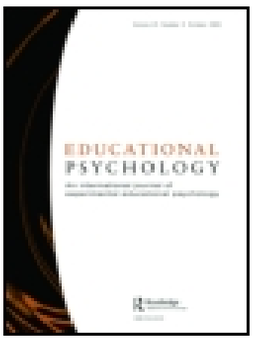

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# Longitudinal relations between perceived autonomy support and basic need satisfaction in two student cohorts

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**ABSTRACT**

The relation between autonomy support and basic need satisfaction was investigated by applying a longitudinal design at a time interval of two years, and by comparing two different grade level cohorts of students. Participants comprised 1.225 Norwegian students divided by two subsamples (6th and 8th grade level/8th and 10th grade level). The results showed stationary effects of autonomy support and basic need satisfaction, respectively, from Time 1 to Time 2. There was also evidence of a causal effect from T1 to T2 between autonomy support and basic need satisfaction, and reciprocal causation from basic need satisfaction T1 to autonomy support T2. These effects were grade level and gender specific. The present study provided support for longitudinal relations between autonomy support and basic need satisfaction. Autonomy support and basic need satisfaction are both antecedents to and consequences of themselves, also when measured at long term intervals.

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**KEYWORDS**
Autonomy support; basic need satisfaction; longitudinal; grade level

## Introduction

Research within self-determination theory (SDT) of motivation contrasts autonomy supportive and controlling modes of instruction among teachers (Ryan & Deci, 2000). Teachers with an autonomy-supportive style engage students by facilitating congruence between students' autonomous sources of motivation and their moment-to-moment classroom activity (Jang, Reeve, & Deci, 2010). Autonomy supportive teachers identify and nurture students' needs and preferences to facilitate congruence between students' self-determined motives and their classroom activities (Reeve, Jang, Carrell, Jeon, & Barch, 2004). In contrast, controlling teachers typically use controlling, coercive language, and rely on extrinsic motivation (Reeve, 2009).

Experimental research indicates that autonomy-supportive teachers facilitate positive educational and developmental outcomes in students (Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). According to SDT, autonomy support is an important prerequisite for basic need satisfaction of autonomy, competence, and relatedness, which is the underlying motivational mechanism that energises and directs people's behaviour (Deci & Ryan, 2000). More

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specifically, teachers' autonomy support, structure, and involvement provide support for students' psychological needs for autonomy, competence, and relatedness (Jang et al., 2010). Whereas these needs are inherent, they also require supportive conditions in order to be satisfied (Cheon, Reeve, & Moon, 2012). For students, teachers' autonomy support during instruction in class is a main source for such need satisfaction in their lives (Reeve, 2009).

Accordingly, previous research has found relations between autonomy support and basic need satisfaction in cross sectional research (Adie, Duda, & Ntoumanis, 2008; Jeno & Diseth, 2014; Levesque, Zuehlke, Stanek, & Ryan, 2004; Reinboth, Duda, & Ntoumanis, 2004) and experimental studies (Reeve et al., 2004; Sheldon & Filak, 2008). There has also been research on the relations between autonomy support and basic need satisfaction by means of longitudinal designs in naturally occurring classroom contexts. For example, Jang, Kim, and Reeve (2012) measured these variables among Asian students at three different points during a single semester, and found evidence of complex relations in a cross-lagged design. However, they also suggested that this research should be performed on other samples in different cultures, and within a longer time frame.

Hence, the present study attempts to further investigate the relation between autonomy support and basic need satisfaction by using a longitudinal design over the course of two years in a Norwegian school context, thus addressing both the need to study these relations in a longer time frame and to replicate findings from an Asian culture (Jang et al., 2012) among students in a western sample. In particular, the relatively long time frame of two years provides a stronger test of temporal causality, compared to shorter time frames. Also, the scope of this research will be expanded by comparing results from two different age level cohorts, as well as an investigation of gender differences. Finally, the present study comprises an investigation of how perceived autonomy support from teachers within the school may account for basic need satisfaction in general with no specific reference to the school domain. This is in accordance with the observation that research has increasingly begun to focus on context-free satisfaction of basic needs (Sheldon & Hilpert, 2012), and that teacher support is important for students' lives beyond the school domain (Danielsen, Samdal, Hetland, & Wold, 2009).

### *Autonomy support and basic need satisfaction*

Autonomy support may be defined as the process of providing choice whenever choice is possible, offering a meaningful rationale when no choice can be made available, and taking the perspective of e.g. the student in such situations (Deci & Ryan, 1985). For instance, a teacher may communicate to the students that s/he has a choice regarding how to learn the multiplication table and communicate the importance of learning it despite the fact that it may not be experienced as fun for the student.

Autonomy supportive behaviour promotes satisfaction of basic psychological needs for autonomy, competence, and relatedness (Ntoumanis & Standage, 2009). The need for autonomy is the inherent desire to feel volitional and to experience a sense of choice and psychological freedom (Ryan & Deci, 2000), whereas competence is the inherent desire to feel effective in interacting with the environment (Deci & Moller, 2005), and relatedness is the innate tendency to feel connected to others (Baumeister & Leary, 1995). More specifically, the need for autonomy refers to freedom of choice in terms of not being coerced or controlled by others (Ryan & Deci, 2000), for example when students are free to make

independent decisions regarding the content and organisation of their assignments. In order to satisfy the need for autonomy, teachers may use different autonomy-supportive practices during instruction, such as allowing students to express dissatisfaction with learning tasks or providing opportunities to make own choices (Stefanou, Perencevich, DiCintio, & Turner, 2004).

