Soc Psychol Educ (2017) 20:97–114
DOI 10.1007/s11218-017-9366-1

You are not alone: colleague support and goal-oriented cooperation as resources to reduce teachers' stress

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Received: 10 September 2015 / Accepted: 3 January 2017 / Published online: 13 February 2017

Abstract The teaching profession is associated with high levels of perceived stress due to time constraints, heavy workload, and extra-curricular obligations. Teachers' perceived stress affects the quality of their instruction and consequently their students' motivation. According to social interdependence theory, frequent cooperative activities with colleagues may lead to more giving and receiving of support at the workplace. Research findings indicate that colleague support serves as a resource for teachers and has a positive influence on their performance. However, the relationship between teachers' perceived stress, goal-oriented cooperation with colleagues, and support of one another has been explored rarely. The theoretical background has not been applied to teachers in Germany. In this longitudinal study, 2648 teachers completed the same questionnaire at a first measurement wave (Time 1), a second wave 2 years later (Time 2), and a third measurement wave 2 years after that (Time 3). We aimed to test the mediation hypothesis that teachers' perceived stress is affected by frequent cooperative lesson planning with colleagues via colleague support. The dependent variable was teachers' perceived stress at Time 3. Teachers' perceived stress correlated negatively with colleague support at Time 2, and this correlated positively with the frequency of cooperation at Time 1. Our results indicate that reduced perceived stress was indirectly associated with frequent cooperation in reaching the common goal of planning lessons via colleague support among teachers. These findings might be used to help school principals ensure

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cooperation among teachers and thereby keep stress levels low and the quality of teaching high.

Keywords Teachers' stress · Colleague support · Frequency of cooperation

1 Introduction

Research over the past three decades has shown that the teaching profession is associated with high levels of perceived stress (Lieberman 1986; Roeser et al. 2013; Skaalvik and Skaalvik 2010; vbw 2014). To summarize previous definitions (e.g., Kyriacou 2001), teachers' perceived stress results from a relative lack of balance between demands and resources at school. Negative emotions (e.g., anger or anxiety) are associated with that mismatch (e.g., Kyriacou 2001). Poor working conditions can be sources of stress as well, e.g., no individual workplace at school, not enough paid time for cooperation or preparation, teaching unmotivated students, managing discipline in class, and having to agree with evaluations by others (Kyriacou 2001).

Teachers have both curricular and extra-curricular obligations (Kyriacou 2001) such as planning, preparing and conducting lessons, supervising playgrounds, organizing school events, coordinating with secretaries, and communicating with parents or social scientists. Furthermore, teachers have to deal with various impediments and constraints such as fixed timetables and limited resources. Teachers have little influence in decision-making or setting education standards (Egodawatte et al. 2011; Gallimore and Goldenberg 2001), and adhering to ministry and school-specific guidelines in Germany (Booth et al. 2014; Steinert et al. 2006) or local school board standards for instruction in the U.S. (e.g., Henderson et al. 2015).

The German constitution defines education as primarily the domain of the *Bundesländer, the German states.* The German constitution prohibit cooperative school policies between the federal government and the states. German state policies regarding education are negotiated by the *Kultusministerkonferenz,* the national gathering of state secretaries of education (Henderson et al. 2015). The teacher compensation and the lion's share of school funding in Germany comes from the federal states. German teacher compensation is higher than teacher compensation in the U.S. There are few privately funded schools in Germany (e.g. Henderson et al. 2015).

An increasing number of German schools have extended students' time at school from about noon to the afternoon by providing lunch and extra-curricular activities. Students in most U.S. schools are in attendance from early in the morning until late in the afternoon, including lunch at school, classes, and extra-curricular activities. Local governments in the U.S. are important for school funding because about 50% of funding comes from taxes, U.S. states contribute with less than 50% of funding and the federal government with less than 20% (Henderson et al. 2015). Education in the U.S. is known for its high number of privately funded schools.

According to the applicable standards and guidelines, German teachers are usually educated to teach two subjects, the exact composition of which tends to depend upon subject combination opportunities at university (e.g., Mathematics and Physics or Spanish and Art). They serve as class teacher for at least one class and teach courses to groups of students in various subjects and at different levels of achievement depending on the type of school (e.g., *Gesamtschulen*, schools for both occupational and academic education, versus *Gymnasien*, schools for academic education only). Teachers in the U.S. are usually educated to teach one subject.

Teachers' perceived stress often results from trying to fulfill occupation-related requirements, similar in both the German and the U.S. educational systems, produce positive learning outcomes, meet students' individual learning needs, and deal with occasional deviant behavior of students (Fernet et al. 2012). These numerous time-consuming demands on teachers prevent them from interacting and helping one another in planning their lessons and curricula (Kyriacou 2001; Roeser et al. 2013; Smith and Gillespie 2007). Cooperation among colleagues is uncommon for teachers in Germany (e.g., Steinert et al. 2006). When teachers perceive this lack of teamwork, their levels of stress may increase (Collie et al. 2012; Fernet et al. 2012).

