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Autonomy Support and Academic Stress: A Relationship Mediated by Self-regulated Learning and Mastery Goal Orientation

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Abstract

This study examines the relationship between autonomy support from instructors, self-regulated learning, mastery goal orientation and academic stress. College and graduate students in China (*N*=366) participated in this study. Mediation analysis was used to examine the relationships between the constructs. The results indicate that academic stress is a multidimensional construct with four subconstructs: pressures to perform, stress related to teacher expectation, perception of workload and stress related to academic self-perceptions. These sub-constructs were studied in relation to autonomy support, self-regulated learning, and mastery goal orientation. Direct effects of autonomy support were found on self-regulated learning and mastery goal orientation, as well as on stress related to academic self-perception. Mediation effects of self-regulated learning and mastery goal orientation were found between autonomy support and some of the subconstructs of academic stress.

Introduction

College is a time for many students to explore areas of academic interest and experience new ways of thinking and new ideas. However, today's college students are also facing academic stress from a variety of potential sources. Academic stress refers to unpleasant psychological situations caused by high educational expectations from teachers and family members, pressure on academic achievement, or the educational and examination system (Sarita, 2015). More specifically, Gupta and Khan (1987) defined academic stress as a mental distress due to students' anticipated frustration related to academic failure or even awareness of the possibility of such failure. Academic stress usually happens when academically related demands exceed the adaptive resources available to an individual (Wilks, 2008). It is one of the major factors that can undermine undergraduate and graduate students' wellbeing (Michie, Glachan, & Bray, 2001), although acceptable levels of stress may help to improve the individuals' performance (Sarita, 2015). High levels of academic stress, however, are associated with poor academic performance (Sohail, 2013), and a variety of psychological problems, such as negative emotion (Zhang & Zheng, 2017), depression and anxiety disorders, especially during tests and examination periods (Bedewy & Gabriel, 2015). Studies have identified various sources of academic stress, such as studying for and taking exams, grade competition (Sarita, 2015), mastering a large amount of content in a small

amount of time (Abouserie, 1994; Agrawal & Chahar, 2007), poor time management (Fairbrother & Warn, 2003), high expectations from themselves and others (Ang & Huan, 2006), a challenging learning environment (Tackett, Wright, Lubin, & Pan, 2017), and low self-perception of academic ability (Bedewy & Gabriel, 2015). Since academic stress has a negative impact on students both academically and psychologically, and it is difficult to eliminate it from the sources (e.g., cancelling the exams or reducing the amount of curriculum materials), it is important to identify factors that can mitigate students' academic stress, and examine how these factors work together. According to previous research, instructors' support of students' autonomy facilitates students' self-regulated learning and wellbeing (Black & Deci, 2000; Niemiec & Ryan, 2009), and self-regulation could help students cope with academic stress (Hj Ramli, Alavi, Mehrinezhad, & Ahmadi, 2018) and decrease their anxiety over time (Black & Deci, 2000). Moreover, autonomy support from the instructors increases university students' adoption of mastery goal orientation (Black & Deci, 2000), which in turn produces positive educational outcomes, such as intrinsic motivation and less academic stress (Senko, Hulleman, & Harackiewicz, 2011). Therefore, it is interesting to investigate the relationships among instructors' support on students' autonomy, academic stress, self-regulated learning and mastery goal orientation. However, no studies have examined the direct relationship between autonomy support from instructors and academic stress, as well as whether autonomy support indirectly affects academic stress through its effects on self-regulated learning and mastery goal orientation. The purpose of this study is to examine the above-mentioned relationships.

Autonomy Support and Positive Outcomes

Basic Psychological Needs Theory (BPNT) is a sub theory of Self-determination Theory (SDT) which focuses on the concept of basic psychological needs and their relationship to psychological health and well-being. The theory argues that all three psychological needs are essential and contexts that support these needs will always impact wellness (Ryan & Deci, 2008). Social support is considered as one of the most important ways to help students cope with academic stress (Sarita, 2015; Wilks, 2008), of which teachers' support for autonomy deserves close attention because academic stress occurs in the educational context. According to SDT, autonomy support happens when the teacher (1) takes the student's perspective, (2) allows opportunities for choice and self-initiation, (3) provides a meaningful rationale for the requirement, (4) acknowledges student's feelings and (5) minimizes the use of pressures and demands (Deci, Eghrari, Patrick, & Leone, 1994). Research finds that support of students' basic psychological needs for autonomy in the classroom promotes their self-regulated learning, academic performance and psychological wellbeing (Abdulhay, Rahimi, & Samigorganroodi, 2016; Niemiec & Ryan, 2009). In addition, students with mastery goals do not view an achievement situation as an evaluation of their capabilities, so anxiety or stress should not be present both before and after a challenging task (Sideridis, 2005). In this section, we will review studies that examine the relationship between autonomy support, self-regulated learning, mastery goal orientation and academic stress.