The need for competence reflects trust in personal mastery of tasks. In a school context, this need may be satisfied by mastering assignments that are optimally challenging, and by encouraging students to try to solve problems on their own (Baeten, Dochy, & Struyven, 2013). Finally, the need for relatedness is to be meaningfully connected to significant others, which represents the importance of belonging (Ryan & Deci, 2000). This need is satisfied when students have an experience of being an important part of the class and being accepted by peers and teachers.

Correlational studies have found positive relations between autonomy support and basic need satisfaction of autonomy, competence, and relatedness in different contexts, more specifically among adult male and female sport participants (Adie et al., 2008), young athletes (Reinboth et al., 2004), and upper secondary school students (Jeno & Diseth, 2014). Additional aspects of the learning environment, such as perceived pressure and positive information feedback have also been identified as antecedents of basic need satisfaction in cross sectional research (Levesque et al., 2004).

Experimental studies have provided evidence for a causal relation between autonomy support and several variables associated with basic need satisfaction. For example, Sheldon and Filak (2008) found that support of all three needs (autonomy, competence and relatedness) contributed to increase well-being and thriving in a sample of introductory psychology students. Furthermore, Reeve et al. (2004) found that increasing teachers' autonomy support produced a subsequent enhancement of students' engagement. Finally, Cheon et al. (2012) found that increasing levels of autonomy support from teachers produced subsequent higher levels of basic need satisfaction among students.

Whereas causality presupposes experimental control, experimental designs often fail to capture effects that take place in a naturally occurring classroom process (Jang et al., 2012). By applying a longitudinal design it is possible to find support for temporal causality while retaining ecological validity of the study. Although there is less longitudinal research on the relation between autonomy support and basic need satisfaction, Reinboth and Duda (2006) found that perceptions of an autonomy- supportive climate positively predicted subsequent satisfaction of the needs for autonomy, competence and relatedness among athletes. Of more relevance to the present study, Jang et al. (2012) found that perceived autonomy support and basic need satisfaction at Time 1 predicted the same variables at Time 2, which in turn predicted these variables at Time 3, thus showing evidence of stationary effects. However, they also found temporal causality between perceived autonomy support T1 and basic need satisfaction T2. This effect did not remain stable between T2 and T3, however. Finally, they found reciprocal causality between basic need satisfaction T1 and perceived autonomy support T2, and this effect was also present between T2 and T3. The reciprocal causation refers to the extent to which a variable in the model feeds back to affect its hypothesised cause, as suggested in previous SDT research (Pelletier, Séguin-Levesque, & Legault, 2002). Jang et al. (2012) explained these reciprocal causations not as hypothesised paths, but rather as expressions of complex relations that might unfold naturally in classrooms.

Taken together, the study by Jang et al. (2012) supported the assumption that autonomy support predicts basic need satisfaction (temporal causality), but also that basic need satisfaction predicts perceived autonomy support (reciprocal causation), also when controlling for the stationary effects. Hence, longitudinal relations between autonomy support and basic need satisfaction may be expressed in terms of stationary effects, temporal causality, and reciprocal causation.

Regarding possible gender differences, Ryan and Deci (2000) argued that the motivational processes essential for human functioning, as described by SDT, are equivalent across gender groups. However, the issue of gender differences in autonomy support and basic need satisfaction has not really received much empirical attention (Adie et al., 2008). Regarding the abovementioned study by Jang et al. (2012), they investigated possible gender effects, but found no such effects. Gender did not predict students' scores on perceived autonomy support or basic need satisfaction. Given the lack of gender differences in the data and the lack of gender as an important predictor, they collapsed the data from the two genders into a single data-set. However, they found that males self-reported greater levels of basic need satisfaction than did females. Cheon et al. (2012) also found males to be scoring higher than females on perceived autonomy support. We further investigated the issue of possible gender differences in the present study.

### *Norwegian education*

Research has shown (Chen et al., 2014) that basic psychological need satisfaction contributes to psychological well-being in several countries (USA, China, Belgium, and Peru), which suggests that satisfaction of the basic needs for autonomy, relatedness, and competence are essential nutrients for optimal human functioning across cultural differences. However, the level of autonomy support and basic need satisfaction may differ across cultural contexts. Hence, Jang et al. (2012) recommended additional research on the abovementioned variables in order to test the cross-cultural generalizability, as they investigated middle-school students in the East Asian cultural context of Korea. They remarked that student autonomy is not as valued in the Korean culture as it is in the West. A related example is a cross-cultural comparison which showed that Russian adolescents experienced more controlling teachers than their US counterparts (Chirkov & Ryan, 2001).

The current Norwegian sample represents a western culture which probably is more autonomy supportive compared to eastern cultures. Furthermore, the Norwegian school is characterised by less social inequalities compared to most other countries in the world (Ministry of Education & Research, 2011). Public schools are attended by 97.8% of Norwegian students (Ministry of Education & Research, 2008), and students are not normally organised according to level of ability, gender, or ethnic affiliation (Norwegian Education Act, 1998).

