University of Groningen

A mixed-methods approach to studying co-regulation of student autonomy through teacher–student interactions in music lessons

Kupers, Elisa; van Dijk, Marijn; van Geert, Paul; McPherson, G.E.

Published in:
Psychology of Music

DOI:
[10.1177/0305735613503180](https://doi.org/10.1177/0305735613503180)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2015

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Kupers, E., van Dijk, M., van Geert, P., & McPherson, G. E. (2015). A mixed-methods approach to studying co-regulation of student autonomy through teacher–student interactions in music lessons. *Psychology of Music*, 43, 333-358. <https://doi.org/10.1177/0305735613503180>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

A mixed-methods approach to studying co-regulation of student autonomy through teacher–student interactions in music lessons

Psychology of Music
2015, Vol. 43(3) 333–358
© The Author(s) 2013
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/0305735613503180
pom.sagepub.com

Elisa Kupers¹, Marijn van Dijk¹, Paul van Geert¹
and Gary E. McPherson²

Abstract

Interactions that occur between teacher and student during instrumental music lessons are complex and multifaceted and embrace a full range of promotive and demotive factors that not only underpin effective learning, but also have an impact on whether children will persist with their learning long-term (McPherson, Davidson, & Faulkner, 2012). Such interactions also provide the context in which students gain a sense of personal control and autonomy over their learning (Evans, McPherson, & Davidson, 2012). In this article, we present new ways of conceptualizing autonomy by taking the teacher–student interaction as a unit of analysis to examine the processes of co-regulation of student autonomy. In Study 1, we performed an in-depth qualitative analysis of four teacher – student dyads in individual string lessons. We found large differences between these dyads in the way autonomy is co-regulated from moment to moment. These differences are theorized to be in part connected to the general need for autonomy of the student. In addition, we found that teachers have different ways of dealing with students' expressions of autonomy in lessons. In Study 2, we tested whether large moment-to-moment differences between the teacher's and student's levels of autonomy ('out-of-synch' moments) contributed to macro-level student outcomes. Here, we found a positive relation between the amount of out-of-synch per lesson and, respectively, students' motivation and progress.

Keywords

autonomy, instrumental lessons, mixed methods, Self-Determination Theory, teacher–student interaction

¹University of Groningen, Netherlands

²University of Melbourne, Australia

Corresponding author:

Elisa Kupers, University of Groningen – Developmental Psychology, Grote Kruisstraat 2/1, Groningen 9712 TS, The Netherlands.

Email: w.e.kupers@rug.nl

By providing a chance to express themselves and to engage in meaningful relationships with others, learning to play a musical instrument has the potential to be a highly satisfying, enriching experience for children. But too often music lessons are viewed by children as highly frustrating, stressful, or boring (McPherson & Davidson, 2002; Renwick & Reeve, 2012). Research shows that the ways in which children experience their music lessons are highly relevant in predicting which students persist with their learning and which drop out (McPherson, Davidson, & Faulkner, 2012). This line of research stresses the importance for (music) students to gain a sense of personal control over their learning, and the critical role of autonomy in music learning. In this article, we present new ways of conceptualizing autonomy by taking the teacher–student interaction as a unit of analysis to examine the processes of co-regulation of student autonomy. Thereby, we aim to enrich our understanding of how student autonomy is co-constructed between teacher and student, and how qualities of these interactions contribute to long-term development of student autonomy.

Theoretical background

Autonomy and self-determination theory. Self-determination theory is a macro-theory of human motivation and development (Deci & Ryan, 2008; Deci, Vallerand, Pelletier, & Ryan, 1991), which discriminates between different forms of motivation. More specifically, it distinguishes between intrinsic or self-determined motivation and extrinsic motivation. Motivated actions are self-determined when they are wholly volitional and endorsed by one's sense of self (Deci, Eghrari, Patrick, Leone, & Rochester, 1994). On the other hand, when behaviour is extrinsically motivated, it is dependent on controlling influences from the environment (such as when a student can be extrinsically motivated to practice because his parents promised a reward). Intrinsic and extrinsic motivation are not distinct categories, but rather opposites on a continuum. Although intrinsic motivation is usually seen as the optimal form of motivation, it has also been argued that intrinsic and extrinsic motivation can co-exist within the same individual and can both contribute to successful outcomes (for instance, when a violinist practices because she intrinsically loves playing, but also because she wants to win an important competition [extrinsic]; Gagné, 2010).

A key point in self-determination theory is that all humans have three basic psychological needs that are central to development:

1. Competence: feelings of competence involve the belief that one is able to reach certain goals.
2. Relatedness: the need to engage in meaningful relationships with other people.
3. Autonomy: being self-initiating and self-regulating of one's own actions (Deci et al., 1991).

Self-determination theory asserts that when these three needs are met, an individual is optimally motivated to intrinsically engage in learning. The needs for competence, relatedness and autonomy should not be seen independently, but as operating in relation to each other. For example, the competent completion of a task only results in increased intrinsic motivation when the actions needed to complete the task originated from the self (thus being connected to a sense of autonomy). When a goal is accomplished under circumstances of external control, it is unlikely to be as intrinsically satisfying (Ryan, Deci, & Grolnick, 1995).

The concept of autonomy is a crucial factor in any form of learning, and has therefore become a key topic in developmental and educational psychology (Ryan et al., 1995). A core characteristic of human beings, from birth onwards, is that they are pro-active learners who are characterized by a desire to initiate autonomously in activities that provide novelty and challenge. Therefore, developmental theorists consider the movement towards greater autonomy and self-initiation to be the hallmark of healthy development (Ryan et al., 1995).

Application in (music) educational settings. In the fields of (music) educational research, much attention has been devoted to identifying factors that either promote or hinder students' intrinsic motivation. In terms of psychological needs, students reported a higher level of fulfilment of the needs for autonomy, relatedness and competence when they were highly engaged in music learning, compared to when they decided to cease playing (Evans, McPherson, & Davidson, 2012). For instance Anguiano (2006) examined the relationship between music teachers' autonomy support and students' autonomy and motivation. He found that the student's perception of the teacher's autonomy support (for instance, a child might think 'My band director tries to understand how I see the situation before suggesting how to deal with it') contributes to the students' perception of their own autonomy, which in turn is positively related to their level of motivation. In these ways, autonomy-supportive teaching shows similarities to what is called an 'authoritative leadership' style of teaching (Dinham, 2007; McPherson et al., 2012) in which the teacher shows high responsiveness to the needs of the student, combined with high demands. This can be contrasted with an authoritarian leadership style, which is characterized by equally high demands but low levels of responsiveness to the learner's personal needs (McPherson et al., 2012).

In general educational settings, meta-analyses by Reeve (2009) and Stroet, Opdenakker, & Minnaert (2013) revealed that an autonomy-supportive style of teaching is positively related to many different student outcomes, ranging from intrinsic motivation to task performance and psychological well-being. In addition, teacher's autonomy support has been linked by several researchers to an increased sense of autonomy of the student (Reeve & Jang, 2006; Reeve, Nix, & Hamm, 2003) as well as to more autonomous behaviour (Plimpton & deCharms, 1976).

