

Effects of Perceived Autonomy support from Social Agents on Motivation and Engagement  
of Chinese Primary School Students: Psychological Need Satisfaction as Mediator

## 1. Introduction

Students' motivation and engagement in their learning can, alongside other factors (e.g., intelligence), predict their academic achievement (Dotterer & Lowe, 2011; Taylor et al., 2014). Unfortunately, levels of student motivation and engagement often fluctuate across the school years (Fredricks, Blumenfeld, & Paris, 2004; Patall et al., 2018). This is particularly the case during the transition from primary to middle school (Skinner, Furrer, Marchand, & Kindermann, 2008). Hence, it is imperative to explore the major determinants of students' high-quality motivation and engagement, especially before students leave primary school; this is our study's main objective.

Various theoretical perspectives have been used to study student motivation and engagement, such as expectancy-value theory (Wigfield & Eccles, 2000), goal theory (Elliot & McGregor, 2001), and self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017). In this article, we draw from SDT as it is a theoretical framework that differentiates between quality and quantity of motivation (Ryan & Deci, 2017). We explore how motivation and engagement among Chinese primary school students can be predicted by perceived autonomy support from three social agents (teachers, parents, and peers); the mediating role of the satisfaction of psychological needs in this process was also tested. Before presenting our hypotheses, we review earlier SDT-based research on motivation and engagement.

### *1.1. Self-Determination Theory-Based Research*

#### *1.1.1. Student Motivation and Engagement*

SDT researchers (Ryan & Deci, 2017) conceptualize a continuum of motivational regulations, which vary in their degree of self-determination. Broadly speaking, *autonomous* or *self-determined* types of motivation reflect behavioral engagement as a result of enjoyment/task interest (intrinsic motivation) or integration of a behavior into one's core self and value system (integrated regulation), or due to the perceived personal utility and benefits of the behavior (identified regulation). In contrast, controlled forms of motivation reflect behavioral engagement stemming from internal pressures such as guilt or ego contingencies (introjected regulation), or external pressures such as rewards or punishments (external regulation).

Ryan and Deci (2017) argued that self-determined forms of motivation reflect high-quality motivation and result in desirable consequences. One of these outcomes is student engagement, that is, students' active involvement in learning activities, which can be multidimensional (e.g., behavioral, emotional, and cognitive; Fredricks et al., 2004). Numerous studies have consistently found that self-determined motivation can increase engagement in school activities among high school students (Datu, King, & Valdez, 2018) or among primary school students in grades 4-6 (d'Ailly, 2003), as well as in specific subjects such as physical education (PE) (e.g., Ntoumanis, 2001, 2005; Standage, Duda, & Ntoumanis, 2005, 2006). In contrast, low-quality student motivation (i.e., controlled forms of motivation) is often associated with lack of, or low, engagement such as boredom in PE (e.g.,

Ntoumanis, 2001). Moreover, in view of this evidence, an important question to ask is how different social agents can support student self-determined motivation and engagement?

### *1.1.2. Autonomy Support as Predictor of Motivation and Engagement*

Student motivation and engagement in the classroom have been shown to be influenced by students' social environment, namely their teachers and peers at school as well as their parents at home (Bronfenbrenner & Morris, 2006). In the SDT literature, the role of social agents has been conceptualized and measured in relation to the degree to which social agents support students' three basic psychological needs (see below for more details on these needs). Such support has been traditionally labeled 'autonomy support' (Deci & Ryan, 1985), although in most published studies this variable has been found to be associated with the satisfaction of all three psychological needs, not just autonomy (e.g., Jang, Reeve, Ryan, & Kim, 2009). Autonomy support refers to a group of behaviors that aim to nurture students' inner motivational resources by offering students meaningful choices, attempting to understand their perspectives, providing them with personally meaningful rationales for task engagement, encouraging their input in decision making processes, and giving them opportunities for self-initiated behaviour (Cheon et al., 2019).