The present sample consists of two subsamples in terms of students in 6th and 8th grade, and students in 8th and 10th grade, each measured at a time interval of two years. Hence, we have the opportunity to compare age cohorts within the same schools system (8th-10th grade within lower secondary school) with age cohorts who are in the transition between primary school and lower secondary school (6th–8th grade). These students spend approximately 6 h (lessons) a day at school, excluding cessations. They typically have one main responsible teacher in each class (assigned as a 'contact teacher'), but are taught by several teachers during a typical week at school, approximately by 3–5 teachers, depending on the

local school organisation. Primary and lower secondary education is a unified school system that provides equal and adapted education on the basis of a single national curriculum (Ministry of Education & Research, 2009).

In general, Norwegian students have a high level of well-being in school (Diseth, Danielsen, & Samdal, 2012). However, whereas effort and perceived importance of schoolwork is generally high among younger students, motivation declines particularly between grade 5–10, and motivation is at its lowest in 10th grade (Ministry of Education & Research, 2011). Whereas a cross-sectional study of Norwegian students in grades 5–10 showed no downwards tendency for perceived autonomy support by increasing age (Bru, Stornes, Munthe, & Thuen, 2010), previous research on developmental trends in motivation in the transition between school levels seems inconclusive (Diseth & Samdal, 2014).

### *Problems and hypotheses*

The present study will address the need for testing of the abovementioned variables in alternative samples by investigating autonomy support and basic needs satisfaction among Norwegian students. Furthermore, by extending the time frame to two years, it may be argued that the present study represent a strong test of temporal causality between the variables, as opposed to previous research, which has utilised a shorter time frame (e.g. Jang et al., 2012). In addition, the two age cohorts (6th–8th grade and 8th–10th grade) makes it is possible to compare the abovementioned longitudinal relations between these samples. Whereas the first subsample (6th–8th grade) represent a transition between elementary school (6th grade) and the first year of lower secondary school (8th grade) in the Norwegian school system, the second subsample (8th–10th grade) are within lower secondary school at both points in time. Hence, this gives an opportunity to compare longitudinal relationships between students in a transition phase with students who are not in a transition between school levels.

Additionally, gender differences will be investigated. Finally, the present study extends the scope of this research by investigating how autonomy support within the school context may have a temporal causal effect on generalised need satisfaction with no particular reference to the school context, thus addressing the increasing interest in context-free need-satisfaction (Sheldon & Hilpert, 2012) the importance of teacher support for students' lives beyond the school domain (Danielsen et al., 2009). It should also be mentioned that basic need support by teachers may be operationalized also as support of competence and relatedness, in addition to autonomy support (e.g. Sheldon & Filak, 2008). However, the present study will follow the majority of previous research by addressing autonomy support only (cf. Jang et al., 2012).

Taken together, the present study gives the opportunity to test whether students' perceived autonomy support from teachers at Time 1 predicts general basic need satisfaction at Time 2 (temporal causality), whether basic need satisfaction at Time 1 predicts autonomy support at Time 2 (reciprocal causality), and whether basic need satisfaction/autonomy support at Time 1 predicts the same variables at Time 2 (stationary effects).

It is expected that the present findings will support temporal causality, reciprocal causality, and stationary effects, in line with previous findings (Jang et al., 2012). These hypothesised relations are shown in Figure 1.

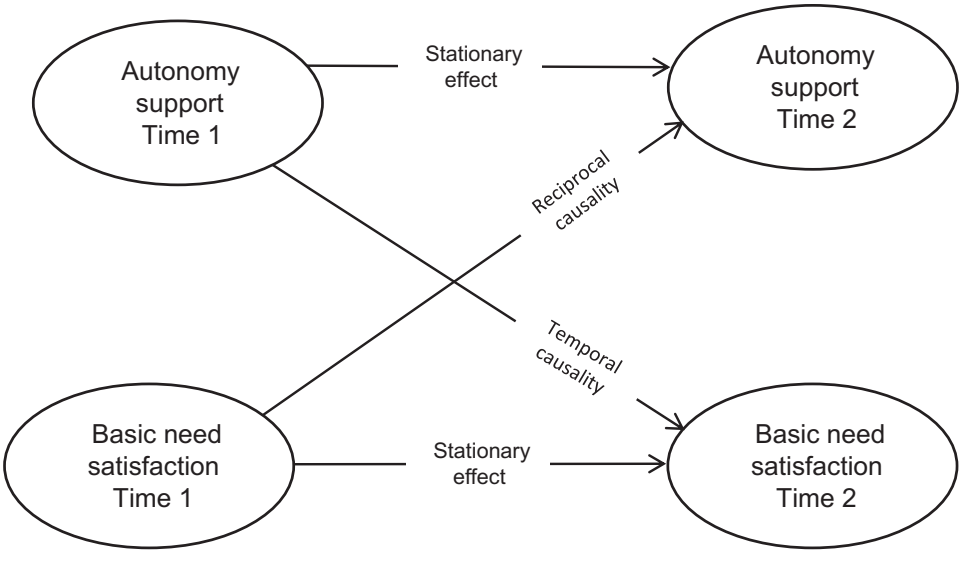


**Figure 1.** Hypothesised relations between autonomy support and basic need satisfaction at Time 1 and Time 2.

However, these relations may be sample specific according to grade levels (6th and 8th grade vs. 8th and 10th grade). More specifically, we expect the stationary effect of autonomy support to be stronger in the 8th and 10th grade sample compared to the 6th and 8th grade sample, because the 8th and 10th grade sample is within the same level of schooling (junior high school) while the 6th and 8th grade sample are in a transition between elementary school (6th grade) and first year of junior high school (8th grade), hence they probably experience less continuity in their experience of autonomy support.