Autonomy as a dynamic, socially constructed concept. Although previous research has contributed to our understanding of what the effects of teacher's autonomy support are on a group level, much less is known about how student autonomy is co-regulated moment to moment within the music lesson itself (Küpers, Van Dijk, & Van Geert, 2013). A growing movement in developmental and educational psychology (Sameroff, 2009; Steenbeek & van Geert, in press; Turner & Patrick, 2008) as well as in music education (McPherson et al., 2012, p. 106; Rostvall & West, 2003) sees learning as a complex, deeply socially embedded process in which student and teacher mutually influence each other. Accordingly, student autonomy is not seen as an individual attribute, but rather as a continuously negotiated process in the student-teacher relationship (Meyer & Turner, 2002). In this study, we take the student-teacher interaction as our unit of analysis to deepen our understanding of exactly how this negotiation unfolds from moment to moment (in 'real time').

One way to study dyadic interactions is to examine *dyadic synchrony*. Fogel (1993) describes synchronous or co-regulated interaction as 'matching action that is partly the partner's and partly your own action reflected back to you.' Within this conception, synchrony involves dynamic adaptation on the part of both partners. Synchrony is not an all-or-nothing state; in

real time, the dyadic interaction can either be described as moving towards synchrony or away from it (Harrist & Waugh, 2002). Dyadic synchrony has been studied mostly in parent–child interactions, especially in infancy to early childhood, although the concept can also be applied in dyads with older children (Harrist & Waugh, 2002). Dyadic synchrony has been found to play an important role in secure attachment, early self-regulation and autonomy development and development of social skills (e.g. Harrist & Waugh, 2002; Lindsey, Cremeens, Colwell, & Caldera, 2009; Lindsey, Mize, & Pettit, 1997). The purpose of this paper is to conceptualize dyadic synchrony in terms of autonomy in the real-time interaction between music teacher and student.

Measuring autonomy in real-time. Several authors have sought to extract teachers' autonomy-supportive or controlling style from observable behaviour (Reeve & Jang, 2006; Renwick & Reeve, 2012). Results show that autonomy-supportive teachers:

- a) Tap into students' inner motivational resources whereas controlling teachers rely on extrinsic motivation such as giving deadlines or requesting compliance.
- b) Provide a rationale for the assignments they give by explaining why something is important (in contrast to controlling teachers who usually do not provide this kind of information).
- c) Use informational language and ask students to take responsibility for their learning (in contrast to controlling teachers who use more directive, pressuring language such as 'You should do this').
- d) Are patient by giving their students a chance to self-pace their learning (in contrast to controlling teachers, who are typically less patient and more inclined to take over aspects of the task, by using such language as 'Here, let me show you').
- e) Acknowledge and accept student's expressions of resistance and negative emotions (compared to how controlling teachers try to change the student's behaviour).

These behavioural clusters suggest that being either autonomy-supportive or controlling is a relatively fixed teacher characteristic. Departing from the assumption that autonomy is co-constructed in social interaction, it is more likely that teachers vary in their levels of autonomy support over time such that the same teacher can be autonomy-supportive in one moment and more controlling in the next, depending on the circumstances.

In comparison to teachers' autonomy support, student autonomy has been far less extracted from observable behaviours in real-time. In literature on parent–child interaction (usually focused on adolescents), behavioural indexes of child autonomy include: being able to express and assert one's own ideas, expressing independence of thought and self-determination in social interaction, and self-confidence in defending one's ideas (Lichtwarck-Aschoff, Kunnen, & Van Geert, 2010).

Plimpton and deCharms' (1976) distinguished between students who displayed high *personal agency* in their behaviour (characterized by commitment to the task, concentration, creativity and frequent interaction with better students and the teacher) to students who displayed low levels of personal agency (characterized by submissive behaviour, strict obedience to authority and helplessness). As such, this construct is closely connected to the concept of engagement, which is described much more in terms of observable behaviour (Reeve, Jang, Carrell, Jeon, & Barch, 2004). Students who display focused attention and effort, who

participate verbally in classroom discussions and who persist in the face of struggle and failure are considered to be engaged. Displays of student agency or autonomy, however, may not always be in line with what the teacher is asking of the student. Rainio (2008) distinguishes between student agency through *active participation and transformation* of classroom activities (in line with the definitions of Plimpton and deCharms, 1976, and Reeve et al., 2004), and student agency through *resistance*.

Using mixed methods to study autonomy. In recent decades, an increasing number of scientists in social science have combined quantitative and qualitative research methods to answer their research questions (Bryman, Becker, & Sempik, 2008). If a combination is made which is relevant for the research question at hand, an advantage of mixing methods is that quantitative and qualitative analyses both provide unique information, which can provide a more complete picture of the given problem. Important conditions for using mixed methods in a meaningful way are: first, pointing out the relevance of mixed methods to the research question(s); second, transparency about the (quantitative and qualitative) methods that are used (see also Odena, 2012); third, a strong integration of the research findings; and fourth, a rationale for using mixed methods (Bryman et al., 2008).

In the methodological literature, a distinction is often made between large scale (often survey) data which is analyzed using multivariate techniques (quantitative) and rich, thick (often observational) data which is collected through prolonged engagement (qualitative) (Onwuegbuzie & Leech, 2005). In other words, quantitative data is generally used for measuring outcomes at the group level, while qualitative data is thought to be more useful for revealing something about the underlying *processes*. The current mixed-method study takes a different approach. Both our qualitative and our quantitative analyses aim to assess the process of autonomy co-regulation. The relevance of mixed methods for our study lies in offering different perspectives on the same (observational) data.

Research questions

In this article, we aim to address the co-regulation of student autonomy on two levels. *Study 1* focused on the processes of autonomy co-regulation at the micro-level; that is, on the time scale of real-time actions and reactions within the music lesson. Our first research question is: In which ways is student autonomy co-regulated through teacher–student transactions? We aimed to answer this question by providing an in-depth, qualitative analysis of four case studies.

Study 2 deals with the connection between the micro-level and the macro- or aggregated level of development. We aim to investigate the relation between autonomy co-regulation on the micro-level, and development on the macro level. Therefore, our second research question is: To what extent are different levels of real-time dyadic synchrony associated with long-term student outcomes?

General method

Research participants

Four violin and four cello teachers and 38 of their beginning students (four to seven students per teacher) participated in this study. The teachers had between 15 and 46 years of teaching

experience. Six teachers were teaching from home or a private music studio, one teacher worked in a public music school and one teacher worked both in a private and a public music school. All teachers used the Suzuki method, an internationally-recognized method of instrumental teaching which allows children to start learning an instrument from a young age, with emphasis on memory training, learning to play before learning to read sheet music and learning through repetition (Suzuki, 1969). At the start of the observations, the students were between 3 years and 11 months, and 11 years and 1 month old. All students had been taking music lessons for less than 18 months. Our sample came from middle to higher socio-economic backgrounds and lived in different parts of the Netherlands.

The teachers were first recruited through a national network of Suzuki teachers, after which the teachers selected the student participants from their beginning students. The teachers selected the students based on how long they were enrolled in music lessons, and on the criterion of whether the parents approved their child's participation in the study. The teachers and parents gave informed consent before the start of the study with these procedures being approved by the Ethical Committee Psychology of the University of Groningen.

Procedure

The data of the current studies (that were part of a larger longitudinal study) consisted of three repeated measurements, spaced across 3-month intervals. During each wave of data collection, the researcher or the music teachers themselves made video recordings of an individual music lesson for each of the students who participated. This resulted in a total of 105 lesson recordings. The teachers and students were asked to carry out their lesson as normal. At the end of the study, the teachers participated in a semi-structured interview where they (among other questions) rated the students' need for autonomy (we asked 'Do you have the impression that this student often takes initiative during the lesson?') on a five-point Likert scale, ranging from 'not at all' to 'very often'. See Appendix 1 for the interview protocol.

