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ORIGINAL PAPER

Relations among Parenting, Child Behavioral Regulation and Early Competencies: A Study on Chinese Preschoolers

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Abstract As an important aspect of self-regulation, behavioral regulation contributes to young children's academic and social-emotional outcomes. In this study, we examined the relations between young Chinese children's behavioral regulation and their mathematics competence, language skills, and behavior problems. We further explored the role of both maternal and paternal parenting in these relations. We tested two competing frameworks. We examined whether behavioral regulation would mediate the relations between parenting and aforementioned child outcomes. We also tested whether parenting would moderate the relations between children's behavioral regulation and their outcomes. A total of 109 Chinese children approximately at three years of age living in Hong Kong participated in the study with their parents. Children's behavioral regulation, number competence, receptive vocabulary, and phonological awareness were tested individually using direct assessments. Parents reported their own parenting and their children's internalizing and externalizing problems. The results showed that paternal supportive parenting moderated the relation between children's behavioral regulation and their number competence, as well as the relation between behavioral regulation and externalizing problems. The findings add to the literature by demonstrating the importance of behavioral regulation for early learning and social-emotional outcomes of young Chinese children. The findings also suggest the crucial role of fathers in helping children utilize their behavioral regulation skills to acquire early mathematics skills and reduce behavior problems.

Keywords Behavioral regulation · Mathematics competence · Behavior problems · Chinese paternal parenting

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Introduction

The development of early language, mathematics, and social-emotional competencies lays the foundation for children's academic achievement and social-emotional functioning in school settings (Duncan et al. 2007). Significant individual differences on the development of these early competencies emerge by preschool if not earlier (Calkins and Bell 2010). Children who are not well equipped with these early skills often experience difficulty during the transition to school and fare poorly in later schooling (Duncan et al. 2007; McClelland et al. 2000; Raver 2003). Much research has been dedicated to revealing factors that can promote early mathematics, language, and social-emotional competencies. Children's behavioral

regulation has been consistently identified as a critical factor in early academic achievement (e.g., Lan et al. 2011; McClelland et al. 2007; Sektnan et al. 2010), whereas its role in social-emotional functioning has been less explored (Zhou et al. 2012).

Behavioral regulation falls under the broad construct of self-regulation and is closely linked to the construct of executive functioning (EF). EF includes attentional or cognitive flexibility (selecting and attending to relevant information), working memory (cognitively maintaining and manipulating information), and inhibitory control (suppressing inappropriate responses) (Best et al. 2009). McClelland et al. (2014) defined behavioral regulation as deliberately applying multiple component processes of EF to overt, socially contextualized behaviors, and it thus represents the integration of EF processes into "adaptive, real-world behaviors" (p. 2). Behavioral regulation entails key learning-related behaviors, such as the abilities to follow directions, control behaviors, and remain engaged in learning activities (McClelland et al. 2007; Ponitz et al. 2009). Successfully integrating the EF components into ecologically-relevant behaviors helps a child to meet school- and task-related demands and eventually contributes to the child's early learning. Accumulated research has shown that behavioral regulation can predict children's academic outcomes, even after controlling for initial achievement levels, child IQ, and a host of socio-demographic variables (McClelland et al. 2014; Ponitz et al. 2009). Behavioral regulation has also been associated with mathematics, early literacy, and reading skills among Chinese preschoolers (Lan et al. 2011; Wanless et al. 2011; Zhang 2016).

Studies on the associations between child behavioral regulation and social-emotional outcomes produced mixed findings. McClelland et al. (2007) reported that preschoolers' behavioral regulation positively predicted responsibility, cooperation, and independence. Components of EF such as inhibitory control and attentional focusing were also found to contribute to peer competence and reduced behavior problems (Riggs et al. 2003; Semple et al. 2010), as they likely support children to "be more independent and responsible in the classroom by helping them process and encode relevant instruction" (McClelland et al. 2007, p. 94). However, Ponitz et al. (2009) found no direct relations between kindergarten children's behavioral regulation measured by a direct assessment called the Head-Toes-Knees-Shoulders (HTKS; McClelland et al. 2014) task and their behavior problems.