Although student motivation and engagement in school are shaped by multiple social agents, past empirical studies grounded in SDT have tended to test the effects of autonomy support provided by teachers or parents in isolation. The positive influences of teacher autonomy support on student self-determined motivation and engagement are well-documented in terms of general learning activities (e.g., Jang et al., 2009), as well as in specific subjects such as PE (e.g., Ntoumanis, 2005) and science (Lavigne, Vallerand, &

Miquelon, 2007). Such findings have been observed in Western individualistic contexts (e.g., Ntoumanis, 2005) and Asian collectivistic cultures (e.g., Zhou, Ma, & Deci, 2009), and in academic levels ranging from elementary (e.g., Zhou et al., 2009) to secondary (e.g., Jang et al., 2009) to college/University level (e.g., Hassan & Al-Jubari, 2016).

Although far less SDT-based research has focused on the relation between parental autonomy support and student motivation, the results of such research have also shown parental autonomy and relational support to predict self-determined motivation for planning to attend college among high school students (Niemic et al., 2006). In a sample of Chinese students, Vansteenkiste, Zhou, Lens, and Soenens (2005) revealed that parental autonomy support significantly predicted self-determined motivation in a foreign study program. However, the participants were young adults with an average age of over 20 years, some of whom had migrated to Belgium eight months previously.

Lastly, with regard to peer interactions and relationships (e.g., acceptance and friendship), research has shown that they become progressively more influential as children grow older (Rubin, Bukowski, & Parker, 1998). For example, children under the age of 10 years rely more on adult feedback to judge their competence. In contrast, for those in late childhood and early adolescence peer comparison and feedback are highly influential (Horn & Weiss, 1991). One previous SDT-based study has demonstrated that peer autonomy support has a positive effect on academic engagement among Iranian high school students (Hakimzadeh, Besharat, Khaleghinezhad, & Jahromi, 2016). To our knowledge, the possible effect of autonomy support from parents or peers on motivation and engagement among Chinese primary school students has not been tested by previous SDT-based research.

Very few studies based on SDT framework have examined the joint contributions of autonomy support from multiple social agents on student motivation and engagement. For example, in a sample of high school students in Canada, Vallerand, Fortier, and Gaya (1997) reported that parental autonomy support better predicted students' self-determined motivation, compared to support from teachers and school administrators, although autonomy support from all three social agents were significant predictors of student motivation. Another past study has documented that both teacher need support (i.e., autonomy, structure, and involvement support) and peer emotional and academic support uniquely predicted motivation and engagement among students from a middle school (Grades 6-8) in the southeastern United States (Kiefer, Alley, & Ellerbrock, 2015).

Two SDT-based studies have examined the joint effects of perceived support from parents, teachers, and peers. Sampling high school students from four countries (i.e., Hungary, Estonia, Britain, and Finland), Hagger et al. (2009) showed that both parental and peer autonomy support had direct effects on student autonomous motivation in a leisure-time physical activity context; teacher autonomy support had an indirect effect via PE-specific autonomous motivation. However, these associations were tested in relation to physical activity in leisure time context and not in terms of school or subject-specific motivation. Legault, Green-Demers, and Pelletier (2006) revealed that perceived support (i.e., autonomy, competence, and interpersonal affiliation support) from parents, teachers, and peers were negatively linked to amotivation among Canadian high school students; parental support showed the strongest effects. However, this research only examined amotivation (i.e., lack of motivation).

To date, however, there is a lack of studies based on the SDT framework which have investigated the joint effects of autonomy support from teachers, parents, and peers on student motivation and engagement in learning activities, and whether such relations are mediated by student psychological need satisfaction. This is addressed in the current study.

### 1.1.3. *The Mediating Role of Need Satisfaction*

One of the central assumptions within SDT is that fulfillment of students' three basic psychological needs — autonomy, competence, and relatedness, results in positive human development (Ryan & Deci, 2017). *The need for autonomy* is proposed as the need for an individual to make their own choices and feel that they are in control of their actions. *The need for competence* refers to the pursuit of experiences of accomplishment in personally meaningful tasks. *The need for relatedness* is defined as the need to be close to and accepted by others (Deci & Ryan, 2000).

