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Citation
Vemde, L. van, Donker, M. H., & Mainhard, T. (2022). Teachers, loosen up! How teachers can trigger interpersonally cooperative behavior in students at risk of academic failure. *Learning And Instruction*, *82*. doi:10.1016/j.learninstruc.2022.101687

Version: Publisher's Version
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Downloaded from: https://hdl.handle.net/1887/3515037

Note: To cite this publication please use the final published version (if applicable).

Learning and Instruction 82 (2022) 101687

Contents lists available at ScienceDirect

Learning and Instruction

journal homepage: www.elsevier.com/locate/learninstruc

Teachers, loosen up! How teachers can trigger interpersonally cooperative behavior in students at risk of academic failure

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ARTICLE INFO

Keywords:
At-risk students
Dyadic teacher-student interaction
Moment-to-moment interpersonal behavior
Student cooperativeness
Timeseries analysis

ABSTRACT

Student cooperativeness underlies high quality teacher-student relationships, and has been positively associated with students' school engagement. Fostering cooperative rather than oppositional student behavior might be especially helpful for protecting at-risk students against academic failure. To understand how exactly students' cooperativeness can be fostered, we investigated the interpersonal behaviors of secondary school teachers and at-risk students during dyadic interactions ($N = 82$ dyads) in the context of positive teacher-student relationships. Using Continuous Assessment of Interpersonal Dynamics, moment-to-moment teacher and student behavior was captured in terms of interpersonal agency (dominance vs. submissiveness) and communion (opposition vs. cooperation). Time-series analyses were used to analyze interpersonal behavior within individuals, within dyads, and between dyads. Cooperative student behavior was most likely if teachers acted friendly and cooperatively and if teachers 'loosened up' their agency and the structure they imposed on the interaction repeatedly, which may give students more freedom to express themselves and to cooperate.

1. Introduction

Students at risk for early school dropout show not only low motivation (Fortin et al., 2006), low school engagement (Fredricks et al., 2004) and alienation from school (Baker, 1999), but also more opposition towards school and their teachers (Fortin et al., 2006; McGrath & Van Bergen, 2015). This is problematic, as uncooperative and hostile behaviors impair students' social relations with peers (Newcomb et al., 1993) and teachers (Lewis et al., 2005) and may thus further increase the risk of academic failure.

On the contrary, positive teacher-student relationships foster secondary school students' engagement (for meta-analyses, see Quin, 2017; Roorda et al., 2017), classroom participation and interest in school activities (Archambault et al., 2013; Muller, 2001), and academic achievement (for meta-analyses, see Cornelius-White, 2007; Roorda et al., 2017). Positive relations with teachers can thus be a protective factor against academic failure and school dropout of students at risk (Archambault et al., 2009; Wang & Fredricks, 2014).

Most previous studies on teacher-student relationships and student engagement used student self-reports (Roorda et al., 2017), which usually summarize the general quality of teacher-student interactions as relationship quality over longer periods of time (Den Brok et al., 2004; Morris-Rothschild & Brassard, 2006). Such an approach, however, does not capture the dynamic nature of the interaction between teachers and students (Pennings & Mainhard, 2016), which is problematic because moment-to-moment interactions have been framed as the building blocks of relationships (Granic & Patterson, 2006; Kiesler, 1983). More specific knowledge of these interactions could thus provide more precise information on how teachers can trigger positive and cooperative interactions with students at risk. Hence, the present study focused on moment-to-moment observations of interpersonal behavior during dyadic interactions.

1.1. Positive teacher-student relationships with at-risk students

Students from minority groups, low socioeconomic backgrounds and/or students with low motivation or low academic achievement are at-risk for academic failure and early school dropout (Fortin et al., 2006). Especially for such at-risk students, a cooperative, positive, and affectionate relationship with the teacher can function as a protective factor for more severe behavioral problems and academic failure (Longobardi et al., 2016; Roorda et al., 2017). However, such students

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https://doi.org/10.1016/j.learninstruc.2022.101687
Received 13 December 2021; Received in revised form 25 August 2022; Accepted 27 August 2022
Available online 14 September 2022
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often report more negative teacher-student relationships (i.e., relationships characterized by opposition and disharmony between teacher and student) as compared to not-at-risk peers (McGrath & Van Bergen, 2015). Moreover, students who perceive the relationships with their teachers as negative are more likely to show more defiant and less cooperative behavior (Gregory & Weinstein, 2008; Mercer & DeRosier, 2010).

Interestingly, Gregory and Thompson (2010) found that defiant behavior was not found in the interactions with every teacher. Thus, some teachers succeed in engaging in more positive, friendly, and cooperative interactions. However, most teachers find it difficult to engage in a positive relationship with students who show problematic or hostile behavior (Lewis et al., 2005). In order to understand how teachers can build and maintain a cooperative interpersonal relationship with at-risk students, it is important to know how behaviors and interactions that underly such a positive relationship can be fostered by teachers. To this end, we examined interactions between at-risk students and their favorite teacher, as this teacher is most likely a teacher that students feel close to and with whom students have a relationship characterized by relatively lower levels of opposition and disharmony.

1.2. An interpersonal perspective on teacher-student interaction

The *communicative systems approach* on communication (see Watzlawick et al., 1967) indicates that every form of communication has a content- and an interpersonal aspect. Whereas the content aspect covers the actual message conveyed to the interaction partner, the interpersonal aspect provides information on how to interpret the message conveyed (Watzlawick et al., 1967; Wubbels et al., 2006). When aiming to understand how teachers can build and maintain cooperative interpersonal relationships with students, the interpersonal aspect of the interaction is highly relevant.

Interpersonal theory (e.g., Kiesler, 1983; Leary, 1957) conceptualizes interpersonal behavior exhibited in interaction with others. Interpersonal behavior is described as a combination of two underlying dimensions, which are usually combined in a circumplex model as orthogonal dimensions. In Fig. 1, such a circumplex is provided for the application of interpersonal theory to the educational context, as pioneered by Wubbels et al., in 1985. The horizontal dimension, *Communion,* connotes cooperation and interpersonal warmth and support and ranges from opposition or antagonistic behavior to cooperativeness or friendliness. Communion can thus be understood as a general concept of sociability and cooperation as a sociable action. Following Wubbels et al. (2016), we view this conceptualization as closely related to the *closeness* and *conflict* dimension of teacher-student relationships from an attachment perspective (Koomen et al., 2012; Pianta, 2001), but also to providing emotional support (see the CLASS-framework; Pianta & Hamre, 2009), as well as to the student support dimension (see the three basic dimensions of teaching quality; Praetorius et al., 2018). The vertical dimension, *Agency*, describes the amount of power and social influence behavior conveys during interaction and ranges from submissiveness or passivity to striving for social influence (Horowitz & Strack, 2011). This conceptualization of teacher behavior can also be found in the classroom organization domain (see CLASS; Pianta & Hamre, 2009) and the classroom management dimension (see the three basic dimensions of teaching quality; Praetorius et al., 2018). Also, low agency (e.g., submissiveness) is reminiscent of dependency as defined in the attachment framework, as dependency indicates how reliant the student is on the teacher (Koomen et al., 2012; Pianta, 2001).

Note however, that interpersonal theory and the interpersonal circle, just like attachment theory, solely concerns social and interpersonal processes rather than instructional or didactic aspects of teaching.