Considering the Chinese culture and preschool context, it is particular important to examine the relations between Chinese children's behavioral regulation and their early competencies. First, Chinese culture values interpersonal harmony and interdependence, and one's abilities to regulate emotions and behaviors to meet the needs of the group are strongly encouraged (Muhtadie et al. 2013; Wanless et al. 2011). Therefore, children who are better at regulating themselves may be perceived more positively by adults and peers, leading to better academic and social-emotional outcomes. Second, academic preparation is one of the main focuses in Chinese preschools, and many activities in the classroom aim at stimulating children's pre-academic skills. Children need to manage their own behaviors to effectively engage in these learning activities. Additionally, Chinese preschool classrooms often have a larger class size and a higher student–teacher ratio compared to those in Western societies, and large-group activities are also more prevalent (Hu et al. 2015). Thus, children may receive limited attention and support from teachers, and their abilities to regulate own behaviors affect how well they are involved in learning activities and social interactions with peers.

Recently, there is a growing body of research that examines the role of parenting in the relations between self-regulation and child outcomes. We reviewed the literature and found two theoretical frameworks that guided this line of research. It is worth noting that existing research mainly focused on maternal parenting, and similar research on paternal parenting is increasing. On one hand, there is an emerging proposition positing that parenting may interact with self-regulation to predict children's learning and social-emotional outcomes. This proposition is supported by empirical research on the relations between parenting and effortful control. Effortful control, defined as a child's ability to suppress a dominant response to perform a subdominant response, is a construct "situated at the intersection of the temperament and behavioral regulation literature" (Kochanska et al. 2000, p. 220). Interactions between effortful control and parenting have been found in relation to children's social-emotional competence. For instance, Karreman et al. (2009) found that both maternal and paternal positive control buffered the negative effect of low levels of effortful control on externalizing problems among preschool-aged children. Morris et al. (2002) showed similar interactions between maternal hostility and effortful control in predicting children's externalizing problems. Muhtadie et al. (2013) reported an interaction between authoritarian parenting (mainly reported by mothers) and effortful control in predicting internalizing behavior among Chinese children. Thus, parenting may moderate the relation between behavioral regulation and child adjustment.

However, on the other hand, some researchers conceptualized self-regulation as a mediator of the relations between parenting and child outcomes (e.g., Spinrad et al. 2007; Valiente et al. 2007). Some empirical studies have highlighted the role of parenting in the development of self-regulation, which may subsequently affect child outcomes

(e.g., Elden et al. 2007; Towe-Goodman et al. 2014). For example, Bernier et al. (2010) found that maternal sensitivity, mind-mindedness, and autonomy support assessed when children were 12–15 months old predicted their EF at 18 and 26 months. Towe-Goodman et al. (2014) and Lucassen et al. (2015) showed that paternal parenting made independent contribution to children's self-regulatory skills above that of maternal parenting. Liang et al. (2013) looked at the developmental trajectory of Chinese preschoolers' effortful control and reported that fathers' encouragement and acceptance behavior promoted effortful control, while paternal rejection and punishment impeded such development. Interestingly, Elden et al. (2007) showed that mothers' but not fathers' warmth/sensitivity predicted children's self-regulation at 3 years of age.

The moderation and the mediation frameworks are both reasonable, as self-regulation has a temperamental basis and is also influenced by social experience (Zhou et al. 2012). Zhou et al. (2012) suggest that the mediating and moderating mechanisms underlying the links between self-regulation and adaptive functions have been overlooked. Thus, it is important to examine both the mediation and the moderation theoretical frameworks in a single study. Furthermore, research on paternal parenting is needed to investigate whether mothers' parenting and fathers' parenting produce independent effects on child outcomes. Chinese fathers have become more involved in childrearing than their predecessors due to social changes (e.g., mass female participation in the workforce, the rise of nuclear families, increased levels of parents' education), although fathers' levels of involvement are still much lower than mothers' (Li and Lamb 2015). Father's engagements can directly, as well as indirectly affect children's cognitive abilities and social-emotional functioning through their influence on mother–child relationship for instance (Tamis-LeMonda et al. 2004). An increasing body of research has shown that paternal parenting influences various aspects of child development. Fathers' supportiveness in play was found to contribute to young children's receptive vocabulary and general cognitive abilities above and beyond mothers' supportive parenting (Tamis-LeMonda et al. 2004). Cabrera et al. (2007) found that father intrusiveness had negative impact on young children's language development. Huang et al. (2017) found that Chinese fathers' involvement in numeracy activities contributed to young children's mathematics skills above mother involvement. McDowell and Parke (2009) showed that mothers and fathers both made unique contributions to children's social competence through engaging in warm and responsive interactions, offering quality advice, and providing opportunities for peer interactions. Chinese fathering has been linked to young children's cognitive development, academic achievement, social-emotional competence, mental health, and problem behavior (see review by Li and Lamb 2015).