The duration of the lesson differed (usually according to the age of the student) from 15 to 30 minutes. The first 10 minutes of every lesson were coded. We selected only the first 10 minutes because the coding procedure was very time-intensive. These 10 minutes (which amounts to 200–300 coded utterances per session) gave us a representative image of the teacher–student interaction during a lesson, while still being able to include enough participants. For the coding of the lesson videos, we used The Observer (Noldus, 2012, version 10.5), which is a widely used program for coding observational data. It allowed us to code the video using a pre-defined coding scheme. The video recordings were coded by the first author. Interobserver reliability was assessed by comparing the codes of the first author with three independent, trained observers. Eighteen videos (17% of all recordings) were double coded for the main categories of teacher and student autonomy levels, and 10 (9.5%) videos for the subcategories of teacher autonomy support. This resulted in a Cohen's Kappa of .96 for the variable Teacher autonomy support (between 86% and 99% agreement per video), Cohen's Kappa of .79 for the sub categories of Teacher autonomy support (72%–89% agreement), Cohen's Kappa of .84 for the variable Student autonomy expression (64%–100% agreement) and Cohen's Kappa of .93 for Student on/off task (79%–100% agreement).

Throughout the data collection, the parents and student completed practice diaries (short questionnaires about practice habits and motivation) every 3 months.

Table 1. Overview of variables and measurement levels.

Variable	Measurement level	Instrument
Teacher autonomy support	Micro	Coded video-observations
Student autonomy expression	Micro	Coded video-observations
Motivation (Teacher)	Macro	Semi-structured teacher interview (see Appendix 1)
Autonomy	Macro	Semi-structured teacher interview (see Appendix 1)
Progress	Macro	Semi-structured teacher interview (see Appendix 1)
Motivation (Parent)	Macro	Parent questionnaire

Measurements

Table 1 provides an overview of all variables, the instruments used to measure these variables and the measurement level of each variable.

Teacher autonomy support was coded for every verbal utterance of the teacher, on a scale from -1 to 1 . This scale was based on the literature on behavioural indices of teacher autonomy support (Reeve & Jang, 2006; Renwick & Reeve, 2012). First, we coded the *content* of the instructions on autonomy support (either negative [-1], neutral [0] or positive [1]). The content of the instruction can explicitly refer to the student's sense of autonomy either positively or negatively. For instance, when the teacher asked the student to make a relevant choice or reacted positively to the student's initiative, this would be coded as a value of 1 . If, however, the teacher responded negatively to the student's initiative, or emphasized that the student needed extra help, this would receive a code of -1 . All neutral utterances (value 0) were then recoded to values of $-.6$, $-.2$, $.2$ or $.6$. (see Figure 1). This scale was based on the autonomy-supportive versus controlling teacher behaviours listed by Reeve and Jang (2006). In general, the recodings were based on how much room the teacher utterances allowed for student initiative. Directive instructions (e.g. 'Do this') left little room for student initiative, while questions and emotional scaffolding such as 'I understand this is hard for you' were more focused on the student's point of view and therefore left more room for the student to respond.

Student autonomy was measured for every verbal utterance of the student. Student autonomy was coded as value 1 when the student was taking initiative, 0 when the verbal utterance was not a clear initiative (for instance, when the student answered a question) and -1 when the student did not answer the previous question of the teacher. For the student's utterances, the codes 0 were not recoded.

Macro-level outcomes were obtained from the teacher exit interviews and the last parent practice diaries. Motivation (Teacher), Autonomy and Progress were assessed by the teacher for every student on a five-point scale during the interview (see Appendix 1). Motivation (Parent) was an aggregated score over several questions concerning the students' practice habits (the amount of time that was devoted to practice during the past week, whether the student took the initiative to practice, and persistence during practice sessions).

Study I

Method

Research participants. Participants in this study were a violin and a cello teacher, together with four of their beginning students (two students per teacher). The two teachers were randomly

Figure 1. Scale of teacher autonomy support, ranging from autonomy diminishing to autonomy supportive.

Table 2. Student characteristics of the four cases of study 1.

Student	Age	Instrument	Months of lessons at time of recording	Autonomy score
Miriam	4 years, 5 months	Violin	9	3
Maria	5 years, 4 months	Violin	12	1
Patrick	5 years, 10 months	Cello	6	5
Sam	8 years, 1 month	Cello	10	1

selected from the eight teachers in our dataset. The students were between 4 years and 5 months and 8 years and 1 month old at the time of the video recording, and had followed between 6 and 12 months of music lessons with the same teacher. The students were selected from the larger dataset (as described earlier) on the basis of their overall need for autonomy, as assessed by their teacher on a 5-point scale (two students with different levels of autonomy were selected per teacher, in order to compare how the same teacher interacted with students with different levels of need for autonomy). One student had a high need for autonomy (score of 5), one average (3), and two low (1). See Table 2 for an overview of the student characteristics.

Measurements. We added an extra dimension to the coding of student autonomy – Is the student, at any point in time, moving towards the task at hand or away from it? – in order to be able to distinguish between the direction of the student’s verbal behaviour. This resulted in two dimensions for coding the verbal behaviours of each student. The first dimension comprised a measure of high versus low autonomy (as discussed in the *General method*); the second dimension was categorized as negatively versus positively engaged. The combination of these two dimensions resulted in four quadrants of student autonomy expression (see Figure 2).

1. *Autonomous engagement* (high autonomy and positively engaged). The student was taking on-task initiative, by asking questions or making relevant on-task remarks.
2. *Resistance* (high autonomy and negatively engaged). The student was actively resisting the task, by saying, for example, ‘I don’t want to do this,’ or by making off-task remarks such as ‘I’m going to the playground later.’
3. *Mimicry* (low autonomy and positively engaged). The student was ‘going with the flow,’ doing what was expected by the teacher and without taking any personal initiative.

Figure 2. Four quadrants of student states of autonomy.

4. *Absence* (low autonomy and negatively engaged). The student was not engaged with the task, responding verbally as expected (not answering teacher questions), but was also not actively resisting it.

Analyses. For each of the four coded lessons, the student states of autonomy expression were plotted as time series combined with the teacher level of autonomy support. The student was deemed to be in a state of *Mimicry* when the level of autonomy expression was 0, and in a state of *Absence* when the level of autonomy expression was -1. Because a level of 1 can indicate both Autonomous engagement and Resistance, these states were marked with different lines in the time series.

The time series of the autonomy expressions were inspected visually. We looked for a) moments where the teacher–student interaction seemed to change such as when a student switched from expressing resistance to expressing autonomous engagement, and b) moments that seemed typical for the interaction of this teacher–student dyad such as patterns that were common in the time series of that dyad. We transcribed these fragments and employed qualitative, thematic analysis on these transcriptions. Thematic analysis is a widely used qualitative method in social sciences for identifying, analyzing and reporting patterns in a dataset (Braun & Clarke, 2006). We employed theoretical (deductive) thematic analysis; our descriptions of the data were specifically focused on finding patterns associated with co-regulation of autonomy within the interaction. The data was first coded and described thematically by the first author; this description was discussed and further interpreted together with the fourth author. Hereafter, the interpretations were reviewed by the second author.

Results

Research question 1: In which ways is student autonomy co-regulated within the teacher-student interaction?