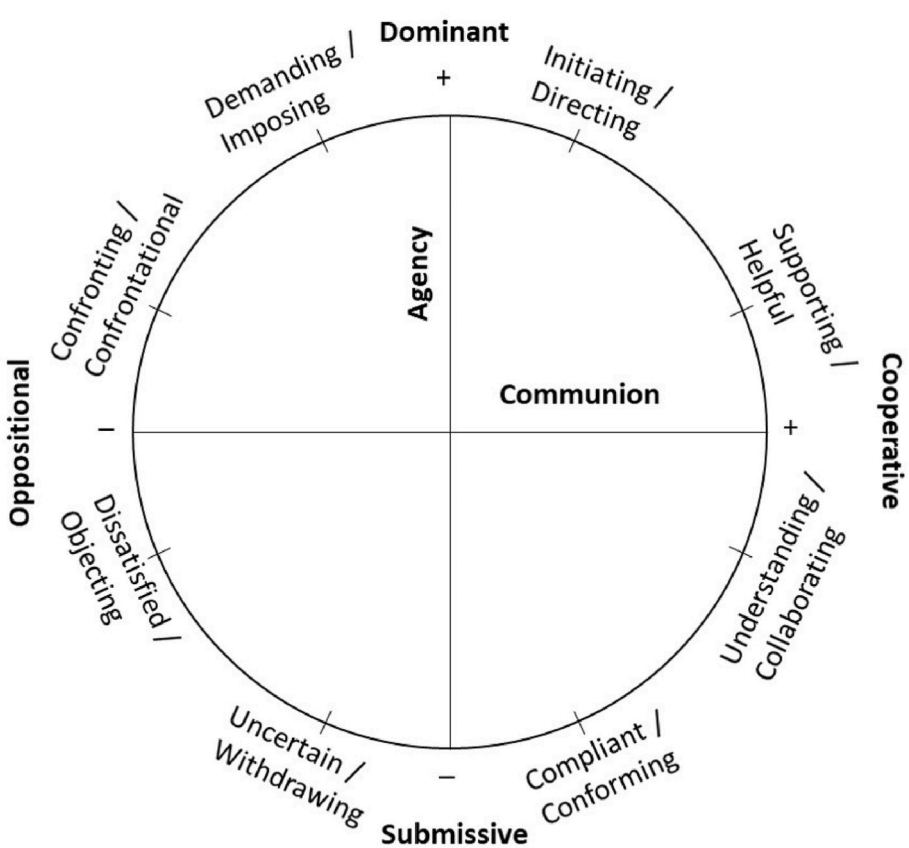


Fig. 1. Interpersonal circumplex (IPC) for the educational setting.
Note. Words close to the circle represent teacher behavior and the other words represent student behavior (cf. Claessens et al., 2017; Pennings et al., 2018).

Although providing structure to interpersonal interactions can serve didactic ends, a clearly structured lesson plan can be delivered in more or less agentic ways by the teacher. In line with this, communion and agency can be combined in different ways. The circumference of the circumplex in Fig. 1 denotes specific combinations of agency and communion, which can be seen as eight prototypical interpersonal behaviors. For example, helping behavior indicates high levels of communion and medium high levels of agency, while uncertain behavior indicates moderately low communion combined with low agency.

In general, both students and teachers favor relationships characterized by high levels of teacher communion and agency (Woolfolk Hoy & Weinstein, 2006; Wubbels et al., 1985, 2006). Especially teacher communion is important for positive student emotions (Mainhard et al., 2018), (at-risk) student engagement (Engels et al., 2016), and for decreasing (at-risk) students' externalizing behavioral problems (Lei et al., 2016). Regarding student behavior, teachers prefer cooperative and friendly behavior too (Claessens et al., 2017).

Much research with at-risk students and their relationships with teachers focused on constructs related to communion (e.g., Hamre & Pianta, 2005). However, studies based on Interpersonal theory (e.g., Sadler et al., 2009; Thijs et al., 2011) suggest that also someone's agency can elicit cooperative behaviors in the other. In addition, also in the context of classroom management it has been suggested that teachers take agentic actions to maintain an orderly working climate, such as providing rules, procedures, and structure, which at the same time are needed to get students to cooperate and work on-task (Aloe et al., 2014; Emmer & Stough, 2001). Therefore, the present study includes both interpersonal communion and agency.

1.3. Measuring agency and communion in teacher-student interaction

Earlier research examining teacher and student agency and communion mostly used self-reports (e.g., Roorda et al., 2017), which results in information about the general quality of the teacher-student relationship. However, these relationships are formed by moment-to-moment interactions between teachers and students (Granic & Patterson, 2006; Kiesler, 1983) and empirical research has shown that interpersonal behavior differs not only between teacher-student dyads but also within dyads over the course of an interaction (Donker et al., 2020; Lizdek et al., 2016) as well as that there is little school-level variance in teacher agency and communion (Wubbels et al., 2006). Although, retrospective measures like daily or weekly self-reports using experience sampling (i.e., teachers and students fill out multiple short questionnaires during the interaction) could also provide inside in the dynamics at play when trying to establish these positive interactions, evaluating your own behavior while participating in the interaction might be difficult (Scherzinger & Wettstein, 2019). Moreover, such self-reports are still prone to biases such as recall inaccuracies (Becker et al., 2014; Carson et al., 2010) or the individual's mood (Goetz et al., 2015) and filling out questionnaires during an interaction reduces ecological validity (Becker et al., 2014). Therefore, assessing these moment-to-moment changes within teacher-student dyads using moment-to-moment observations in addition to between-dyad variation can give more insight in the dynamics at play when trying to establish positive and cooperative interactions.

Next to average agency and communion levels, the present study therefore includes the variability (i.e., magnitude of the changes) and (in)stability (i.e., predictability or abruptness of changes, also referred to as inertia) of interpersonal behavior. Furthermore, we included *within*-person correlations between agency and communion (i.e., how both are connected over time) and *within*-dyad correlations (i.e., how teacher agency and communion are connected to student agency and communion over time). Below we will discuss each aspect of interpersonal dynamics in more detail. As only few studies examined dyadic teacher-student interaction at the process level, we also discuss findings not specifically situated in the educational setting.

1.3.1. Within-person dynamics

1.3.1.1. Mean levels. Although both agency and communion exhibited during interaction vary greatly between dyads (Dermody et al., 2017; Lizdek et al., 2016), in the educational setting both students and teachers in various age groups typically show rather high levels of communion, whereas teachers show more agency than their students (Pennings et al., 2018; Thijs et al., 2011). Based on these findings we expected that in dyadic interactions with an at-risk student and in the context of generally positive teacher-student relationships, teachers show cooperative and dominant behaviors too, while students at risk would behave in less agentic ways than their teachers. In line with earlier studies that indicated that students at risk behaved less cooperatively than other students (Gregory & Thompson, 2010), we deemed it possible that students would show somewhat lower communion levels than their teachers.

1.3.1.2. Variability and (in)stability. Student perceptions of teachers' (instructional) behaviors are stable over time (Fauth et al., 2020; Mainhard et al., 2011; Praetorius et al., 2014). Nonetheless, teachers show a wide range of behaviors during moment-to-moment teaching (Donker et al., 2020; Pennings et al., 2018). The present study examines the (in)stability and variability of moment-to-moment teacher and student behavior. Whereas variability in behavior indicates how much someone changes their behavior during interactions, instability indicates how predictable and abrupt the changes in behavior are.

Results from studies examining teacher-class interaction in secondary education (i.e., focusing on teacher-group interaction rather than individual students) have indicated that variability in agency and communion signified chaos in class and was associated with a more negative classroom climate in general (Mainhard et al., 2012; Pennings et al., 2018). Moreover, providing consistent emotional support was related to positive academic and social outcomes of kindergarten students (Curby et al., 2013). Nonetheless, it is likely that whole-class teaching affords other interpersonal teacher behavior than dyadic interaction, for example, to maintain an orderly working climate.

Notably, studies examining dyadic (parent-child) interactions have found the opposite: In a study by Lunkenheimer et al. (2011), more variability in interpersonal behavior between parents and their young children was associated with less behavioral problems. Similarly, in adolescence, more variability in affect (including also hostile interaction) during conflict interactions between mothers and adolescents was associated with less depression and anxiety symptoms in adolescents later on (van der Giessen et al., 2015). More variability during such interactions was also associated with less perceived conflict and higher perceived support and the feeling of being able to solve conflicts (Branje, 2008; Lichtwarck-Aschoff et al., 2009). In contrast, studies in the family context have also shown that a lack of variability (i.e., rigidity) is associated with more problematic behaviors and relationships (e.g., Hollenstein et al., 2004). Although these studies examine affect rather than interpersonal behavior, affect and interpersonal communion are closely related, as communion also connotes the affective response to others (Horowitz & Strack, 2011). Moreover, interpersonal processes and affect, or more specifically emotions, are intertwined (e.g., Fischer & van Kleef, 2010; Mainhard et al., 2018) and in psychology emotions are also conceptualized as informing interpersonal processes (e.g., Frijda, 1986). Moreover, according to Baumeister and Leary (1995) emotional reactions directly follow belongingness in the interpersonal relationships and the reinforcement of such relationships induces positive affect. Therefore, the studies examining variability in affect can still be informative regarding variability in interpersonal communion.

Because dyadic teacher-student interaction reflects some qualities of parent-child interaction, such as the hierarchical nature, and given that

both parents and teachers can be considered significant others in students' lives (Martin & Dowson, 2009), this makes them potentially interesting to formulate hypotheses about dyadic teacher-student interactions on. Therefore, we explore whether variability in cooperation and dominance in dyadic teacher-student interaction is beneficial for students at risk too or whether, in line with teacher-class interaction less variability in cooperation and dominance is more beneficial.

