresses students' problems'').

Based on the students' ratings, the three factors, namely monitoring, cognitive challenge, and social support for students were formed. The goodness-of-fit of the instruction measurement model was $\chi^2(50,\ N = 323) = 332.392$, $p < .05$; CFI = .959, RMSEA = .038, $SRMR_{within} = .031$, $SRMR_{between} = .092$.

Table 3 lists all items of the teacher and student questionnaires with factor loadings and residuals from the measurement models that were calculated separately for teacher self-reports and students' ratings. Table 4 shows the factor

Table 3
Measurement models for instructional behaviours as rated by teachers and students: standardized factor loadings and residuals

Items	*E*	Factor loadings					
		Teachers' self-reports			Students' ratings		
		MO	CAS	SOS	MO	CCH	SOS
Teachers' self-reports							
As a rule, I soon notice if students get distracted, and I put a stop to it at once	.35/.46	.80/.74					
I notice immediately if one or more students aren't concentrating; I then immediately involve them in the lesson	.66/.59	.59/.64					
I work on the basis of the students' ideas and carry on with that working until the students see whether their approach will lead to the goal or whether incongruities are becoming apparent	.68/.68		.57/.57				
If a student makes a mistake when a new topic is being covered, I initially accept the suggestion without comment, and carry on working through the problem with the students until the mistake becomes obvious	.62/.62		.62/.62				
I sometimes deliberately let the students go astray until they realise that something must be wrong	.58/.58		.65/.65				
I work on the basis of the students' suggestions and carry on with that working until the students notice that something doesn't add up	.40/.41		.78/.77				
If a student makes a mistake when a new topic is being covered, I ask the class for their opinion without commenting myself	.76/.75		.50/.50				
I take care of my students if they have problems	.48/.28			.72/.72			
I build up trusting relationships with my students	.27/.32			.86/.85			
I show understanding for my students	.33/.32			.82/.82			
I take time to listen if my students want to discuss something with me	.57/.57			.65/.66			
Students' ratings							
In mathematics our teacher always knows exactly what is going on in class	.09/.08				.95/.96		
In mathematics our teacher makes sure that we pay attention	.22/.23				.87/.88		
In mathematics our teacher immediately notices if we get distracted	.10/.11				.95/.95		
Our mathematics teacher sometimes asks us to demonstrate several different ways of solving a problem	.56/.57					.66/.66	
Our mathematics teacher asks us to explain our thought processes thoroughly	.02/.03					.99/.98	
Our mathematics teacher often expects us to explain our working in detail	.53/.52					.68/.69	
Our mathematics teacher always takes time to talk if students want to discuss something with him/her	.05/.05						.98/.98
Our mathematics teacher always addresses students' problems	.04/.04						.98/.98
Our mathematics teacher does his/her best to respond to students' requests as far as possible	.05/.05						.97/.97

E = residuals; MO = monitoring; CAS = cognitive autonomy support for students; CCH = cognitive challenge; SOS = social support for students; for all coefficients $p < .05$.
The numbers before the slash report coefficients from the measurement models that were calculated for each questionnaire separately, the numbers after the slash report coefficients from the measurement model of the full SEM.

Table 4
Factor intercorrelations between instructional behaviours as rated by teachers and students

	Teacher's self-reports		Student ratings		
	CAS	SOS	MO	CCH	SOS
Teachers' self-reports	.09	.24*	.21*	−.08	−.01
Monitoring		.20*	.13	.26*	.16*
Cognitive autonomy support for students			.23*	.17	.31*
Social support for students					
Students' ratings				.70*	.69*
Monitoring					.66*
Cognitive challenge					

The coefficients are based on the latent factors and thus represent estimates free of measurement error; $*p < .05$.
MO = monitoring; CAS = cognitive autonomy support for students; CCH = cognitive challenge; SOS = social support for students.

intercorrelations. The intercorrelations between teacher self-reports and student ratings of the corresponding aspects of instruction were moderate, ranging from $r = .21$ to $r = .31$.

2.3.5. Students' ratings of mathematics teachers' enthusiasm questionnaire

Three items in the student questionnaire captured student perceptions of their mathematics teacher's enthusiasm: "Our mathematics teacher seems to really enjoy teaching", "…is an enthusiastic teacher", and "…is enthusiastic about the subject of mathematics". These items tap displays of enthusiasm in general, enthusiasm for teaching, and enthusiasm for the subject matter. Confirmatory factor analysis confirmed that they can reliably be subsumed under a single factor, $\chi^2(16, N = 323) = 268.378$, $p < .05$, CFI = .935, RMSEA = .047, $\text{SRMR}_{\text{within}} = .020$, $\text{SRMR}_{\text{between}} = .037$.