For the same reason we also expect the temporal causality between autonomy support T1 and T2, and the reciprocal causation from basic need satisfaction T1 to autonomy support T2 to be stronger in the 8th–10th grade sample compared to the 6th–8th grade sample. However, the temporal stability of basic need satisfaction T1 and T2 may be rather equal in the two samples, because this variable to a larger extent than autonomy support reflects individual differences among students rather than perceived support from the environment.

## Methods

### *Participants and procedure*

Data were collected at two time points (T1–T2) at an interval of two years. At T1, students in 6th and 8th grade responded. Two years later, the same students responded in 8th and 10th grade at T2. However, due to insufficient coding of students identity in some schools and classes at T1, it was not possible to connect data from T1 to T2 for all of the students. This insufficient coding occurred randomly. Hence, the final sample which could be identified at both time points, consisted of 1.225 students, divided by two subsamples (6th–8th grade vs. 8th–10th grade) as follows: 475 students (242 boys and 233 girls) responding at the 6th and 8th grade level. This subsample comprised 49.43% of the original 961 students measured

in 6th grade at T1. Finally, 750 students (369 boys, 378 girls, and 3 unidentified) responded at the 8th and 10th grade level. This subsample comprised 68.24% of the original 1.099 students measured in 8th grade at T1. The students were given sufficient time to respond to a survey (described below) during a class hour, and this procedure was repeated after two years on the same sample. The survey was administered late in the fall term (November/December) at both points in time, which is considered as a stable period in the semester. Because of the unitary school system, there are reasons to regard the participating classes in the present study as demographically representative of other classes in Norwegian education (cf. Danielsen, Wiium, Wilhelmsen, & Wold, 2010).

## Measures

### Autonomy support

To measure the students' perception of their teachers' autonomy support, a short 6-item version of the Learning Climate Questionnaire – LCQ (Black & Deci, 2000; Williams & Deci, 1996) was utilised, as described by Diseth and Samdal (2014). This is also in accordance with the original theoretical framework in SDT, which utilise a narrow conceptualisation of motivating style that focused only on autonomy support (Deci, Schwartz, Sheinman, & Ryan, 1981). These six items were as follows: 1. 'I feel that my teachers provide me with choices and options', 2. 'I feel understood by my teachers', 3. 'My teachers show their confidence in my ability to do well in the subject', 4. 'My teachers encourage me to ask questions', 5. 'My teachers listen to how I would like to do things', 6. 'My teachers try to understand how I see things before suggesting a new way to do things'.

Measurement of perceived autonomy support at school is typically performed by referring to a specific class or teacher. However, instructions for this particular scale (LCQ) also states that it is possible to measure the general learning climate with reference to support from several teachers (Perceived Autonomy Support: The Climate Questionnaires, 2012), as described in previous research (Diseth & Samdal, 2014; Soenens & Vansteenkiste, 2005). Hence, the students indicated to what extent their teachers at school could be described according to several statements on a scale ranging from 5 (completely agree) to 1 (completely disagree). Measurement of alpha reliabilities showed good internal consistency (T1 $\alpha = .89$, T2 $\alpha = .92$).

### Basic need satisfaction

Measurement of basic need satisfaction was based on items from a basic need satisfaction in general scale (21 items) – BNSG-S (Gagné, 2003) which was originally adapted from a measure of need satisfaction at work (Ilardi, Leone, Kasser, & Ryan, 1993). For the present study, 13 items were selected on basis of experience with previous collected unpublished data, in which several of the original 21 items showed weak and/or inconsistent factor loading. This is in accordance with a study by Sheldon and Hilpert (2012), which showed weaknesses in the original 21-items BNSG-S in terms of failure to meet rigorous fit requirements and failure to differentiate adequately between one general need factor or three related but distinguishable need factors. Also, Johnston and Finney (2010) showed that a 16 item version of the original 21-item survey produced the best results, with a method effect for negatively worded items. The 13 items in the present study corresponds to11 of the items retained in the abovementioned study by Johnston and Finney (2010).

In Gagné's (2003) original research, the three subscales of autonomy, competence, and relatedness satisfaction were averaged to form an index of general need satisfaction, similar to a study of basic need satisfaction by Deci et al. (2001), which applied a higher order one-factor solution for these three needs. However, more recent research has typically calculated composite scores of each specific need (competence, autonomy and relatedness) and utilised a single latent basic need satisfaction factor to account for these specific needs (e.g. Cheon et al., 2012). The present 13-items measure of basic psychological need satisfaction were assessed on a scale ranging from 5 (completely agree) to 1 (completely disagree), and produced satisfactory alpha reliability scores (competence $\alpha$ [4 items] T1 = .70, T2 = .79, autonomy $\alpha$ [3 items] T1 = .66, T2 = .68, relatedness $\alpha$ [6 items] T1 = .86, T2 = .89).