1.3.1.3. Within-person associations between agency and communion. Interpersonal theory (e.g., Kiesler, 1983; Leary, 1957) states that agency and communion are orthogonal dimensions at the between-person level (Horowitz & Strack, 2011), meaning that teachers' general agency level does not necessarily allow to infer their level of communion. However, studies using moment-to-moment observation have shown that the two dimensions are connected *within persons during interaction* in various ways and that the way and strength of the coupling represents a person characteristic (e.g., Donker et al., 2020; Pennings et al., 2018).

Overall, it is somewhat more likely that people combine becoming more cooperative with becoming more dominant too, as was found in unacquainted mixed-sex dyads doing a card-sorting task (Sadler et al., 2009) but also in teacher-student dyads in kindergarten (Thijs et al., 2011). We therefore expected students at risk and their teachers to combine their dominant and cooperative behavior in a positive way during dyadic interaction too. For example, when teachers show behaviors indicating a low intensity of understanding (see Fig. 1, the third octant), increasing their cooperation would likely go together with an increase in dominance too, resulting in teachers moving to the upper right side of the IPC (see Fig. 1, octants 1 or 2 or directing and helping behavior) rather than only showing more intensified understanding behavior. Note however that in classrooms, when interacting with entire classroom groups, teachers combine their agency and communion on average in a *negative* way (i.e., becoming stricter), probably to maintain classroom order (Donker et al., 2020).

1.3.2. Associations between teacher and student interpersonal behavior

1.3.2.1. Complementarity. According to the *interpersonal complementarity principle* (Kiesler, 1983), one's behavior can be viewed as an interpersonal bid (Pennings et al., 2018), which invites certain behavior from the other. The interpersonal bid of cooperation initiates *sameness*. For example, when teachers increase their communion, it is likely that students become more cooperative as well. High levels of agency can be considered as an interpersonal bid that is likely to evoke *oppositeness* and thus submissive behavior (Kiesler, 1983; Pennings et al., 2018).

Studies investigating interpersonal complementarity in dyadic interaction in both general psychological research and in education, found that interactions mostly followed these complementarity principles (e.g., Dermody et al., 2017; Sadler et al., 2009; Thijs et al., 2011). We therefore expected that the behavior in our dyads would follow complementary patterns. However, based on earlier research we also expected that this effect might be less strong for cooperativeness (Pennings et al., 2018; Thijs et al., 2011). The reason for this is that teachers' professional role may sometimes ask for noncomplementary reactions to student behavior (Pennings et al., 2018; Thijs et al., 2011). That is, when students show oppositional behavior, teachers' professional role may lead them to act in noncomplementary ways and they stay cooperative instead. This cooperative teacher behavior may ultimately help to elicit cooperative behavior in the student too.

1.3.2.2. Cross-dimensional correlations. Besides complementarity, people's interpersonal behaviors can also be connected across dimensions. Sadler et al. (2009) found that in mixed-sex dyads communion of one member was positively associated with the agency of the interaction partner. Thijs et al. (2011) found similar results for teachers in interaction with young children. When teachers were more dominant, children were more cooperative, probably because they appreciated the increased structure. Similarly, when teachers were less friendly, students were more dominant. Such dynamics have also been found in teacher-class interactions in secondary education (Pennings et al., 2018; Pennings & Hollenstein, 2020). We therefore expected dominant teacher behavior to be positively associated with cooperative student behavior.

1.3.2.3. Associations from moment-to-moment. Since existing studies mostly investigated correlations concurrently, that is at the same timepoint during interaction, it remains unclear who is influencing whom over time (Horowitz et al., 2006). The few studies that investigated the sequentiality in teacher-student interactions found that both teacher cooperativeness and dominance positively influenced students' later cooperativeness (Pennings et al., 2018; Thijs et al., 2011). However, for both teachers' and students' behavior there are typically high auto-correlations. That is, behavior from an individual on one dimension is usually best predicted by previous behavior by the same individual on that same dimension (Donker et al., 2018). Hence, we expect that there is an effect of teacher behavior on student cooperativeness over time, but that this is a relatively small effect.

1.4. The present study

Cooperative teacher-student interaction and in particular cooperative instead of oppositional student behavior, is considered to be especially beneficial for at-risk students (Longobardi et al., 2016), because such behavior is positively associated with their engagement and because positive relations with teachers are built on these positive interpersonal behaviors (Archambault et al., 2009; Wang & Fredricks, 2014). It is therefore important to understand how teachers can foster students' cooperation during interaction. Interpersonal theory suggests (e.g., Kiesler, 1983; Leary, 1957) and empirical studies have shown (Pennings et al., 2018; Thijs et al., 2011) that during interaction teachers can evoke cooperative student behavior by their own cooperative behavior and by acting in relatively leading or dominant ways (e.g., by providing structure).

The present study aimed at extending existing research by examining dyadic interactions between *at-risk* students and their teachers at the *micro* level and by identifying if and how teachers can foster student cooperativeness and reduce opposition. We examined interactions in the context of positive teacher-student relationships because this provides insights into behavior that underlies such relations. This information might help teachers to better support their at-risk students. As dyadic teacher-student interaction in the normal classroom setting is rather fragmented and (very) short (van Braak et al., 2021) we focused on dyadic mentor sessions students at risk typically have with their teachers.

Our first research question was:

1. What does interpersonal behavior of teachers and students at risk look like in dyadic teacher-student interactions in the context of generally positive teacher-student relationships?

We expected that teachers would on average show somewhat more agency and communion than their students (Pennings et al., 2018; Pennings & Hollenstein, 2020) and that both teachers and students would combine their agency and communion predominantly in positive ways (Thijs et al., 2011). Moreover, we explore whether the levels of teacher and student agency would be characterized by frequent changes (e.g., van der Giessen et al., 2015) or that they would be more stable (e.g., Pennings et al., 2018).

Our second research question was:

2. How is interpersonal teacher behavior associated with at-risk students' behavior during dyadic interaction and, specifically, how is teacher behavior related to student cooperativeness?

We expected that these associations would follow the complementarity principles (Pennings et al., 2018; Pennings & Hollenstein, 2020), that teacher agency would go together with student communion and thus more cooperation (Pennings et al., 2018; Pennings & Hollenstein, 2020), and that within dyads, teacher agency and communion at one moment would precede student cooperation at later time points (Thijs et al., 2011).

At the between-dyad or sample level we expected that student cooperative behavior would be more likely with higher levels of teacher communion as well as with higher teacher agency. In line with studies that showed that greater variability in interpersonal behavior resulted in more positive parent-adolescent interactions (Branje, 2008; van der Giessen et al., 2015), we explored whether also in teacher-student dyads more variability in teacher behavior would, overall, go together with more student cooperation, or whether in line with teacher-class interaction (Mainhard et al., 2012; Pennings et al., 2018) less variability in cooperation and dominance is more beneficial.

2. Methods

2.1. Procedure

At-risk students were recruited via their schools. Participating schools were asked to select students from the practical pre-vocational track,[1] who could be regarded as being at risk of academic failure following either one or a combination of these criteria: low motivation, behavioral problems, problematic situation at home and/or overall risk of dropout or significant school delay. Given that the practical pre-vocational track is the lowest level of secondary education that students in the Netherlands can attend, this is the track level where most often also the most problematic students, in terms of academic abilities and behavioral problems, end up. Students and parents were then invited and informed about the study. Active written parental and student consent were required for participation. Students were asked to indicate their favorite teacher, who was then invited to participate in the study. Three teachers declined to participate in the present study after which the students were are asked to select another teacher. These teachers were then invited to participate in the study.

Short mentor sessions between the student and their favorite teacher were organized during school hours in a separate room. Such one-on-one conversations between students and teachers are rather common in Dutch schools and are usually initiated by the students' mentor when there is a need to talk. However, all teachers can invite a student for a talk and students can ask all teachers, thus the current setting resembles real-life practice.

Before the start of the conversation, teachers were instructed by the researcher that the conversation was supposed to cover an important subject for the students' functioning at school (e.g., behavior in class or motivation for doing homework) and that the goal was to actually make some progress regarding this topic - as a mentoring session would. Since students at risk, even due to academic failure in one or a few subjects, are always extensively discussed in teacher meetings that are attended by all teachers of the student, we expected that the students' favorite teacher was also aware of the problems students might have in other subjects or with other teachers. Conversations were videotaped, while the research assistant left the room. Per conversation an average of 9 min ($SD = 0.39$s) of process data on interpersonal behavior was available. Students received a gift card after participation.

2.2. Participants

In total, 83 Dutch secondary school students participated. One teacher-student dyad was excluded due to technical problems with the camera. Dyads were divided over nine schools across the Netherlands. We did not examine school level differences due to the fact that this requires at least 30 schools to do so reliably (Maas & Hox, 2005). Moreover, the participating schools were all similar in terms of that they all educated students in the lowest track level and therefore had to deal with problematic student populations. Furthermore, unlike countries that have a very clear distinction between private and public schools, the Netherlands does not have this clear distinction. Almost all schools in the Netherlands are publicly funded and therefore have the same resources. Although there are some private schools in the Netherlands, these schools were not included in the present study.