2.3.6. Reliability of the class-level student measures

Because student ratings of instruction were assessed at the individual student level, but represent class-level constructs, we first investigated the feasibility of this approach by computing between-class variance, reliability indices for the class means and agreement within classes. As indicated by the intra-class correlations (ICC_1) ranging from .09 to .27 (see Table 1), student ratings varied systematically between teachers. Moreover, with the exception of the cognitive challenge scale, the reliability of the scales at the class level based on class means was satisfactory (ICC_2, based on the Spearman–Brown equation, which takes the number of ratings per class into account), ranging from .54 to .82 (as a rule of thumb, an $ICC_2 > .70$ is considered indicative of good reliability; Lüdtke, Trautwein, Kunter, & Baumert, 2006).

In addition, we calculated the mean Absolute Deviation index (AD_M), which provides an indicator of student agreement within classes (Lüdtke et al., 2006). The AD_M is calculated per class and can be interpreted in terms of the original rating metric. For instance, an AD_M of 1 means that, on average, the students in the class deviate from the class mean by 1 unit on the rating scale. As shown in Table 1, the mean deviation within classes is smaller than 1 scale point in all scales (from .66 to .70). For organizational contexts, Burke, Finkelstein, and Dusig (1999) proposed an $AD_M < .67$ to indicate significant interrater agreement on a 4-point scale. All of our scales reached or were close to this threshold, though it is important to note that its applicability to student samples has not yet been tested. In sum, the indices inspected indicate that the levels of between-class variance and within-class agreement observed are sufficient for aggregated student data to be used to assess teachers' instructional behaviour.

2.4. Statistical analyses

Teachers' questionnaire data were matched with the respective student data. Because student ratings were collected from several students per teacher, the data have a hierarchical structure, with students nested within teachers. This hierarchical data structure is accounted for in the reliability estimations for the student ratings on the class level as well as in the general statistical procedure.

Given the hierarchical data structure, we used a two-level approach in which the student variables were modelled simultaneously on the individual (student) level and on the class (teacher) level using Mplus (Muthén & Muthén, 1998). One advantage of this procedure is that it divides the variance into a within-class and a between-class covariance matrix (based on the mean ratings per class) and takes the number of units per class into account, thus weighting classes according to the number of students providing ratings. In addition, the two-level approach can detect differences in the data structure between these two levels. Because the present research was only interested in variable relations at the teacher level, we investigated differences between teachers or classes, not individual students. We therefore focus on the teacher level as the main level of analysis. Consequently, although we modelled the scales of the student ratings simultaneously on the student and teacher level, we only report findings on the teacher level (where the student ratings feature as class means). For all models that were tested at the between-teacher level, the N (number of clusters) is 323.

We employed structural equation modelling (SEM) to investigate relations between latent factors that account for the items of the various questionnaires. In all models, the factor loadings of the first item in a factor were set to 1 and the variances were freely estimated. Because a small amount of data was missing (see Table 1), all parameters were estimated using a full information maximum likelihood (FIML) procedure, allowing us to make use of the full sample size. Statistical significance for all testing was set at the 5% level.

3. Results

The results section is organized as follows: First, based on the structure of the two-factor enthusiasm scale presented in Section 2.3.1, we describe the relations of enthusiasm with teachers' personal characteristics. Second, we present the results of SEM models investigating how teacher enthusiasm is related to instructional behaviours as reported by the teachers themselves and rated by their students.

3.1. Enthusiasm and teachers' personal characteristics

We examined whether teachers differed in their enthusiasm as a function of personal characteristics such as biographical data (gender, age and teaching experience) or other measures of teacher motivation (general job satisfaction, student-rated enthusiasm). To this end, a structural equation model was specified to examine the (measurement-free) correlations between factors. Because the biographical data were represented by single items only, we specified latent factors with single items for which the residual variances were set to 0. The other constructs were represented by latent factors with multiple indicators. The results of this correlation analysis are presented in Table 5. The coefficients are based on the latent factors and thus represent estimates free of measurement error, $\chi^2(91, N = 323) = 422.889$, $p < .05$, CFI = .940, RMSEA = .022, $SRMR_{within} = .009$, $SRMR_{between} = .049$. There was no correlation between gender and either type of enthusiasm, and neither age nor teaching experience correlated significantly with enthusiasm for mathematics. However, a small negative correlation between age and enthusiasm for teaching was observed, indicating that younger teachers tend to be more enthusiastic about the activity of teaching than their older colleagues. We also found moderate associations between teachers' general job satisfaction and self-reported enthusiasm. The correlations between teachers' self-rated enthusiasm and the enthusiasm ratings they received from their students are of particular interest. Although students' ratings correlated with both types of enthusiasm, the correlation between students' perceptions of teacher enthusiasm and teachers' enthusiasm for teaching was significantly higher than that between students' perceptions and teachers' enthusiasm for mathematics.[1]