Considerable research in education, including in PE, has shown that satisfaction of these three basic needs positively contributes to self-determined motivation (e.g., Zhang, Solmon, Kosma, Carson, & Gu, 2011) and engagement (e.g., Rutten, Boen, & Seghers, 2012). Additionally, the mediating role of need satisfaction in the perceived support - motivation associations has been examined. For example, Standage et al (2005) reported that need support from PE teachers positively predicted student intrinsic motivation and engagement-related outcomes (e.g., concentration) via psychological need satisfaction. In a classroom-based longitudinal study of 8<sup>th</sup>-grade Korean students, Jang, Kim, and Reeve (2012) reported that perceived autonomy support from teachers teaching different subjects (i.e., biology, geology, earth science, sociology, Korean, and history) positively predicted student mid-

semester satisfaction with their autonomy need; the latter subsequently predicted better student engagement and higher school grades at the end of the semester.

### *1.2. Contributions and Hypotheses of the Present Study*

The central focus of the present study was to test a model which simultaneously investigated the predictive effects of perceived autonomy support from parents, teachers, and peers on Chinese primary school students' motivation and engagement, as well as the mediating role of psychological need satisfaction in these relations. In doing so, this study extends existing literature in four important ways.

*First*, this is the first study to test simultaneously the predictive effects of perceived autonomy support of three social agents on students' motivation and engagement in school activities. Our work extends previous studies that have tested the effects of autonomy support from only some of these social agents, or looked at these effects in relation to non-school specific outcomes, or in relation to amotivation only, or did not consider the mediatory role of psychological need satisfaction.

*Second*, we used a sample of Chinese students, which have rarely been studied in SDT research in primary education. Some scholars have argued that the accumulated evidence from SDT research obtained in Western cultures might not apply to Eastern cultures (e.g., Wu, Lai, & Chan, 2014). Students in Western countries with individualistic cultures place more emphasis on the self, whereas students in collectivistic Asian countries value more social obligations (Hakimzadeh et al., 2016; Hassan & Al-Jubari, 2016). Hence, the support and satisfaction of individual needs might not predict as strongly optimal student outcomes,



as has been the case in Western societies. Therefore, it is worthwhile to investigate SDT propositions among Chinese students.

*Third*, most of the previous research in this area has been conducted with high school or university students; comparatively, there is much less research with students from upper primary grades. However, understanding and supporting motivation in the latter age group could be beneficial in terms of preventing reductions in student self-determined motivation observed in early adolescence (Ntoumanis, Barkoukis, & Thøgersen-Ntoumani, 2009).

*Fourth*, the current study will explore gender differences in the relations among the study variables. One of the assumptions of SDT is that the processes linking autonomy support, need satisfaction, motivation, and motivation-related outcomes are invariant across gender and other personal characteristics (Ryan & Deci, 2017). This assumption has been tested by a limited number of studies focusing on teacher support. For instance, research in PE domain has indicated that the pattern of the associations among perceptions of PE teacher autonomy support, student need satisfaction, autonomous motivation, and PE-related adaptive outcomes were invariant across gender (e.g., Standage, Gillison, Ntoumanis, & Treasure, 2012). However, no prior research has assessed gender invariance in the relations among autonomy support from all three social agents, need satisfaction, and indices of student motivation and engagement in school. Therefore, testing gender differences in the proposed associations would be of theoretical and applied importance.

We put forward the following hypotheses: (1) Perceived autonomy support from parents, teachers, and peers would all positively link to students' need satisfaction, because such support creates conditions and interactions that nurture feelings of effectance, belongingness,

and being in control; (2) Need satisfaction would positively contribute to student self-determined motivation and engagement in general, because the satisfaction of basic psychological needs facilitates the internalization of behavioral engagement; (3) Self-determined motivation would also be a positive predictor of student engagement, because such type of motivation fosters curiosity, interest, and personal value in activity engagement; (4) Need satisfaction would mediate the effects of perceived autonomy support on student motivation and engagement, because need satisfaction is the key mechanism by which the social environment triggers self-interest in learning, and (5) The proposed model was expected to be invariant across gender, because the aforementioned processes are purported by the theory to be universal.