### *Data analysis*

The structural equation model (SEM) programme IBM SPSS AMOS 23.0 (Arbuckle, 2014) was utilised to produce a measurement model of the abovementioned constructs, and to test the structural relationship between latent variables in accordance with theoretical assumptions described in the introduction. The model was evaluated according to the comparative fit index (CFI), which should ideally be close to .95, but CFI above .90 may be acceptable, the root mean square error of approximation (RMSEA), which should ideally be below .05, but below .08 is acceptable, and the chi square/degrees of freedom ($\chi^2$/df) ratio, which should ideally be less than two (Byrne, 2011), but even a $\chi^2$/df ratio of 5–1 may be reasonable (Wheaton, 1987). In general, reliance upon chi-square statistics is debated, because large sample sizes tend to inflate chi-square values, resulting in incorrect rejection of the model (Schumacker & Lomax, 2004).

## Results

### *Measurement model*

A measurement model was produced by means of a confirmatory factor analysis in order to test the structural validity of the constructs. The measurement model comprised six indicators of perceived autonomy support and three indicators of basic need satisfaction (composite scores of competence, autonomy and relatedness) as previously shown by Cheon et al. (2012), across both waves of data collection on the total sample, allowing for covariance between latent factors, similar to the procedure by Jang et al. (2012). This model provided good fit to the data ($\chi^2$ = 493.04, df = 125, $p < .001$, $\chi^2$/df = 3.94, CFI = .97, RMSEA = .05).

We also tested configural invariance and structural invariance of factor loadings for the model. The model was first analysed on basis of the two cohorts (6th–8th vs. 8th–10th grade), which produced model fit as follows: $\chi^2$ = 716.09, df = 252, $p < .001$, $\chi^2$/df = 2.84, CFI = .963, RMSEA = .039. When factor loadings were constrained to be equal across grade level cohorts, the model fit was as follows: $\chi^2$ = 810.70, df = 274, $p < .001$, $\chi^2$/df = 2.959, CFI = .957, RMSEA = .040. The $\chi^2$ difference in the unconstrained and constrained model turned out to be significant ($\Delta\chi^2$ = 94.61, $\Delta$df = 22, $p < .01$), but the change in CFI was negligible at .006, well below the recommended .01 limit proposed by Cheung and Rensvold (2002). We performed the same test by gender, which produced model fit in the unconstrained model as follows: $\chi^2$ = 670.798, df = 252, $p < .001$, $\chi^2$/df = 2.662, CFI = .967, RMSEA = .037. When factor

**Table 1.** Descriptive statistics for autonomy support and basic need satisfaction (BNS) including range, mean, standard deviation (SD), skewness, kurtosis, alpha, and intra class correlation (ICC) by cohort.

| | Range | Mean | SD | Skew. | Kurt. | α | ICC |
|---|---|---|---|---|---|---|---|
| *Total sample* | | | | | | | |
| Aut.supp. T1 | 1–5 | 2.94 | .65 | .58 | 1.55 | .88 | – |
| Aut. supp. T2 | 1–5 | 2.84 | .79 | .79 | 1.31 | .93 | – |
| BNS T1 | 1–5 | 3.16 | .51 | .74 | 2.04 | .89 | – |
| BNS T2 | 1–5 | 3.13 | .56 | 1.00 | 3.20 | .91 | – |
| *6th–8th grade* | | | | | | | |
| Aut. supp. T1 | 1–5 | 3.04 | .64 | .52 | .97 | .88 | .04 |
| Aut. supp. T2 | 1–5 | 2.93 | .68 | .82 | 1.9 | .89 | .02 |
| BNS T1 | 1–5 | 3.25 | .45 | .26 | −.52 | .84 | .03 |
| BNS T2 | 1–5 | 3.22 | .53 | 1.18 | 3.89 | .83 | .01 |
| *8th–10th grade* | | | | | | | |
| Aut. supp. T1 | 1–5 | 2.88 | .65 | .62 | 1.91 | .84 | .03 |
| Aut. supp. T2 | 1–5 | 2.63 | .83 | .69 | .98 | .91 | .05 |
| BNS T1 | 1–5 | 3.17 | .53 | .99 | 2.98 | .91 | .01 |
| BNS T2 | 1–5 | 3.12 | .57 | 1.01 | 3.29 | .92 | .01 |

loadings were constrained to be equal across gender, the model fit was as follows: $\chi^2 = 725.124$, df = 270, $p < .001$, $\chi^2/df = 2.686$, CFI = .964, RMSEA = .037. The $\chi^2$ difference in the unconstrained and constrained model was significant ($\Delta\chi^2 = 54.326$, $\Delta df = 18$, $p < .01$), but similarly to the above test of grade level cohort differences, the CFI difference of .003 was negligible. Hence, model fit was similar across grade level cohorts and gender.

## *Descriptive statistics and correlations*

The abovementioned measurement model provides basis for analysis of descriptive statistics (Table 1), which shows that skewness and kurtosis values were within normal range, except for basic need satisfaction which has a high kurtosis value in the 6th–8th grade sample (T1) and in the 8th–10th grade sample (T1 and T2) indicating a high degree of cluster for this variable. Alpha values showed high levels of internal consistency for all of the variables. Finally, analysis of intra-class correlations (ICC) showed that less than 5% of the variance in the variables was accounted for at the level of class belongingness, and design effects (DEFF) were below two for all variables. Hence, there were no basis for multi-level modelling, and the subsequent analyses were performed at individual level.