3.2. Enthusiasm and instructional behaviour

We then investigated the correlations between the factors representing the different aspects of instructional behaviours and the two dimensions of teachers' enthusiasm. To this end, a structural equation model was specified to

[1] This difference can be statistically substantiated—a model in which the correlation coefficients were fixed to be equal led to a significant reduction in goodness-of-fit: free estimation of correlation coefficients, $\chi^2(16, N = 323) = 268.378$, $p < .05$, CFI = .935, RMSEA = .047, $SRMR_{within} = .020$, $SRMR_{between} = .037$, vs. correlation coefficients constrained to be equal, $\chi^2(17, N = 323) = 279.680$, $p < .05$, CFI = .933, RMSEA = .046, $SRMR_{within} = .020$, $SRMR_{between} = .065$; $\Delta\chi^2(1) = 10.14$, $p < .05$. Because the student items referred to both enthusiasm for the subject ("Our mathematics teacher is enthusiastic about the subject of mathematics") and enthusiasm for teaching ("Our mathematics teacher seems to really enjoy teaching"), we carried out additional analyses with each of the three student-rated enthusiasm items separately. Results showed that the one item referring explicitly to the subject did not show differential correlations with the two teacher enthusiasm scales.

Table 5
Correlations between teacher enthusiasm and other teacher characteristics

	Enthusiasm for mathematics	Enthusiasm for teaching
Gender	−.056	−.064
Age	−.119	−.164*
Teaching experience	−.080	−.115
General job satisfaction	.193*	.262*
Student-rated enthusiasm	.168*	.409*

*$p < .05$; gender coded as 1 = female, 2 = male.

examine the correlations between factors. The coefficients are based on the latent factors and thus represent estimates free of measurement error, $\chi^2(49, N = 323) = 626.159$, $p < .05$, CFI = .958, RMSEA = .014, $\text{SRMR}_{\text{within}} = .012$, $\text{SRMR}_{\text{between}} = .061$. These latent factor correlations are presented in Table 6. Two main correlational patterns emerge. First, moderately high positive correlations were observed between teachers' self-reports of their enthusiasm and of their instructional behaviours, indicating that more enthusiastic teachers tend to report higher quality instructional behaviours. Second, teachers' enthusiasm for teaching was related to higher student ratings of quality teaching, but their enthusiasm for the subject of mathematics was not.

To determine the specific contribution of the two types of enthusiasm to instructional behaviours, we next ran a structural equation model in which the correlational model was replaced by a regression model that specified the teachers' enthusiasm for teaching and for mathematics as predictors of their instructional behaviours. With enthusiasm for mathematics and enthusiasm for teaching being considered simultaneously as predictors, the regression coefficients (standardized regression coefficients) can be interpreted as the specific effect of the respective enthusiasm dimension on instructional behaviours. The results of this analysis, therefore, expand the findings from the correlations, revealing specific predictive patterns for the two dimensions of enthusiasm and for the two modes of assessing instruction.

The results of the regression analysis are shown in Fig. 1. For reasons of clarity, only the regression coefficients and the intercorrelation between the two enthusiasm factors are shown; the residual correlations between the instruction factors were very similar to the bivariate correlations reported in Table 6 (because this model is a fully saturated