Mastery Goals, Autonomy Support and Academic Stress

Achievement goal theory classifies learners into two distinct achievement profiles: mastery goals and performance goals (Ames, 1992). Central to a mastery goal is the belief that effort and outcome covary and this belief maintains achievement-directed behavior over time (Weiner, 1986). Those who adopt mastery goals aim to develop their competence, make progress, improve themselves, and overcome challenges through hard and persistent work (Dweck, 1986; Reeve, 2014). Students' achievement goal orientation patterns are relatively stable, and these patterns are associated with students' academic well-being (Tuominen-Soini et al., 2012). Mastery goals are easier to attain and therefore provide greater feelings of competence, which would lead to positive educational outcomes (Senko et al., 2011). For instance, Korean nursing students with mastery approach goal orientations experienced less academic stress than those with performance goal orientations (Kim, Lim, & Noh, 2016). The same occurred among university students in Iran (Kadivar et al., 2011). Benita, Roth, and Deci, (2014) found higher levels of enjoyment and less stress in classes that supported autonomy.

The adoption of mastery goals increases with the increase of autonomy support from instructors in college students (Akram, Sultan, & Ijaz, 2014). Students who perceive their teachers and learning tasks to support their autonomy, often exhibit higher intrinsic motivation (Niemiec & Ryan, 2009), and intrinsic motivation is closely associated with mastery goal orientation among college students (Bieg, Reindl, & Dresel, 2017; Tariq, Mubeen, & Mahmood, 2011). In an autonomy-supportive context (e.g., when students perceive their level of choice is high, mastery goals foster positive emotional experiences (Pekrun, Cusack, Murayama, Elliot, & Thomas, 2014), interest, enjoyment and behavioral engagement (Benita et al., 2014; Black & Deci, 2000). This is perhaps because students whose need for autonomy is met do not always have to meet standards of performance to feel worthy because their self-esteem has been nurtured (Shih, 2013). As a result, a negative correlation is found between intrinsic motivation and academic stress and depression (Huang, Lv, & Wu, 2016). The relationships between autonomy support and mastery goal orientation, and between mastery goal orientation and academic stress, suggest that autonomy support might influence students' academic stress indirectly through mastery goal orientation.

Self-regulated Learning, Autonomy Support and Academic Stress

Self-regulated learning refers to learning that is guided by metacognition, strategic action in terms of planning, monitoring, evaluating progress against a standard, and motivation to learn (Zimmerman, 1990). It describes one's ability to understand and control one's learning environment in terms of goal setting, self-monitoring, self-instruction, and self-reinforcement (Harris & Graham, 1999; Schraw, Crippen, & Hartley, 2006). Self-regulated learning helps students to reduce academic stress (Hj Ramli et al., 2018), decreases their anxiety over time (Black & Deci, 2000), and it is negatively related to depressive symptoms for Chinese and American adolescents (Jia, Way, Ling, Yoshikawa, Chen, Hughes, & Lu, 2009). Self-regulated learning strategies, such as time management behavior, reduce academic stress (Misra & McKean, 2000).

Teachers' support of students' autonomy has been found to facilitate students' self-regulated learning, wellbeing, and academic performance (Niemiec & Ryan, 2009). When students perceived that their instructors supported their autonomy, this support directly increased university students' autonomous self-regulation and use of self-regulated learning strategy (Abdulhay et al., 2016; Black & Deci, 2000). Autonomy support sometimes increases self-regulated learning indirectly through structure in the classroom (e.g., Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009). Students perceiving higher levels of teachers' autonomy support seek academic help more often (Shih, 2013), which is a common self-regulated learning strategy (Gonida, Karabenick, Stamovlasis, Metallidou, & Greece, 2019), because it indicates that the individual is closely monitoring his/her progress and has the ability to choose efficient problem-solving strategies. Overall, the existing findings indicate that autonomy support from teachers can promote students' self-regulated learning and students' self-regulated learning can reduce their academic stress. Hence, we anticipated that there might be an indirect relationship between teachers' autonomy support and academic stress through self-regulated learning.