In order to investigate possible differences between the final sample which could be identified at both time points (T1 and T2) and the students who participated only at T1 which were not included in the final sample, separate mean level analyses were performed for this latter group of students. For the group of students participating only at T1, the mean levels for autonomy support T1 was 2.93 (6th grade sample = 2.98, 8th grade sample = 2.89) and the mean level for basic need satisfaction T1 was 3.23 (6th grade sample = 3.26, 8th grade sample = 3.20). Hence, the mean level values of the participants which were not included are very similar to the mean values in the final sample (see Table 1).

The bi-variate correlations between all of the included variables are shown in Table 2. Whereas all of the variables were positively correlated in both grade level samples, the correlations between autonomy support T1 and basic need satisfaction T2 were weaker in the 6th–8th grade sample compared to the 8th–10th grade sample. This difference in correlation was significant ($z = 3.07$, $p < .002$)

**Table 2.** Bi-variate correlations between autonomy support and basic need satisfaction T1 and T2 with 6th–8th grade sample above diagonal and 8th–10th grade sample below diagonal.

| | Aut.supp. T1 | Aut.supp T2 | BNS T1 | BNS T2 |
|---|---|---|---|---|
| Aut.supp T1 | – | .20** | .51** | .15** |
| Aut.supp T2 | .37** | – | .14** | .55** |
| BNS T1 | .50** | .28** | – | .31** |
| BNS T2 | .32** | .39** | .43** | – |

**$p < .01$.

## *Structural equation model*

In order to show the relation between the abovementioned latent variables, a SEM was produced. This analysis was performed as a multi-group analysis, including the 6th–8th grade subsample, the 8th–10th grade subsample, and these subsamples divided by gender. The current SEM provided good model fit ($\chi^2 = 1120.37$, df = 375, $p < .001$, $\chi^2/df = 2.99$, CFI = .97, RMSEA = .03).

This model (Figure 2) showed temporal causality from autonomy support Time 1 (T1) to basic need satisfaction (BNS) Time 2 (T2) for the 8th and 10th grade sample, but not for the 6th and 8th grade sample. Furthermore, it showed reciprocal causation from basic need satisfaction T1 to autonomy support T2 for the 8th and 10th grade sample, but not for the 6th and 8th grade sample. Finally, it showed stationary effects for both subsamples (6th–8th grade and 8th–10th grade) regarding autonomy support at T1 and 2, and basic need satisfaction T1 and T2, respectively.

The abovementioned analysis showed some differences between the subsamples. In order to analyses these differences further, analysis of parameter value differences (6th–8th grade vs. 8th–10th grade) were performed, with critical ratios for differences between

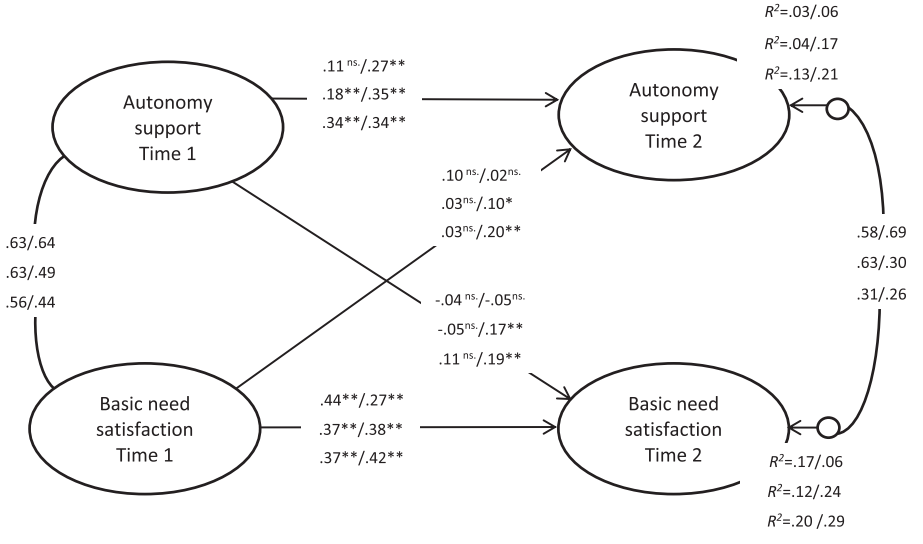


**Figure 2.** Autonomy support and basic need satisfaction at Time 1 and Time 2 with results shown for 6th–8th graders/8th–10th graders respectively (middle line), 6th–8th graders boys/girls (upper line), and 8th–10th graders boys/girls (lower line).
Note: *$p < .05$, **$p < .01$, ns. = not significant.

parameters as follows: *z*-score above 1.960 indicate significance at the 5% level, *z*-score above 2.326 at the 2% level, and *z*-score above 2.576 at the 1% level. This analysis showed significant differences between the subsamples (6th–8th grade vs. 8th–10th grade) regarding the paths between autonomy support T1 and T2 ($\beta = .18/.35, z = 2.37, p < .020$) and between autonomy support T1 and basic need satisfaction T2 ($\beta = -.05/.17, z = 2.10, p < .050$). Hence, these parameters were significantly stronger in the 8th–10th grade sample than in the 6th–8th grade sample.