Some students indicated the same favorite teacher, resulting in a total of 50 participating teachers. Most teachers participated with one (68%) or two (20%) student(s), three teachers participated with three (6%), one with five (2%), one with six (2%), and one teacher with eight (2%) students, which was controlled for in the analysis. On average students were 13.65 years old ($SD = 0.79$; 33 females). Teachers were on average 39.86 years old ($SD = 11.47$; 24 females) and had 13.44 years ($SD = 10.52$) of experience. Teachers taught various subjects and often more than one subject. The distribution amongst the teachers was as follows: Languages (30%), science (24%), mathematics (14%), social studies (12%), and arts (6%). Seven teachers (14%) taught other subjects, like PE.

2.3. Instruments

2.3.1. Interpersonal behavior

Teacher and student agency and communion were coded based on a video recording of the conversation using *Continuous Assessment of Interpersonal Dynamics* (CAID; for a detailed description, see Lizdek et al., 2012). With this approach, interpersonal behaviors are captured as they unfold over time using a computer joystick apparatus. The coding program used the interpersonal circle as an underlying coding framework. Trained coders used a joystick to move over the interpersonal circle, following the behaviors shown in the video. As such, agency and communion were coded in an integrated way and based on the eight prototypical behaviors as described in Fig. 1. Examples of agentic behaviors were speaking forcefully and directing the conversation or following the others' lead and were coded by moving the joystick up or down. Communal behaviors included smiling and supporting the other and were coded on the horizontal axis (Ross et al., 2017). The intensity of the behavior was taken into account by moving further away from the center of the interpersonal circle. Teacher and student behavior were coded in separate sessions to prevent spill-over effects. Behavior coordinates were recorded twice per second on a scale ranging from −1000 to 1000. Coding resulted in separate timeseries for agency and communion with an average of 1107 ($SD = 82$, range 865–1291) data points for each conversation. Each video was coded by three out of a total of six trained coders. Intra-class correlations (ICC(k = 3)) were used as a measure of reliability and indicated strong agreement between the observers for agency ($ICC_{teachers} = 0.72$; $ICC_{students} = 0.79$) and moderate agreement for communion ($ICC_{teachers} = 0.55$; $ICC_{students} = 0.53$; LeBreton & Senter, 2008). The lower reliability for communion is in line with earlier research using CAID (Dermody et al., 2017; Donker et al., 2018, 2020): People tend to be more stable in their communion, which makes relatively small discrepancies during the coding process relatively more influential on the ICC-values (Donker et al., 2020).

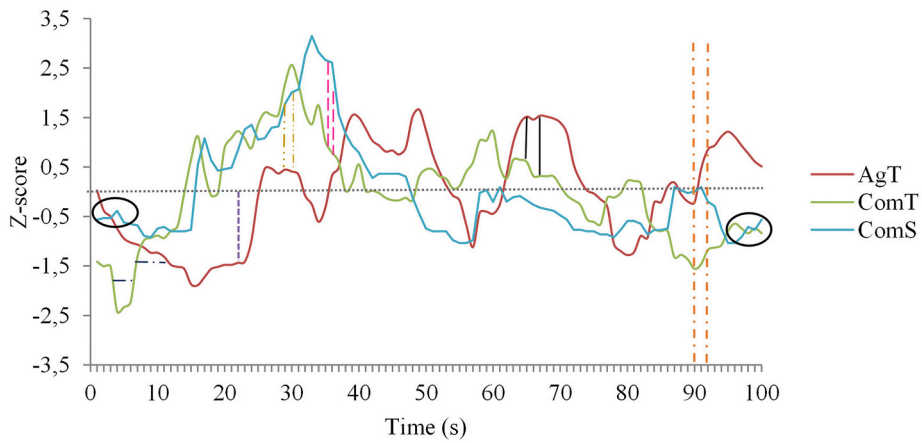
[1] Dutch secondary education is divided into three tracks, from lowest tot highest respectively: pre-vocational education, higher general education, and pre-university education. Within the pre-vocational track, four levels can be distinguished, where the lowest level is mostly practice-oriented and the highest level is more theoretical.

2.4. Data analyses

For all analyses, we first computed the indicators per individual and dyad. Next, we computed descriptive statistics while taking the hierarchical structure of the data (i.e., students nested in teachers) into account by using cluster-robust standard errors (i.e., including "type = complex" in the Mplus syntaxes; McNeish et al., 2017). See the "Assumption testing for all analyses" (Online Resource) for details regarding assumption testing. All analyses were executed in Mplus (Version 8.5; Muthén & Muthén, 2019).

2.4.1. RQ1: Within-person dynamics

Variability was assessed as the standard deviation of a timeseries and a larger SD indicated more variability. The instability of a timeseries (i.e., the degree to which interpersonal behavior was characterized by abrupt changes) was assessed using the Mean Square Successive Difference (MSSD; Jahng et al., 2008). The MSSD is computed by first squaring the difference between the two consecutive moments *t-1* and *t*, and then taking the mean of all squared differences per person. Higher MSSD values indicate more instability. The way teachers and students tended to combine their agency and communion was assessed using Pearson cross-correlations, reflecting the strength and co-occurrence between agency and communion within a person at the same time. Fig. 2 illustrates these different within-person indicators.



Line	Indicator	Calculation	Possible range
Within-Person Dynamics			
.....	Mean level	Average of all data points	-1000 to 1000
O–O=	Difference Score Student communion	Difference between the average communion at the start and end of the conversation[a]	-1000 to 1000
- - - - - - -	Variability (SD)	Standard deviation of the timeseries	-1000 to 1000
-·-·-·-	Instability (MSSD)	Mean of the squared difference between two consecutive moments	0 to 4000000
———	Within-Person Association	Individual cross-correlation between agency and communion	-1 to 1
Within-Dyad Associations			
- - - - -	Complementarity	Connectedness between teacher and student behavior within the dimensions	-1 to 1
-·-·-·-	Cross-Dimensional Correlation	Connectedness between teacher and student behavior across the dimensions	-1 to 1
Within-Dyad lagged correlations			
–·–·–	VAR parameters	Autoregressive and cross-lagged effects between two consecutive moments within and across dimensions	-1 to 1

Note. T and S represent teachers and students; Com and Ag represent communion and agency. Student agency was not included in the figure to enhance readability. (The reader is referred to the web version of this article for a colored version of this figure.)

[a] The difference score is computed over the length of the total conversation. For illustration purposes we placed a line at the end of the graph.

Fig. 2. Illustration of the different statistical indicators computed in the present study that were used to examine the association between teacher behavior characteristics and student cooperation between dyads.

2.4.2. RQ2: Associations between teacher and student interpersonal behavior

2.4.2.1. Within dyads

2.4.2.1.1. Complementarity. We computed Pearson cross-correlations, with a lag of zero, between the teacher and student timeseries, separately for agency and communion (see Fig. 2 for an illustration).

2.4.2.1.2. Cross-dimensional correlations. Pearson cross-correlations were used to examine the connectedness of teacher and student behavior across the agency and communion dimensions (see Fig. 2 for an illustration).

2.4.2.1.3. Associations from moment-to-moment. For each dyad separately, a vector autoregressive (VAR) model was estimated. The VAR model relates several simultaneous timeseries to each other (Chatfield, 2004), and thus can be used to analyze cross-lagged effects (see Fig. 3). Based on assumption testing (see "Assumption testing for all analyses" [Online Resource]), a cubic trend was added to the VAR model to correct for stationarity. We used Bayesian estimation with 50,000 iterations, in order to prevent overfitting of the data by shrinking the parameters higher than first-order correlations towards zero (Chatfield, 2004). See Fig. 2 for an illustration of this indicator in relation to other behavioral indicators.

2.4.2.2. Between dyads. At the sample level, we examined how teacher behavior characteristics were associated with student cooperative

Table 1
Descriptive statistics for interpersonal teacher and student behavior (Averaged across 82 Dyads).