In social interdependency theory (SIT), Johnson and Johnson (2003, 2005) maintain that there is a link between psychological well-being and dealing positively with stress and teamwork. They assume that colleague support is a resource given in a cooperative climate and that it has a positive influence on performance in learning and working groups. Collective norms and values, shared uncertainties, skills, insights (Kelchtermans 2006; Louis et al. 1996), a common focus on student learning, and reflective discussions of methods and learning objectives are characteristics of professional cooperation (Johnson and Johnson 2003; Louis et al. 1996). Research findings have supported the assumption that colleague support (Klusmann et al. 2008; Roeser et al. 2013) and cooperation among teachers in general (Lossen et al. 2013) serve as resources for teachers. Sharing occupational interests, goals, understanding, and experiences reduces stress (Lossen et al. 2013) and promotes psychological health (Bartholomew et al. 2014; Johnson and Johnson 2003).

To ensure high quality instruction and positive learning outcomes in their schools, principals need to find ways to keep teachers' perceived stress levels low (Egodawatte et al. 2011; vbw 2014). To help school principals reach this goal, researchers need to identify resources within school processes as well as among teachers that could reduce teachers' perceived levels of stress.

In this study, we first identified theoretically what resources teachers have for reducing their perceived stress. Second, we analyzed whether teachers' perceived stress was determined by cooperating with colleagues to reach the shared goal of planning lessons via perceived colleague support. In alignment with the SIT (Deutsch 2011; Johnson and Johnson 2003), we hypothesized a relationship between perceived teacher stress, colleague support, and the frequency of cooperation among teachers. We tested the mediation hypothesis: Lower levels of perceived stress result from frequent cooperation in planning lessons via increased perceived colleague support.

1.1 Social interdependency theory (SIT)

The SIT is based on the idea that individual behavior is associated with social processes involving interdependencies among individuals (Johnson and Johnson 2003). In SIT terms, cooperative procedures comprise several steps from actions to outcomes (Johnson and Johnson 2005), and corresponding consequences can be identified which involve psychological processes and interaction patterns among individuals such as teachers. In SIT, psychological processes are involved, for example, when setting goals and conducting reflections. Thus, teachers could set the common goal of preparing a content-related educational unit (Steinert et al. 2006) and reflect on its implementation either while preparing or after completing this unit. Johnson and Johnson (2003) showed that cooperative processes and competitive social processes have different outcomes. The cooperative interaction patterns postulated in SIT promote group processing and psychological health and maintain low levels of stress (Johnson and Johnson 2003). For instance, effective collaborative lesson planning distributes effort and operates as a resource. On the other hand, competitive attitudes in the workplace generally lead to less verbal communication and more tension among colleagues (Johnson and Johnson 2003), e.g., when there is opposition—or a lack of motivation—to cooperate. In addition, interactions among teachers may be "contrient" (Johnson and Johnson 2005, p. 292); a given teacher might thus invest more psychological and physiological energy in relationships with colleagues at school than his or her colleagues do. Moreover, interaction might be infrequent and irregular (Deutsch 2011) due to teachers' obligations between classes (Skaalvik and Skaalvik 2010). Social interdependence emerges during social processes when an individual's behavior depends on the cooperative or competitive behavior of other people. The SIT has been applied in previous studies of learning groups, teams in business and industry, health care, and other organizational settings (Johnson and Johnson 2009).

1.2 The need to reduce teachers' stress

Teachers' mental and physical health affects the quality of their instruction and, in turn, their students' motivation (Fernet et al. 2012; Klusmann et al. 2008). In several studies, teachers' perceived stress was associated with *intrapersonal* factors such as self-efficacy and motivation (Fernet et al. 2012; Klusmann et al. 2008; Skaalvik and Skaalvik 2010). Teachers' self-efficacy had an impact on their students' motivation and achievement (Fernet et al. 2012; Klassen and Chiu 2010; Skaalvik and Skaalvik 2010). Thus, teachers who feel stressed at work and less self-efficient teach less enthusiastically, which could impair the quality of their lessons. In addition, associations between teachers' perceived stress and students' cortisol levels have been found, i.e., teachers' stress predicted the stress level of their students in the morning when they came to school (Oberle and Schonert-Reichl 2016).

Teachers' perceived high levels of stress can be associated with negative psychological states originating from diverse reciprocal interactions with students and other teachers and from the often-noisy school environment (Hobfoll 1998; Lazarus 1966). The transactional model of stress and coping theory by Lazarus and

Folkman (1984) suggests weighing demands and resources. The wide variety of interactions within a given school environment frame teacher resources, and stress results from an imbalance between increased demands and stable or decreased resources (Hobfoll 1998; Lazarus 1966).

