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What motivates early adolescents for school? A longitudinal analysis of associations between observed teaching and motivation

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ABSTRACT

For many early adolescent students, motivation for school declines after their transition to secondary education. Increasingly, the decisive importance of teachers in shaping early adolescents' motivation is stressed; thus far, however, both longitudinal and observational studies on this topic have been scarce. The present study investigated how early adolescents' interactions with their maths teachers were associated with the development of their motivation for maths. In line with self-determination theory, videotaped teacher–student interactions were coded in terms of their being supportive or thwarting of the three fundamental human needs for autonomy, competence, and relatedness, i.e. in terms of their providing autonomy support, structure, and involvement. To assess need-supportive teaching, at four measurement time-points equally spread over the first year of secondary education, video analysis was conducted of, in total, 137 complete maths lessons in 20 maths classes (40% female teachers). To assess developments in motivation at each of the four measurement time-points, questionnaires were distributed to the 489 students (aged 12–13; 49.9% girls) in the 20 maths classes. Multilevel analysis did not indicate associations of autonomy-supportive teaching with any of the four motivational constructs incorporated in the study (autonomous motivation, controlled motivation, amotivation, and performance avoidance). For structure, associations in expected directions were found with autonomous motivation (positive) and amotivation (negative), but not with the other two motivational constructs. For teacher involvement, associations in the expected direction were found with all four motivational constructs. The findings are discussed in terms of their implications for research and educational practice.

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1. Introduction

Motivation is an important prerequisite for learning that has been shown to be predictive of, among other things, school achievement (e.g. Richmond, 1990; Steinmayr & Spinath, 2009; Wigfield & Cambria, 2010), transfer of learning (Laine & Gegenfurtner, 2013), and persistence in learning over time (e.g. Richmond, 1990). For many early adolescent students, however, motivation for school declines after their transition to secondary education (e.g. Anderman & Maehr, 1994; Gottfried, Fleming, & Gottfried, 2001; Peetsma, Hascher, van der Veen, & Roede, 2005; Van der Werf, Opdenakker, & Kuyper, 2008; Wigfield, Byrnes, & Eccles, 2006), making this a particularly urgent period for studying motivation and how it can be fostered. This decline is worrisome, especially because it is in their early adolescence that children develop their identity at a rapid pace

and shape their cognitive and emotional responses to school (Wigfield, Eccles, & Rodriguez, 1998). As it is more and more emphasised that social and situational factors can be decisive in shaping students' motivation (Perry, Turner, & Meyer, 2006; Pintrich, 2004), in the present study, we focused on the question of how early adolescents' motivation for maths can be fostered in their maths classrooms. Because in these classrooms the teachers have a central position, we aimed specifically to relate characteristics of teacher–student interactions to various motivational constructs.

Teacher–student interactions can be linked with students' motivation by using the encompassing theoretical framework of self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000). According to SDT, three fundamental human needs exist: for autonomy, for competence, and for relatedness; and students' motivation is affected by whether these are supported or thwarted. A wide array of research is already available, indicating positive associations between early adolescents' motivation and the degree to which they perceive their teachers as need supportive (see Stroet, Opdenakker, & Minnaert, 2013 for a review). Among the prior SDT research, two features render the present study unique. First, to enhance ecological validity and help bridge the gap between

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educational theory and practice, we focused on observed rather than student-perceived need-supportive teaching. Second, we measured the development over the course of a school year of both need-supportive teaching and student motivation to further elucidate how teacher–student interactions affect the development over time of various motivational constructs. We opted to study maths classrooms because maths is considered a very important subject on the curriculum, and in The Netherlands broadly the same material is covered in all schools.

We continue by discussing need-supportive teaching as defined from the SDT perspective (section 2.1) and various motivational constructs and their relationship with students' learning (section 2.2). We then provide an overview of empirical evidence on effects of need-supportive teaching on early adolescents' motivation (section 2.3).

2. Theoretical background

2.1. Need-supportive teaching

What motivates early adolescent students for school? A first interpretation of this question relates to social and situational factors that shape motivation (e.g. Perry et al., 2006). Besides, among other things, early adolescents' home environments and peer groups, research shows that it matters what happens in students' classrooms (Opdenakker, Maulana, & den Brok, 2012; Stroet, Opdenakker, & Minnaert, 2014; Vedder-Weiss & Fortus, 2011). SDT is a prominent theoretical framework in current educational research (e.g. Wentzel & Wigfield, 2009). As mentioned in the introduction, in the classroom, teachers can foster their students' motivation by supporting their students' fundamental needs for autonomy, competence, and relatedness. In the SDT literature, three dimensions of practices of need-supportive teaching are described, on which we elaborate below. Although each of these dimensions can be associated with a specific need, this connection is neither perfect nor unique; rather, the three dimensions complement one another in their effects on students' general level of need satisfaction (Connell & Wellborn, 1991). A need-supportive teaching style may imply beliefs about the nature of student motivation, but it is not a prescribed set of techniques and strategies (Reeve, 2006). When teacher–student interactions are being interpreted in terms of these dimensions, this should be done in context, as a statement cannot be detached from the situation in which it has been uttered (e.g. Malinowski, 1930).

The first dimension, autonomy support versus thwarting, is associated with the need for autonomy. This need finds its origin in people's desire to be causal agents and to experience volition. For students to experience autonomy in their learning, it is crucial that they consider their schoolwork as personally valuable or interesting. Autonomy-supportive teaching includes adopting students' perspectives and providing explanatory rationales when choice is constrained in order to help them meaningfully connect their learning activities to personal goals and prevent them from feeling controlled. For referenced goals not to be experienced as controlling, they should be intrinsic, i.e. satisfying in their own right. Teaching is autonomy thwarting, for example, when it incorporates the assertion of power to overcome students' complaints or when pressure is exerted, such as via guilt induction.

The second dimension, structure versus chaos, is associated with the need for competence. This need refers to people's innate striving to exercise and elaborate their interests and to seek challenges, while at the same time feeling effective in doing so (White, 1959). Teachers can provide structure and help their students to feel effective in their schoolwork by communicating clear and consistent guidelines and expectations, and by being available when students have questions. Further, communicating that success at school

tasks depends on internal controllable factors instead of on inborn talent can foster students' competence; providing constructive, non-comparative feedback is also important in this regard. Finally, an important component of structure is the teacher giving step-by-step directions when answering questions on content, thereby adjusting to the student(s). In contrast, teachers provide chaos when they communicate contradictory expectations, are unavailable when students have questions, or are discouraging.