## **2. Method**

### *2.1. Participants*

Using random cluster sampling, 614 participants were selected from three primary schools (17 classrooms) in the southeast of China; approximately two-thirds were from rural settings. Due to an error in data coding, it is not possible to identify which students belonged to each class. The age of sampled students ranged from 9 to 13 years ( $M = 11.07$ ,  $SD = 1.12$ ). Students were from Grade 3 ( $n = 145$ ), Grade 4 ( $n = 185$ ), Grade 5 ( $n = 220$ ) and Grade 6 ( $n = 64$ ); 301 were boys (49%) and 313 girls (51%). In terms of family type, 366 participants came from one-child families (59.6%) and 203 (33.1%) from families with two or more children; 45 did not answer this question.

## 2.2. Measures

Each item of the following measures was rated by students on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Individual items were averaged to yield each variable score, except for the overall motivation score (see below for details).

### 2.2.1. *Autonomy Support from Parents, Teachers, and Peers*

The six-item short version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996) was used to assess students' perceptions of autonomy support provided by their social agents (i.e., parents, teachers, and peers). In total, 18 items were administered, with 6 items repeated and customized for each social agent. A sample item for parental, teacher, and peer autonomy support is: "I feel understood by my parents/teacher/peers".

The LCQ has been widely used in previous SDT-research, showing satisfactory validity and reliability (e.g., Ntoumanis, 2005; Reeve, 2013; Yu, Traynor, & Levesque-Bristol, 2018; Zhou et al., 2009). The Cronbach's alpha coefficient for the 18 items was .89, and the alphas for parental, teacher, and peer autonomy support were .84, .84, and .86, respectively.

### 2.2.2. *Need Satisfaction*

The Chinese version (Zhou, Li, Yang, & Ren, 2017) of the Activity-Feeling States Scale (AFS; Reeve & Sickenius, 1994) was used to measure the extent of student satisfaction of their three basic psychological needs at school. The stem for the questionnaire was "During classes, I feel...". Nine items (three items for each subscale) were used to assess autonomy satisfaction (e.g., "I'm doing what I want to be doing"), competence satisfaction (e.g., "competent"), and relatedness satisfaction (e.g., "people care about me").

Previous research has often used the AFS as a score of overall need satisfaction and has shown the scale scores to be reliable and valid in samples from collectivistic societies (e.g., Jang et al., 2009). In the present study, the 9-item measure had a Cronbach's alpha coefficient of .79.

### 2.2.3. *Student Motivation*

Student motivation was assessed using the Self-Regulation Questionnaire-Academic (SRQ-A; Ryan & Connell, 1989), which was further revised by Roth, Assor, Kanat-Maymon, and Kaplan (2006). Listing different reasons for taking part in various typical learning activities, twenty-one items were designed to measure four types of motivation that lie along a continuum from highly controlled to highly self-determined motivation. These are external regulation (5 items, e.g., "I do my class work because that's the rule"), introjection regulation (5 items, e.g., "I do my class work because I'll feel ashamed of myself if I don't"), identified regulation (5 items, e.g., "I invest in my class work because studies are important to me"), and intrinsic motivation (6 items, e.g., "I do my class work because it is fun"). The Chinese version of this scale for primary school students (Zhou & Li, 2017) does not include two external regulation items (i.e., "I try to do well at school because I don't want to have problems" and "I do my homework because this is what I am required to do"), due to low item-total scale correlations.

We used the Relative Autonomy Index (RAI), a frequently utilized measure in the SDT literature, as it provides a succinct representation of the degree of relative self-determination, (given that the different types of motivation proposed by SDT are located on the self-determination continuum), but we acknowledge that other approaches are also utilized in the

literature (e.g., person-centered; see Ryan & Deci, 2017 for an overview). Recent extensive testing by Sheldon, Osin, Gordeeva, Suchkov, and Sychev (2017) has shown that, although there was only a very minor difference between the unweighted and weighted RAI scores in terms of their correlations with validity measures, the unweighted RAI score was better because it provided a more efficient and unbiased indicator of overall motivation. Therefore, an unweighted RAI score was created for each item through the formula:  $RAI = \text{Intrinsic Motivation} + \text{Identified Motivation} - \text{External Motivation} - \text{Introjected Motivation}$ . In the present study, the overall Cronbach's alpha coefficient for the RAI items was .84.