Our assumption was that perceived colleague support helps buffer and, subsequently, reduces perceived stress. In line with this assumption, previous studies indicated that teachers report low levels of stress when they believe they act competently, perceive a certain level of occupational autonomy, and identify with other teachers in their school (Deci and Ryan 2012; van den Broeck et al. 2008). However, the exchange of information and experiences among teachers is limited due to their work in classrooms. Teachers usually have no contact with colleagues (Steinert et al. 2006; see also Maag Merki 2014). The relative lack of occasions to share information and experiences, especially difficult ones, might lead to high levels of stress. Frequent interaction among teachers is related to colleague support and low levels of stress (Fernet et al. 2012; Klusmann et al. 2008). Teachers' daily work is associated with their colleague's and principal's expressed support, e.g., by promoting teachers' autonomy or limiting it (Fernet et al. 2012). Accordingly, the behavior of colleagues and principals might have an impact on teachers' stress levels (Kyriacou 2001). Therefore, the relationship between teachers' support of one another and the frequency of their cooperation as interpersonal resources is outlined below.

1.3 Colleague support and the frequency of cooperation among teachers

Learning at school can occur only when all individuals work together, although situations, needs, values, and commitment differ (Lieberman 1986). Teaching is a profession which involves imparting knowledge and experience to students without expecting students to impart knowledge and experience in return. To do this every day and do it well, teachers need professional, constructive interactions in which they can expect not only mutual assistance, exchange of needed resources, effective communication and trust from colleagues, but also effective management from the principal (Johnson and Johnson 2005). During such interactions, teachers combine their efforts, which can reduce their perceived stress.

Colleague support is postulated as a social resource that can reduce teachers' stress (Fernet et al. 2012; Smith and Gillespie 2007). Supporting a colleague in a school setting could be a qualitative reaction to someone's situational needs (Kelchtermans 2006). Colleague support might be perceived positively or negatively depending on various conditions, such as whether the school climate is cooperative or competitive (Collie et al. 2012). Cooperation can be associated with negotiation and disagreement (Egodawatte et al. 2011; Trötschel et al. 2011). Perceptions and assumptions about learners and learning are a priori invalid in assessment (Horn 2007) and are related to uncertainty experiences (Kelchtermans 2006; Kennedy 2005; Little 2012) about the urgency of immediate and multiple tasks. Goal-oriented cooperation with other teachers compensates for such uncertainties and might strengthen colleague support. Interactions are considered mainly positive when they involve cooperating to reach a common goal (Johnson

and Johnson 2005), for example, to produce a teaching unit (Steinert et al. 2006). According to SIT, teachers who exhibit positive attitudes towards one another (Johnson and Johnson 2005) help to develop a positive climate (Deutsch 2011; Johnson and Johnson 2005). One characteristic of such a positive climate is that cooperative interactions take place (Deutsch 2011).

Johnson and Johnson (2005) mentioned a research gap in terms of a statistically tested mediation effect of supportive interaction with path analyses that include cooperative action frequency, colleague supportive interaction, and outcomes. In line with SIT, we aim to identify the advantages of cooperation procedures. Cooperation levels among teachers can be based on problem-solving abilities (Steinert et al. 2006) and on school improvement (Maag Merki 2014). Following Steinert et al. (2006), a higher level of cooperation is associated with greater cooperation complexity. The levels of cooperation among teachers are as follows: fragmented, differentiated, coordinated, interactive, and integrated. Fragmented cooperation means that teachers seldom communicate to colleagues what they teach (Level 1). Differentiated cooperation involves formal exchange about teaching preparation and informal reports about teaching practice (Level 2). Coordinated cooperation refers to teachers who sometimes plan together with colleagues the content each will teach (Level 3). Interactive cooperation occurs when teachers set and work towards achieving common teaching goals and give one another support (Level 4). Integrated cooperation occurs when teachers discuss and negotiate common teaching goals and the realization and evaluation of their teaching behavior systematically (Level 5). If teachers met weekly to prepare some of their teaching material by means of constructive cooperation, they would be able to share support and resources. Teachers need to discuss their experiences in the classroom and how they may draw on experiences to prepare lessons with their colleagues (Maag Merki 2014; Steinert et al. 2006). Teachers who miss this opportunity to interact with their colleagues might perceive higher levels of stress because they feel alone in facing the demands of instruction. Teachers spend most of their time with heterogeneous classes of students (Maag Merki 2014; Steinert et al. 2006). They work on their own in a classroom, and the frequency of teacher cooperation is generally rather low (Gallimore and Goldenberg 2001; Horn 2007), especially in Germany (Steinert et al. 2006). Evidence exists with a focus on cooperation among teachers as a precondition of instructional quality (Klusmann et al. 2008). This research indicates: Setting and working towards a common goal encourage shared effort among teachers and result in interactions that are perceived mainly positively and improved quality of instruction (Hochweber et al. 2012; Maag Merki 2014).