In this study, we examine multiple domains of young children's early competencies as outcomes of interest, including early mathematics skills, early language skills (receptive vocabulary and phonological awareness), and internalizing and externalizing problems. We focus on two main research questions. First, does children's behavioral regulation contribute to aforementioned outcomes? We hypothesize that higher levels of behavioral regulation are related to better mathematics competence and language skills and less internalizing and externalizing behavior. Second, what are the roles of maternal and paternal parenting in the relations between children's behavioral regulation and their early competencies? We test both the moderation and mediation models. Testing the effects of maternal parenting and paternal parenting simultaneously allows us to examine whether mothers' parenting and fathers' parenting have unique effects on the relations between children's behavioral regulation and their early competencies, controlling for one another.

Method

Participants

This study is part of an on-going longitudinal project about Chinese children's mathematical development, and the data came from the first wave of assessment. Out of the 258 Chinese children solicited from 10 nursery classes in six preschools in Hong Kong, 109 children (response rate 42.2%; 64 girls, 45 boys) participated. All the children were native Cantonese speakers. In most Hong Kong preschools, Cantonese is mainly used in instruction, and English and Mandarin are used as supplements; this is also the case for the schools involved in this study. At the time of assessment (i.e., June and July in 2013), children were about to finish a full-day or half-day one-year-long nursery program, and their age ranged from 31 to 42 months ($M = 38.01$, $SD = 2.68$). Parental consent was obtained before data collection.

It is worth mentioning that the study sample did not represent the diversity of Hong Kong society, as only about 30% of young children in this age group attend nurseries in Hong Kong. In terms of socioeconomic status, families in the study can be considered middle to high. About 63.4% of the families had a monthly household income of 40,000 Hong Kong dollars (approximately 5160 US dollars), which was notably higher than the overall median monthly household income of 22,400 Hong Kong dollars (approximately 2890 US dollars) in Hong Kong at the time of this study (Census & Statistics Department 2014). Monthly household income was coded into five categories: 1 =

below HK$10,000 (4.9%), 2 = *HK$10,000 to HK$29,999* (19.5%), 3 = *HK$30,000 to HK$59,999* (40.2%), 4 = *HK $60,000 to HK$99,999* (24.4%), and 5 = *above HK $100,000* (11.0%). Additionally, 67.6% of the fathers and 59.5% of the mothers held a Bachelor's degree or above. Maternal and paternal education levels were strongly correlated ($r = .54$, $p < .001$). Thus, we used the highest education in the household to indicate parental education, in order to be able to use data on education for almost all family structures and to reduce the amount of missing data. We used five categories to characterize parental education levels: 1 = *junior high school* (2.7%), 2 = *high school to associate degree* (21.6%), 3 = *Bachelor's degree* (44.6%), 4 = *Master's degree* (29.7%), and 5 = *Doctoral degree* (1.4%).

Procedure

The recruitment and data collection procedures were approved by the institutional review board of the second author's university at the time, and parental consents were collected. The questionnaires on parenting practices and child behavior problems were mailed out to parents along with other questionnaires for the larger project. Mothers and fathers were instructed to fill out the questionnaires independently and return them to the children's teachers after completion. For the direct assessments of number competence, vocabulary, phonological awareness, and behavioral regulation, children were tested individually in Cantonese by trained testers. Each tester had been trained for about two hours in which s/he was introduced to the content of the assessments and ways to interact with children and then administered mock assessments with his or her fellow tester. The testing took place in a quiet room in the preschools during school hours. To avoid fatigue, the tasks were administered in two sessions on separate days, with each session lasting 15–25 min, and the two sessions were completed less than seven days apart.