To sum up, the abovementioned stationary effects were stable across both samples, whereas the temporal and reciprocal causality was evident only in the 8th–10th grade sample. Finally, the stationary effect for autonomy support and the temporal causality for autonomy support T1 and T2 was significantly stronger in the 8th–10th grade sample compared to the 6th–8th grade sample.

In order to investigate whether these effects were stable across gender, multi-group analyses were performed for boys and girls respectively by each sample (6th–8th grade vs. 8th–10th grade). In the 6th–8th grade sample, stationary effects in terms of autonomy support T1 → T2 was not significantly stronger among girls than among boys ($z = 1.22, p > .05$), and stationary effects in terms of basic need satisfaction T1 → T2 was not significantly stronger among boys than among girls ($z = -1.33, p > .05$). There were no significant gender differences in temporal or reciprocal causality in this subsample. In the 8th–10th grade sample, no gender differences were observed in the stationary effects. Also, test results of gender differences in temporal causality (autonomy support T1 → BNS T2, $z = -.80, p > .05$) and the reciprocal causation BNS T1 → autonomy support ($z = 1.84, p > .05$) were insignificant, despite the fact that temporal causality and reciprocal causation were significantly evident only among girls when the 8th–10th grade sample was divided by gender.

Gender was also tested as a predictor in this model (not shown in Figure 1), which showed that girls experienced less autonomy support at T2 than boys both in the 6th–8th grade group ($\beta = .18, p < .002$) and in the 8th–10th grade group ($\beta = .13, p < .015$), but there were no other significant predictor effects of gender.

### *Mean level differences*

In order to further explore grade level and gender differences, analysis of mean level differences were performed. These analyses (Table 3) showed that for the 6th–8th grade sample, girls reported a significantly lower level of autonomy support than boys at T2 (mean gender difference = .22, $t = 3.39$, df = 419, $p < .001$) and BNS (mean gender difference = .10, $t = 1.97$, $p < .049$). Furthermore, girls showed a significant mean level decline in autonomy support from T1 to T2 (mean difference T1–T2 = .20, $t = 2.98$, $p < .003$).

In the 8th–10th grade sample, girls experienced a lower level of autonomy support than boys at T1 (mean gender difference = .13, $t = 2.56$, $p < .010$) and T2 (mean gender difference = .17, $t = 2.70$, $p < .007$), and a lower level of BNS at T2 than boys (mean gender difference = .17, $t = 2.99$, $p < .003$). Furthermore, a decline in the mean level of autonomy support between T1 and T2 both for boys (mean difference T1–T2 = .23, $t = 4.82$, $p < .001$) and for girls (mean difference T1–T2 = .28, $t = 6.21$, $p < .001$), and in the mean level of BNS for girls were demonstrated (mean difference T1–T2 = .13, $t = 3{,}63$, $p < .001$).

Taken together, these mean level differences by grade level and gender showed a decline in autonomy support between T1 and T2 among girls in both samples, a decline in basic need

**Table 3.** Mean level differences (*t*-test) in autonomy support and basic need satisfaction (BNS) by grade level (T1–T2) and gender (T1–T2).

| | Mboys | Mgirls | MdiffGENDER |
|---|---|---|---|
| *6th–8th grade* | | | |
| Aut. supp. T1 6th | 3.06 | 3.02 | .04 |
| Aut. supp. T2 8th | 3.04 | 2.82 | .22** |
| Mean diff. T1–T2 Boys | .02 | | |
| Mdiff T1–T2 Girls | | .20** | |
| BNS T1 6th | 3.26 | 3.25 | .01 |
| BNS T2 8th | 3.28 | 3.18 | .10* |
| Mdiff T1–T2 Boys | −.02 | | |
| Mdiff T1–T2 Girls | | .07 | |
| *8th–10th grade* | | | |
| Aut. supp. T1 8th | 2.95 | 2.82 | .13** |
| Aut. supp. T2 10th | 2.72 | 2.55 | .17** |
| Mean diff. T1–T2 Boys | .23** | | |
| Mdiff T1–T2 Girls | | .27** | |
| BNS T1 8th | 3.17 | 3.16 | .01 |
| BNS T2 10th | 3.20 | 3.06 | .17** |
| Mdiff T1–T2 Boys | .03 | | |
| Mdiff T1–T2 Girls | | .10* | |

*$p < .05$; **$p < .01$.

satisfaction among girls in the 8th–10th grade sample, and a decline in autonomy support in the 8th vs. 10th grade sample for boys. Furthermore, the mean levels of autonomy support and basic needs satisfaction were significantly lower among girls than among boys, particularly at T2, suggesting a decline in these variables between T1 and T2 is mostly prevalent among girls.

## Discussion

The main purpose of the present study was to investigate longitudinal relations between autonomy support and basic need satisfaction measured at a time interval of two years, and to perform multi group comparisons in terms of grade level (6th–8th vs. 8th–10th grade) and gender differences. The results supported a structural model in which autonomy support and basic need satisfaction measured at T1 predicted autonomy support and basic need satisfaction measured at a T2. This model included temporal causality, reciprocal causality, and stationary effects.