Lossen et al. (2013) analyzed the same data source used in this study and suggested longitudinal associations among teachers' stress, colleague support, and cooperation among teachers, presenting them in an autoregressive model with cross-lags. Unfortunately, only group process variables at the school level were included in this model, although teachers' initial stress levels were individual states (Roeser et al. 2013). Because teachers work mostly in classrooms, we assume that more frequent joint planning of lessons would lead to higher levels of perceived colleague support. Conversely, perceived colleague support cannot increase without additional cooperative interactions (Johnson and Johnson 2005).

In summary, we consider colleague support to be a perceived qualitative reaction to someone's need in a special situation, instead of a descriptive interval of interactions (Egodawatte et al. 2011) or cooperative actions (Skovholt and Trotter-Mathison 2011). We assume cooperation among teachers is characterized by shared work towards a common goal and more formal than informal interactions within a culture of respect and constructive, positive communication (Collie et al. 2012). Positive, goal-oriented cooperation could help increase perceived colleague support through shared effort and professional theory-based exchange, while also enhancing instructional performance (Deutsch 2011; Roeser et al. 2013). Thus, one way to enhance instructional quality might be to decrease teachers' perceived stress by stimulating goal-oriented cooperation among teachers (Gallimore and Goldenberg 2001).

2 Research questions and hypotheses

Our research question was: Can perceived low stress levels be explained by frequent cooperative lesson planning via increased colleague support? We investigated this previously unexplored area of research in the current study by assessing the relationship between teachers' perceived stress, colleague support, and the cooperation frequency over 4 years. First, we hypothesized that group processes at the school level explain the variance in the cooperation frequency and in colleague support. Second, we hypothesized that perceived low levels of stress (Time 3) can be explained, via perceived high levels of colleague support (Time 2) 2 years before, by perceived high cooperation frequency at the first measurement wave (Time 1) 4 years before. We used longitudinal data that contained responses of the same teachers at Time 1, Time 2 and Time 3.

3 Method

3.1 Data source and the school system in Germany

The data analyzed in this study came from the Study on the Development of All-Day Schools, a longitudinal study which took place over a period of 4 years and involved three measurement waves at schools. The school system in Germany is multi-layered and run by federal states (Fischer and Klieme 2013). *Gymnasium* is the most academically challenging of secondary school in Germany. In teacher education programs, teaching undergraduates need to choose which type of school they want to teach in and obtain a corresponding degree.

Data were assessed every 2 years, reflecting the fact that developments at school and the implementation of new processes at school usually span more than 1 year (Dimmock 2013). Teachers completed a questionnaire that included items on stress (Böhm-Kasper et al. 2000), colleague support (Quellenberg 2009), and cooperation frequency in planning lessons (Quellenberg 2009).

3.2 Sample

We included responses of $n = 2648$ teachers from 271 schools in our study because these teachers participated at all three measurement waves over 4 years. Data collected for teachers who participated in only one or two measurement waves were excluded (for full data description, see Fischer and Klieme 2013). The proportion of these excluded data was above 50%. Thus, imputation models were not appropriate (van Buuren 2012). The sample consisted of 13,045 teachers, including data (Fischer and Klieme 2013).

To test for possible differences between excluded data and included longitudinal data, we conducted a Chi squared test (variables: sex, Gymnasium) and a one-way analysis of variance (ANOVA, variables: age, stress at Time 3, colleague support at Time 2, cooperation frequency at Time 1) to expose differences between subjects excluded from the analysis (e.g., teachers who participated only once or twice) and the sample included in the analysis (e.g., teachers who participated at all three measurement waves).

Of the 13,045 teachers $n = 2258$ teachers were at a Gymnasium at Time 1, of which $n = 374$ teachers (17% of $n = 2258$) participated at all three measurement waves and $n = 1884$ teachers (83% of $n = 2258$) participated only once or twice. Of the $n = 10{,}787$ teachers at other types of schools at Time 1, $n = 2274$ teachers (21% of $n = 10{,}787$) participated at all three measurement waves and $n = 8513$ teachers (79% of $n = 10{,}787$) participated only once or twice. The difference in the number of teachers working at a Gymnasium who responded was statistically significant ($\chi^2 = 24.51$, $df = 1$, $p < .001$). The one-way ANOVA showed a statistical difference in colleague support at Time 2 ($M_{once/twice} = 2.88/M_{attend1-3} = 2.93$, $SD_{once/twice} = .55/SD_{attend1-3} = .53$, $F(1) = 12.31$, $p < .001$) and in cooperation frequency ($M_{once/twice} = 2.78/M_{attend1-3} = 2.87$, $SD_{once/twice} = .74/SD_{attend1-3} = .71$, $F(1) = 32.39$, $p < .001$). However, an additional ANOVA with colleague support as the dependent variable and attendance as the independent variable showed a very small effect size of $\eta_p^2 = .002$, $F(1) = 12.31$, $p < .001$. Similarly, cooperation frequency had a small effect of $\eta_p^2 = .004$, $F(1) = 32.39$, $p < .001$. These differences between the whole sample and our subsample have to be considered when interpreting the results.