Figure 3. Case 3: Miriam. Time series of student autonomy expressions and teacher levels of autonomy support during one lesson. Subscripts indicate selected fragments.

Case 1: Miriam

Lesson overview. Figure 3 displays Miriam's states of autonomy and the teacher's levels of autonomy support over time as a means of distinguishing certain patterns in this interaction. Miriam's teacher had overall a relatively low level of autonomy support. One thing that stands out is that Miriam's states of high autonomy (both autonomously engaged and resistant) are often preceded by a higher level of autonomy support of the teacher. Also, the first two instances of resistance were preceded by an interval of fast-paced, autonomy diminishing utterances (e.g. directive instructions) by the teacher. For Miriam, this indicates that high levels of autonomy support triggered engagement, whereas low autonomy support triggered resistance.

Qualitative analysis of lesson fragments

Conclusions: Miriam. When comparing the three transcripts (see Tables 3, 4 and 5), one thing that stands out is the different ways in which the teacher responds to Miriam's resistance. In the first fragment, the teacher responded by explaining why it was important to do the assignment her way. The assignment itself seemed to be non-negotiable; however, by providing a rationale, the teacher was able to turn the student's resistance into autonomous engagement. In the second fragment, the teacher told Miriam to try again immediately after she gave up, but failed to tell her what she had done wrong or how she could have done better, resulting in Miriam resisting to try again. By responding with emotional scaffolding, the teacher was able to get Miriam to go along with the task. In the third fragment, the teacher initially did not respond to the student's resistance. Compared to the other two fragments, it took longer to get the student engaged in the task again.

Table 3. Transcript and comments on Fragment 1 from Miriam’s lesson.

Transcript	Comments
<i>The teacher showed a picture of a child playing the violin with imaginary strings from the top of her head, wrists etc. to illustrate good posture. While playing, Miriam tends to tilt her head to the side.</i>	
T: That’s really difficult to keep thinking about the string, right? That’s really difficult for you.	The teacher acknowledges that the student is struggling (emotional scaffolding).
S: Let’s do without the string. [Resistant]	The student resists trying it again; she tries to persuade the teacher to make the assignment easier.
T: No, we do it with the string.	The teacher responds negatively to the student’s initiative (probably because the student is trying to neglect an essential part of technique). However, after that she provides a rationale of why it is necessary to keep your head up straight while playing.
T: Otherwise you’ll be playing the violin like this [demonstrates with head tilted], that’s not good.	Following the rationale of the teacher, the student switches from verbally expressing resistance to expressing autonomous engagement. She takes initiative by demonstrating that she knows how to keep her head up straight.
T: No, it’s better like this. With your head up straight [demonstrates]!	The teacher instructs the student to try the same assignment again. Although she is not immediately following the directions of the teacher, she is also not resisting like before.
S: That’s a bit skewed. [Engaged].	
T: This is very skewed [demonstrates]. This is nice up straight! [demonstrates].	
S: That’s still a bit skewed. Like this (stands up very still and straight). (Engaged).	
T: That’s nice up straight. Well done.	
T: Try it again. On the scale.	
S: So not like this [demonstrates very skewed] and not like this [demonstrates a bit skewed]. [Engaged].	
T: Not like that, no . . .	
S: Not like that [neutral].	

Case 2: Maria

Maria’s teacher displayed overall relatively low levels of autonomy support, comparable to her behaviour in Miriam’s lesson (see Figure 4). The difference, however, is that the fast-paced, directive episodes of teacher instruction do not seem to trigger any resistance from Maria, whereas this was the case for Miriam. The lesson seemed fairly stable, with Maria complying with what the teacher wanted her to do. When Maria displayed negative levels of autonomy, this did not seem to be triggered by changes in the teacher’s behaviour. Neither did the absent episodes seem to cause any subsequent change in the teacher’s level of autonomy support.

Qualitative analysis of lesson fragments. In the fragment above (see Table 6), as well as throughout the lesson, Maria displayed low levels of autonomy, whilst being positively engaged most of the time (e.g., mimicry). The teacher was relatively directive, but the student did not show resistance in response to this (as in Miriam’s case). Instead, there seemed to be a continuous pattern of the teacher deciding what was supposed to happen, and Maria going along with these intentions.

Case 3: Patrick

Patrick’s teacher displayed moderate to high levels of autonomy support throughout this lesson (see Figure 5). Importantly, and especially in the first half of the lesson, she responded

Table 4. Transcript and comments of Fragment 2 of Miriam's lesson.

Transcript	Comments
<i>The student attempts to play a scale, while the teacher repeatedly instructs her to keep standing up straight.</i> T: Remember your head. T: Keep standing up straight. [Student stops playing without finishing the scale.] T: Now you're suddenly a bit confused. T: Try again. T: You can do it. S: No. [Resistant.]	The student is struggling with the assignment, after which she gives up before finishing it. The teacher responds by giving negative feedback.
T: You're very good at putting your fingers in place. [Student retakes the bow and reaches for the violin.]	The teacher urges the student to try again. However, she doesn't explain what she did wrong or how she can improve. This, together with the previous experience of failure, might contribute to the following resistance of the student. The teacher emphasizes the part of the skill that the student already masters. This probably encourages the student to give up resistance and do what the teacher wants of her.

Table 5. Transcript and comments of Fragment 3 of Miriam's lesson.

Transcript	Comments
<i>The student attempts to play a scale. The teacher repeatedly instructs her to keep standing up straight. When the student doesn't improve her posture, the teacher slightly tickles her head/pulls her ear to get her head back in the correct position.</i> T: How's your head. [tickles the student's head] T: Come here with your head [slightly pulls the student's hair] T: Come here with your head [supports the student's left arm and pulls her ear a bit]. S: Tsss. [looks annoyed, stops playing and moves away from teacher]. [Resistant] T: Come here with your head. T: Your head is very skewed now T: And then when I pull your hair a bit you're still not keeping it straight. [Student puts violin on the floor and moves further away] S: Uh-oh. . . [Neutral] T: Uh-oh. [pause] T: Let's see when I do the bow and you do the fingers, whether your head will stay up straight. [The student lays down on the floor] T: Come here, we'll try. [picks up the violin] T: Come here. [The student stands up and reaches for the violin]	While the student is playing, the teacher is repeatedly giving directive instructions and physical instructions (touching her head, pulling her hear/ear). The student responds by expressing (verbal and non-verbal) resistance. After the student's resistance, the teacher first tries to pick up the lesson as if nothing happened (by repeating the last instruction). When the student moves even further away (note that this could also be labelled resistance, except it is non-verbal), the teacher proposes a variation on the assignment. After the student still doesn't respond, the teacher becomes more directive, telling her to come back.

Figure 4. Case 2: Maria. Time series of student autonomy states and teacher levels of autonomy support. Subscripts indicate selected fragments.

Table 6. Transcript and comments on Fragment 1 from Maria’s lesson.