	Variable	*M*	*SD*	*Min*	*Max*
Mean level	ComT	445.25	103.05	99.34	633.23
	ComS	317.02	145.43	−306.86	599.10
	Difference ComS	18.00	88.54	−289.16	149.33
	AgT	342.26	175.55	−127.17	657.75
	AgS	−254.06	245.20	−759.93	198.70
Variability (SD)	ComT	80.63	19.61	40.77	131.60
	ComS	64.88	20.18	30.84	136.18
	AgT	135.21	44.08	64.19	270.45
	AgS	180.08	54.27	72.71	302.16
Instability (MSSD)	ComT	216.42	148.49	20.39	650.46
	ComS	175.40	144.89	23.33	818.86
	AgT	262.23	148.23	54.32	741.09
	AgS	290.67	179.65	43.97	1004.06
Within-person associations	ComTAgT	.02	.34	−.68	.76
	ComSAgS	.27	.32	−.70	.86
Within-dyad associations	ComTComS	.28	.31	−.50	.81
	AgTAgS	−.64	.25	−.95	.28
	ComTAgS	.02	.32	−.79	.64
	AgTComS	−.10	.29	−.72	.61

Note. Agency (Ag) and communion (Com) ranged from −1000 to 1000. T and S represent teacher and student respectively.

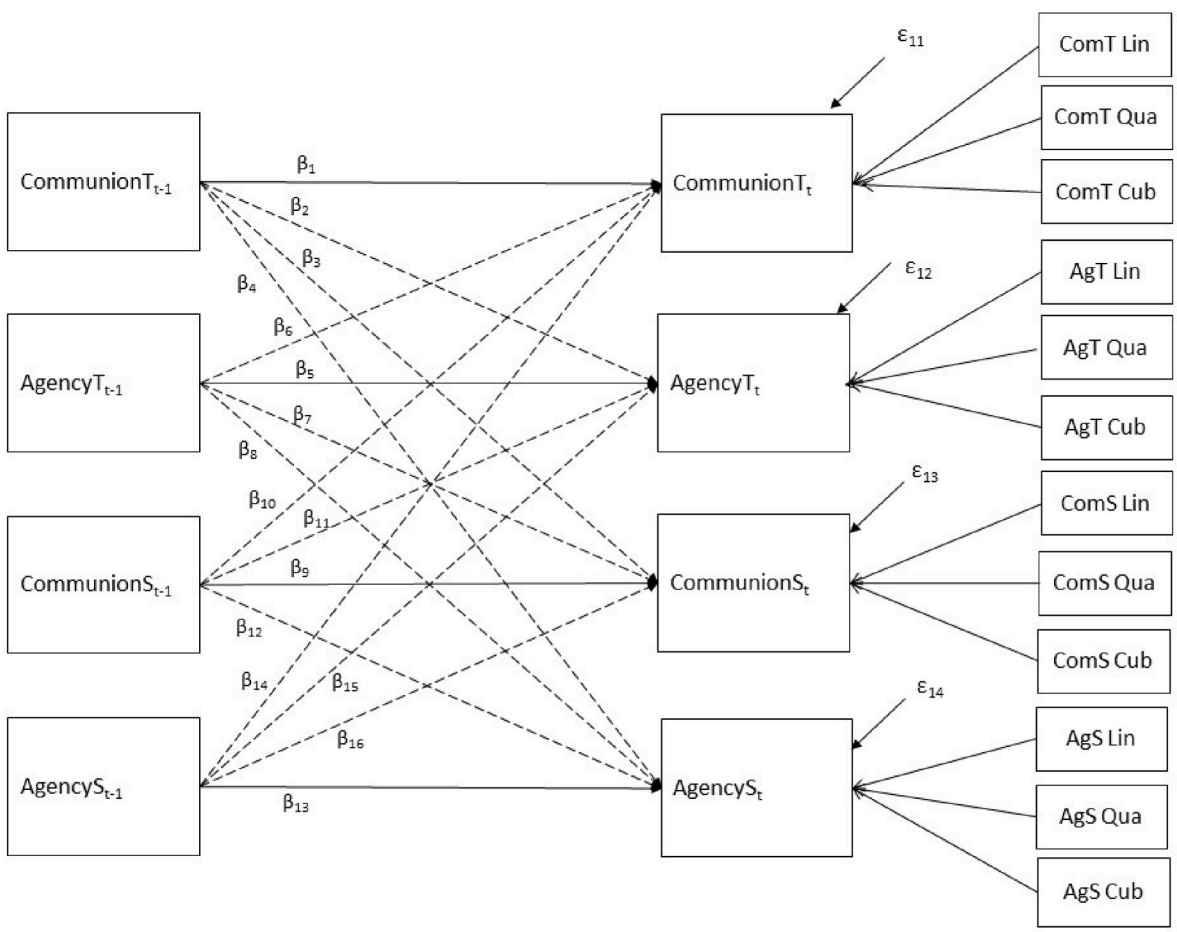


Fig. 3. VAR model estimated for each dyad separately.
Note. T and S represent teachers and students; and Com and Ag represent communion and agency. The subscripts *t* and *t-1* refer to a time point and one lag (i.e., 0.5s) before previous time points in the timeseries. Lin, Qua, and Cub represent the linear, quadratic, and cubic trend respectively. The solid arrows represent the autoregressive parameters and the dashed arrows the cross-lagged parameters.

behavior. We used the *mean level* of student communion during the conversation as well as the difference in student communion between the start and the end of the conversation as dependent variables. The *difference score* was computed in two steps: 1) the student's communion scores during the first minute and the last minute of the conversation were averaged, and 2) the average score of the first minute of the conversation was subtracted from the average score of the last minute. A negative value indicated that a student ended the conversation with less cooperation compared to the start.

3. Results

3.1. RQ1: Within-person dynamics

3.1.1. Mean levels

Table 1 provides the descriptive statistics averaged across the 82 dyads. Wide ranges for all mean scores indicated that behavior differed substantially between persons and dyads. To provide a general idea of the range of the coded interactions, Fig. 4 depicts the behavior of all the teachers and students in the sample together. Overall, and in line with their role as favorite teacher, teacher behavior was mostly positive on the agency and communion axes (i.e., located in the right upper quadrant of the interpersonal circle in Fig. 4). None of the teachers showed negative average communion levels (see Table 1, 'Mean level - Com T': range = 99.34–633.23).

Student behavior consisted of generally positive communion (i.e., interpersonal cooperation) and somewhat lower levels of agency as compared to the teachers (see Table 1, 'Mean levels'). Fig. 4 also indicates that there were moments when students showed oppositional behavior (i.e., located at the left side of the circle in Fig. 4). Some students did behave in overall oppositional ways (see Table 1, 'Mean level – ComS': range = −306.86–599.10). On average students' communion levels were higher at the end of the interaction than at the start, although this varied largely between students (see Table 1 'Mean level - Difference ComS').

3.1.2. Variability and instability

Variability connotes the overall level of change in someone's behavior and more variability indicates larger changes in behavior over time. Instability is linked to variability but provides information on how predictable and abrupt the changes in behavior are. Teachers were more variable and instable in their communion than students (see Table 1, Variability: $M_{\mathrm{ComT}} = 80.63$, $M_{\mathrm{ComS}} = 64.88$; MSSD: $M_{\mathrm{ComT}} = 216.42$, $M_{\mathrm{ComS}} = 175.40$), whereas students were more variable and instable in their agency (see Table 1, Variability: $M_{\mathrm{AgT}} = 135.21$, $M_{\mathrm{AgS}} = 180.08$; MSSD: $M_{\mathrm{AgT}} = 262.23$, $M_{\mathrm{AgS}} = 290.67$). Thus, students tended to show a smaller range of communal behaviors and stayed cooperative or uncooperative for longer periods of time, while teachers were more instable in their behavior, meaning that they switched in their interpersonal behavior more often and more pronouncedly or abruptly. Some teachers and students were clearly more variable and instable in their behavior than others.

3.1.3. Within-Person Associations Between Agency and Communion

Teachers and students differed considerably in the ways they combined their agency and communion (see Table 1 'Within-person associations). Overall, when students became more cooperative, they also tended to become more dominant and vice versa ($r_M = 0.27$, $r_{SD} = 0.32$). While some teachers generally became less cooperative when their agency increased (i.e., moving towards more strict or confrontational behaviors), others became *more* cooperative (i.e., moving towards more structuring or helping behaviors) as indicated by the range in within-person associations for teachers ($r_M = 0.02$, $r_{SD} = 0.34$).

3.2. RQ2: Associations between teacher and student interpersonal behavior

3.2.1. Within dyads

3.2.1.1. Complementarity. On average, students and teachers interacted in complementary ways (see Table 1 'Within-dyad associations'). For example, if one interaction partner acted cooperatively this tended to be reciprocated by the other (*r* ComTComS, $r_M = 0.28$). For agency, complementarity was even more pronounced than for communion (AgTAgS, $r_M = -0.64$). Again, the ranges indicated that the strength and direction of these correlations varied between dyads.