Measures

Vocabulary

We assessed children's receptive vocabulary using 30 items from the Hong Kong Cantonese Receptive Vocabulary (Cheung et al. 1997). The tester read aloud each item to the child, and the child was asked to select one picture out of four options to match. Among the three distracting options, one is phonologically close to the target, one is semantically close to the target, and one is unrelated to the item. The raw sum scores of correct items were calculated. The Cronbach's α was .69 in the study.

Phonological awareness

We assessed children's phonological awareness using a syllable awareness test. Each three-syllable phrase was presented orally by a tester, and the child was asked to isolate one of the syllables. For example, for the phrase/ *daai6 mun4 hau2/* with the Arabic digits indicating Cantonese lexical tones (Cantonese has six contrastive tones defined according to their pitch height and contour: *1 = high level*, *2 = high rising*, *3 = middle level*, *4 = mid-low falling*, *5 = mid-low rising*, and *6 = mid-low level*), the child was asked to say aloud the initial syllable, with the correct answer being/daai6/. A similar test format has been used to measure syllable awareness in the English language (e.g., *mailman* with the initial syllable isolated would be *mail*; Learning Disabilities Association of Alberta 2009). The test contains 16 items, with one point given for each correct answer. The test has been used successfully in previous studies with Hong Kong preschoolers (e.g., Zhang and Lin 2015). The raw sum scores of correct items were used. The Cronbach's alpha was .89.

Number competence

We used the number competency core battery (Jordan et al. 2009) to assess children's number competence. This assessment was originally developed in the United States to use among five- to six-year old children, and it included seven subsets: *counting sequence*, *counting principles*, *number recognition*, *number comparison*, *nonverbal calculation*, *story problems*, and *number combinations*. We dropped the last two subsets of the battery to decrease the difficulty of the assessment, in order to allow its use among three-year olds. The remaining 34 items were translated into Cantonese by the second author and a research assistant. Using a variety of formal and informal strategies (e.g., interviews with teachers, repeated discussion in the research group, psychometric analyses), three members of our research team carefully examined the items in the measures in order to ensure cultural appropriateness. All 34 items were adopted, but the wording that was not appropriate for use in Chinese children was adapted. Jordan et al.'s standard procedures were followed when administering and scoring the test, so that potential bias could be reduced.

The counting sequence task measures children's ability to count, and they were asked to count as high as they could. Children scored one point if they successfully counted to ten and two points if they counted to 50 successfully. The counting principle task contains eight items, assessing principles of one-to-one correspondence, cardinality, and stable order. For this task, a finger puppet and a set of either five or nine alternating yellow and blue dots were used. The finger puppet counts the dots either in accordance with or in

violence of the counting principles, and children were asked to indicate whether the puppet counted "OK" or "not OK." For each item, children received a score of one for a correct response, and zero for an incorrect response. In the number recognition task (seven items), the tester presented seven numbers one by one, and asked children to read each number. In the number comparison task (nine items), three types of questions were administered: (1) children were asked what number came after a given number and what number came two numbers after that given number; (2) given two numbers, children were asked to identify which number was bigger and which was smaller; (3) given three numbers arranged in the shape of an equilateral triangle, children were asked to identify which number was closer to the target number placed at the triangle's apex. In the nonverbal calculation task (eight items), four addition and four subtraction problems were presented using chips and a cover. A set of chips were first placed on the desk, and children were told the amount of the chips. The tester then hid the chips under a cover. The tester added or removed chips one at a time through the side opening of the cover. Children were asked to indicate the amount of chips left "hiding" under the cover. Children could signify the number by placing chips on the desk or directly state the number. The sum scores of correct items were calculated to indicate overall number competence. The Cronbach's α was .71 in the study.

Internalizing and externalizing problems

Mothers and fathers rated children's behavior problems independently using the Chinese-version Child Behavior Checklist for 1.5- to 5-year olds (CBCL/1.5–5; Achenbach and Rescorla 2000; Liu et al. 2011). Each item describes a specific kind of behavioral, emotional, or social function problem that young children may experience. Parents rated the frequency of each behavior based on their child's behaviors during the last two months (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*). The CBCL/1.5-5 includes six symptom subscales, and "internalizing" and "externalizing" problem scores are derived from the six subscales. Internalizing problem scores are based on the *Emotionally Reactive* (9 items), *Anxious/Depressed* (8 items), *Somatic Complaints* (11 items), and *Withdrawn* (8 items) subscales. Externalizing problem scores are based on the *Attention Problems* (5 items) and *Aggressive Behavior* (19 items) subscales. Liu et al. (2011) examined the psychometric properties of the CBCL among Chinese preschoolers, and showed consistent factor structure with the original one derived using data from the U.S samples. In the current study, the Cronbach's alphas were .94 and .92 for mothers' and fathers' reports of internalizing problems, and .93 and .92 for mothers' and fathers' reports of externalizing problems, respectively. Mothers' and fathers' ratings were averaged together, as they were highly correlated ($r = .64$, $p < .001$ for internalizing problems, and $r = .59$, $p < .001$ for externalizing problems).