Transcript	Comments
<p><i>Assignment: play rhythms on open strings. The teacher explains how a relaxed bow hold helps with making a good sound.</i></p> <p>T: I hear these squeaking sounds. Do you hear them too?</p> <p>S: Yes. [neutral]</p> <p>T: That is because of the thumb.</p> <p>T: [When the thumb holds the bow very tight, it goes a bit kgg kggg. A bit squeaky.</p> <p>T: [The teacher ‘molds’ student’s hand in the right position.]</p> <p>Go and try to bow with your thumb very relaxed.</p> <p>[The student starts playing, with less squeaky sounds.]</p> <p>T [while student plays]: Good job! Well done!</p> <p>T [while student plays]: Try to aim for the right string</p> <p>T: Now ‘bim bam’ [rhythm] for bowing nice and straight.</p> <p>T [while student plays]: Try to aim for the right string.</p> <p>[interrupts student and puts the bow on the right place herself]</p> <p>T: There is the a-string.</p> <p>T: Now you go. [student starts playing]</p> <p>T [while student plays]: You’re already on the D string</p> <p>[takes student’s hand and puts the bow on other string].</p> <p>T [while student plays]: Do you hear that?</p> <p>[student doesn’t answer question] [Absent]</p> <p>T [takes student’s hand and plays on the A-string]: That is the one we want to hear.</p>	<p>The teacher asks the student whether they are hearing the same thing. The teacher explains where the sound comes from, so that the student understands why she has to change the bow hold.</p> <p>Sequence of the teacher giving directive instructions, the student following them up, and the teacher providing feedback.</p> <p>The teacher is quite directive (also in her physical instructions), but the student does not seem to mind; she doesn’t resist the teacher correcting her.</p>

Figure 5. Case 3: Patrick. Time series of student autonomy states and teacher levels of autonomy support. Subscripts indicate starting point of selected fragments.

with high autonomy support to the student's expressions of autonomy, both when the student was displaying autonomous engagement and when he was displaying resistance. Patrick displayed both autonomous engagement and resistance in the first part of the lesson. Over time, his resistance decreased and he displayed more frequent episodes of autonomous engagement.

Qualitative analysis of lesson fragments. What is typical about the patterns in this lesson (see Tables 7, 8 and 9) is that the teacher typically responded to Patrick's initiative by providing high levels of autonomy support, both when he was expressing resistance and when he was autonomously engaged. In the first fragment for instance, Patrick displayed resistance (by indicating that he did not like the rhythm/"food" that the teacher proposed). The teacher acknowledges this, after which Patrick introduced other suggestions for the exercise (thereby demonstrating autonomous engagement). The teacher went along with the suggestions that Patrick provides. The fragments illustrate a process in which the student and teacher positively reinforced each other in terms of high levels of autonomy (the teacher responding positively to student initiative, whether positively or negatively engaged, leading to the student taking more initiative, and so on).

Case 4: Sam

Sam's teacher displayed relatively high levels of autonomy support throughout the lesson, although her levels were not as high as in Patrick's lesson (see Figure 6). His lesson was characterized by repeated instances of autonomy support by the teacher, followed by absence of the student. There did not appear to be a real change in this pattern throughout the lesson.

What stands out in Sam's lesson (see Table 10) is that the teacher repeatedly showed high levels of autonomy support, but that this did not seem to elicit high autonomy expressions from

Table 7. Transcript and comments on Fragment 1 from Patrick's lesson.

Transcript	Comments
<i>The teacher makes up rhythms based on types of food that the student is supposed to play on open strings.</i> T: Do you like to eat this? [demonstrates on own instrument] Chips-with-may-onaise. S: No. [neutral] T: No. T: But you can play it. S: But I don't like [to eat] it. [Resistance] T: You don't like that. Then we can't play it, can we? S: Ice-cream! [Autonomously engaged] T: Ice-cream, chips with ice-cream? S: No, chocolate ice-cream! [Autonomously engaged] T: Chocolate ice-cream [sings]. T: Chocolate ice-cream, chocolate ice-cream [sings and demonstrates rhythm on own instrument, intending student to imitate her]. [The student plays rhythm on own instrument]	The teacher proposes a rhythm, after which the student refuses to play it because he doesn't like it. The teacher gives in to this initiative, by emphasizing that when Patrick doesn't like the food, he doesn't have to play this rhythm on the cello. Following the teacher's autonomy support, the student immediately comes up with an alternative. The student-teacher interaction here is a playful dialogue, which is not steered in any direction by the teacher. The teacher responds to the student's initiative positively, by creating a new rhythm based on the preference of the student.

Table 8. Transcript and comments on Fragment 2 from Patrick's lesson.

Transcript	Comments
<i>The teacher explains good cello posture.</i> T: And what leg is most important when we play the cello? This one [briefly touches student's leg] or that one? S: This [points to left leg with bow] [Neutral] T: That one, right? [Neutral] T: So this one always has to be good. This one [points to right leg] you might as well take it off. It's no use to us. [Student plays some open strings. Looks away.] T: Yes, ok. [Neutral] T: And ehm, mister rugby [referring to his t-shirt] student laughs T: Shall we make a real rugby Twinkle? S: Noooo. [Resistant] T: Why not? S: Ice cream! [Resistant] T: Ice cream. It's again. . . S: Strawberry ice cream! [Resistant] T: Strawberry ice cream. Delicious. T: Then we're going to play strawberry. . . T: What do strawberry ice creams sound like?	The student goes along with the task and is able to identify the correct leg. The teacher relates to the student's interest in rugby to start a new assignment (play whole song instead of rhythms on open strings). However, the student resists this idea. He repeatedly tries to go back to the previous task; playing rhythms on ice cream flavours. The teacher gives in to his resistance and lets him play what he wants.

Sam. This pattern stayed relatively consistent throughout the lesson. Although the teacher constantly asked Sam for his input, the student remained very shy and often did not respond with an answer.

Table 9. Transcript and comments on Fragment 3 from Patrick’s lesson.

Transcript	Comments
<i>Same exercise as above</i> S: One time I ate stracciatella with vanilla and cream. [autonomously engaged] T: Sounds yummy man! T: Hey, but strawberry ice-cream. T: What other flavours do we like? S: Chocolate ice-cream [neutral] T: Chocolate ice-cream. Play chocolate ice-cream for me on D. [The student plays rhythm] T: Oh, yummy. T: I want another [flavour]. So we have chocolate. . . S: I know one! [Autonomously engaged] T: Which one? [The student plays very elaborate rhythm] T: [laughs] That was stra-cia-tel-la-with-vanil-la-and-cream! I heard it! S: [laughs] With cream...! [neutral]	<p>The student takes initiative by sharing a story that related to the topic of the lesson. The teacher responds positively, and asks for more input from the student regarding the rhythms they are playing.</p> <p>After finishing the assignment, the teacher starts summing up the flavours done already. Although she is not explicitly asking the student for a new suggestion, he takes initiative by making up a new rhythm by himself. The previous, playful dialogue, in which teacher and student had an equal role in shaping the assignment, probably contributed to the current initiative (e.g. an environment is created in which the student can freely express autonomy, and the teacher reinforces the student’s initiatives).</p>

Figure 6. Case 4: Sam. Time series of student autonomy states and teacher levels of autonomy support. Subscripts indicate selected fragments.

Discussion

Our first research question was: In which ways is student autonomy co-regulated through teacher–student transactions? After analyzing four case studies of different teacher–student

Table 10. Transcript and comments on fragment 3 from Sam's lesson.