The age distribution in the data used ($n = 2648$) was as follows: 3% under 30 years ($n = 65$), 21% 31–40 years (n = 558), 38% 41–50 years ($n = 995$), 37% 51–60 years ($n = 980$), 1% over 60 years ($n = 34$), 1% missing values ($mis = 16$). In the current sample, 14% ($n = 374$) of the teachers were working at a Gymnasium, 70% of n in a middle-track school ($n = 1850$), and 16% of n in an elementary school ($n = 424$). The proportion of missing values ranged from 2 to 6%, which is rather low (Collie et al. 2012; van Buuren 2012). Missing values are presented in Tables 1, 2, and 3, and we considered them in our analyses by using full information maximum likelihood (FIML, Enders 2010; Graham 2009). This means that no cases in the sample we used were deleted due to missing values.

Table 1 Psychometric quality: teachers' stress scale

Item	λ	*SE*	*M*	*SD*	$r_{\text{it-i}}$	Missing values in %
My academic load interferes noticeably with my daily routine	.637	.016	2.53	.914	.582	2.50
I believe that my professional stress level is affecting my health	.801	.012	2.37	.966	.705	2.39
I have a feeling that I will not be able to cope with the time-related demands of teaching	.777	.010	1.68	.783	.717	2.54
Occupational stress has a negative effect on my personal life	.797	.012	1.97	.862	.728	2.43
I often am exhausted due to my job	.832	.009	2.36	.894	.741	2.39
The newly introduced full day of school added to my stress	.520	.019	1.90	.968	.507	4.93

4-point scale, 1 = *not true at all*, 4 = *true*. λ = factor loadings (in a 3-factor model). $r_{\text{it-i}}$ = item-scale intercorrelation. Missing values per variable in % ($n = 2648$)

Table 2 Psychometric quality: colleague support

Item	λ	*SE*	*M*	*SD*	$r_{\text{it-i}}$	Missing values in %
There is consensus among teachers about the school's philosophy	.765	.016	2.89	.615	.700	3.25
There is good team spirit at our school	.808	.014	3.06	.642	.741	3.06
We stick together as a team	.840	.013	2.96	.696	.754	3.32
There is consensus among our colleagues concerning the educational concept of our school	.814	.014	2.96	.635	.741	3.55
When teachers have different opinions, we talk about them openly	.531	.021	2.78	.696	.502	3.21

4-point scale, 1 = *not true at all*, 4 = *true*. λ = factor loadings (in a 3-factor model). $r_{\text{it-i}}$ = item-scale intercorrelation. Missing values per variable in % ($n = 2648$)

3.3 Measures

Table 1 shows the six items on the questionnaire that were related to teachers' stress. The items were introduced with the question "Do you agree with the following statements?" On a 4-point scale ranging from 1 = *not true at all* to 4 = *true,* teachers subjectively rated the impact of working as a teacher on their health and life. The items covered health status and work-life balance (e.g., feelings of strain) and stressors (e.g., additional work at the all-day school) as well as an appraisal of their effectiveness of coping (e.g., the extent to which participants felt able to cope with time demands). The *newly-introduced full day of school* refers to schools that began offering additional extra-curricular activities (Fischer and

Table 3 Psychometric quality: frequency of cooperation

Item	λ	*SE*	*M*	*SD*	$r_{it\text{-}i}$	Missing values in %
Frequency of cooperation: preparation for term or year (learning material, projects, working groups)	.414	.025	2.39	.839	.371	5.57
Frequency of cooperation: preparation of teaching–learning material	.672	.017	2.75	1.233	.584	3.66
Frequency of cooperation: selection of teaching material (e.g., textbooks, workbooks)	.362	.023	2.19	.643	.337	3.88
Frequency of cooperation: communication of teaching materials	.643	.016	3.94	1.139	.547	4.82
Frequency of cooperation: development of teaching units	.764	.015	2.80	1.217	.628	4.15
Coordination of performance measurement and evaluation (e.g., coordination of evaluation criteria)	.609	.021	3.09	1.141	.533	5.57

5-point scale, 1 = *not at all*, 2 = *semi-annually or less*, 3 = *quarterly*, 4 = *monthly*, 5 = *weekly*. λ = factor loadings (in a 3-factor model). $r_{it\text{-}i}$ = item-scale intercorrelation. Missing values per variable in % (n = 2648)

Klieme 2013). Table 1 shows psychometric properties. Cronbach's alpha was α = .86.