Finally, the third dimension, involvement versus disaffection, is associated with the need for relatedness. This need concerns the desire to form and maintain strong and stable interpersonal relationships, to connect with and be accepted by others, and to belong (Baumeister & Leary, 1995; Bowlby, 1979; Harlow, 1958; Ryan, 1995). The need for relatedness can be satisfied within interpersonal relationships or through feelings of belongingness to social groups. This final dimension of need-supportive teaching concerns the distinction between teachers showing, as opposed to not showing, interest in the individual students, understanding what is of importance for them, and being available to offer support.

2.2. Motivational constructs and their associations with students' learning

A second interpretation of the question of what motivates early adolescent students for school relates to the factors that give impetus to action or lack thereof (e.g. Deci & Ryan, 1985; Wentzel & Wigfield, 2009). SDT differentiates between motivation that is autonomous, i.e. regulated by personal interest or valuing of the task at hand, and motivation that is controlled, i.e. regulated by feelings of pressure by others or obligation to perform a task. In addition, SDT discerns amotivation, i.e. the state of lacking the intention to act. A prerequisite for any type of motivation, whether autonomous or controlled, is that a student must feel competent to perform the task at hand. For motivation to be autonomous, however, besides competence, students need to experience autonomy. Relatedness is central to promoting students' internalisation of positive values on schoolwork (Ryan & Deci, 2002).

The decline in early adolescents' motivation has been shown to be particularly induced by declines in (elements of) autonomous motivation (Corpus, McClintic-Gilbert, & Hayenga, 2009; Gottfried et al., 2001; Opdenakker et al., 2012; Otis, Grouzet, & Pelletier, 2005). Autonomous motivation is considered pivotal to students' learning, as it has been linked with, among other things, creativity (Amabile, 1996), adaptive coping strategies (Boggiano, 1998; Ryan & Connell, 1989), deep conceptual learning strategies (Meece, Blumenfeld, & Hoyle, 1988), and academic achievement (Boggiano, 1998; Gottfried, 1985; Spinath, Spinath, Harlaar, & Plomin, 2006). Controlled motivation, in contrast, has been associated with negative outcomes such as negative emotions (Dowson & McInerney, 2001; Harter, 1992; Ryan & Connell, 1989), maladaptive coping strategies (Boggiano, 1998; Ryan & Connell, 1989), and poor academic achievement (Lepper, Corpus, & Iyengar, 2005), although positive associations with self-regulation (Miller, Greene, Montalvo, Ravindran, & Nichols, 1996) and adjustment to secondary education (Otis et al., 2005) have also been found.

Another motivational construct that has consistently been shown to be a good predictor of students' engagement in learning in general and learning maths in particular is performance avoidance. Need-supportive teaching is expected to have a negative effect on performance avoidance, which relates to students' avoidance of situations where others will notice their shortcomings. In particular, students' performance avoidance seems closely associated with their perceiving themselves as competent and effective in their schoolwork. Performance avoidance is closely associated with test anxiety (Elliot & McGregor, 1999) and has predominantly been found to be negatively related to students' achievement (e.g. Elliot & Murayama,

2008) and transfer of training (see Laine & Gegenfurtner, 2013, for a meta-analysis).

We continue by providing an overview of prior research on effects of need-supportive teaching as defined in SDT and early adolescents' motivation, thereby paying special attention to the motivational constructs described in this section.

2.3. Need-supportive teaching and early adolescents' motivation: an overview of prior research

In line with SDT, all three dimensions of need-supportive teaching are expected to have positive effects on autonomous motivation and negative effects on both controlled motivation and amotivation. Further, for autonomous motivation, the autonomy-support dimension (associated with the need for autonomy) is expected to be particularly important, whereas, to avoid amotivation and performance avoidance, the provision of structure (associated with the need for competence) is expected to be pivotal.

A large body of research is available that links student-perceived need-supportive teaching with early adolescents' motivation in correlational studies. These studies showed positive associations of need-supportive teaching (Katz, Kaplan, & Gueta, 2010) and of autonomy-supportive teaching (Chirkov & Ryan, 2001; Hardré & Reeve, 2003; Shih, 2008, 2009; Tucker et al., 2002; Vallerand, Fortier, & Guay, 1997) with students' autonomous motivation. In addition, in one study, a negative association of autonomy support with controlled motivation was found (Chirkov & Ryan, 2001), whereas in another study, contrary to expectations, a positive association was found (Shih, 2008). For teacher involvement—or measures closely related thereto—positive associations were found with autonomous motivation (Maulana, Opdenakker, den Brok, & Bosker, 2011; Ryan, Stiller, & Lynch, 1994), and no associations with controlled motivation (Maulana et al., 2011). Finally, in one study, autonomy support, structure, and involvement each appeared to be uniquely associated with students' autonomous motivation (Tucker et al., 2002).

Thus far, most SDT studies among early adolescents have relied on student perceptions (Stroet et al., 2013). Increasingly, however, to enhance the ecological validity of findings and to help bridge the gap between educational theory and practice, the importance of conducting observational research in classrooms is emphasised (Perry et al., 2006; Stefanou, Perencevich, DiCintio, & Turner, 2004). The few studies that did use observational measures typically correlated observed autonomy support and student engagement, finding positive associations (Jang, Reeve, & Deci, 2010; Stefanou et al., 2004). Further, teacher training on autonomy support was found to generate positive effects on observed autonomy support, and levels of the latter appeared to be predictive of changes in engagement between the pre- and post-measures that took place four weeks and nine weeks after the intervention (Reeve, Jang, Carrell, Jeon, & Barch, 2004). In addition, whereas in one study associations between observed structure and observed engagement—but not student-perceived engagement—were found (Jang et al., 2010), in another study the development of observed need-supportive teaching over time was shown to be negatively related to the development of controlled motivation, but not of autonomous motivation (Maulana, Opdenakker, Stroet, & Bosker, 2013).