Whereas the stationary effects were present across samples, the temporal and reciprocal causality were significantly stronger in the 8th–10th grade sample, as compared to the 6th–8th grade sample, in accordance with the hypotheses. When analysing each subsample (cohort and gender), we found that these effects were significantly evident only among girls in the 8th–10th grade sample, but not in the 6th–8th grade sample. Hence, we may conclude that there are temporal and reciprocal causality, but the current data does not support this effect as being stable across the subsamples. Nevertheless, the temporal causality may be interpreted as a genuine effect of autonomy support at T1 as predictors of basic need satisfaction at T2, in accordance with previous research on longitudinal data (Jang et al., 2012), correlational research (Adie et al., 2008; Deci et al., 2001; Jeno & Diseth, 2014; Reinboth et al., 2004) and experimental research (Reeve et al., 2004; Sheldon & Filak, 2008). For example, experimental longitudinal research has shown that increased teacher autonomy support causes increased basic need satisfaction among students (Cheon et al., 2012). Importantly, the temporal causality between autonomy support at T1 and basic need satisfaction at T2

occurred also when controlling for the effect of basic need satisfaction T1. Hence, there was a unique causal effect of autonomy support at T1 on basic need satisfaction at T2, also when controlling for stationary effects of basic need satisfaction at T1.

As regards the significant reciprocal causality from basic need satisfaction T1 to autonomy support T2, this effect has previously been explained in terms of the students' response on teachers movement towards greater autonomy support when student autonomy is high, and conversely to lesser autonomy support and more teacher control when student autonomy is low (Skinner & Belmont, 1993). These effects are similar to the findings observed in a sample of Korean students (Jang et al., 2012), thus adding to the cross-cultural validity of SDT (Chen et al., 2014).

The present findings indicated no temporal or reciprocal causality in the 6th–8th grade sample. However, these students responded at a time interval representing a transition from primary school (6th grade) to lower secondary school (8th grade). Hence, they experienced important changes in the learning environment (new schools and new teachers), which may have weakened temporal and reciprocal causality in this sample. This assumption was supported by the fact that the 6th–8th grade sample showed a temporal stability between T1 and T2 for basic need satisfaction which was similar to the temporal stability for the 8th–10th grade sample, whereas the temporal stability for autonomy support, which is probably more sensitive to environmental changes, was significantly weaker in the 6th–8th grade sample as compared to the 8th–10th grade sample.

The results showed some longitudinal mean level differences, but these effects were gender specific. Overall, girls experienced a lower mean level of autonomy support and basic need satisfaction than boys, and girls also showed a more consistent decline in the mean level of both variables between T1 and T2. Hence, the present results are in line with the observation of a developmental decline in motivation among Norwegian students (Ministry of Education & Research, 2011), but our results suggest that this decline is more prevalent among girls than among boys. Whereas Jang et al. (2012) generally found small effects of gender, they did report that greater levels of basic need satisfaction among boys than girls, similarly to our findings. Cheon et al. (2012) also found that males scoring higher than females on perceived autonomy. However, previous research seems to have been less concerned about gender differences regarding these variables (cf. Adie et al., 2008), and possible explanations for these differences have not been provided.

## Limitations

The present longitudinal design has the advantage of a higher degree of ecological validity by including more of the actual processes among students occurring in a classroom compared to an experimental design (Jang et al., 2012). However, it may be argued that the abovementioned effects of temporal causality and reciprocal causation are not very strong. Nevertheless, given the relatively long time frame of this study (two years between T1 and T2), these effects are still remarkable, and the relatively long time frame has the advantage of providing a strong test of the hypotheses.

The structural model shown above is based upon individual level of analysis, not at the level of e.g. class belongingness, due to low levels of ICC and DEFF in the present findings. This lack of multi-level analysis means that the current results reflect students' individual perceptions of the learning environment (autonomy support), rather than common

perceptions shared by students in the same class, which might have been indicative of actual teacher behaviour. This differs from the analyses performed by Jang et al. (2012), who found evidence of DEFF at the classroom level, although their study also showed that most of the variance in autonomy support was accounted for at the student level. However, our findings are in accordance with previous research, which also has observed limited evidence of design effect regarding autonomy support (Diseth & Samdal, 2014; Diseth et al., 2012).

It should also be mentioned that the lack of design effect may be accounted for by the fact that autonomy support was measured with reference to several teachers, as opposed to a single teacher or a particular class. While this approach to measurement of autonomy support is legitimate (Soenens & Vansteenkiste, 2005), it may also have limited the possibility of obtaining DEFF. In addition, students may find it difficult to average their perceptions of autonomy support from different teachers, as support from teachers may vary.

## Conclusion

Despite these limitations, the present study has provided support for longitudinal relations between autonomy support and basic need satisfaction, as well as support for cross-cultural generalizability of former research. In particular, we found support for stationary effects, temporal causality and reciprocal causation for these variables in a longer time span than previously investigated (cf. Jang et al., 2012). However, the level of perceived autonomy support and basic need satisfaction may be gender specific, which is particularly interesting given the fact that girls' perceived autonomy support and basic need satisfaction shows a declining trend.

Practitioners may find it useful to know that perceived autonomy support has longitudinal effects on basic need satisfaction, thus emphasising the importance of autonomy support. Finally, students' basic need satisfaction affects subsequent perception of autonomy support. Hence, autonomy support and basic need satisfaction are, in fact, both antecedents to and consequences of themselves.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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