Behavioral regulation

We used the Head-Toes-Knees-Shoulders (HTKS, McClelland et al. 2014) task to assess children's behavioral regulation. The task has been successfully used in Hong Kong Chinese children with high reliabilities (e.g., interrater reliability = 0.90, Cronbach's alpha = 0.91) and strong validity (e.g., criterion validity: correlation with reading skills = 0.54, $p < .001$; Chung 2015). Children were asked to do the opposite of the tester's commands (i.e., "touch your head," "touch your toes," "touch your knees," and "touch your shoulders"). For instance, if the tester says, "touch your toes," the child is supposed to touch his/her head instead of following the command. The last part of the task added a final switch. For instance, if the tester says, "touch your toes and shoulders," the child is supposed to touch his/her head and then knees. The HTKS task requires inhibitory control (a child must inhibit the dominant response to the command), executive attention (a child must focus attention to the directions), and working memory (a child must remember the rules of the task). The task includes 30 trails (0 = *incorrect*; 1 = *self-correct*; 2 = *correct*), and the raw sum scores were used. The Cronbach's α was .92.

Parenting behavior

Fathers and mothers completed a parenting measure used by Chen et al. (2005) among Chinese parents. The measure was adapted from the Child Rearing Practice Report (Block 1981), and it captures multiple aspects of parenting (e.g., parental warmth and responsiveness, inductive reasoning, parental control, punitive disciplining). Parents rated each statement using a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). Based on Chen's (personal communication, July 20, 2013) suggestion, we performed an exploratory factor analysis (EFA) to identify factors that best capture the parenting practices of parents in the study. EFA were conducted using Mplus 7.0, and items that had nonsignificant loadings on all factors as well as items that had similar loadings on more than one factors were removed. A similar two-factor model was identified for both fathers' and mothers' reports, despite slight differences on the inclusion of several items. The factor "supportive parenting" captured positive parenting behaviors (e.g., "I discuss with and explain to my child the things that he/she has done wrong"), such as parental warmth, the use of inductive reasoning, and respecting the child's views. The factor "aversive parenting"

reflected negative parenting behaviors (e.g., "I think physical punishment is the best way to discipline children"), such as punitive disciplining, directiveness, and negligence. For fathers' reports, the Cronbach's alphas were .83 and .76 for supportive (18 items) and aversive (12 items) parenting, respectively, and .76 (supportive parenting, 17 items) and .75 (aversive parenting, 15 items) for mothers' reports.

Data Analyses

We conducted all data analyses using Mplus 7.0. We first conducted hierarchical multivariate multiple regression (MMR) analyses. In the first step, we examined the role of child behavioral regulation in children's early learning and social-emotional outcomes. In the second step, maternal supportive parenting and aversive parenting were added. In the third step, fathers' supportive parenting and aversive parenting were added. In the last step, all the interaction terms between parenting and child behavioral regulation were added to the model to examine whether maternal parenting and paternal parenting would moderate the relations between children's behavioral regulation and their early learning and social-emotional outcomes. We then conducted path analyses to test the mediation model in which child behavioral regulation was hypothesized to mediate the relations between parenting practices and child outcomes.

Results

Table 1 contains the descriptive statistics and Table 2 presents the correlations among the study variables. Overall, child behavioral regulation showed significant positive correlations with number competence, vocabulary, and phonological awareness, but it was not correlated with internalizing or externalizing problems. Child behavioral regulation was not correlated with maternal or paternal parenting behavior. In terms of the relations between parenting behavior and child outcomes, children with fathers who reported higher levels of aversive parenting had poorer number competence, and more internalizing and externalizing problems. Mothers' aversive parenting was positively associated with children's internalizing and externalizing problems. Additionally, higher levels of paternal supportive parenting were related to fewer internalizing and externalizing problems. Next, we proceeded to conduct moderation and mediation analyses. Models were estimated separately for moderation and mediation analyses, because they were based on two competing theories.