In addition to the scarcity of studies relying on observational measures of need-supportive teaching, there is a scarcity of longitudinal SDT studies on early adolescents (Stroet et al., 2013). Such research is crucial, however, to further elucidate how the development of students' motivation is associated with their teachers being need supportive. Besides the studies by Reeve et al. (2004) on observed autonomy support and Maulana et al. (2013) on observed involvement described above, we traced three longitudinal studies using student perceptions. These studies showed need-supportive teaching

in autumn associated with changes in engagement between autumn and spring (Skinner, Furrer, Marchand, & Kindermann, 2008), but no associations were found for structure in autumn with changes in motivation between autumn and spring (Pintrich, Roeser, & de Groot, 1994). Finally, (a measure closely related to) involvement in winter was found to be positively associated with changes in student motivation between autumn and spring (Lapointe, Legault, & Batiste, 2005).

In conclusion, together these studies further our understanding of associations among early adolescents of need-supportive teaching with various motivational constructs. At the same time, they point towards gaps in the available empirical evidence supporting SDT. In addition to the scarcity of longitudinal studies and research based on observations rather than on student perceptions, there is a lack of studies linking the structure dimension with autonomous motivation and of studies focusing on amotivation or performance avoidance in general.

2.4. Present investigation

The present study aimed to enhance understanding of how teachers can foster their early adolescent students' motivation in their classrooms. To do so, SDT was applied in a longitudinal study (four waves) that associated observed need-supportive teaching with early adolescents' autonomous motivation, controlled motivation, amotivation, and performance avoidance. By incorporating various motivational constructs, we could examine their discerned associations with the dimensions of need-supportive teaching.

We focused on students in their first year after the transition to secondary education. To measure need-supportive teaching, we used an observational measure that distinguished between the three dimensions: autonomy support versus thwarting, structure versus chaos, and involvement versus disaffection. We chose maths because this is considered a key subject in the curriculum and because, in The Netherlands, differences between schools in terms of subject content are small as a large majority of schools use one of two popular textbooks¹: *Getal en Ruimte* (60%) and *Moderne Wiskunde* (30%) (personal communication, January 2, 2014).

Following recommendations by Snijders and Bosker (2012), we included as predictors both the maths teachers' average levels of need-supportive teaching between measurement time-points and their deviations from these levels per measurement time-point. For both, we hypothesised positive associations of each of the three dimensions of need-supportive teaching with developments of autonomous motivation for maths and negative associations with developments of controlled motivation, amotivation, and performance avoidance for maths.

3. Method

3.1. Participants

The data collection consisted of four waves, with 489 students participating in each wave. These 489 students (49.9% girls) were divided over 20 classes, with class size ranging from 17 to 31 students, in 10 schools, with two classes per school. In total, 16 maths teachers (6 of whom were female, teaching in 40% of the classes) were involved; this total is less than 20 because in some cases a teacher taught in two of the participating classes. In conversations with department heads, it was established that the maths teachers in the participating classes were representative of their schools. The 20 classes were all Grade 7, which in The Netherlands

¹ Both published by Noordhoff Publishers, Groningen, The Netherlands.

is the first year after the transition to secondary education. Students attending this grade are aged 12–13. Further, all classes were at the prevocational level of Dutch secondary education ('vmbo'). In the Dutch educational system, the prevocational level is the lowest track of the three mainstream tracks and is attended by more than half of students (Dutch Inspectorate of Education, 2012).

The participating schools were all non-religious and state funded (as are nearly all schools in The Netherlands). Geographically, these schools were spread across The Netherlands, with the exclusion of the south, and located in areas that ranged from rural to urban and from low to high average socio-economic status. Further, schools varied in their educational approaches, ranging from more student centred to more teacher centred. The incorporation of this variety enhanced the generalisability of findings across school settings. All 10 schools used one of the two main textbooks in Dutch education (see section 2.4).

School department heads decided upon participation in the study in consultation with their teams. Prior to the start of the study, the students' parent(s)/guardian(s) had received information letters informing them that they could decide not to grant permission for their child to participate in the study, or to withdraw him/her at any time should he/she not wish to continue. One student's parent(s)/guardian(s) refused to allow their child to participate in the questionnaire part of the study.

3.2. Measures

3.2.1. Need-supportive teaching

The first wave of data collection took place around 11 weeks after the start of the 2010–2011 school year and the other three waves were evenly spread over the rest of the school year. In The Netherlands, the school year starts and ends at different dates depending on the school's location (either one or two weeks apart from one another); this was taken into account in our planning. At each measurement time-point, in each of the 20 classes, at least one and whenever considered desirable (e.g. when we were not sure that the first lesson videotaped was a typical lesson, for example, because some of the class arrived late) two maths lessons were videotaped. As in the end in 57 of the 80 cases we videotaped two lessons instead of one, this yielded a total of 137 (80 + 57) videotaped lessons. Four cameramen shot the videos: three trained university students and the first author. Classrooms were equipped with two cameras: one fixed camera facing the class and one action camera operated by a cameraman at the back of the class. The action camera was directed at the teacher, or, when the teacher was talking to an individual or a small group of students, at the on-going teacher–student(s) interaction. Teachers were equipped with a small wireless microphone, so that all teacher–student interactions would be audible on the videotapes, including softly spoken interactions with individuals or small groups of students. The cameramen tried to limit interference to an absolute minimum, so that the teacher and the class could proceed with their lesson as usual. It was made clear to both the teachers and the students that the study was interested in normal classroom communication, and it was emphasised that all material would be processed anonymously.

The videotaped lessons were coded using an existing rating sheet assessing need-supportive teaching from the SDT perspective. This rating sheet, presented in Table 1, was used and validated previously in schools for prevocational education (Stroet, 2014). In the development of this rating sheet, existing rating sheets were considered (i.e. Reeve et al., 2004: autonomy support; Wiebenga, 2008: need-supportive teaching; Maulana et al., 2013: involvement), and an extensive review was conducted of available SDT literature on practices of need support and thwarting within teacher–student interactions (e.g. Alfi, Katz, & Assor, 2004; Assor, Kaplan, & Roth, 2002;

Belmont, Skinner, Wellborn, & Connell, 1992; Deci & Ryan, 1994; Deci, Ryan, & Williams, 1996; Jang et al., 2010; Katz & Assor, 2006; Reeve, 2006; Ryan, 1982; Stefanou et al., 2004; Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008; Vansteenkiste, Niemiec, & Soenens, 2010).