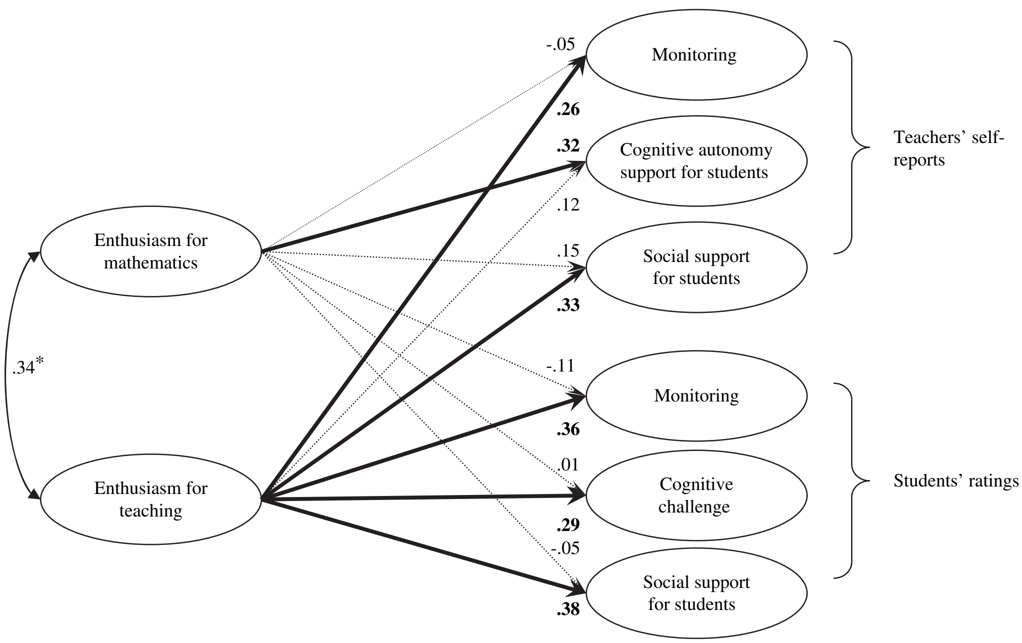

Fig. 1. Teacher enthusiasm as a predictor of instructional behaviours. Paths that are statistically significant at $p < .05$ are indicated by solid lines.

Table 6
Correlations between teacher enthusiasm and instructional behaviours

	Enthusiasm for mathematics	Enthusiasm for teaching
Teachers' self-reports		
Monitoring	.029	.240*
Cognitive autonomy support for students	.360*	.224*
Social support for students	.358*	.380*
Students' ratings		
Monitoring	.002	.321*
Cognitive challenge	.098	.290*
Social support for students	.056	.357*

$^*p < .05$.

model, its fit is equivalent to the correlational model; information on factor loadings and residuals can be found in Table 3). When enthusiasm for mathematics as a subject was controlled, teachers' enthusiasm for teaching significantly predicted two aspects of their self-reported instructional behaviour. Specifically, the more teachers enjoyed teaching, the more monitoring they reported ($\beta = .26$, $p < .05$) and the more social support they claimed to provide their students ($\beta = .33$, $p < .05$). Their reported use of cognitive autonomy support for students was not substantially predicted by their enthusiasm for teaching ($\beta = .12$, $p > .05$). The only instructional aspect predicted by enthusiasm for mathematics when teaching enthusiasm was held constant was teachers' cognitive autonomy support for students ($\beta = .32$, $p < .05$).

Turning to student-rated instructional behaviours specific patterns emerged for mathematics enthusiasm and teaching enthusiasm. Whereas teacher enthusiasm for teaching significantly predicted students' perceptions of instructional behaviours in the classroom, teacher enthusiasm for mathematics did not. When mathematics enthusiasm was controlled, teachers who were more enthusiastic about teaching were perceived to monitor their students more carefully ($\beta = .36, p < .05$) and to provide students with more social support ($\beta = .38, p < .05$) than their less enthusiastic counterparts. Moreover, students whose teachers were more enthusiastic about teaching reported experiencing higher levels of cognitive challenge in the classroom ($\beta = .29$, $p < .05$). In contrast, no associations were observed between teachers' enthusiasm for mathematics and students' reports of instruction when teaching enthusiasm was held constant. In other words, teachers' enjoyment of the subject matter did not seem to be uniquely reflected in behaviours that students rated as stimulating or supportive. However, the enthusiasm of teachers who enjoyed the activity of teaching seemed to be evident to students in the form of high quality instructional behaviours.