To assess perceived colleague support, teachers responded to the question "When you think of the other teachers in your school, to what extent are the following statements true?" with ratings a 4-point scale ranging from 1 = *not true at all* to 4 = *true*. The assessment consisted of five items based on the educational concepts of coordination and collegiality, which support coherent instructional activities. In this study, perceived colleague support reflected general perceptions about cultural cohesion, cultural values, and team spirit. One example was "When teachers have different opinions, we discuss them as a team." The psychometric properties of the items are presented in Table 2 (α = .86).

To assess cooperation frequency, teachers responded to the question "In which cases do you regularly cooperate with your colleagues? Please rate the cooperation frequency for the current school year" and completed six items concerning lesson preparation with colleagues: for example, the selection of teaching materials, the development of teaching units, and evaluation criteria (see Table 3). In terms of the five cooperation levels (Steinert et al. 2006) described above, the items are also located at Level 5: Integrated cooperation towards planning lessons, which occurs when teachers discuss and negotiate common teaching goals and the realization and evaluation of their teaching behavior systematically. Teachers rated the six items on a five-point scale (1 = *not at all*, 2 = *twice a year or less*, 3 = *once every 3 months*, 4 = *monthly*, 5 = *weekly*). One example of an item was "Cooperation frequency: Preparation of teaching–learning material". The psychometric properties are depicted in Table 3 (α = .76).

Table 4 Psychometric quality: intra-class correlations

Time 1–3 measurement waves 1–3, *ICC* intra-class correlation coefficient

	ICC 1	ICC 2
Frequency of cooperation at Time 1	.128	.093
Colleague support at Time 2	.202	.092
Teachers' stress at Time 3	.056	.034

Intra-class correlations based on schools (ICC 1 and ICC 2, Lüdtke et al. 2006) were computed to estimate the correlations of teacher's responses within schools (ICC 1). The mean of teachers' responses in a school was correlated with individual teacher's responses (ICC 2, see Table 4). ICC 1 is defined as the quotient of the variance between groups and the total variance (variance between groups plus the variance within groups). This coefficient represents the reliability of individual ratings, which are aggregated with regard to a construct at the group level (Lüdtke et al. 2006). Applying the Spearman-Brown formula to ICC 1 results in ICC 2, which takes the number of individuals per group into account (Lüdtke et al. 2006). Therefore, ICC 2 represents the reliability of a group-mean rating with regard to a construct at the group level. These two coefficients point to divergent teacher perceptions of stress, colleague support, and cooperation frequency (Table 4). We estimated a three-by-three factor model including the item responses of the three scales at Time 1, the responses 4 years after that at Time 3, and the $k = 271$ schools as clusters in a confirmatory factor analysis (using Mplus 7.1 with grand mean centering and FIML). The FIT indices supported the assumed three-by-three-factor model over the 4 years (root mean square error of approximation: RMSEA = .043, 90% confidence interval: CI [.042, .045], comparative fit index: CFI = .929, standardized root mean square residual: SRMR = .031).

The variables *colleague support* and *cooperation frequency* were related to group processes at the school level (Lossen et al. 2013), whereas *teachers' perceived stress* was related to perceptions within groups at the individual level (Fernet et al. 2012). Therefore, we conducted a two-level mediation analysis (Muthén 2011; Pituch and Stapleton 2011) to investigate the relationship between teachers' perceived stress, colleague support, and cooperation frequency in lesson planning. Teachers' perceived stress within groups (individual level) at Time 3 served as the dependent variable (see Fig. 1). Perceived colleague support at Time 2 was the assumed mediator, and cooperation frequency at Time 1 was the independent variable. We included colleague support and cooperation frequency within groups (individual level) and between groups (school level) in the mediation analysis (Pituch and Stapleton 2011). The number of teachers per school was statistically considered at the individual and school level. This also applied to colleague support.

4 Results

The teachers used the full range of all three ratings scales. Descriptive statistics showed relatively homogeneous and low levels of perceived stress at Time 3 (see Table 1, $M = 2.14$, $SD = .07$, 4-point scale, 1 = *not true at all*, 4 = *true*). The