The unit of analysis was 'teacher–student interaction'. A teacher–student interaction was defined as a whole conversation regarding one topic; e.g. when a student posed a question and the teacher responded, the whole conversation on this question made up one teacher–student interaction. Lessons typically consisted in frontal instruction and in students working individually or in small groups and all communication in both these parts was segmented into teacher–student interactions. Occasionally, codes referred to complete lessons instead of to teacher–student interactions (see Table 1). Each teacher–student interaction was classified either as not being relevant in terms of need-supportive teaching or as providing students with one or more of its dimensions (autonomy support versus autonomy thwarting, structure versus chaos, and/or involvement versus disaffection). If a teacher–student interaction could not be coded (e.g. because it was inaudible), then 'no code' was to be used; in practice this did not occur. Teacher–student interactions were interpreted in context and from what we considered the perspective of the student(s). All our codes were linked to the complete video fragments to which they related, so that we could adequately map both frequency of occurrence and duration.

In Table 1, the dimensions of need-supportive teaching and need-thwarting teaching are explicated, including their respective components. For example, autonomy support consists of the components of choice, fostering relevance, and respect. The first dimension of need-supportive teaching, autonomy support versus autonomy thwarting, is associated with the need for autonomy. An illustrative example of an autonomy-supportive teacher–student interaction is a teacher who responds to a student who proposes an alternative strategy to solve a maths problem: "There are two ways. This way is more for economics. I do not think it is very convenient for maths, because ..." (Teacher continues to provide arguments). We considered this interaction supportive of the student's autonomy, because the teacher acknowledged her perspective (*respect*) and fostered the relevance of the strategy that he proposed (*fostering relevance*).

The second dimension of need-supportive teaching, structure versus chaos, is associated with the need for competence. An example of a teacher–student interaction that provides chaos is a teacher responding to a student's work by saying: "For a dyslexic, she did well". In this example, we considered that the teacher was discouraging the student (*discouragement*), because she fostered the view that success in learning activities depends mostly on inborn talent.

The third dimension, involvement versus disaffection, is associated with the need for relatedness. An example of a student–teacher interaction that we considered as communicating involvement is a teacher asking a student: "What are you doing? Besides wearing a very cool T-shirt?" We considered that this teacher–student interaction demonstrated affection and interest (*affection*), because the teacher communicated a sense of personal connection between him and the student.

Final coding was conducted by the first author. To enhance validity and establish the reliability of the rating sheet, we followed several steps (Stroet, 2014). First, the video material for two classes was studied in-depth, and the codes of large amounts of fragments were discussed among the authors and with university students, thereby following Heath, Hindmarsh, and Luff's (2010) recommendations on data sessions. Second, another researcher working on SDT received training and coded some of the video material to establish interrater reliability. To establish levels of agreement with the first coder, for two lessons the unweighted kappa coefficient was calculated, yielding values of .70 for the dimension of autonomy support/autonomy thwarting, .71 for structure/chaos, and .75 for involvement/disaffection. Third, in the coding process, when in doubt,

Table 1

Rating sheet ‘Components of need-supportive teaching’.

Teachers’ <u>autonomy support/thwarting</u>	
<i>Choice</i> Creating opportunities for students to work in their own way and incorporating their interests, curiosity, or sense of challenge into the lesson.	<i>Control</i> Keeping possession of the learning material, providing solutions before students have time to reflect by themselves, exerting pressure, or disrupting students’ natural rhythm by not allowing them to realise their action plans.
<i>Fostering relevance</i> Meaningfully connecting the learning activity to a goal that is of personal value to the student(s).	<i>Forcing meaningless activities</i> Actively attempting to compel students to do things they find boring or meaningless or connecting the learning activity to an extrinsic goal.
<i>Respect</i> Listening and responding to students’ feelings, thoughts, perspectives, and complaints.	<i>Disrespect</i> Not allowing differences in opinion, complaints, or negative affect.
Teachers’ provision of <u>structure/chaos</u>	
<i>Clarity</i> Clear organisation that includes communicating clear and consistent guidelines and being available when students have questions on task management (coded per lesson).	<i>No clarity</i> No clear organisation or not being available when students have questions on task management (coded per lesson).
<i>Guidance</i> Being available to answer questions on content (coded per lesson) and providing step-by-step directions when needed, thereby adjusting to the student(s).	<i>No guidance</i> Not being available to answer questions on content (coded per lesson) and clearly not monitoring or adjusting to students’ level of comprehension.
<i>Encouragement</i> Fostering non-competitive learning structures, fostering views that success in learning activities depends on internal controllable factors rather than inborn talent, and demanding effort.	<i>Discouragement</i> Fostering competitive learning structures, fostering students’ views that success in learning activities depends mostly on inborn talent, not demanding effort, or treating poor performance judgementally.
<i>Informational feedback</i> Providing constructive, non-comparative feedback focused on helping students gain control over valued outcomes.	<i>Evaluative feedback</i> Providing comparative feedback focused on evaluating students’ performance, or feedback with a controlling locution, e.g.: “Good, you did just as you should”.
Teachers’ <u>involvement/disaffection</u>	
<i>Affection</i> Showing warmth, demonstrating interest, fostering a sense of connectedness by encouraging empathy and pro-social behaviour, and treating students fairly and as important	<i>Disaffection</i> Talking in an unfriendly tone, showing lack of interest, communicating that students do not belong, or treating students unfairly and as unimportant.
<i>Attunement</i> Showing understanding of what is of importance for the students.	<i>No attunement</i> Showing no understanding of what is of importance for the students.
<i>Dedication of resources</i> Being available to all students in class.	<i>No dedication of resources</i> Not being available to (all) students, e.g. appearing occupied with other things or walking out of the classroom.
<i>Dependability</i> Being available to offer support and showing commitment to students’ learning.	<i>No dependability</i> Clearly not being available to offer support and showing no commitment to students’ learning.