#### *2.2.4. Student engagement*

To capture students' engagement in the classes, we used the Individual Self-Report Engagement scale (Jang, Reeve, & Deci, 2010). The scale began with the stem, "During classes," and included the following four items: "I pay attention" (behavioral engagement), "I work very hard" (behavioral engagement), "I try to learn as much as I can" (cognitive engagement), and "I enjoy the lesson" (emotional engagement). These 4 items were combined to represent overall student engagement. The Cronbach's alpha coefficient was .80.

#### *2.3. Procedure*

Ethical approval was granted by the first author's University Ethics Committee. Prior to completing the survey, separate information sheets were given to schools, parents, and students. In the information sheets, we explained the purpose of the study and reassured the participants of the voluntary, anonymous and confidential nature of their involvement, as well as their right to withdraw at any time. Informed consent was obtained from school

administrators, teachers, and students. Students responded to the questionnaires individually in the course of regular class sessions.

#### *2.4. Data Analyses*

Data were analyzed using SPSS 19.0 and AMOS 17.0. The reliability of each scale, descriptive statistics, and Pearson's correlations amongst the study variables were calculated with SPSS 19.0. Following the recommendation of Anderson and Gerbing (1988), a two-step approach was used to test the hypothesized structural model in AMOS 17.0. First, confirmatory factor analysis (CFA) was conducted to verify the adequacy of the proposed measurement model. The measurement model was a six-factor model consisting of perceived parental, teacher, and peer autonomy support, need satisfaction, motivation and student engagement; all six factors were allowed to correlate with one another. Second, the adequacy of the proposed structural model was also tested. The structural model was a full mediation model in which parental autonomy support, teacher autonomy support, and peer autonomy support were indirectly related to motivation (RAI) and student engagement via the mediation of overall need satisfaction. Need satisfaction directly linked to motivation and engagement; motivation also contributed to engagement. The three autonomy support measures were intercorrelated with each other. Bootstrapping procedure was conducted to further examine the mediating effects (Preacher & Hayes, 2008). Using AMOS, we performed 5000 bootstrap resamples analyses to calculate the 95% confidence intervals (95% CI) of each indirect effect. Support for a significant indirect effect is indicated if the 95% CI does not include the value of zero (Preacher & Hayes, 2008).

Following the example of Ntoumanis (2005), the latent variable for overall need satisfaction was indicated by three indicators, one for each need. Student engagement was represented by its 4 items. Furthermore, due to the modest sample size, we created three parcels to represent teacher autonomy support. The parcels were created by combining the strongest loading item with the weakest loading item, and so on. In the same way, parental and peer autonomy support were indicated by three 3 parcels each. Parceling the same items for each significant other (i.e., the content of the parcels was the same across the three significant others) produced identical results; these are available upon request.

With regard to student motivation, following the example from previous research (e.g., Niemiec et al., 2006), we created three parcels, each representing a relative RAI score (i.e., RAI-1, RAI-2, and RAI-3). These RAI scores were calculated using the formula for RAI described above; items with subscales containing more than three items were collapsed to form three composites before the RAI parcels were created.

Gender invariance (boys = 0, girls = 1) was tested through a sequence of steps (Byrne, 2010) within which increasing constraints were sequentially imposed to test gender measurement and structure invariance. First, the hypothesized model was tested separately for boys and girls. Then, the configural model (Model 0) with no invariance constraints was tested across both groups simultaneously, followed by the metric invariance model (Model 1) in which the factor loadings were constrained to be equal across gender. Further analyses were conducted to test Model 2 (scalar invariance; constraining item intercepts) and Model 3 (constraining errors variances). To test structural invariance, Model 4 furthered constrained

factor variances and factor covariances to be invariant across boys and girls, Model 5 constrained the latent factor means, and Model 6 constrained the structural paths.