4. Discussion

Our study aimed to provide theoretical clarification of the construct of teacher enthusiasm and to test the longstanding claim that enthusiasm is one of the defining characteristics of effective teachers (Brophy & Good, 1986; Shuell, 1996; Walberg & Paik, 2000). To this end, we matched questionnaire data from a representative sample of secondary mathematics teachers with various indicators of their teaching quality. As expected, two dimensions of enthusiasm were distinguished (hypothesis 1). These two dispositions were related to, but different from, teachers' general job satisfaction and corresponded with students' ratings of their teachers' enthusiasm, which may be seen as an indication of the criterion validity of the scales (hypothesis 2). Most importantly, as predicted by hypothesis 3, our findings highlight the significance of teacher enthusiasm in the classroom, showing that higher enthusiasm is significantly related to higher quality instructional behaviours, particularly in terms of teachers' monitoring of student behaviours and provision of social support. At the same time, our results indicate that a differentiated approach is required. The two enthusiasm variables showed differential correlations with teachers' instructional behaviours, with enthusiasm for teaching being a stronger predictor of instructional quality than enthusiasm for mathematics. Moreover, as predicted by hypothesis 4, the correlations between teacher-reported enthusiasm and instructional quality were higher than the correlations between teacher enthusiasm and student ratings of instruction. In the following, we first discuss the implications of our study for the construct of enthusiasm and its meaning for the instructional process. We then raise methodological issues, discussing how further research can overcome some of the limitations of our study.

4.1. The construct of enthusiasm as a dispositional teacher characteristic

Our research showed that it is possible and useful to distinguish between enthusiasm as a disposition on the teacher's part and "enthusiastic teaching" as an aspect of instructional behaviour that may be seen as a manifestation of that disposition. Our conceptualization of enthusiasm as a teacher disposition is based on recent theories of motivational engagement in learning contexts (Eccles & Wigfield, 2002; Pintrich, 2003b). Placing the construct of enthusiasm within the framework of motivational engagement theories proved a very fruitful approach, particularly because it inspired us to distinguish enthusiasm for the subject matter of instruction and enthusiasm for the activity of teaching as two distinct dimensions, each with specific meaning. However, in motivational research in particular, inflated use of new terms and constructs has been criticized, with researchers being cautioned to carefully consider whether the introduction of new terms is helpful (Murphy & Alexander, 2000). Especially the conceptual overlap between enthusiasm as an affective disposition and individual interest as a broader construct is an important theoretical issue that warrants further investigation. Further studies are needed to link the present enthusiasm scales with existing motivational and behavioural measures, and to establish whether enthusiasm is a unique construct with specific predictive validity or whether it can be subsumed under existing theoretical approaches. As discussed above with reference to the constructs of topic interest and intrinsic motivation, however, not all motivational constructs that have proved useful for explaining differences in students' motivation necessarily also apply to teachers. Care should therefore be taken to examine whether theoretical assumptions about learners' motivational characteristics are equally applicable to teachers. Butler's (Butler, 2007; this issue) recent work on teachers' goal orientations demonstrates that existing frameworks may need to be differentiated and expanded to capture the specific demands of the teaching profession.

4.2. Teacher enthusiasm and the instructional process

Several studies of student motivation have documented the relevance of intrinsic motivation for engaged, committed and resourceful working and learning behaviour (Eccles & Wigfield, 2002; Pintrich, 2003a; Ryan & Deci, 2000; Schiefele, 1991). Thus, it seemed reasonable to hypothesize that teachers' behaviours are also influenced by their motivation. As expected, our findings showed that teachers' enthusiasm is reflected in their instructional behaviours. Both teachers' self-reports and students' ratings indicated that more enthusiastic teachers provided more stimulating and effective instruction. The patterns of association between perceived teacher enthusiasm and instructional behaviours confirmed that it is important to distinguish between two types of enthusiasm, namely enthusiasm for the subject matter taught and enthusiasm for teaching that subject matter: only the latter was consistently associated with higher teaching quality in teachers' self-reports and students' ratings. The only instructional aspect that was systematically linked to teachers' enthusiasm for mathematics was the teacher-reported provision of cognitive autonomy support, indicating that teachers who enjoy and like the topic of mathematics are especially committed to engaging their students in high-level cognitive activities in that domain. If one interprets teacher vs. student ratings of instruction as indicators for intended vs. experienced teaching quality (Kunter & Baumert, 2006), however, it seems that the students do not necessarily respond to these efforts. Evidently, teachers' interest in and enjoyment of a subject matter is not necessarily reflected in specific classroom behaviours—or any such behaviours may go unnoticed by students.