Note: Components are coded per teacher–student interaction, unless indicated otherwise.

the coder discussed fragments with other researchers working on SDT to reach a decision. Finally, to determine the reliability of the final coding, we used four videos to calculate the intrarater reliability, yielding values of Cohen’s kappa of .78 for the dimension of autonomy support/autonomy thwarting, .85 for structure/chaos, and .83 for involvement/disaffection; this indicates good to very good agreement.

For autonomy support, autonomy thwarting, structure, and chaos, we used durations of coded teacher–student interactions to calculate levels because we considered durations to most properly indicate their expression. For example, longer provision of step-by-step directions seemed indicative of higher levels of structure or the more time teachers took to show respect by listening carefully to students, the higher the levels of autonomy support appeared. For involvement and disaffection, we used frequencies of coded teacher–student interactions to establish levels because, for two reasons, we considered frequencies to most properly indicate their expression: first, more than is the case for the other two dimensions, utterances seemed to indicate involvement or disaffection rather independent of their duration; second, we found expressions of involvement and disaffection often to be manifest in part of teacher–student interactions only, so that a focus on duration would somewhat mask the data.

3.2.2. Student motivation

In addition to the collection of video material, questionnaires were administered in each wave to measure students’ motivation for maths, thereby focusing on four motivational constructs, i.e. autonomous motivation, controlled motivation, amotivation, and performance avoidance. Each time, questionnaires were administered after the videos had been shot in a class, on average one week later, with a maximum of three weeks later. The students’ mentors administered these questionnaires during regular (mentor) lessons. In Dutch school classes, typically one of the students’ teachers is appointed as class mentor. In each wave, the mentors received a letter containing standardised instructions to guide the students through the questionnaires. The mentors were instructed not to check the students’ answers and to make clear that all of the data would be processed anonymously. All items had five response categories, ranging from completely disagree (1) to completely agree (5), and were in Dutch, students’ school language.

Autonomous motivation for maths was assessed using an adapted and shortened version of the intrinsic and identified motivation subscales of the [Ryan and Connell \(1989\)](#) self-regulation questionnaire. The subscales were made course specific and consisted of eight items. For example: “I work on maths because I enjoy it”, “I work on maths because I want to learn new things”. In the current study,

the scales had Cronbach's alphas ranging for the five measurement time-points from .88 to .92, indicating high internal consistency.

Controlled motivation for maths was assessed using an adapted and shortened version of the introjected and extrinsic motivation subscales of the [Ryan and Connell \(1989\)](#) self-regulation questionnaire. The subscales were made course specific and consisted of eight items. For example: "I work on maths because I want others to think I am smart", "I work on maths because I have to". Cronbach's alphas ranged from .77 to .83, indicating high internal consistency.

Amotivation for maths was assessed using an adapted and shortened version of the amotivation subscale of the [Vallerand, Blais, Brière, and Pelletier \(1989\)](#) academic motivation scale. The subscale was made course specific and consisted of three items. For example: "I don't know why I work on maths. Sometimes I feel I am wasting my time". Cronbach's alphas ranged from .80 to .86 for the four measurement time-points, indicating high internal consistency.

Performance avoidance, which refers to situations where students are afraid that others will notice their shortcomings, was assessed using the 6-item self-defeating ego-orientation subscale of [Seegers, van Putten, and de Brabander's \(2002\)](#) goal orientation questionnaire. For example: "I feel embarrassed when I have to ask for help during maths lessons". The Cronbach's alphas ranged from .86 to .95, indicating high internal consistency.

3.3. Analytical approach

To answer our research questions, we used hierarchical linear modelling (HLM), thereby following a multilevel approach to take into account the longitudinal and hierarchical structure in the data.

First, a missing data analysis was conducted, because several students had data missing from one or more motivation questionnaires over the study period. These students were included in the analysis. In HLM, missing data are unproblematic, provided that all students have measures on at least one questionnaire and that data are missing at random. The former of these two conditions was met; to check whether the latter condition was also met, we performed an additional analysis ([section 4.1](#)).

For need-supportive teaching, in all analyses, the coded teacher-student interactions were used to calculate net levels of autonomy support, structure, and involvement. To determine these net levels, per class, per measurement time-point, levels of autonomy thwarting, chaos, and disaffection were subtracted from levels of, respectively, autonomy support, structure, and involvement.

Levels of autonomy support, autonomy thwarting, structure, and chaos consist in proportional durations that were calculated as the summed durations of all teacher-student interactions coded as these respective dimensions multiplied by 10 and divided by total durations of lessons. As an example, a net level of '1' of autonomy support would mean for a 50-minute lesson that the total duration of all teacher-student interactions coded as autonomy supportive is 5 minutes longer than the total duration of all teacher-student interactions coded as autonomy thwarting. Levels of involvement and disaffection consist in frequencies that were calculated as the total number of teacher-student interactions coded as involvement and disaffection, respectively, multiplied by 10, divided by the numbers of hours in the respective lessons (as lessons lasted about 50 minutes, the number of hours in one lesson typically was about .83). As an example, a net level of '1' of involvement would mean for a 48-minute lesson that 8 more teacher-student interactions are coded as involvement than as disaffection.

Second, the developments over time of need-supportive teaching and of motivation were depicted by descriptive statistics and figures ([section 4.2](#)).

Third, a series of unconditional models was estimated to calculate the proportion of variance within students, among students, and between classes ([section 4.3](#)).

Fourth, a series of reference models was estimated that only included effects of 'time' and 'gender' (boys functioned as the reference group) on motivational constructs. These models functioned as reference models to which we could compare the final models. In the reference models, the linear effect of 'time' was always included as a fixed effect; random slopes of 'time' for classes and polynomials to the second degree were added in turn when this significantly increased the fit of the reference model. The significance of the increase in fit was determined by means of χ^2 tests with 2 degrees of freedom for the random slope of 'time' (variance random slope and covariance random intercept and random slope), and 1 degree of freedom for the fixed effect of '(time)²' ([section 4.4](#)).