Gaps in Literature and Hypotheses

Autonomy support from instructors has often been studied in relation to students' motivation, but the relationship between autonomy support and academic stress has rarely been examined. Self-regulated learning and mastery goal orientations have often been studied in relation to academic achievement; their relationship with academic stress has not been examined extensively either. Besides, most studies on academic stress have focused on one variable that impacts academic stress (e.g., Tuominen-Soini et al., 2012) and test only the direct relationship between them (e.g., Abdulhay et al., 2016; Black & Deci, 2000). Indirect predictors of academic stress need to be explored. Last but not least, most studies on academic stress do not differentiate between general academic stress and academic stress related to a particular class/course (Bedewy & Gabriel, 2015), so participants' survey responses might refer to either of them and make the results unreliable. The current study includes multiple variables in the model, allowing for simultaneous study of their respective impact on academic stress and also the interrelationships between them.

Based on results of existing literature, we developed the following hypotheses: (1) autonomy support from instructors directly and positively predicts college students' self-regulated learning and mastery goal orientation and negatively predicts students' academic stress; (2) autonomy support influences students' academic stress indirectly through mastery goal orientation and self-regulated learning.

Current Study

The current study examines academic stress among Chinese college students. According to Salili, Chiu, and Lai (2001), Chinese students appear to work harder and experience more academic stress, such as test anxiety, than their counterparts in the West. Main sources of Chinese university students' academic stress include competition among fellow students, low learning efficiency, and poor relationships with teachers or other students (Li, Lin, Bray, & Kehle, 2005).

However, academic stress among college students has not received enough attention, even though China has many college students who face growing academic stress, which affects their well-being (Zhang & Zheng, 2017). The current study surveyed participants about their academic experience in a class they were taking to learn about their academic stress level, autonomy support from the instructor, and their goal orientation and self-regulated learning habits for that class.

Methods

Participants

Data were collected from undergraduate and graduate students in China. Graduate students were included to see if there was any difference in academic stress experienced by undergraduate and graduate students. Four hundred seventy two questionnaires were collected from more than 10 universities in different provinces of China, and the majority of questionnaires came from seven universities. Questionnaires with large amount of missingness and with the same options for all items were discarded. One hundred six questionnaires were considered invalid and were excluded, leaving 366 valid for further analysis. The mean age of the participants was 21.15, and 145 (39.6%) of them were male and 221 (60.4%) were female; 288 (78.7%) were undergraduates and 78 (21.3%) were graduates.

Procedure

The survey was translated into Chinese, and a pilot study was conducted with 15 undergraduate and graduate students to check the clarity and comprehensibility of the items before it was administered to the students in China. Translations of a few items were modified to clarify the meaning based on the respondents' comments. The translated survey was compiled on a website (wjx.cn) and administered to the participants in China via an email link and a mobile app. The researchers contacted university faculty and staff to send the survey link to their students. The students completed the survey either on their computer or on their smart phone. Participants had the chance to win a small incentive if their responses were considered valid by the researchers.

Instruments

Altogether four scales were used for this study (For a list of the items for each scale category, see the Appendix). Participants' demographic information, such as age, gender, and grade level was also collected. A 6-point Likert scale was used throughout the survey. The Likert scale measures the frequency of an action, from 1 = never to 6 = always, or the degree to which the participants agree with the statement, from 1 = strongly disagree to 6 = strongly agree.

The Perceived Academic Stress Scale (Bedewy & Gabriel, 2015). This is a multidimensional scale that measures perceptions of academic stress among college students. This scale measures academic stress in general instead of academic stress in a specific academic course, so five items were excluded because they are not applicable for the current study. Altogether 13 items were

used. Sample items include "Examination times are very stressful to me," and "I believe that the amount of work assignment is too much."

Learning Climate Questionnaire (Williams & Deci, 1996). A short form of this questionnaire with six items was used to measure autonomy support from teachers as perceived by students. Sample items include "I feel that my instructor provides me with choices and options," and "My instructor encouraged me to ask questions."

Self-regulated Learning Scale (Iwamoto, Hargis, Bordner, & Chandler, 2017). Seven items were adopted from this scale to measure how students plan, monitor, exert effort, and evaluate their personal progress in study. Example items include "I ask myself questions to make sure I know the material I have been studying," and "Even when study materials are dull and uninteresting, I keep working until I finish."

Task Goal Orientation Scale (Midgley & Urdan, 2001). This scale examines achievement goal orientation, including mastery goal orientation and performance goal orientation. Because the current study focuses only on mastery goals, three items from this scale were adopted to measure participants' mastery goal orientation. Sample items include "An important reason why I do my schoolwork is because I like to learn new things" and "I do my schoolwork because I'm interested in it."