Acceptable model fit is indicated by CFI and TLI values exceeding .90 as well as SRMR and RMSEA values of .08 or less (Hu & Bentler, 1999; Kline, 2011). Further, a change in CFI values ( $\Delta\text{CFI} < .01$ ) between two nested models was taken as an indication that the more restrictive model fit equally well to the less restrictive model (Cheung & Rensvold, 2002).

### 3. Results

#### 3.1. Preliminary Analyses

Table 1 presents the means, standard deviations, and intercorrelations amongst the study variables. As expected, students' reports of perceived autonomy support from teachers, parents, and peers were positively and significantly related to their overall need satisfaction, motivation, and class engagement. We also looked at the correlations (available upon request) between each autonomy support factor and each individual need separately; the correlations were very similar to each other, supporting our decision to combine the three needs into an overall score in order to improve model parsimony. Moreover, positive correlations were found between overall need satisfaction, motivation, and class engagement. A CFA indicated that the six-factor measurement model showed a satisfactory fit to the data [ $\chi^2(137) = 266.99$ ,  $\chi^2/df = 1.95$ ,  $p < .001$ ; RMSEA and 90% CI = .034 (.032 - .045); SRMR = .03; TLI = .97; CFI = .97]. All of the observed variables strongly loaded on their corresponding latent factor (mean  $\lambda = .745$ ). In sum, the six-factor measurement model was supported by the data. We also used CFAs to test the factorial structure of LCQ and the AFS individually; these results are reported in Supplementary File 1.



### 3.2. Testing the Hypothesized Model

The results of structural equation modeling indicated that the proposed structure model fit the data well [ $\chi^2(143) = 284.23$ ,  $\chi^2/df = 1.99$ ,  $p < .001$ ; RMSEA and 90% CI = .040 (.033 - .047); SRMR = .04; TLI = .97; CFI = .97]. All of the hypothesized paths were significant at 0.01 level. As can be seen (*Figure 1*), parental autonomy support, teacher autonomy support, and peer autonomy support were positively related to student psychological need satisfaction, which in turn was linked to student engagement. The latter was also affected associated with student motivation. Significant indirect effects were found between the three support variables and student motivation and engagement via psychological need satisfaction (Table 2). In both cases, parental autonomy support had stronger indirect effects on motivation and engagement, compared to teacher and peer autonomy support (see Table 2). The direct effect of perceived parental autonomy support on need satisfaction was also stronger than the direct effects of perceived teacher and peer autonomy support. In order to statistically compare the magnitude of the path coefficients from the three support variables on need satisfaction, we constrained the three paths to be equal. The constrained model fit the data well [ $\chi^2(146) = 298.67$ ,  $\chi^2/df = 2.05$ ,  $p < .001$ ; RMSEA and 90% CI = .041 (.035 - .048); SRMR = .05; TLI = .96; CFI = .97] and did not fit any worse than the hypothesized model ( $\Delta CFI = .002$ ), indicating that the predictive contributions of the three supports did not differ significantly from each other.

The results of gender invariance are presented in Table 3. The separate girls and boys' models fit well; all paths in both groups were significant except the path from teacher autonomy support to need satisfaction which was significant in boys ( $\beta = .21$ ,  $p = .011$ ) but

not in girls ( $\beta = .14, p = .077$ ). Given that the two paths were relatively similar in the two gender groups, the subsequent gender invariance testing still included this path. Across all models of increasing invariance, the hypothesized model was shown to be invariant, with  $\Delta CFI < .01$  in each sequential model comparison. Thus, the model was shown to have strong measurement and structural invariance. At the suggestion of an anonymous reviewer, we also tested for measurement and structural invariance as a function of family situation (one child family vs two or more children family) and grade level [lower-grade group (Grades 3 and 4,  $n = 330$ ) and higher-grade group (Grade 5 and 6,  $n = 284$ )]. Our model was shown to have strong measurement and structural invariance across family situation and the two grade groups. The results of these analyses are in Supplementary File 2.