3.2.1.2. Cross-dimensional correlations. On average, higher levels of teacher agency had a slight tendency to go together with lower levels of student communion and vice versa (see Table 1 'AgTComS', $r_M = -0.10$). The wide range of these cross-dimensional correlations, however, indicated highly dyad-specific processes: While for some teachers agency was negatively associated with their students' communion, for other dyads this effect was non-significant or reversed.

3.2.1.3. Associations from moment-to-moment. Table 2 shows the results

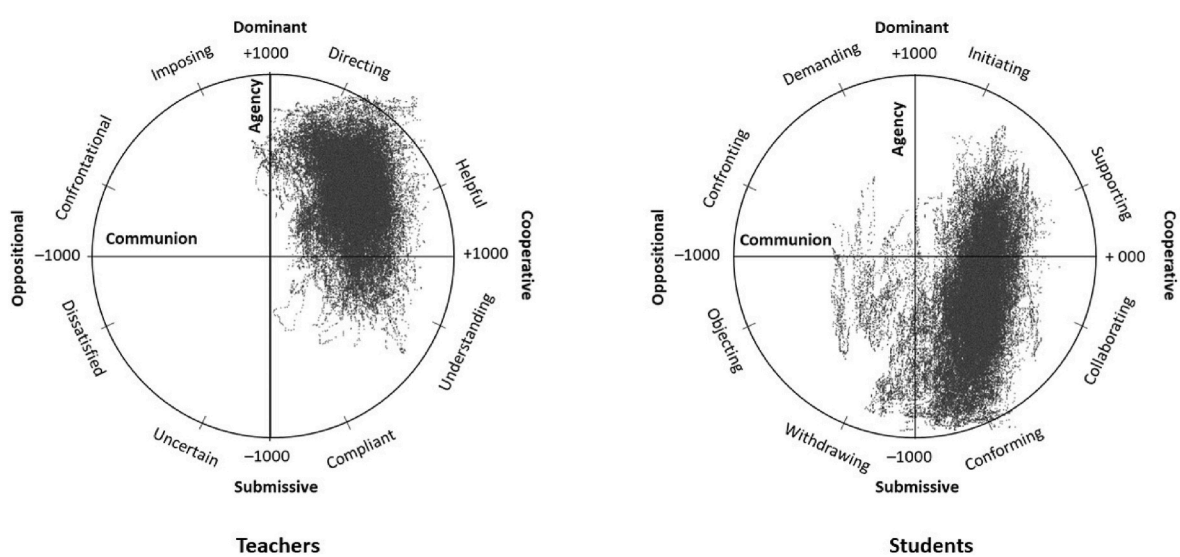


Fig. 4. Behavior exhibited by all teachers (Left) and students (Right) mapped onto the interpersonal circle.

Table 2
Results of VAR models (Averaged over 82 Dyads).

Parameters		β_M	β_{SD}	β_{min}	β_{max}	% $p < .05$[a]
β_1	$ComT_{t-1}$– $ComT_t$	.973	.019	.919	1.000[b]	100%
β_2	AgT_{t-1} – $ComT_t$	−.001	.017	−.053	.038	34.1%
β_3	$ComS_{t-1}$ – $ComT_t$	.003	.013	−.049	.037	35.4%
β_4	AgS_{t-1} – $ComT_t$	.004	.017	−.046	.063	34.1%
β_5	AgT_{t-1} – AgT_t	.987	.016	.920	1.000[b]	100%
β_6	$ComT_{t-1}$ – AgT_t	.004	.018	−.059	.100	53.7%
β_7	$ComS_{t-1}$ – AgT_t	−.000	.011	−.028	.039	45.1%
β_8	AgS_{t-1} – AgT_t	−.002	.016	−.055	.047	47.6%
β_9	$ComS_{t-1}$ – $ComS_t$	.969	.019	.900	.996	100%
β_{10}	AgS_{t-1} – $ComS_t$	.007	.019	−.037	.053	36.6%
β_{11}	$ComT_{t-1}$ – $ComS_t$	.011	.057	−.024	.500	29.3%
β_{12}	AgT_{t-1} – $ComS_t$	−.002	.014	−.040	.035	36.6%
β_{13}	AgS_{t-1} – AgS_t	.987	.012	.948	1.000[b]	100%
β_{14}	$ComS_{t-1}$ – AgS_t	.001	.009	−.029	.022	51.2%
β_{15}	$ComT_{t-1}$ – AgS_t	−.006	.011	−.050	.023	59.8%
β_{16}	AgT_{t-1} – AgS_t	−.007	.014	−.044	.036	64.6%
Explained variance						
Variables		R^2_M	R^2_{SD}	R^2_{min}	R^2_{max}	
ComT		.976	.019	.913	.998	100%
AgT		.990	.009	.950	.999	100%
ComS		.972	.024	.888	.997	100%
AgS		.992	.012	.919	.999	100%

Note. The individual dyads all had a different number of time points ($M = 1107$ time points). Com and Ag represent communion and agency, and T and S represent teacher and student respectively. The subscripts *t* and *t-1* represent a time point and one lag (i.e., 0.5s) before a time point respectively.

[a] The percentages indicate in what percentage of teacher-student dyads the specific pathway was significant at an α of 0.05. Please note that we used the percentage because we did not want to average p-values. Moreover, these values should be interpreted with caution, due to the high autocorrelations in the model and the large number of datapoints used to estimate the beta.

[b] Some autoregressive parameters were estimated as greater than 1, even after adjusting for stationarity. Since the largest value did not exceed 1.023, it was decided to treat these autoregressive parameters as one and the timeseries as stationary.

of the VAR models as averaged across the 82 dyads, as well as the percentage of betas that was significant for each path in the VAR models. (Small) cross-lagged correlations indicated that over time students and teachers also generally interacted in complementary ways (for communion see β_3 and β_{11}, for agency see β_8 and β_{16} in Table 2). Note that these effects were rather small given the large auto-correlations in the model. Also, we found wide ranges in these effects.

Looking at how teachers could elicit student cooperativeness specifically, Table 2 shows that the average cross-lagged correlation between teacher communion and student communion was positive ($\beta_M = 0.011$, $\beta_{SD} = 0.057$). This correlation was significant in 29.3% of the VAR models and out of these 23 significant effects, 18 were positive correlations, indicating that increasing cooperation was most likely to be associated with a successive increase in student cooperation. Second, the average cross-lagged correlation between teacher agency and student communion was negative ($\beta_M = -0.002$, $\beta_{SD} = 0.014$). In 36.6% of the VAR models this correlation was significant and out of these 30 significant betas, 19 were negative correlations. This indicates that lowering agency was most likely to be associated with a successive increase in student cooperation. In line with this, the average cross-lagged correlation between student agency and student communion was positive ($\beta_M = 0.007$, $\beta_{SD} = 0.019$). This correlation was significant in 36.6% of the models and out of these 30 significant effects, 23 were positive correlations. This indicates that when students were able to show more agentic behaviors, this was most likely associated with an increase in cooperation later on. The average negative cross-lagged correlation between teacher agency and student agency at later timepoints ($\beta_M = -0.007$, $\beta_{SD} = 0.014$) also supports this mechanism. This correlation was significant in 64.6% of the models and out of the 53 significant correlations, 42 were negative correlations. This indicates that when teachers lower their agency this is most likely to be followed by an increase in student agency. So, it seems that both lower teacher agency and an (related) increase in student agency could potentially foster cooperative student behavior later on. Finally, students' own cooperative behavior is the main predictor of their cooperation later on. For students, increasing their cooperation was always associated with an increase in their later cooperation ($\beta_M = 0.969$, $\beta_{SD} = 0.019$).

3.2.2. *Between dyads*

To examine the value of within-person and within-dyad indicators for student outcomes, we conducted correlational analyses at the between-dyad level. The correlations listed in Table 3 indicate that teacher and student average communion levels were clearly positively associated, but teachers' average communion was not associated with students' communion difference scores that compared the start with the end of the conversation (see Table 3, column 1, row 2 and 3).

Teachers' average level of agency, on the other hand, was negatively associated with both students' average communion and with the students' communion difference scores (see Table 3, row 4, column 2 and 3). This implies that students became more cooperative or remained cooperative when teacher communion was high and teacher agency was low and that students were more likely to end a conversation with high cooperativeness levels when teachers' average level of agency during the interaction was lower.

Both teachers' variability and instability in agency were positively associated with students' communion (see Table 3, column 2, row 8 and 12). In combination with a negative correlation between teacher agency mean levels and the instability and variability of teacher agency (see Table 3, column 4, row 8 and 12), the former result seems to indicate that especially teachers who *lowered* their agency levels several times during a conversation better support their student's cooperativeness. Fig. 5 illustrates this by presenting two opposite dyads in terms of teachers' agency and the student's communion. Panel A shows a dyad where the teacher varied substantially in agency, which went together with an increase in student cooperativeness from the beginning to the end of the conversation. Panel B on the other hand, shows a teacher with a relatively high and invariable agency, which went together with lower levels of student communion and increased oppositional behavior from the start to the end of the conversation.