Plan of Analysis

Mediation analysis was conducted to analyze the relationships among the latent factors with the lavaan package in R (R Core Team, 2019). The mediation models in the present study incorporates three kinds of variables: (a) the endogenous variables, which are academic stress and its subconstructs; (b) the exogenous variable, which is autonomy support from the teachers; (c) mediator variables, which are self-regulated learning and mastery goal orientation. Demographic variables including age, gender, and grade level were added into the models as covariates to determine their influence on academic stress.

Tested models were evaluated by using the following global model fit indices: (1) the comparative fit index (CFI); (2) Tucker-Lewis index (TLI); (3) standardized root-mean-square residual (SRMR); (4) root mean square error of approximation (RMSEA); (5) Chi-square statistic and degrees of freedom; (6) the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Acceptable fit in the current study was defined as CFI and TLI values of 0.90 or greater (Schumacker & Lomax, 1996), an SRMR of 0.08 or less, an RMSEA value 0.08 or less (Hu & Bentler, 1999; Joreskog & Sorbom, 1996). Degrees of freedom divided by chi-square with values smaller than 3 indicate acceptable fit (Kline, 1998). Lower AIC and BIC values indicate better fit. Local fit indices used to examine the models include standardized loadings, regression coefficients and R-squares.

Results

Normality of Data

Normality of the data were checked to decide which estimation method was appropriate. The values of skewness for all items were between -1.37 and 0.69, and the values of kurtosis were between -0.79 and 1.72, except for one item in mastery goal subscale with a slightly higher kurtosis value of 2.8. With all but one value under 2, we can say that univariate normality holds. Mardia's test and plot of the data also showed that the data were roughly normally distributed, so maximum likelihood estimation method was used in the following analysis.

Reliability

McDonald's omega was computed to estimate the reliability of the entire survey and four scales separately. Coefficients of McDonald's omega was .87 for the total survey, .85 for the academic stress scale, .82 for the mastery goal scale, .88 for the autonomy support scale, and .77 for the self-regulated learning scale. In addition, reliability coefficients of subdimensions of academic stress were .76, .79, .74, and .81. In general, all reliability coefficients were acceptable.

Exploratory and Confirmatory Factor Analysis

An exploratory factor analysis (EFA) was done to explore dimensions of Academic Stress Scale, because academic stress is a multidimensional construct and the original survey was adapted. Four subdimensions of academic stress were found: perception of academic workload, pressure from teacher expectation, pressure to perform, and academic self-perception. The four-factor model established in the EFA was then replicated with confirmatory factor analysis (CFA) (see Table 1). The CFI = .89, TLI = .85, RMSEA = .077, SRMR = .070, $\chi^2 = 242.97$, $df = 59$, $p < .001$, AIC = 15393.02, BIC = 15520.75. Descriptive statistics indicate that the biggest contributors of stress were pressure to perform (M=3.57) and stress related to teacher expectations (M=3.54), followed by perceptions of academic workload (M=3.47), and stress related to academic self-perceptions of academic ability (M=2.95).

Table 1. *Factor Structure of the Academic Stress Scale*

Items	**Factor Loadings**			
	F1	F2	F3	F4
I believe that the amount of work assignment is too much.	.66			
The size of the curriculum (workload) is excessive.	.74			
The examination questions are usually difficult.	.75			
My teachers are critical of my academic performance.		.70		
Teachers have unrealistic expectations of me.		.74		
Examination times are very stressful to me.			.43	
I fear failing courses this year.			.65	
Examination time is short to complete the answers.			.69	

I am unable to catch up if getting behind the work.			.76	
I am confident that I will be a successful student.				.50
I can make academic decisions easily.				.60
I have enough time to relax after work.				.74
The time allocated to classes and academic work is enough.				.73

Note: F1 = perception of academic workload; F2 = pressure from teacher expectation; F3 = pressure to perform; F4 = academic self-perception.

Mediation Models

Mediation analyses were conducted to examine the direct effect of autonomy support on academic stress and its indirect effect on academic stress through mastery goal orientation and self-regulated learning. Mediation model with academic stress (when it is treated as a unidimensional construct) as the endogenous variable did not yield good model fit with either mastery goal orientation or self-regulated learning as the mediator (see Table 1 and 2 for global model fit indices), and the path coefficient between autonomy support and academic stress was not significant. Therefore, the subconstructs of academic stress were used in the following analysis, and eight models were run with each of the four subconstructs of academic stress as the endogenous variables, autonomy support as the exogeneous variable, and mastery goal orientation and self-regulated learning as the mediators respectively.