Fifth, final models were estimated to answer the research questions. In turn, for each of the three dimensions of need-supportive teaching, net levels were added to the model (Models 1, 2, and 3 in [Table 4](#)). In these models, both the teachers' average levels of need-supportive teaching over the four measurement time-points and the deviations from these average levels per measurement time-point were included as predictors. The significance of the increase of fit of this series of models relative to the reference models was determined by means of a χ^2 test with 2 degrees of freedom. A fictitious example of how β -coefficients in Models 1, 2, and 3 should be interpreted is that a β -coefficient of 1 for 'autonomy support (average)' for autonomous motivation would mean that an increase of 1 in the average net level of autonomy support is associated with an increase of 1 point on the 5-point scale of autonomous motivation ([section 4.5](#)).

4. Results

4.1. Missing data analysis

Because several students had data missing at one or more measurement time-points of the motivation questionnaire, an analysis was first conducted to check that the HLM assumption that data were missing at random was not violated. The vast majority of missing data in the student motivation measures in the present study consisted of 8 of the 20 classes missing one measurement time-point for pragmatic reasons (e.g. miscommunication between mentors). These missed time-points could not be compensated for due to the longitudinal nature of the study and the tightly scheduled measurement time-points. The first measurement time-point was missed by two classes, the third by four classes, and the fourth by two classes; classes never missed more than one measurement time-point. Further, occasionally, students missed a single item in their questionnaire, assumedly at random. The scores for these items were always imputed as the mean of the scale.

In addition, missing data consisted of some individual students missing one or more measurement time-points. In 12 of the 20 classes, more than 15% of the students had not filled in the questionnaire at one or more of the measurement time-points. As we considered this type of missing data a potential threat to the HLM assumption that data should be missing at random, for each measurement time-point we checked that the students with missing data had not scored differently from the other students on a pre-measure of motivation for maths administered at the beginning of the school year. Data on this pre-measure were nearly complete. Whenever we found significant differences, we checked whether these remained when students were compared within schools only. These comparisons typically did not reveal differences between students with and without missing data; except for one school (2 of 20 participating classes) for the fourth measurement time-point. Although this finding presents a violation of the missing-at-random assumption, the impact is small, as the assumption appeared to be violated for the fourth measurement time-point and for one school only.

Table 2

Means (M), standard deviations (SD), and subsample without missing data (n) for the dimensions of need-supportive teaching and motivational constructs for all four measurement time-points.

	t1		t2		t3		t4	
	M (SD)	n	M (SD)	n	M (SD)	n	M (SD)	n
Need-supportive teaching								
Net autonomy support	.07 (.11)	20	-.16 (.13)	20	-.33 (.92)	20	-.54 (.11)	20
Net structure	.81 (1.0)	20	.86 (1.2)	20	.89 (1.2)	20	.97 (1.1)	20
Net involvement	.32 (.77)	20	.12 (1.1)	20	-.01 (.63)	20	-.19 (.73)	20
Motivational constructs								
Autonomous motivation	3.44 (.90)	308	3.27 (.91)	406	3.09 (.85)	328	3.18 (.78)	365
Controlled motivation	2.42 (.81)	305	2.36 (.74)	406	2.49 (.76)	328	2.53 (.77)	365
Amotivation	1.99 (.98)	306	2.13 (.99)	406	2.37 (.97)	328	2.33 (.98)	365
Performance avoidance	1.83 (.86)	302	1.83 (.84)	390	1.92 (.88)	327	2.02 (.93)	358

Notes: 'Net' implies that levels of 'thwarting' are subtracted from levels of 'support'. Net autonomy support and net structure are measured in proportions of lessons*10. Net involvement is measured in frequencies per 6 minutes.

4.2. Developments over time of need-supportive teaching and motivation

The results presented in Table 2 show declining trends for the net levels of autonomy support and involvement, and an upward trend is visible for structure. From Fig. 1, it can be seen that autonomy support declined over the course of the year, whereas there was an increase in autonomy thwarting. Levels of structure remained stable, and levels of chaos decreased. Finally, involvement decreased and disaffection increased. Further, Table 2 and Fig. 2 reveal somewhat declining trends for all four motivational constructs.

4.3. Distribution of variance

The results presented in Table 3 show that, for net levels of autonomy support, structure, and involvement, (well) over half of the variance was attributable to class level, and for all three dimensions

substantial proportions of variance appeared to be attributable to the time-point level as well. Further, although for all four motivational constructs most variance was attributable to student and time-point level, meaningful differences between classes were also apparent. For autonomous motivation, amotivation, and, in particular, performance avoidance, substantial parts of the variance were attributable to class level. For controlled motivation, a smaller but still meaningful part of the variance was attributable to class level.

4.4. Reference models

Reference models were estimated to which we could compare the final models (section 4.5). From these models presented in Table 4, it can be seen that, for autonomous motivation, amotivation, and performance avoidance, a linear effect with a random slope at class level was sufficient to model the effect of 'time', whereas, for controlled motivation, adding a polynomial to the second degree

Fig. 1. Development over time of need-supportive teaching and its respective (positive and negative) dimensions. Notes: Autonomy support, autonomy thwarting, structure, chaos, net autonomy support, and net structure are measured in proportions of lessons*10. Involvement, disaffection, and net involvement are measured in frequencies per 6 minutes.

Fig. 2. Development over time of four motivational constructs.

significantly increased the fit of the model. Gender differences were found for controlled motivation, amotivation, and performance avoidance, but not for autonomous motivation. The direction of effects was negative, indicating lower levels of controlled motivation, amotivation, and performance avoidance for girls than for boys.

4.5. Associations of need-supportive teaching with the development of students' motivation over time

In answer to the present study's research questions, the results presented in Table 4 show the degree to which levels of need-supportive teaching were associated with developments of students' motivation.

For *autonomy support*, associations were not found with autonomous motivation, controlled motivation, or amotivation, or with performance avoidance.

For *structure*, positive associations were found for average levels ($\beta = .21$), but not for deviations from these levels, with autonomous motivation. Further, negative associations were found for average levels ($\beta = -.19$), but not for deviations from these levels, with amotivation. No associations were found with controlled motivation or with performance avoidance.

For *involvement*, positive associations were found for average levels ($\beta = .25$), but not for deviations from these levels, with autonomous motivation. Further, negative associations were found for average levels with controlled motivation ($\beta = -.18$), amotivation ($\beta = -.39$), and performance avoidance ($\beta = -.21$; approaching significance), but not for deviations from these levels.