Transcript	Comments
<p><i>Start of the lesson</i></p> <p>T: What have you prepared for today?</p> <p>[student doesn't answer question] [Absent]</p> <p>T: Because we were at the end of Book 2.</p> <p>T: And we even started in Book 3.</p> <p>T: That is correct, isn't it?</p> <p>[student nods]</p> <p>T: The lullaby, right?</p> <p>[student nods]</p> <p>T: What [piece] do you want to start with today?</p> <p>[student doesn't answer question] [Absent]</p> <p>T: You can choose.</p> <p>[Long pause. Eventually, student looks at mum and says something to her in a very soft voice. Mum puts the book in front of him. Teacher briefly talks to student's brother.]</p> <p>T: Ok. Put your paws [feet] on the floor.</p> <p>T: That's very important.</p> <p>T: We're in Book 3 now, so there are a couple of things that are important.</p> <p>T: That we always have a good posture. [counts on fingers]</p> <p>T: That we always have a good bow hold. [counts on fingers]</p> <p>T: Ehm. . . and what else?</p> <p>[The student doesn't answer] [Absent]</p> <p>T: What are we supposed to do with the bow? [demonstrates]</p> <p>student doesn't answer [Absent]</p> <p>T: We should always. . . ?</p> <p>[The student doesn't answer] [Absent]</p> <p>T: Feel, right?</p> <p>T: We should always feel [the bow].</p>	<p>The teacher asks a question, but the student doesn't answer. The teacher is trying to prompt an answer by providing additional information.</p> <p>Here, the teacher supports student autonomy by letting the student make a relevant choice (by letting him choose what song to play). However, the student doesn't respond and eventually looks at his mother for help.</p> <p>The teacher provides information of what to pay attention to always when playing a piece. She wants the student to also come up with a point, but he doesn't respond to her questions. Throughout this fragment, the autonomy support does not seem to elicit autonomous behavior of the student.</p>

dyads, we can conclude that there are large differences between the dyads in the way autonomy is co-regulated from moment to moment. These differences seem to be in part connected to the general reported need for autonomy of the student. Comparison of the students who are, in general, highly autonomous, showed different patterns emerging within a lesson compared to dyads with a low autonomy student. In the case of Miriam, who had a relatively 'directive' teacher, we observed that the teacher was more likely to respond negatively to student resistance, and more positively to autonomous engagement. In the case of Patrick, however, we detected a distinct difference between teacher reactions. In his lesson, the teacher reinforced Patrick's initiative, irrespective of whether he was displaying resistance or autonomous engagement. This seemed to result in more student initiative.

When comparing the cases of Maria and Sam (both students with a low need for autonomy) we also observed some differences in within-lesson patterns. In the case of Sam, we found a teacher who tried to support student autonomy (by letting the student choose what to do next, and asking questions), even though the student responded negatively (by not answering the questions of the teacher). Although previous studies have found that an autonomy-supportive style of teaching results in higher levels of student autonomy (Reeve & Jang, 2006; Reeve et al., 2003) this was not supported by our data; high levels of teacher autonomy support resulted in more student initiative for Patrick, but not for Sam. In the case

of Maria, however, the interaction patterns appeared more 'smooth' because the teacher was not expecting her to be highly autonomous. The teacher was clearly in charge, and the student simply went along with the teacher's directions. Importantly, besides differences between students, we also found teachers have different ways of dealing with students' autonomous expressions, or lack thereof.

From this first study, it was clear that the patterns of autonomy co-regulation vary between different teacher–student dyads. In the second study, we aimed to test quantitatively whether differences in moment-to-moment transactions contributed to macro-level student outcomes.

Study 2

Method

Participants. All four violin and four cello teachers with 38 of their beginning students (four to seven students per teacher) participated in this study (see *General method*).

Calculating dyadic synchrony. The levels of teacher autonomy support and student autonomy were plotted as time series and slightly smoothed by calculating the moving average per 5 seconds. We then calculated the differences between the moving averages of the student and teacher levels. If the difference score was larger than 1 or smaller than -1 , we coded this as a moment in the lesson where the dyad was out-of-synch in terms of autonomy. For every observation, the duration of out-of-synch moments was calculated in seconds.

Analyses. An important assumption of many statistical analyses (e.g., univariate or multivariate regression analyses) is that the research participants are selected independently of each other. Therefore of our dataset (we selected the teachers and then the teachers selected several of their students) this assumption was violated. Because of this nested data structure, we chose to perform multilevel analyses, a form of statistical modelling that takes into account the hierarchical structure of the data (Snijders & Bosker, 1999). We performed the multilevel regression analyses with MLwiN software (Rabash, Brown, Healy, Cameron, & Charlton, 2005). Because of the limited sample size we chose to conduct separate univariate analyses for each dependent variable instead of one multivariate multilevel analysis. Also, because a multilevel model does not allow predicting variables at the student level from a variable at the observational level (dyadic synchrony), we had to average the three observations per dyad (in the case of missing data ($n = 6$) we had to average over one or two observations). The dependent variables were centred around their mean, which makes interpretation of the results easier. The parent questionnaire had a response rate of 47%; the teacher interview had a response rate of 92% (the teachers rated all students except three students who dropped out early in the study). Although multilevel modelling can in general handle missing values (Snijders & Bosker, 1999), the few data points that remained for the variable Motivation (Parent) can cause problems in building the model. More specifically, when multiple parent questionnaires are missing, resulting in only one or two data points for this variable per teacher for some teachers, including the teacher level in the multilevel model does not make much sense. For this reason we performed correlational analyses for the variables that did not have much explained variance at the teacher level.

Results

Explorative analyses: Relations among dependent variables. Table 11 displays the correlations among the four dependent variables. Three of the six correlations were significant. First, and as

Table 11. Correlations among dependent variables.

	Motivation teacher	Motivation parent	Progress	Autonomy teacher
Motivation teacher	1			
Motivation parent	.56*	1		
Progress	.53*	.18	1	
Autonomy teacher	.17	.37*	.14	1

*significant at $p < .05$.

Table 12. Parameter estimates of the multilevel analysis.

Dependent variable	Parameter estimate Out-of-Synch	Standard error
Motivation (teacher)	.034*	.015
Progress	.034*	.016

*significant at $p < .05$.

expected, we observed that motivation as rated by the teacher relates to motivation as rated by the parent. Second, there was a substantial correlation between Motivation (Teacher) and Progress. Also, there was a weaker (but statistically significant) relation between Autonomy (rated by the teacher) and Motivation (rated by the parent).

Research question 2: To what extent is dyadic synchrony in levels of autonomy support and expression associated with long-term student outcomes?

We built the univariate multilevel models in three steps. Model 1 only contained the student level. Model 2 is a random intercept model, meaning that the intercept of the regression lines can vary between teachers. For the dependent variables Motivation (Parent) and Autonomy (Teacher), the explained variance of Model 1 and Model 2 did not differ, meaning that the added teacher level did not contribute to the prediction of these variables from Out-of-Synch. Therefore, we performed correlational analyses on these two variables, and estimated random intercept models for the other variables Motivation (Teacher) and Progress. As we can see in Table 12 (which provides us with values for the parameters in the regression model for both variables, along with the standard error of these estimations), Out-of-Synch is a significant predictor of Motivation (Teacher) and Progress. For the other variables, no significant correlation was found. However, the direction of the effect was opposite to what we had expected based on our hypotheses; there was actually a *positive relation* between Out-of-Synch and the students' motivation and progress after 18 months.

Post hoc analyses: Distinguishing between positive and negative Out-of-Synch. Until this point, we defined Out-of-Synch as the *absolute* micro-level difference between the teacher's level of autonomy support and the student's level of autonomy expression, measured in seconds. In order to further investigate how Out-of-Synch predicts increased Motivation (Teacher) and Progress, we distinguished between positive and negative Out-of-Synch. Positive Out-of-Synch refers to moments where the level of teacher autonomy support is much *higher* than the concurrent level of student autonomy expression; negative Out-of-Synch meant that the teacher's level was much *lower* than the student's level.