Models with mastery goal orientation as the mediator. Based on global model fit indices and local parameters of the models, three acceptable models were identified, and significant direct and mediating effects were found. Three of the four models with mastery goal orientation as the mediator yielded good model fit, and the model with pressure from teacher expectations as the endogenous variable was not identified, so there was no way to analyze the results (see Table 2). Factor loadings of the indicators in the models ranged between .41 and .90. Significant effects of demographic variables was only found in one model.

Table 2. *Global Model Fit Indices of Models with Mastery Goal Orientation as the Mediator*

Endogenous Variable	CFI	TLI	SRMR	RMSEA	χ^2	DF	AIC	BIC
Academic stress	0.85	0.83	0.081	0.084	634.17	167	22688	22859
Academic workload	0.93	0.91	0.068	0.067	219.51	84	11894	12011
Pressure to perform	0.93	0.91	0.064	0.076	295.57	113	14478	14610
Academic self-perception	0.92	0.9	0.073	0.085	266.57	98	12810	12934
Teacher expectations								

The model with perception of academic workload as the endogenous variable and mastery goal orientation as the mediator yielded adequate global model fit. Autonomy support positively

predicted mastery goal orientation (b = .42, p < .001), and mastery goal orientation negatively predicts perception of academic workload (b = -.17, p = 0.017). Autonomy support did not significantly predict perception of academic workload (b = -.02, p = .78), but the indirect effect between autonomy support and perception of academic workload mediated by mastery goal orientation was significant (b = -.07, p = .02), so there was a full mediation (see Figure 1). The total variance in perception of academic workload explained by the direct and indirect effects was .155.

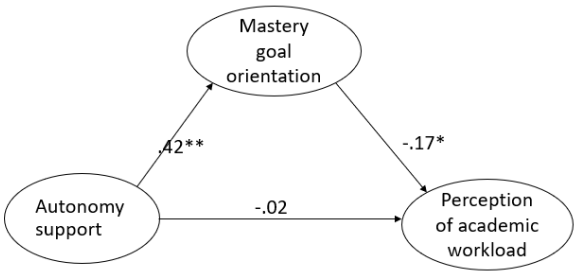

Figure 1. Model on relationship between autonomy support, mastery goal orientation and perception of academic workload.

The model with pressure to perform as the endogenous variable and mastery goal orientation as the mediator yielded good global model fit. Loadings of the indicators ranged between .41 and .90. Autonomy support positively predicted mastery goal orientation (b = .43, p < .001), and mastery goal orientation negatively predicted pressure to perform (b = -.15, p = 0.033). Autonomy support did not significantly predict pressure to perform (b = -.015, p = .827), but the indirect effect between autonomy support and pressure to perform mediated by mastery goal orientation is significant (b = -.07, p = .04), so there was a full mediation (see Figure 2). The total variance explained in pressure to perform was .132.

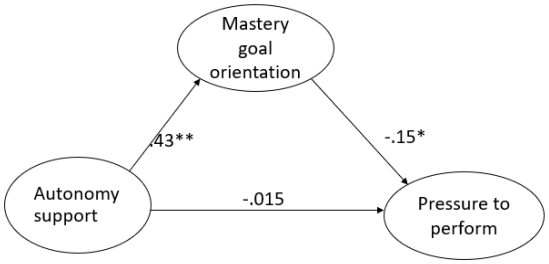

Figure 2. Model on relationship between autonomy support, mastery goal orientation and pressure to perform.

The model with stress from academic self-perception as the endogenous variable and mastery goal orientation as the mediator yielded good model fit. Autonomy support positively predicted mastery goal orientation (b = .44, p < .001), and mastery goal orientation negatively predicts stress from academic self-perception (b = -.21, p = 0.002). Autonomy support negatively predicted stress

from academic self-perception (b = -.34, p < .001), and the indirect effect between autonomy support and stress from academic self-perception mediated by mastery goal orientation is also significant (b = -.09, p = .004), so there was a partial mediation (see Figure 3). Gender difference was found in this model, with women students perceiving more stress related to academic self-perception than men (b = .14, p = .014). The total variance explained in the academic self-perception was .403.

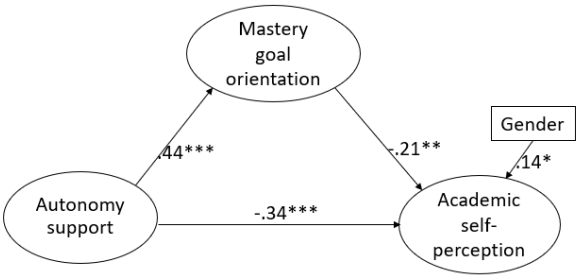

Figure 3. Model on relationship between autonomy support, mastery goal orientation and stress from academic self-perception.