The close association between teachers' enthusiasm for teaching and their instructional behaviours warrants further discussion. Given the cross-sectional nature of our data, we must be careful about commenting on the causal status of teacher enthusiasm in instructional behaviours. Of course, it seems plausible to assume that teachers' enthusiasm shapes their classroom behaviour. Yet teachers' experience of their professional activities might equally be influenced by the characteristics of their students, meaning that they might come to enjoy teaching a particular class precisely *because* that class allows them to teach in a stimulating and effective way. In the study by Pelletier et al. (2002), for instance, teachers' views of their students as being intrinsically motivated predicted their own feelings of intrinsic need satisfaction. Qualitative studies, in which teachers were interviewed about factors influencing their motivation in positive and negative ways, point in the same direction (Blase, 1986; Stenlund, 1995). Characteristics of the students taught and aspects of teacher–student interaction often emerged as the most important sources of motivational variation in these studies.

Because the items we used to tap enthusiasm for teaching made explicit reference to a particular class, we cannot rule out the possibility that a class-specific effect underlies the correlation observed between teacher enthusiasm and students' instructional ratings. To disentangle these possible effects and take a broader view on enthusiasm for teaching, the existing 2-item scale will have to be extended to include more items tapping the enjoyment of teaching in general. Similarly, the enthusiasm for mathematics scale will need to be extended to ensure sufficient reliability and validity. In a current follow-up study, an extended version of the two enthusiasm scales is being tested, with new items such as ''I enjoy interacting with students'' and ''I enjoy teaching'' tapping enthusiasm for teaching and ''I engage in my subject because I enjoy it'' tapping mathematics enthusiasm.

4.3. Research designs for the investigation of teacher enthusiasm

Finally, our findings offer some suggestions for further research in the field of teacher enthusiasm and teacher motivation. One major shortcoming of many previous studies is their restriction to single data sources. For example, research on teacher effectiveness tends to assess teacher motivation on the basis of student ratings only, whereas studies in areas such as teachers' self-efficacy tend to rely on teachers' self-report data (Tschannen-Moran & Hoy, 2001). As observers, students seem able to describe interactions in their classrooms, but they may not be the best source of information on teachers' personal motivational dispositions. Rather, teachers may be the optimal informants here. However, the validity of teachers' self-reports on their instruction is often limited by self-serving biases or by a lack of reflective awareness (Mayer, 1999; Porter, 2002; Wubbels, Brekelmans, & Hooymayers, 1992). In addition, the possibility of general positive or negative assessment bias needs to be considered for both student and teacher data. The combination of student and teacher data in our analyses permitted us to avoid these specific pitfalls and thus allowed for more valid interpretations.

Turning to the issue of research designs, our study considered classroom situations within a correlational design. The field sample of teachers and their classes provided insights into occurrences in real classrooms, and allowed us to work with natural variations in enthusiasm and instructional quality, as well as with teachers and students who share a joint history. Because we were able to draw on a representative class sample, our findings have a high level of generalizability. Given that empirical data on teacher enthusiasm is very scarce, our research seems an important step towards gaining a better understanding of the phenomenon. At the same time, as mentioned above, the study's correlational design, and the fact that information from one class only was available for each teacher, means that no conclusions can be drawn on the causal mechanisms underlying the observed correlations.

Experimental studies are usually considered the optimal approach for testing causal assumptions. However, true experimental studies may be of limited value in the context of motivational dispositions. The experimental studies reported above (Brigham et al., 1992; McKinney et al., 1984; Patrick et al., 2000) have confirmed that teacher motivation and its expression are important variables in the instructional process. Because the instructor's enthusiasm was artificially manipulated, however, and because most of the effects investigated relate to very specific ratings of a short lecture, the results cannot necessarily be generalized to real classroom situations. The use of quasi-experimental studies or longitudinal data is thus required in future research. For example, a recent study on teacher emotions (Frenzel & Goetz, 2007) found that gathering data about several classes taught by the same teacher over an extended period of time may be a fruitful way to disentangle teacher and class effects.

Longitudinal approaches might also cast more light on the antecedents of enthusiasm. As Doyle (1986) pointed out, classrooms are characterized by properties such as simultaneity (i.e., several parallel lines of action), immediacy, unpredictability, publicness and a shared history of teacher–student interaction. Our findings show that teachers differ in the extent to which they enjoy this interaction with their students, and that those who enjoy it more seem better equipped to meet the demands of the teaching profession. In an application of expectancy-value framework to describe teacher education students' career decisions, Richardson and Watt showed that the intrinsic value attached to teaching is one of the most important motivations for choosing a teaching career (Richardson & Watt, 2006; Watt & Richardson, 2007). Research on the reasons for these interindividual motivational differences may provide insights into the defining characteristics of effective teachers and offer evidence-based recommendations on how to support teacher effectiveness.

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