Figure 7(a) and 7(b). Relation between positive and negative Out-of-Synch and Motivation (teacher), respectively.

Figures 7(a) and 7(b) display the relation between respectively positive and negative Out-of-Synch on the one hand and Motivation (Teacher) on the other hand. From the graphs, it is apparent that the relation that we observed between total Out-of-Synch and Motivation (Teacher) disappeared when we distinguished between positive and negative Out-of-Synch. Furthermore, both relations were asymmetrical (lower values of motivation coincide with lower levels of Negative or Positive Out-of-Synch, while higher values of Motivation can occur with both high and low values of Out-of-Synch). This should be interpreted with caution, however, because lower values of Motivation were in general much rarer than higher values.

Second, we displayed the relation between positive and negative Out-of-Synch, and Progress in Figures 8(a) and 8(b). Here, we see that the relation between positive Out-of-Synch and Progress is much stronger than the (negative) relation between negative Out-of-Synch and Progress (respectively, $R^2 = .22$ and $R^2 = .01$), meaning that the overall positive relation between Out-of-Synch and Progress stemmed mainly from the positive Out-of-Synch.

Discussion

Our second research question focused on whether dyadic synchrony in teachers' level of autonomy support and students' level of autonomy expression from moment to moment within the

Figure 8(a) and 8(b). Relation between positive and negative Out-of-Synch and Progress (Teacher), respectively.

lessons was related to student outcomes on the macro level. Because the need for autonomy is central in children's healthy development, and because dyadic synchrony has proven to be an important indicator of the quality of interaction between parents and (young) children, we expected dyadic synchrony in autonomy levels to be positively related with long term student outcomes, as motivation, progress and overall need for autonomy, which was based on previous literature on this topic (Reeve, 2009; Stroet, Opdenakker, & Minnaert, 2013). However, this hypothesis is less supported by research using observational measures of teacher autonomy support; see Stroet et al., 2013, for an overview. The picture that arose from our data was different. For two macro-level variables (motivation rated by the parent and general need for autonomy rated by the teacher), there was no relation with dyadic synchrony. The lack of relation between the students' general need for autonomy and the micro-level dyadic synchrony between teacher and student levels of autonomy, did tell us that the dyadic synchrony measure provided information on autonomy development that would have been overlooked if we only used the students' level of autonomy, as is generally evident in previous studies (e.g., high student autonomy does not equal high dyadic synchrony). Dyadic synchrony was able to predict motivation (measured by the teacher) and progress after 18 months. However, the direction of the effect was opposite to what we had expected: more out-of-synch moments during the lesson were related to higher motivation and higher progress. For motivation, this effect disappeared when we distinguished

between positive and negative out-of-synch moments. For Progress, the effect was particularly strong for the positive out-of-synch (moments where the teacher's level of autonomy support was much higher than the student's concurrent level of autonomy expression). We interpreted this to mean that students who were considered 'talented' by their teachers were stimulated more, relative to the student's concurrent level of expressed autonomy, to increase their autonomous expression, as compared to students whose progress was below average.

General discussion

Our literature review shows that the need for autonomy is central in children's healthy development. The social context plays an important role in this development. Several studies that have been conducted in music lessons (e.g. Anguiano, 2006), but also in other educational contexts (Reeve, 2009; Stroet et al., 2013) suggest that on average, teacher's autonomy support is associated with positive learning outcomes. We took a different approach by not taking the average level of teacher autonomy support and student autonomous expressions, but instead their micro-level transactions, as a unit of analysis. Also, we did not measure teacher autonomy support in a dichotomous way (autonomy-supportive versus controlling) but on a continuous scale.

The picture that arose from our data was quite different from that of a linear, positive relationship between autonomy support and students' autonomy expression that is predominant in the literature. On a micro-level, we detected that there is a bidirectional influence between teacher and student. On the one hand, the teacher can stimulate the student to behave more autonomously, but on the other hand, some students may elicit more autonomy support from their teachers. From the qualitative case studies, we saw large differences between the dyadic transactions of students with a higher overall need for autonomy, compared to students with a low need for autonomy. Instead of the teacher being the 'locus of control' in terms of autonomy support, we observed that autonomy is more 'negotiated' between teacher and student.

In some moments the autonomy support and autonomy expression levels of the teacher and student were well synchronized, whereas in other moments there were large differences. The second study led to the question of what exactly the function is of dyadic synchrony in autonomy levels when learning to play an instrument. The literature that mainly deals with synchrony in parent-infant interactions (e.g. Harrist & Waugh, 2002) suggests that more adaptation or synchrony is related to healthy developmental outcomes. Our results suggest something much more complex, with dyadic synchrony taking on a different function in teacher-student interactions. When learning to play a musical instrument, which is a complex task, the joint effort of the teacher and student is to push the boundaries of the zone of proximal development (Vygotsky, 1978). The friction of an out-of-synch transaction (for instance, one in which the teacher offers autonomy support at a much higher level than the student's current level of autonomy) might well be necessary to maintain momentum in the learning process. In this respect, it might make sense that the relation between *positive* out-of-synch and progress is the main contributor to the overall relation. However, the relation between motivation and Out-of-Synch could not be attributed to the positive Out-of-Synch and therefore needs further investigation. It should be noted also that the maximum length of out-of-synch moments in the observed lesson was still quite low (44 out of 600 seconds). One would expect that when the teacher-student dyad becomes locked in a pattern with much higher levels of out-of-synch that this might result in negative learning outcomes. Research that examines dyads with higher levels of out-of-synch situations is therefore needed in order to more fully investigate the issues examined in this research study.

Limitations and implications for future research and practice. This mixed-method study on the here-and-now of autonomy co-regulation in music lessons offers an interesting addition to questionnaire studies on autonomy development in the music literature (e.g. Anguiano, 2006; Evans et al., 2012). As stated before, we took a different approach from previous studies by measuring teacher autonomy support on a scale instead of dichotomous categories (either autonomy-supportive or controlling). We did this in order to be able to assess more subtle differences in the extent to which teacher utterances are autonomy-supportive. However, the values that are assigned to the behaviours on the scale are somewhat arbitrary. This way to measure teacher autonomy support (and therefore also Out-of-Synch) must be described as explorative and needing more validation in future studies.

The sample of our study consisted only of teachers who were certified Suzuki teachers, and violin and cello students. The choice for this particular method was made because it is an internationally widely-used method of teaching musical instruments to young children. We wanted all teachers to be comparable in this way because we were interested in the personal differences in teacher–student interaction, and we wanted to rule out the effects of different teaching methods. Future studies could include teachers who use different methods and students with different musical instruments.

For music educational practice, this study has several implications. First, it shows examples of strategies teachers can use to foster students' autonomy. However, it also shows that there is no 'one size fits all' approach to autonomy development; what works for a student with a high need for autonomy does not necessarily work for a student with a lower need for autonomy. Second, the study shows possible functions of moment-to-moment synchrony in teacher–student interactions. We showed that friction in the interaction is not necessarily something to avoid at all cost; rather, a moderate amount of asynchrony in the lesson might well have a role in challenging and stimulating students.

Funding

This research was funded by a PhD Fund grant of the Graduate School of Behavioral and Social Sciences of the University of Groningen, together with a Prince Bernhard Fellowship of the Prince Bernhard Cultural Fund, both granted to the first author.