5. Discussion

5.1. Overview of findings

In the present study, we investigated how the development over time of early adolescents' motivation for maths was associated with their maths teacher being need supportive. Following SDT, we defined need-supportive teaching in terms of support instead of thwarting of the fundamental human needs for autonomy, competence, and relatedness. The results of this study notably advance research on motivational classroom practices as two features render it unique. The first is that, whereas most research on effects of teaching practices on student motivation has relied on students' perceptions of these practices (Perry et al., 2006), we used an observational measure. Although research on student perceptions is important for investigating the premises underlying educational theory, ultimately, to enhance ecological validity and to translate theory into practice, it is necessary to conduct observational research in classrooms. The second distinguishing feature of this study was its longitudinal nature, incorporating measures on the development over the course of the school year of both need-supportive teaching and student motivation. Whereas the decline in early adolescents' motivation is well documented, research has rarely been focused on identifying factors that affect the development of early adolescents' motivation over time.

By incorporating various motivational constructs, we could examine their discerned associations with the dimensions of need-supportive teaching. Indeed, for the various constructs, the results revealed distinct patterns. For autonomy support, associations were not found with developments of any of the motivational constructs. For structure, associations in the expected direction were found with autonomous motivation and with amotivation, but not with controlled motivation or performance avoidance. For involvement, associations in the expected direction were found with all four motivational constructs (approaching significance for performance avoidance). In the analyses, a distinction was made between two conceptualisations of teachers' need support. First, teachers' average levels of need support over the school year (one measure per teacher) were considered. Second, for each of the four measurement points, teachers' deviations from their individual average levels (four measures per teacher) were considered. In the results described above, all reported positive and negative associations concerned the teachers' average levels of need-supportive teaching; we did not find any associations of deviations from these levels with students' motivation.

5.2. Implications for theory and practice

The results have implications for both educational research and practice. First, they advance support for SDT among early adolescent students by partly corroborating prior research relying on student perceptions. Because teaching practices can only affect students via students' psychological responses to these practices (Deci, 1975), an often-expressed argument against using observations is

Table 3
Distribution of the total variance over the class, student, and time-point level.

Variable	Autonomy support	Structure	Involvement	Autonomous motivation	Controlled motivation	Amotivation	Performance avoidance
Class	57.6%	65.1%	50.5%	9.3%	4.8%	10.6%	14.3%
Student				48.8%	47.4%	42.5%	43.1%
Time-point	42.4%	34.9%	49.5%	41.8%	47.8%	46.9%	42.6%

Notes: In the analyses, net levels of autonomy support, structure, and involvement are used. 'Net' implies that levels of 'thwarting' are subtracted from levels of 'support'.

Table 4

Results from the HLM analyses predicting the development over time of four motivational outcomes by autonomy support, structure, and involvement.

Variable	Autonomous motivation						Controlled motivation					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Fixed effects												
Intercept	3.60	.12	3.38	.12	3.56	.11	2.61	.12	2.68	.13	2.64	.12
Time	-.12*	.03	-.11*	.03	-.12*	.03	-.15†	.09	-.15†	.09	-.15†	.09
(Time) ²							.04*	.02	.04*	.02	.04*	.02
Gender	-.12	.07	-.12	.07	-.12	.07	-.16*	.06	-.16*	.06	-.16*	.06
Autonomy support (average)	.09	.08					-.04	.05				
Autonomy support (deviation)	-.03	.02					.01	.02				
Structure (average)			.21*	.06					-.07	.05		
Structure (deviation)			-.03	.02					-.00	.02		
Involvement (average)					.25*	.10					-.18*	.06
Involvement (deviation)					-.03	.03					-.02	.03
Random effects												
Class level												
Var. intercept	.18	.08	.18	.08	.15	.07	.07	.04	.07	.04	.06	.03
Var. slope time	.01	.01	.01	.01	.01	.01	.01	.00	.01	.00	.01	.00
Var. slope (time) ²												
Cov. intercept $\times$ slope time	-.04	.02	-.04	.02	-.03	.02	-.02	.01	-.02	.01	-.02	.01
Cov. intercept $\times$ slope (time) ²												
Cov. time $\times$ (time) ²												
Individual level												
Var. intercept	.38	.03	.38	.03	.38	.03	.27	.03	.27	.03	.27	.03
Time-point level												
Var. intercept	.29	.01	.29	.01	.29	.01	.27	.01	.26	.01	.26	.01
Decrease deviance	2		12*		6†		1		2		8*	

Variable	Amotivation						Performance avoidance					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Fixed effects												
Intercept	1.97	.11	2.17	.13	2.02	.10	1.88	.10	1.89	.12	1.88	.09
Time	.14*	.03	.13*	.03	.14*	.03	.04	.03	.05	.03	.04	.03
(Time) ²												
Gender	-.29*	.07	-.29*	.07	-.28*	.07	-.19*	.06	-.19*	.06	-.19*	.06
Autonomy support (average)	-.13	.09					.01	.09				
Autonomy support (deviation)	.02	.03					-.02	.03				
Structure (average)			-.19*	.08					-.03	.08		
Structure (deviation)			.03	.03					-.01	.03		
Involvement (average)					-.39*	.10					-.21†	.11
Involvement (deviation)					.01	.04					-.03	.03
Random effects												
Class level												
Var. intercept	.14	.07	.15	.07	.08	.05	.11	.05	.11	.05	.08	.04
Var. slope time	.01	.00	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
Var. slope (time) ²												
Cov. intercept $\times$ slope time	-.02	.02	-.03	.02	-.02	.01	-.02	.02	-.02	.01	-.02	.01
Cov. intercept $\times$ slope (time) ²												
Cov. time $\times$ (time) ²												
Individual level												
Var. intercept	.41	.04	.41	.04	.41	.04	.33	.03	.33	.03	.33	.03
Time-point level												
Var. intercept	.43	.02	.43	.02	.43	.02	.31	.01	.31	.01	.31	.01
Decrease deviance	2		6†		12*		1		0		4	

Notes: In the analyses, net levels of autonomy support, structure, and involvement are used. 'Net' implies that levels of 'thwarting' are subtracted from levels of 'support'.