#### **4. Discussion**

SDT researchers have argued that autonomy support provided by social agents is essential for fostering human development, well-being, and motivation through psychological need satisfaction (Deci & Ryan, 1985; Ryan & Deci, 2017). In our study, we tested parts of this proposition by building on and expanding previous work in the school context on student motivation and engagement. Specifically, we examined the relative predictive effects of perceptions of autonomy support from parents, teachers, and peers, on Chinese primary school students' need satisfaction, motivation and engagement.

##### *4.1. The associations among the study variables*

As expected (hypothesis 1), the results of the hypothesized structural model showed that autonomy support from parents, teachers, and peers, all positively linked to students' overall satisfaction of their basic psychological needs. Although the effects of adult support have

been extensively studied in school settings, the influence of peer autonomy support has been largely overlooked (for exceptions, see Kiefer et al., 2015; Hakimzadeh et al., 2016), which is very surprising because previous work has indicated that peer influence becomes increasingly important from late childhood onwards (e.g., Ntoumanis, Taylor, & Thøgersen-Ntoumani, 2012).

The effect from parental autonomy support ( $\beta = .36$ ) was stronger than the effects from peer ( $\beta = .19$ ) and teacher autonomy support ( $\beta = .17$ ). However, constraining the three paths to be equal produced no worse model fit than the fit of the hypothesized model, indicating that the assumption that the predictive effects of all three social agents are equal could not be dismissed. No previous SDT studies have tested the relative effects of all these three sources of autonomy support on students' psychological need satisfaction. However, the relative stronger parental effects have also been identified in previous research focusing on the relations between autonomy support (parents, teachers, and school administration) and need satisfaction (Vallerand et al., 1997), between need support (parents, teachers, and peers) and amotivation (Legault et al., 2006), and between need support (from teachers and parents), reciprocal friendships, and student motivation (Ricard & Pelletier, 2016). A possible explanation for the relative stronger effects from parental autonomy support is that Chinese parents value the importance of academic achievement and invest a great deal of energy and resources in their children's education (Zong, Zhang, & Yao, 2018).

In support of hypothesis 2, psychological need satisfaction was associated with the relative self-determined motivation. The size of the effect was moderate ( $\beta = .30$ ; Cohen, 1988), possibly because the RAI is an index of the relative as opposed to an absolute level of

autonomous motivation (i.e., autonomous minus controlled motivation). Further, psychological need satisfaction was a strong ( $\beta = .55$ ) predictor of student engagement. These results are concordant with SDT and prior research which have reported positive associations between need satisfaction with intrinsic motivation in PE, as well as with physical activity engagement within and beyond the school context (Zhang et al., 2011). The present findings imply that students' overall need fulfillment may provide an essential nutrient for their self-determined motivation and engagement in learning activities. In support of hypothesis 3, there was a moderate link ( $\beta = .36$ ) between relative autonomous motivation and student engagement. This finding is also in line with SDT and findings from previous research in schools (e.g., Ntoumanis, 2001; 2005).

As predicted by hypothesis 4, there were significant indirect effects from parental autonomy support, teacher autonomy support, and peer autonomy support to both motivation and engagement. Most of the indirect effects we found were small in size, but significant. Parental autonomy support had stronger indirect effects, compared to teacher and peer autonomy support, although in an absolute sense the size of these effects was similar. Such indirect effects have been previously tested in terms of need support from PE teachers (Ntoumanis, 2005; Rutten et al., 2012; Standage et al., 2005; Zhang et al., 2011), or autonomy support from PE teachers (Standage et al., 2006, 2012), science teachers (Lavigne et al., 2007), and sport coaches (Amorose & Anderson-Butcher, 2007).

Taken together, the present results are in line with previous studies using Western samples and provide support for key SDT propositions in a large collectivistic country (e.g., Wu et al., 2014). As argued by Deci and Ryan (1985), although the means by which

psychological needs are satisfied might differ as a function of cultural factors, the satisfaction of these needs by important social agents is a key prerequisite for high-quality motivation and associated outcomes. Additionally, the results of both measurement and structural invariance testing revealed that the hypothesized model was invariant across gender, in support of our last hypothesis and previous relevant research (e.g., Tian, Han, & Huebner, 2014).