References

- Anguiano, K. R. (2006). *Motivational predictors of continuing motivation and achievement for early adolescent instrumental music students*. University of Iowa. Retrieved from <http://books.google.nl/books?hl=nl&lr=&id=kGmkDVkTrkAC&oi=fnd&pg=PR17&dq=anguiano+music&ots=SW8qkkwPyB&sig=JaXStWy9n0UD7Lb5xC4TKk7BZtE#v=onepage&q=anguiano music&f=false>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Bryman, A., Becker, S., & Sempik, J. (2008). Quality criteria for quantitative, qualitative and mixed methods research: A view from social policy. *International Journal of Social Research Methodology*, 11(4), 261–276.
- Deci, E. L., Eghrari, H., Patrick, B. C., Leone, D. R., & Rochester, U. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality*, 62(1), 119–142.
- Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie canadienne*, 49(3), 182–185.
- Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist*, 26(3), 325–346.
- Dinham, S. (2007, August). Authoritative leadership, action learning and student accomplishment. In C. Glascoine & K.-A. Hoad (Eds.), *The leadership challenge: Improving learning in schools. Conference proceedings*. Melbourne: Australian Council for Educational Research.

- Evans, P., McPherson, G. E., & Davidson, J. W. (2012). The role of psychological needs in ceasing music and music learning activities. *Psychology of Music*. Advance online publication. doi:10.1177/0305735612441736
- Fogel, A. (1993). *Developing through relationships: Origins of communication, self and culture*. Chicago, IL: The University of Chicago Press.
- Gagné, F. (2010). Motivation within the DMGT 2.0 framework. *High Ability Studies*, 21(2), 81–99.
- Harrist, A. W., & Waugh, R. M. (2002). Dyadic synchrony: Its structure and function in children's development. *Developmental Review*, 22, 555–592.
- Küpers, E., Van Dijk, M., & Van Geert, P. (in press). 'Look closely at what I'm doing!' Scaffolding in individual music lessons: two case studies. *International Journal of Music Education*.
- Lichtwarck-Aschoff, A., Kunnen, S., & Van Geert, P. (2010). Adolescent girls' perceptions of daily conflicts with their mothers: Within-conflict sequences and their relationship to autonomy. *Journal of Adolescent Research*, 25(4), 527–556.
- Lindsey, E. W., Mize, J., & Pettit, G. S. (1997). Mutuality in parent-child play: Consequences for children's peer competence. *Journal of Social and Personal Relationships*, 14(4), 523–538.
- Lindsey, E. W., Cremeens, P. R., Colwell, M. J., & Caldera, Y. M. (2009). The structure of parent-child dyadic synchrony in toddlerhood and children's communication competence and self-control. *Social Development*, 18(2), 375–396.
- McPherson, G. E., & Davidson, J. W. (2002). Musical practice: Mother and child interactions during the first year of learning an instrument. *Music Education Research*, 4(1), 143–158.
- McPherson, G. E., Davidson, J. W., & Faulkner, R. (2012). *Music in our lives: Rethinking musical ability, development and identity* (1st ed.). New York, NY: Oxford University Press.
- Meyer, D. K., & Turner, J. C. (2002). Using instructional discourse analysis to study the scaffolding of student self-regulation. *Educational Psychologist*, 37(1), 17–25.
- Noldus, L. P. J. (2012). The Observer (version 10.5) [Computer software]. Wageningen, The Netherlands: Noldus.
- Odena, O. (2012). Using software to tell a trustworthy, convincing and useful story. *International Journal of Social Research Methodology*, 1–18.
- Onwuegbuzie, A. J., & Leech, N. L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, 8(5), 375–387.
- Plimpton, F., & deCharms, R. (1976). Origins and pawns in the classroom. In R. DeCharms (Ed.), *Enhancing motivation: Change in the classroom* (1st ed., pp. 112–140). New York, NY: Irvington Publishers, Inc.
- Rabash, J., Brown, W., Healy, M., Cameron, B., & Charlton, C. (2005). *MLwiN*. London, UK: Multilevel Models Project, Institute of Education, University of London.
- Rainio, A. P. (2008). From resistance to involvement: Examining agency and control in a playworld activity. *Mind, Culture, and Activity*, 15(2), 115–140.
- Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy-supportive. *Educational Psychologist*, 44(3), 159–175.
- Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98(1), 209–218.
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support 1. *Motivation and Emotion*, 28(2), 147–169.
- Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology*, 95(2), 375–392.
- Renwick, J., & Reeve, J. (2012). Supporting motivation in music education. In G. E. McPherson & G. E. Welch (Eds.), *The Oxford handbook of music education, volume 1* (pp. 143–162). Oxford, UK: Oxford University Press.
- Rostvall, A.-L., & West, T. (2003). Analysis of interaction and learning in instrumental teaching. *Music Education Research*, 5(3), 213–226.

- Ryan, R. M., Deci, E. L., & Grolnick, W. S. (1995). Autonomy, relatedness and the self: Their relation to development and psychopathology. In D. Cichetti & D. J. Cohen (Eds.), *Developmental psychopathology, Vol. 1: Theory and methods. Wiley series on personality processes* (pp. 618–655). New York, NY: Wiley.
- Sameroff, A. (2009). The transactional model. In A. Sameroff (Ed.), *The transactional model of development: How children and contexts shape each other*. (pp. 3–20). Washington, DC: American Psychological Association.
- Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. London, UK: SAGE.
- Steenbeek, H., & van Geert, P. (2013). The emergence of learning-teaching trajectories in education: A complex dynamic systems approach. *Nonlinear Dynamics, Psychology, and Life Sciences*, 17(2), 233–267.
- Stroet, K., Opdenakker, M.-C., & Minnaert, A. (2013). Effects of need supportive teaching on early adolescents' motivation and engagement: A review of the literature. *Educational Research Review*, 9, 65–87.
- Suzuki, S. (1969). *Nurtured by love*. Smithtown, NY: Exposition Press.
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: The MIT Press.
- Turner, J. C., & Patrick, H. (2008). How does motivation develop and why does it change? reframing motivation research. *Educational Psychologist*, 43(3), 119–131.
- Van Dijk, M., & Van Geert, P. (2013). *The nature and meaning of intraindividual variability in development in the early life span*. Manuscript submitted for publication.
- Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Appendix I: Teacher final interview

January 2012

Name teacher:.....

1. Questions about students

Name student:.....

a) How would you describe this student's progress so far?

1	2	3	4	5
below average		average	above average	

b) How would you describe the student's development during the past 18 months?

Follow-up question: What lesson goals were important for this student?

Follow-up question: How would you describe this student's strengths and weaknesses?

c) To what extent is this student motivated to follow violin/cello lessons?

Follow-up question: Do you have the impression that the student regularly practices at home?

Follow-up question: What is the role of the parents in the student's motivation and practice habits?

d) Do you have the impression that . . .

. . . this student likes to play the violin/cello

1	2	3	4	5
not at all		average	very much	

. . . this student thinks he/she is good at playing the violin/ cello

1	2	3	4	5
not at all		average	very much	

. . . this student wants to take initiative during the lesson

1	2	3	4	5
---	---	---	---	---

<i>not at all</i>		<i>average</i>		<i>very often</i>
... this student is attached to you personally.				
1	2	3	4	5
<i>not at all</i>		<i>average</i>		<i>very much</i>

N.B. Questions 1a to 1d are repeated for every student

2. Questions about the teacher

- a) How many years have you been teaching?
- b) What do you think is important in teaching?

Possible follow-up question: Has this changed over the years?