Models with self-regulated learning as the mediator. The global model fit of the four models with the subconstructs of academic stress as the endogenous variable and self-regulated learning as the mediators was not good enough, with CFIs and TLIs under .90, some of the SRMRs and RMSEAs above .80 (see Table 3), and values of $\chi 2$/df slightly greater than 3. But these values and the AICs and BICs were all better than those in the model with academic stress (as a unified construct) as the endogenous variable. We can say that these models had near model fit. Factor loadings of the indicators in the models ranged between .43 and .90.

Table 3. *Global Model Fit Indices of Models with Self-regulated Learning as the Mediator*

Endogenous Variable	CFI	TLI	SRMR	RMSEA	$\chi 2$	DF	AIC	BIC
Academic stress	.80	.78	.940	.082	967.11	249	28075	28278
Academic workload	.88	.85	.078	.086	400.21	101	19304	19467
Pressure to perform	.85	.83	.086	.071	512.58	183	18607	18747
Academic self-perception	.89	.87	.074	.066	376.48	146	16589	16736
Teacher expectations	.87	.85	.076	.071	364.58	129	15692	15832

In the model with perception of academic workload as the endogenous variable, autonomy support positively predicted self-regulated learning (b = .34, p < .001) and negatively predicted perception of academic workload (b = -.13, p = 0.047). However, self-regulated learning positively predicted perception of academic workload (b = .14, p = 0.045), and the mediation effect was not significant. In the model with pressure to perform as the endogenous variable, autonomy support positively predicted self-regulated learning (b = .24, p < .001), no significant effects of autonomy

support and self-regulated learning were found on pressure to perform, and the mediation effect was not significant.

In the model with stress from academic self-perception as the endogenous variable, autonomy support positively predicted self-regulated learning (b = .24, $p < .001$) and negatively predicted stress from academic self-perception (b = -.32, $p < .001$). Self-regulated learning negatively predicted stress from academic self-perception (b = -.37, $p < .001$), and the mediation effect was also significant (b = -.07, $p = .003$), so there is a partial mediation (see Figure 4). The effect of gender on academic self-perception was also significant (b = .11, $p = .044$).

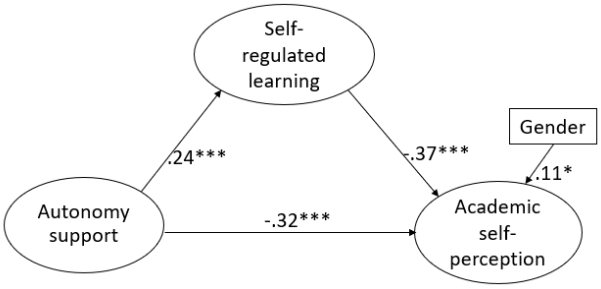

Figure 4. Model on relationship between autonomy support, self-regulated learning and stress from academic self-perception.

In the model with pressure from teacher expectation as the endogenous variable, autonomy support positively predicted self-regulated learning (b = .24, $p < .001$) and negatively predicted pressure from teacher expectation (b = -.12, $p = 0.05$), and self-regulated learning positively predicted pressure from teacher expectation (b = .33, $p < .001$). The mediation effect of self-regulated learning between autonomy support and pressure from teacher expectation was also significant (b = .10, $p < .001$), so there is a partial mediation (see Figure 5).

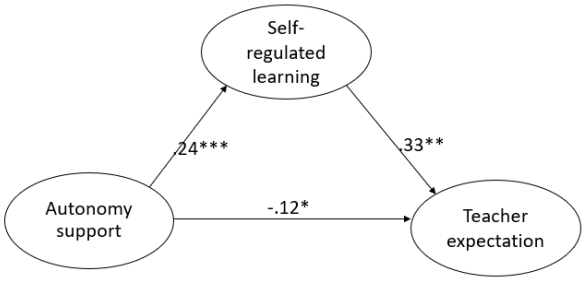

Figure 5. Model on relationship between autonomy support, self-regulated learning and stress from teacher expectation.

Discussion

Results of the current study revealed new findings. First, we got better model fit when we examined subconstructs of academic stress. Second, we found that autonomy support from the

instructors has a negative effect on stress from academic self-perception, perception of academic workload, and stress from teacher expectation. Third, autonomy support also has indirect effects on the subdimensions of academic stress mediated by mastery goal orientation and self-regulated learning. Finally, results of the study also provide further evidence on the effects of autonomy supports on mastery goal orientation and self-regulated learning. The findings provide evidence of the applicability of using BPNT to study academic stress, students' goal orientation and self-regulated learning habit.