Specifically, evidence for metric (factor loadings), scalar (intercepts), and strict (errors variances) invariance indicated that both boys and girls had a similar understanding of each item measured in the present research. In addition, the invariance of factor variance and covariances, factor latent means, and path coefficients provides additional support for the universality notion of the SDT autonomy support-need satisfaction-motivation sequence, and indicates no gender differences in the mean levels of any of the studied constructs.

#### *4.2. Limitations and Future Research Directions*

Our study had some limitations. One of them is its correlational design based on student self-reports. Future research could use more objective measures (such as observational ratings of autonomy support) to reduce common method bias. Nevertheless, self-report measures are useful, because in the self-determination theory literature it is often the subjective experience of others' behaviors and autonomy support that is the strongest predictor of motivational outcomes than others' reports of autonomy support (Ryan & Deci, 2017) or reports provided by trained raters (Jang et al., 2010). Future studies need to adjust for clustering effects which was not possible in our study, given that we did not record the classes in which the students belonged. Nevertheless, our standard errors were very small and, hence, our conclusions are unlikely to have been affected by any clustering adjustment. Future studies could also test

separate models at the student and class levels using multilevel structural equation modeling with a sufficient number of classes (at least 50). It is also important to use longitudinal and/or experimental designs (ideally targeting teachers, parents, and peers), to provide causal tests of the hypothesized model.

Another limitation is that we could not determine which specific types of parental, teacher, and peer autonomy supports students considered to be important. Additional studies should identify the specific behaviors that students perceived to be supportive of their psychological needs; this information would be very helpful in terms of designing future intervention studies. We also did not measure the extent to which the significant others thwart students' psychological needs (cf. Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011), something that should be considered by future research. A further limitation of our study is that we did not distinguish between maternal and paternal support, which would be a worthwhile attempt in the future. For example, d'Ailly (2003) reported that autonomy and involvement support from mothers, but not from fathers, predicted motivation among both male and female Taiwanese students. Additionally, motivation and engagement were measured at the school level. Future research could explore the predictive role of autonomy support from parents, teachers, and peers with regard to domain-specific motivation and engagement. The last limitation is related to the relatively narrow age range of our sample. Future studies with broader age ranges could examine developmental differences in autonomy support provided by different significant others.

### *4.3. Implications and Conclusions*

Collectively, the results indicate that social agents (parents, teachers, and peers) construe an autonomy supportive learning environment to meet students' psychological needs for autonomy, competence, and relatedness, which is important for student motivation and engagement. In addition, the robust gender invariance indicated that, regardless of gender, student motivation and engagement can be facilitated by an autonomy supportive learning context.

Such an environment can be created via the utilization of different strategies, such as increasing students' opportunities for task choice, listening to their ideas and concerns about learning, and developing small learning groups to promote positive peer interactions (Ntoumanis, Quested, Reeve, & Cheon, 2018). Targeting multiple social agents in autonomy supportive interventions in schools is also important because lack of autonomy support from one significant other can be compensated to some degree by the presence of support provided by another social agent. For example, students who feel controlled by their parents can still be highly motivated and well engaged in class due to the positive influence of their teachers or peers. The extent to which these three sources of autonomy support operate in a parallel or sequential fashion needs to be further explored. For example, peer autonomy support might require facilitation from teachers or parents, but it can also operate independently.

In summary, the present study is the first of its kind in the SDT literature to test the relative predictive effects of autonomy support from parents, teachers, and peers on student motivation and engagement via the mediation of need satisfaction. The findings provide an important insight into the antecedents of student motivation and engagement at a crucial

development stage (i.e., just prior to the transition from primary to middle school). The strong gender invariance of the hypothesized model in a large collectivistic country provides further evidence for the universality of both the tenets of the theory and the means by which motivation and engagement can be supported in different cultures.



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