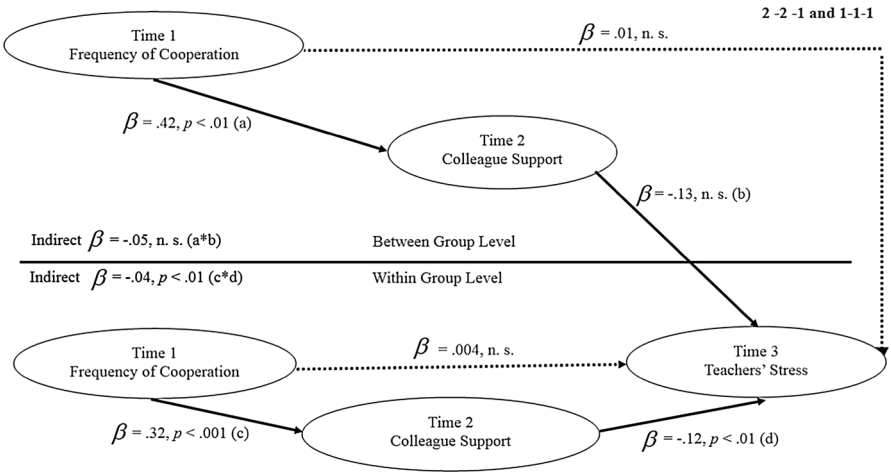

Fig. 1 The indirect effect on teacher stress ($n = 2648$, MLR, two-level random after grand mean centering) when including teachers' colleague support at Time 2 between teachers' frequency of cooperation at Time 1 and teachers' stress at Time 3 at both levels simultaneously, the between teacher group at school level and the teachers' stress at individual level (2-2-1) and the within teacher group at individual level (1-1-1). The regression paths between latent factors are depicted

mean rating of colleague support at Time 2 was mid-range ($M = 2.93$, $SD = .04$, 4-point scale, 1 = *not true at all*, 4 = *true*) and the mean cooperation frequency reported at Time 1 was located at mid-range on the 5-point rating scale described above.

We conducted an ANOVA to explain teachers' stress (dependent variable) as a function of age, sex, and type of school (independent variables). Results showed no statistical difference in teachers' stress levels by age with $F(4) = 1.71$, $p = .15$, sex with $F(1) = .01$, $p = .93$, or type of school with $F(1) = 1.10$, $p = .29$ ($n = 2648$). Therefore, we decided not to include these variables in our regression models as control variables.

We then tested the mediation hypothesis in two steps: first, with a two-level random regression analysis, with teachers' stress depending on teachers' cooperation frequency; second, with a two-level mediation analysis. An indirect effect would exist were there to be a statistically significant regression path between teachers' stress and cooperation frequency that disappears when including colleague support into the equation. The two-level random regression analysis showed a statistically significant effect between teachers' stress and cooperation frequency at the within level ($\beta = -.10$, $p = .02$) but not at the between level ($\beta = .03$, $p = .79$, RMSEA = .034, CI [.031, .035], CFI = .971, SRMR = .028). When including colleague support in the analysis, there was no longer a significant effect between perceived stress and cooperation frequency. Results of the two-level mediation analysis (Muthén 2011; Pituch and Stapleton 2011) are depicted in Fig. 1. The levels within and between teacher groups per school are included. At the between level, the only significant association was found between colleague support and teachers' cooperation (Time 1, $\beta = .42$, $p < .01$, see Fig. 1). The model showed no

significantly explained variance in teachers' stress levels within groups (individual level) at Time 3 by teachers' cooperation at Time 1 via colleague support at Time 2 between groups (school level).

Variance in teachers' stress levels within groups (individual level) at Time 3, was significantly explained by colleague support within groups at Time 2 ($\beta = -.12$, $p < .01$). In turn, variance in colleague support within groups (individual level) at Time 2 was significantly explained by cooperation frequency within groups at Time 1 ($\beta = .32$, $p < .001$). Variance in teachers' stress at Time 3 was not significantly explained by cooperation frequency within groups at Time 1 (i.e., no direct effect). However, variance in teachers' stress levels at Time 3 was indirectly explained by cooperation frequency at Time 1 within groups. The results indicated a significant indirect effect on teachers' stress levels at Time 3 by cooperation frequency at Time 1 via colleague support at Time 2 within groups (individual level).

5 Discussion

The present study aimed to analyze the relationship between teachers' perceived stress, colleague support, and cooperation frequency in planning lessons. Following SIT (Johnson and Johnson 2005), we expected the relationship between perceived stress and cooperation frequency to be mediated by the amount of experienced colleague support. We assumed that very frequent cooperation in planning lessons would lead to a high level of colleague support and not vice versa, because teachers work mostly in classrooms and need additional periods of time to cooperate with other teachers towards a common goal (Johnson and Johnson 2005; Steinert et al. 2006).

The results indicated an indirect effect. Teachers who had prepared classes in cooperation with colleagues at Time 1 reported higher levels of colleague support 2 years later (Time 2) than those who did not prepare classes in cooperation with colleagues. Additionally, teachers who had prepared classes in cooperation with colleagues at Time 1 demonstrated lower levels of perceived stress at school 4 years later (Time 3) than those who did not cooperatively prepare classes. This result is in line with SIT and with findings from previous research (Klusmann et al. 2008; Roeser et al. 2013). Results from others studies have also indicated an association between teachers' stress and interpersonal factors such as colleague support (Collie et al. 2012; Egodawatte et al. 2011; Lossen et al. 2013). Teachers' stress decreases, if they feel supported by their colleagues (Smith and Gillespie 2007). When teachers modify their perception of their work environment so as to see it more positively, they perceive less stress (Fernet et al. 2012).