Academic Stress as a Multidimensional Construct

The results from EFA and CFA models showed that academic stress was multiterminal. When academic stress was treated as a unified construct, the model fit indices were not adequate and the direct and indirect effect of autonomy support on academic stress were not significant. Interestingly, when autonomy support was studied in relation to the subconstructs of academic stress, model fit was good and significant direct and indirect effects were found. This is perhaps because each subconstruct concerns a distinct aspect of academic stress which are not closely correlated. Therefore, the strengths of association between autonomy support and the different subconstructs of academic stress are different. The need to examine the subconstructs separately is also shown by the larger values of CFI and TLI, and smaller values of SRMR, RMSEA, AIC and BIC in the models with the subconstructs of academic stress as endogenous variables.

Direct Effects of Autonomy Support

Autonomy support directly influences mastery goal orientation, self-regulation and the subconstructs of academic stress. The finding that autonomy support was a positive predictor of mastery goal orientation is consistent with the results in existing research (e.g., Akram et al., 2014). Previous studies found that autonomy support from instructors (such as providing more choices and involving the students in the decision-making process for their learning) provides students with more opportunities to explore their own interest, which is essential for having a mastery goal orientation (Guay, Boggiano, & Vallerand, 2001). With a mastery goal in mind, students do not study just to meet the teachers' requirements, and they may also feel less need to outperform other students. When they are intrinsically motivated, they are more likely to invest in studying and perform better, so they experience less need to fear doing poorly or appearing incompetent (Hulleman, Schrager, Bodmann, & Harackiewicz, 2010).

Our finding indicated that autonomy support positively predicted self-regulated learning. Research has shown that the more students feel that their autonomy is supported by their instructors, the better they tend to self-regulate their own learning (e.g., Niemiec & Ryan, 2009). Autonomy support, such as teachers being respectful for students' opinion, allowing them to be involved in the decision process, and providing a rationale when giving requirements contribute to students' self-regulated learning habits (Sierens et al., 2009). When teachers are less controlling, but instead respect students' opinions, allow them to be involved in the decision process, and provide a rationale when giving requirements, students improve their studies by making plans,

monitoring and evaluating their own study processes and increasing effort to realize their goals; these activities all contribute to self-regulated learning.

It is not surprising that autonomy support was a negative predictor of stress related to academic self-perception. When students perceive autonomy support from their instructors, they have more control over their study and are more likely to be intrinsically motivated (Grolnick & Ryan 1989; Guay & Vallerand 1997). When instructors understand students' feelings and exert less pressure, students are more relaxed and confident, which improves their academic self-perception. Moreover, students who perceive higher levels of teachers' autonomy support seek academic help more often (Shih, 2013). The help-seeking behavior helps them to improve their grades and their academic self-perception.

Mediation Effects of Mastery Goal Orientation

Because autonomy support increases adoption of mastery goals, and mastery goal orientation decreases pressure to perform, perception of academic workload, and stress related to academic self-perception, the mediation effects of mastery goal orientation were detected. Students with higher levels of autonomy support are more likely to adopt mastery goals (Madjar, Nave, & Hen, 2013), and these students experience greater feelings of competence (Senko et al., 2011) and lower level of academic stress (e.g., Kim et al., 2016). With a mastery goal orientation, students attach more importance to mastery of the content instead of competing with other students or to impress the teachers, so they feel less pressure to perform. Students with mastery goal orientation have higher expectancies for success (Sekreter, 2016); so they have a higher academic self-perception. They may also perceive the workload to be appropriate because they think it is necessary to help them grasp the content.

Our results did not find a significant indirect relationship between autonomy and teacher expectations through mastery goal orientation. This is probably because students often adopt more than one goal orientations (Senko et al., 2011), which reduces the effects of mastery goal orientation. For instance, individuals can embrace both mastery and performance goal at the same time, because they want to get competent and grasp the content, but meanwhile they also want to meet teachers' expectations and avoid failure in front of the teachers and classmates.

Mediation Effects of Self-regulated Learning

Self-regulated learning mediates the relationship between autonomy support and stress related to academic self-perception. This might be because students tend to self-regulate their own learning when their autonomy is supported by their instructors (Niemiec & Ryan, 2009), and students who regulate their studying have more control over their time and learning outcome, so they perform better (Daniela, 2015). Students who prosper academically tend to have higher confidence in their ability and experience less stress about their academic self-perception. Besides, self-regulated students are also more likely to ask themselves questions to expand prior knowledge (Palinscar & Brown, 1984), which may improve their academic confidence. This improved confidence may reduce stressing about their academic ability.