Furthermore, stronger communion complementarity went together with more student communion and, in such dyads, students were more likely to end the conversation more cooperatively than they started the conversation (see Table 3, row 16, column 2 and 3). If teacher agency was positively connected to student communion, this tended to go together with higher general student communion and students were more likely to show cooperative behavior towards the end of the conversation (see Table 3, row 19, column 2 and 3).

Finally, students' agency was positively associated with their communion and their communion difference scores (see Table 3, row 5, column 2 and 3), thus more student agency was likely to go together with cooperative student behavior. Further, more variability in student communion went together with lower overall communion and cooperativeness at the end of the conversation as compared to the start was less likely (see Table 3, row 7, column 2 and 3). Likewise, more instability in student agency ad communion made cooperative student behavior at the end of the conversation less likely (see Table 3, column 5, row 11 and 13). Students with a stronger tendency to increase their agency and cooperation together were likely to have relatively lower cooperativeness levels and were more likely to end a conversation with lower cooperativeness than they started the conversation (see Table 3, row 15, column 2 and 3). This seems to indicate that students who only increase their communion together with increasing their agency, in general tend to show less cooperation in interactions. Possible, this could indicate that these students do not have enough possibilities to show agency which could be related to their lower levels of cooperation.

Table 3
Correlations for interpersonal teacher and student behavior (Averaged across 82 Dyads).

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Mean level																						
1	ComT	–																				
2	ComS	**.47**	–																			
3	Difference ComS	.19	**.47**	-																		
4	AgT	**−.38**	**−.35**	**−.23**	–																	
5	AgS	**.26**	**.42**	**.29**	**−.66**	–																
Variability (SD)																						
6	ComT	−.11	−.09	−.08	**.24**	−.13	–															
7	ComS	.06	**−.33**	**−.38**	−.08	−.09	.22	–														
8	AgT	**.27**	**.24**	−.02	**−.42**	.23	.06	**.31**	–													
9	AgS	.09	.14	−.10	**−.37**	**.32**	.11	**.20**	**.59**	–												
Instability (MSSD)																						
10	ComT	.18	.19	.00	.02	.06	**.33**	−.03	.20	**.23**	–											
11	ComS	.21	.07	**−.24**	−.01	−.06	**.27**	.29	**.28**	**.22**	**.56**	–										
12	AgT	**.30**	**.30**	−.01	**−.27**	**.27**	.09	.16	**.30**	.10	**.30**	.11	–									
13	AgS	.02	−.01	**−.25**	−.10	**.23**	.07	.23	**.19**	.06	.19	**.20**	**.61**	–								
Within-person association[a]																						
14	ComTAgT	.06	.00	.06	.21	−.17	−.08	.05	.02	−.09	**−.28**	−.10	−.15	−.07	-							
15	ComSAgS	−.04	**−.23**	**−.27**	.19	−.04	.14	.12	−.10	.07	−.10	−.08	−.10	−.03	−.04	-						
Within-Dyad association[a]																						
16	ComTComS	.14	**.20**	**.58**	−.17	**.21**	.07	−.13	−.00	−.04	−.03	−.13	.04	−.09	−.01	−.15	-					
17	AgTAgS	**−.24**	−.17	.08	.03	−.01	−.11	−.22	**−.52**	**−.58**	−.20	**−.30**	−.11	−.10	−.09	−.09	−.02	-				
18	ComTAgS	.10	.09	.16	**−.28**	**.31**	.14	−.11	.01	−.04	.14	.12	**.20**	**.16**	**−.66**	.08	**.37**	**.22**	-			
19	AgTComS	.14	**.27**	**.40**	−.11	.01	−.17	**−.25**	−.03	−.17	−.02	−.17	.10	−.15	.07	**−.61**	.25	.14	.06	-		
Within-dyad lagged correlations																						
20	$ComT_{t-1}$ – ComS	−.01	−.04	−.08	.10	−.16	.01	−.08	**.08**	**.15**	**.20**	**.10**	−.01	−.02	−.03	.01	**.14**	**−.10**	.05	−.01	-	
21	AgT_{t-1} – ComS	−.03	.03	.05	**−.27**	.06	−.13	−.07	**.19**	.12	−.08	−.19	−.01	−.09	−.15	−.01	−.04	.01	.09	**.16**	−.02	-

Note. Com and Ag represent communion and agency, and T and S represent teacher and student respectively. The subscripts *t* and *t-1* represent a time point and one lag (i.e., 0.5s) before a time point respectively. Significant correlations are shown in bold.

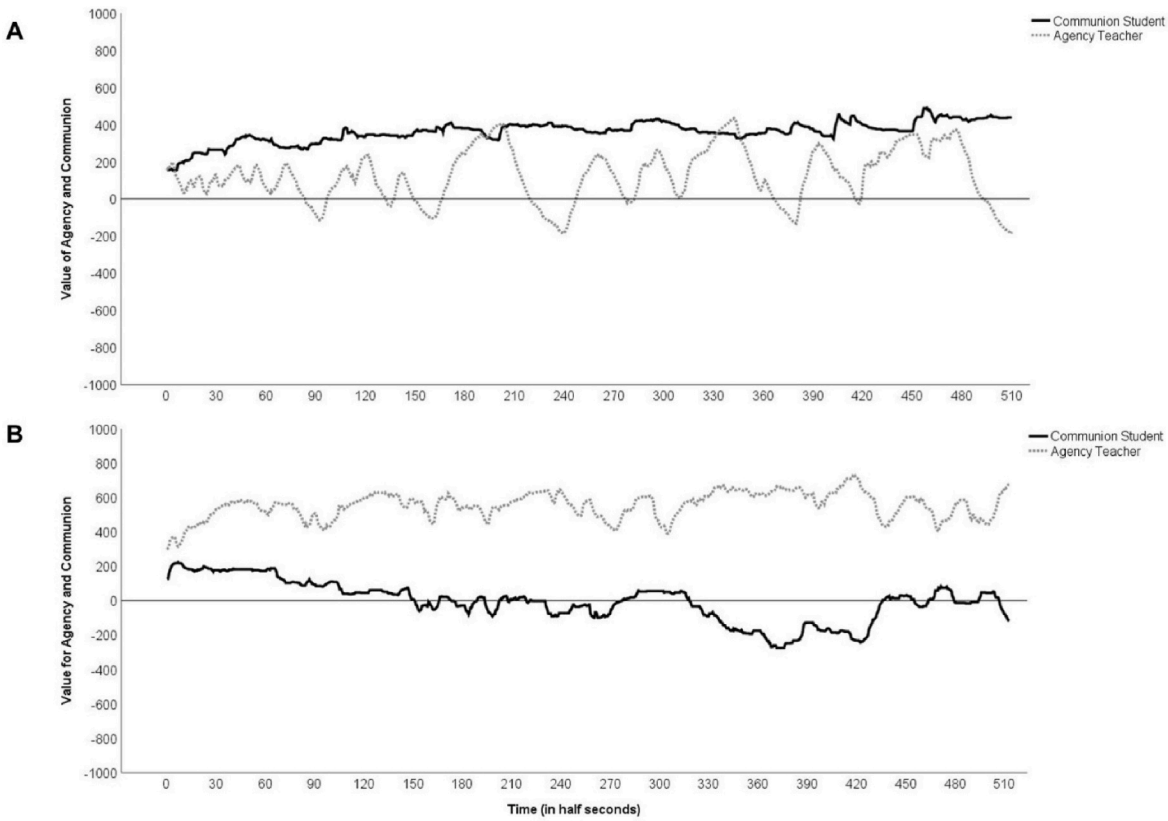


Fig. 5. Bivariate timeseries of teacher agency and student communion in two different dyads (A and B).
Note. Descriptive statistics for dyad A/B respectively: Agency teacher (AgT): 86.42/533.84; Variability AgT: 174.86/76.72; MSSD AgT: 122.57/228.26; Communion student (ComS): 370.53/-4.84; Difference ComS: 149.33/-194.62.