Our results indicate that teachers cooperate in preparing instructional units once every 3 months on average. Thus, frequent and systematic cooperation among colleagues is still uncommon for teachers in Germany. In real school settings, however, teachers cannot plan every modification or new development in their courses 3 months in advance. Sometimes they need the flexibility to cooperate at short notice and to coordinate new instructional approaches and demands (Egodawatte et al. 2011). In our opinion, cooperating every 3 months to prepare

lessons is too seldom and does not allow for short-term coordination of instructional processes. Johnson and Johnson (2005) recommended weekly goal-oriented cooperation, which could be an effective social resource at school before, between, or after classes.

Our results are in line with findings that teachers report more participation in job-embedded professional development in schools when there are high levels of instructionally focused leadership and cooperation among teachers (Opfer and Pedder 2010). Alleviating teachers' stress, schools might provide structures for teachers to cooperate and support each other. Supportive school structures would reduce perceived stress and therefore probably improve instructional quality (Klusmann et al. 2008). As described above, colleague support does not lead to a lower cooperation frequency (Lossen et al. 2013). Conversely, giving teachers paid time in their weekly schedules to work with colleagues could ensure cooperation and coordination of teaching as well as increased perceived colleague support. A rationale for the effect over the time from Time 1 to 4 years later at Time 3 could be that core working processes in schools are rarely modified; classes are organized according to a time schedule (Kyriacou 2001; Roeser et al. 2013).

Consequently, our study's findings underline the importance of cooperation among teachers to improve instructional quality in the classroom. In summary, the findings presented here support the assumption that teachers feel more supported by their colleagues when they frequently cooperate to achieve a common goal, such as preparing lessons. In turn, teachers experience less stress, if they receive support from their colleagues.

5.1 Limitations and implications

We only included data from teachers who completed questionnaires at all three measurement waves (Time 1, Time 2 two years later, Time 3 another two years later) in our analyses; the excluded teachers, who participated only once or twice, showed marginal differences with regard to less colleague support and less frequent cooperation. Moreover, the requirement of close collaboration with colleagues might actually be a source of contention and conflict. In our study, cooperation frequency was measured, but teachers' satisfaction with the cooperation experienced was not. Moreover, all measures were based on teachers' subjective reports rather than on objective measures such as video recordings to assess instructional quality or vital signs to measure teachers' stress (e.g., blood pressure). Teachers might have reported on their perceptions in what they believed to be a socially acceptable or desirable way. In future studies, vital parameters of teachers' stress could be measured using mobile activity monitors and the frequency of their cooperation could be reported in electronic diaries to obtain a more objective view of teachers' stress levels, behavior, and reciprocal effects. The dynamic and reciprocal nature of the stress process should be considered more explicitly in further research and also in interventions in schools. A lack of cooperation and support may lead to perceived stress and this, in turn, is likely to reduce opportunities and motivation to cooperate with other teachers and provide support to them.

6 Conclusion

Long-term associations between teachers' perceived stress, colleague support, and cooperation in general have already been tested over 4 years by computing a cross-lagged panel with group process variables at the school level only (Lossen et al. 2013). Our results support the assumption that teachers' perceptions of stress at individual level play an important role in within-school processes and should be considered in addition to group process variables at the school level.

We conclude from our results that when teachers work together towards a common goal such as lesson planning, they feel more colleague support and less stress. Thus, cooperation frequency with regard to a common goal and colleague support are social resources that protect teachers from the effects of perceived high levels of stress. There is consensus that a shared educational concept and high degrees of collegiality among teachers are important for coherent instructional activities. Cooperation among teachers in their teaching practices can ensure that their actions are congruent and can support cumulative learning across subjects and grade levels (Hochweber et al. 2012; Maag Merki 2014; Steinert et al. 2006). Interventions to encourage cooperation and enhance colleague support among teachers should involve a common teaching goal and should be supported by the school principal, who will need to provide the necessary space (e.g., a quiet room), materials, and time during the workday.

Changing the frequency of teachers' cooperative activities (Johnson and Johnson 2005) should be tried, evaluated, and modified according to individual teachers' needs in particular school settings. Teachers would thus be able to retain their autonomy and could set milestones within a shared teaching goal or hold constructive discussions to meet teaching goals. Such cooperation should occur more frequently than once every 3 months and should be scheduled. In their cooperative endeavors, all members of a team should interact in a transparent way because not all team members will attend every meeting. Constructive and productive cooperation may support teachers' subjective competence and enhance motivation (Deci and Ryan 2012). We assume that, as a result, teachers will be better prepared to deal with the demands of their job, achieve a higher quality of instruction and improve teacher-student-relationships.

Acknowledgements This research was funded by the German Federal Ministry of Education and Research and the European Social Fund.

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