It is difficult to interpret how self-regulated learning increases stress from academic workload and teacher expectation. It might be because the items in self-regulated learning overly stress effort exertion, for example, "keep studying when the content is dull" and "when the teacher did not require doing so." Students who score high on these items may be those who already feel stress from academic workload and teacher expectations, so they force themselves to regulate their own study more. Further analysis needs to be done to determine potential causes.

There was no significant indirect relationship between autonomy support and pressure to perform through self-regulated learning. This is probably because pressure to perform is the biggest source of academic stress, and fears of examinations or not being able to catch up can still be high even if students perceive autonomy support and regulate their learning well.

Conclusion and Implications for Future Research

It is commonly believed that satisfying students' need for support of autonomy is important and relates to positive outcomes. In real life, however, educators often resort to close supervision and monitoring, external controls and evaluations to ensure that learning occurs. This can undermine the natural and voluntary process in high-quality learning (Niemiec & Ryan, 2009; Ryan & Brown, 2005). Since autonomy support is associated with positive academic behaviors, such as self-regulated learning, adoption of mastery goals orientation, and less academic stress, we therefore should promote teachers' autonomy-supportive behaviors, such as providing choices in learning tasks, explaining relevance about a task (Madjar et al., 2013), and conveying a rationale and value for classroom activities (Reeve, Deci, & Ryan, 2004). These practices benefit students by showing the value of schoolwork (Reeve & Jang, 2006) and helping them pursue their interests and attain their own academic goals (e.g., Assor, Kaplan, & Roth, 2002). College professors may not realize the different sources and intensity of students' academic stress. More importantly, professors may not realize the importance of providing autonomy support to students. For instance, professors commonly impose deadlines for homework submission and some even do not accept any late submission, regardless of the reasons. They also seldom provide different options for students. These practices increase students' academic stress and do not inspire them to adopt mastery goals. It is high time that researchers disseminate the importance of autonomy support to college professors to benefit the psychological wellbeing of college students.

This study has limitations which may also provide directions for future research. This study was conducted only with data from college and graduate students in China. There could be more variations in different aspects of autonomy support among students from universities around the world. Future research may closely examine the different aspects of autonomy support. For instance, which aspect do students think is most important for their emotional wellbeing: opportunities for choice, instructors taking their perspective, minimum use of pressures and demands, meaningful rationale for the requirements, or acknowledging student's feelings? Researchers could also explore what hinders professors from supporting students' autonomy and how they may improve in this area. Future research could also examine the effects of support for the other two basic needs (according to BPNT, they are needs for relatedness and needs for competence) and academic stress, and the indirect effects through mastery-goal orientation and

self-regulated learning. Last but not least, as women students reported more stress related to academic self-perception in this study, more research can be done to investigate why women students are more stressed out about academic self-perception and what can be done to help them mitigate it.

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Appendix

Table 1. *Survey Items for the Four Constructs in the Study*

	Survey items
Autonomy support	1. I feel that my instructor provides me choices and options. 2. I feel understood by my instructor. 3. My instructor conveyed confidence in my ability to do well in the course. 4. My instructor encouraged me to ask questions. 5. My instructor listens to how I would like to do things. 6. My instructor tries to understand how I see things before suggesting a new way to do things.
Mastery goal orientation	1. An important reason why I do my schoolwork is because I like to learn new things. 2. An important reason why I do my work in school is because I want to get better at it. 3. I do my schoolwork because I'm interested in it.
Self-regulated learning	1. I ask myself questions to make sure I know the material I have been studying. 2. When work is hard I either give up or study only the easy parts. 3. I work on practice exercises and answer end of chapter questions even when I don't have to. 4. Even when study materials are dull and uninteresting, I keep working until I finish. 5. Before I begin studying, I think about the things I will need to do to learn. 6. I find that when the teacher is talking, I think of other things and don't really listen to what is being said. 7. When I'm reading, I stop once in a while and go over what I have read.
Academic stress	1. I have enough time to relax after work. 2. Examination time is short to complete the answers. 3. I am confident that I will be a successful student. 4. Examination times are very stressful to me. 5. I fear failing courses this year. 6. Teachers have unrealistic expectations of me. 7. My teachers are critical of my academic performance. 8. The examination questions are usually difficult. 9. I believe that the amount of work assignment is too much. 10. I am unable to catch up if getting behind the work. 11. The time allocated to classes and academic work is enough. 12. I can make academic decisions easily. 13. The size of the curriculum (workload) is excessive.