4. Discussion

Cooperative and sociable instead of oppositional student behavior is beneficial for students at risk of academic failure (Longobardi et al., 2016; Roorda et al., 2017), because such behavior fosters engagement, underlies positive teacher-student relationships, and may ultimately protect them from academic problems and dropout (Archambault et al., 2009; Wang & Fredricks, 2014). The way teachers behave interpersonally is a crucial factor for students' behavior. We found that cooperative student behavior was most likely when teachers showed sociable and cooperative behavior (i.e., high interpersonal communion), and when teachers loosened their leading role and the structure they imposed on the conversation on a frequent basis (i.e., low/variable interpersonal agency). Overall, the ways in which teacher and student interpersonal behavior were associated was highly dyad-specific, which points towards the usefulness of personalized interventions.

4.1. RQ1: Within-person dynamics

In line with Pennings et al. (2018) and Pennings and Hollenstein (2020), we found that teachers overall were dominant and cooperative when interacting with students at risk. Students behaved on average cooperatively too, although for them some instances of oppositional behavior were found. Moreover, in line with the hierarchical character of teacher-student relations, students showed lower levels of agency than teachers. Teachers and students tended to combine their agency and communion in a positive way, that is, they tended to become more structuring and initiating rather than imposing or demanding (see Fig. 1). Teacher agency and communion was rather variable and instable, which contradicts findings in the classroom setting (Pennings et al., 2018), but is in line with dyadic parent-adolescent interactions (Branje, 2008; van der Giessen et al., 2015). Thus, teachers used a broader behavioral repertoire as compared to classroom teaching, possibly to be better able to support and tailor to the student's behavior (Pennings et al., 2018).

4.2. RQ2: Associations between teacher and student interpersonal behavior

Cooperative student behavior was best supported by cooperative teacher behavior. The level of complementarity was however weaker than in studies conducted in classrooms (Pennings et al., 2018; Pennings & Hollenstein, 2020), which may indicate that in dyadic settings teachers are more likely to refrain from returning uncooperative or unfriendly student behavior with equally unfriendly behavior (compare Fig. 4). Interestingly, higher overall levels of teacher agency went together with more uncooperative student behavior, which is not in line with studies involving young children (Thijs et al., 2011) and classroom situations (Pennings et al., 2018; Pennings & Hollenstein, 2020). Students at risk might feel marginalized when they are required to be passive learners or feel that they are not heard by the teacher (Batten & Russell, 1995; Riele, 2006). They may, however, be more cooperative when their teacher 'loosens up' every now and then and provides opportunities for the student to take the lead. By lowering their agency, teachers may give more room for student agency and thus may satisfy the student's need for autonomy (Ryan & Deci, 2002), for example by giving students the opportunity to express their ideas (Holt et al., 2008).

In line with this, variability and instability of teacher agency was positively associated with the mean level of student cooperativeness, indicating that teachers who were more flexible in their agency, had students who were more likely to remain cooperative. There were also positive correlations between students' own agency and their

cooperation, indicating that students who had more agency also were more cooperative, overall.

4.3. Strengths, limitations, and future directions

An important strength of the present study is that we examined dyadic interaction from moment to moment, which helped us understand how teachers can support at-risk students' interpersonal cooperation, during one-on-one sessions. Future research should examine to what degree our findings are specific for mentoring students at risk or whether the findings are generalizable to other dyadic teacher-student relationships. Moreover, although our approach gave us detailed information on how teachers can support their students' cooperation during dyadic conversations, this may be different in a classroom context. Future research could therefore examine how teachers get students to cooperate in such settings.

In addition, an important strength of our study is that teachers and students were free to discuss any problem related to the students' functioning at school and they were instructed to make progress on this topic. As the topics related to school functioning differed per student, this increased the ecological validity of the present study. However, the content of the conversation could therefore also differ which might have resulted in different levels of emotional tension between the dyads. This could potentially make it difficult to generalize our findings to more general teacher-student interactions. A next step could be to also include follow-up measures which reflect the degree to which behavioral or academic goals for the student have been achieved. This can further help to understand which interpersonal patterns are effective in which specific situation.

Nonetheless, the goal of the present study was not to understand behavior tied to specific contents but to examine the interpersonal aspect of the communication (see Watzlawick et al., 1967). Since everyone's behavior can be characterized by the same two interpersonal dimensions (i.e., communion and agency), it was possible to extract more general interpersonal patterns in the interactions. Hence, although we cannot link the findings to specific contents, the present study does indicate global behavioral patterns that might be helpful in other dyadic contexts.

Another strength of our study was that we examined how behaviors affected each other not only concurrently, but also over time. However, due to very large auto-correlations, the lagged correlations were small. This is typical for timeseries with a relatively small time lag (i.e., 0.5s) which may be too small for current autoregressive modelling techniques (Donker et al., 2018). Related to this, our findings were based on a correlational design and a convenience sample. A next step could be to move towards more experimental set-ups that could include, for example, interventions in teacher behavior via training.

Finally, research so far has mainly focused on constructs related to interpersonal communion, such as teacher friendliness and emotional support (Hamre & Pianta, 2005). Our findings suggest that it might be worthwhile to take a closer look at constructs related to teacher agency as well. This is in line with studies examining classroom management practices, as they also suggest that teachers at the same time have to provide structure and support individual students' needs to maintain an orderly working climate and to elicit student cooperation and time on-task (Emmer & Stough, 2001). Moreover, studies examining controlling versus autonomy supportive teaching also show that autonomy supportive teaching strategies, such as welcoming students' suggestions and taking their frame of reference, were positively related to students' motivation and engagement (Aelterman et al., 2019; Jang et al., 2009).

4.4. Practical implications

In sum, the present study offers some practical implications for (dyadic) teacher-student interactions involving at-risk students. We identified at least two possible strategies through which teachers could elicit cooperative student behavior. The first pathway is through their own communal and cooperative behavior: Acting friendly and supportive, in a helpful or understanding way (e.g., octants 2 or 3 in Fig. 1), is more likely to elicit cooperative student behavior. A second pathway to elicit student cooperation concerns a teacher's interpersonal agency. Our results indicated that students were more cooperative when they interacted with teachers who took overall relatively more agency as compared to other teachers in our sample, and thus in general provided more structure for the student. If such a teacher then also 'loosened up' their leading role on a frequent basis, for example by acting in an understanding and compliant way (see Fig. 1), this seemed to allow students to take more agency for themselves. For example, a teacher could have a tough conversation with a student about frequently not completing the assigned homework. Although teachers might want to take the lead and act in a dominant, maybe even strict way, this might not result in cooperative student behavior. According to our findings, it could be beneficial if from time to time, teachers 'loosen up' their leading role. Instead of telling the student how they need to behave and advising the student how they need to organize their work, teachers could simply start with stating the problem (e.g., "I know it is hard for you to complete your tasks", i.e., understanding behavior) and then either wait for a student response (i.e., compliant behavior) or ask explicitly for the student's own perspective (e.g., "Can you tell me more about this", i.e., helping behavior), before moving towards advising how to organize homework assignments (i.e., directing behavior). This would also allow for more student agency, which was also likely to go together with an increase in student cooperation. Thus, it is generally helpful for student cooperation if teachers take the lead in friendly ways (i.e., directive or helpful, see Fig. 1), but every now and then teachers should invite student initiative by loosening up their leading role, for example by actively involving the student in finding a solution or by awaiting a student response, for example, by using silences and allowing the student to take the lead for a while.

5. Conclusion

With the current exploration of at-risks students' cooperative behavior in interaction with their favorite teacher, we wanted to highlight potential helpful interpersonal teacher behaviors. Even though the findings might be hard to generalize to regular classroom interactions, this paper has the potential to help us understand dynamic processes leading to positive teacher-student relationships and, eventually, positive outcomes for students. Teachers can potentially foster at-risk students' cooperative behavior with their own cooperativeness and with flexible agency, which provides students with the opportunity to take the lead during interaction repeatedly to share their opinion; especially students at risk may find it easier to cooperate under such conditions. When your aim is to trigger student cooperation in dyads it is thus important to focus not only on warmth, closeness, or friendliness, but also on loosening teacher agency. In this way teachers may foster at-risk students' cooperation via their own interpersonal behavior, which ultimately may help to protect these students from academic failure.

Author contributions

Lian van Vemde: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft; Monika H. Donker: Conceptualization, Writing – review & editing, Supervision; Tim Mainhard: Conceptualization, Data collection, Methodology, Writing – review & editing, Supervision. All authors read and approved the final manuscript.

Funding

This study was funded by The Dutch Research Council [project nr. 451-12-022].

Author bio's and research interests

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Compliance with ethical standards

Ethical Approval.

Approval was obtained from the ethics committee of Utrecht University in The Netherlands. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed consent

Teachers and students (including their parents) provided written active informed consent.

Declaration of competing interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Acknowledgements

The authors would like to thank all teachers and students for their participation. Moreover, the authors would like to thank everyone involved in data collection and video coding.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.learninstruc.2022.101687.

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