* $p < .05$; † $p < .10$ (due to rounding of β and SE exact p -values cannot be deduced from the table).

that this does not yield any of the substantial effects found in studies relying on student perceptions (e.g. Košir & Tement, 2014). The findings of this study show, however, that observed need-supportive teaching can meaningfully be associated with early adolescents' motivation. This seems to be a prerequisite, among others, for SDT interventions to be effective.

Second, although our findings corroborate prior evidence in support of SDT, they do not do so either for all dimensions of need-supportive teaching or for all motivational constructs. A striking finding in this regard is that we did not find autonomy support associated with any of the motivational constructs. This is surprising, particularly as others have found observed autonomy support associated with (observed)

engagement. Contrary to our study, these studies used observational measures of engagement (Jang et al., 2010; Reeve et al., 2004; Stefanou et al., 2004) and/or brief questionnaires that concerned engagement in the observed lessons and were administered immediately after these lessons (Jang et al., 2010). A possible interpretation of these differences in findings could be that, although autonomy-supportive teaching does have an immediate effect on students' engagement in the task(s) at hand, this effect is short term only and does not result in changes in their levels of motivation. To substantiate this finding and its interpretation, further research is necessary.

For teachers' provision of structure, we found associations with development over time of autonomous motivation (positive) and

amotivation (negative). These associations were clearly anticipated in line with SDT and render the present study among the first to link observed structure with early adolescents' motivation. We did not find the negative association of structure with developments in controlled motivation that we had expected—although in SDT terms this link is less clear. A plausible explanation, in line with Vansteenkiste et al. (2012), is that provision of structure has a negative effect on controlled motivation only when students experience a sufficient level of autonomy, whereas, for students who do not experience sufficient autonomy, structure has a positive effect. Further, unexpectedly, the findings did not show structure to be negatively associated with developments in performance avoidance. This is intriguing as it indicates that provision of structure does not trigger students to feel competent enough not to worry about others noticing their shortcomings. Possibly, this finding is subject specific and relates to it being difficult for teachers to affect their students' maths self-concepts.

Teacher involvement appeared to be the dimension of need-supportive teaching most strongly associated with the development over time of all four motivational constructs. Interestingly, even associations of teacher involvement and performance avoidance were stronger than associations of structure and performance avoidance. It could be speculated that, for early adolescents not to feel the urge to avoid situations where their shortcomings will be noticed, it is of particular importance to feel accepted in their classrooms by teachers who are involved, for example, by demonstrating affection, encouraging empathy, and being responsive to emotional distress. In conclusion, these findings indicate the importance of teacher training directed at enhancing teachers' involvement with their students.

Third, our findings extend prior SDT research by showing how need-supportive teaching is associated with the development of early adolescents' motivation over time. Surprisingly, associations with students' motivational developments were found for average levels but not for deviations. In other words, students appeared more motivated when they were taught by a teacher who—on average, over the course of the school year—showed higher levels of need support. However, students' motivation as measured at a specific time-point was not associated with their teachers at that time-point being more or less need supportive than usual. The latter finding indicates that a teacher temporarily changing towards a more or less need-supportive teaching style is not associated with student motivation. A possible explanation could be that teachers temporarily changing their practices causes unpredictability and leaves students unprepared to act upon the opportunities with which they are presented.

5.3. Recommendations for future research

Research is necessary to further investigate how effects of need-supportive teaching are shaped by their context. To realise this aim, among others, longitudinal intervention research is recommended to distinguish between immediate and long-term effects (such as Reeve et al., 2004, for autonomy support; Minnaert, Boekaerts, & de Brabander, 2007, in vocational education). In line with the plausible explanations suggested above, it could be crucial for teachers to properly introduce any changes in their practices (see also Sturm & Bogner, 2008). Further, long-term implementation of SDT interventions could be beneficial, for example, by making them school based.

In future research, it is recommended to determine the generalisability of findings beyond this study's target group of students who are just starting secondary education. A target-group-specific plausible explanation for findings could, for example, be that, whereas initially establishing good teacher–student relationships is critical, it is only later on that having autonomy support starts to gain weight. This interpretation is in line with that of Minnaert,

Boekaerts, de Brabander, and Opdenakker (2011), who showed that relatedness best predicted students' situational interest at the start of a six-month project, whereas later on in the project the importance of autonomy increased. In addition, it is recommended to examine whether the findings of the present study can be generalised to other subject domains, such as languages.

Further, it would be of interest to examine how configurations of need-supportive teaching affect students' motivation. Among other things, it would be relevant to examine how structure and autonomy support interact in their effects on controlled motivation. In addition, analysis focusing on the effects of teachers being consistent and coherent in their support is recommended.

5.4. Limitations

Several limitations of the present study come to mind. The first of these relates to our use of an observational measure of need-supportive teaching. Because in SDT need-supportive teaching is not considered to exist in a prescribed set of techniques and strategies (Reeve, 2006) but should always be interpreted in context, the rating sheet we used had to entail a high degree of interpretation by the coders. Although we tried to counter this limitation by performing several steps to ensure a degree of inter-subjectivity (e.g. elaborate discussions of video fragments), the subjectivity of our coding sheets remains a limitation that is inherent in studying need-supportive teaching in classrooms. In the future, it would be of interest to conduct more research into the question of what need-supportive teaching entails in the daily practice in early adolescents' classrooms, among other things, by conducting more research on links between observed need-supportive teaching, early adolescent students' perceptions of teaching practices, and their motivation.

A second potential limitation is that the teachers and students who participated in our study might have changed their behaviour because of the video cameras in their classrooms. Although we emphasised that all video material would be processed anonymously, it might still have been the case that both teachers and students behaved differently than they would have normally. From our regular conversations with the teachers, however, we did not get this impression, as they regularly indicated that they had forgotten about the cameras and told us that the students acted the same as they did when no cameras were present, at least after the first parts of the first lessons that we videotaped.

Despite these limitations, our findings advance SDT research and provide insights of value for answering the question of what motivates early adolescent students for school. As our findings have a high level of ecological validity, some of these findings can be translated to educational practice directly. In particular, our results indicate that teacher involvement and provision of structure have the potential to lessen the decline in early adolescents' motivation for school.

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