Table 1 Descriptive statistics of study variables

Variable	*M*	SD	Range	Possible range
Number competence	14.02	4.34	4–25	0–33
Vocabulary	15.56	4.37	3–25	0–30
Phonological awareness	.78	2.11	0–11	0–16
Internalizing problem	.29	.20	0–.97	0–2
Externalizing problem	.46	.27	0–1.21	0–2
Child age (months)	38.01	2.68	31–42	NA
Family income	3.17	1.03	1–5	1–5
Parental education	3.05	.83	1–5	1–5
Behavioral regulation	14.34	12.83	0–57	0–60
Mother supportive	4.29	.26	3.65–4.76	1–5
Mother aversive	2.83	.39	1.73–3.67	1–5
Father supportive	4.11	.33	3.50–5	1–5
Father aversive	2.75	.42	1.33–3.58	1–5

Moderation Effects of Parenting on the Relations between Behavioral Regulation and Child Outcomes

We conducted four separate hierarchical multivariate multiple regression (MMR) analyses to examine the associations among child behavioral regulation, parenting, and child early learning and social-emotional outcomes. In MMR, a single regression model was estimated for all of the five outcomes simultaneously (i.e., number competence, vocabulary, phonological awareness, internalizing problems, externalizing problems). We employed MMR instead of estimating a series of univariate multiple regression models for each of the outcomes to lower the Type I error rate. In the first step, the covariates and child behavioral regulation were entered to examine the role of behavioral regulation in children's early learning and social-emotional outcomes. The predictors in the model included child behavioral regulation and several demographic variables, including program type (full-day vs. half-day), child age, child gender, family income, and parental education. As shown in Table 3, after controlling for the covariates, child behavioral regulation was significantly associated with child early learning outcomes, such that better behavioral regulation was related to better number competence, vocabulary, and phonological awareness. However, behavioral regulation was not related to internalizing or externalizing problems.

In Step 2 and 3, we added maternal and paternal parenting respectively. As shown in Table 3, aversive parenting of the mother contributed to both child internalizing ($\beta = .208$, $p = .038$) and externalizing problems ($\beta = .255$, $p = .007$). In addition, higher levels of aversive parenting of the father were associated with more child externalizing problems ($\beta = -.219$, $p = .024$), and higher levels of paternal supportive parenting were related to fewer externalizing problems ($\beta = .233$, $p = .019$), above maternal parenting. We added the interactions between parenting and child behavioral regulation in Step 4. Paternal supportive

Table 2 Correlations among the study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Number competence	–												
2. Vocabulary	.40***	–											
3. Phonological awareness	.49***	.14	–										
4. Internalizing problem	−.17	−.15	.05	–									
5. Externalizing problem	−.27**	−.13	−.01	.84***	–								
6. Child gender	.02	.19*	.002	−.06	−.14	–							
7. Child age	.21	.15	.01	.04	−.04	.02	–						
8. Family income	.20	.11	.24*	−.10	−.15	−.05	.01	–					
9. Parental education	.04	.14	.02	−.16	−.18	.05	.20†	.38**	–				
10. Behavioral regulation	.25**	.21*	.21*	−.03	−.08	−.01	.19†	−.04	−.08	–			
11. Mother supportive	−.08	−.03	−.09	−.04	.02	.02	−.13	−.24*	.01	.07	–		
12. Mother aversive	−.07	.04	−.03	.21*	.23*	.14	.16	−.20	−.21	.18	.003	–	
13. Father supportive	−.01	−.05	.01	−.22*	−.32***	.18	−.10	.05	.17	.01	.05	−.22*	–
14. Father aversive	−.20*	−.03	−.17	.24*	.34***	−.03	.13	−.14	−.10	−.19	−.06	.28**	−.24*

Child gender was dummy coded (0 = boys, 1 = girls)

*$p < .05$, **$p < .01$, ***$p < .001$

parenting interacted with behavioral regulation in relation to children's number competence ($\beta = .215$, $p = .043$) and externalizing problems ($\beta = -.243$, $p = .015$). However, neither maternal parenting nor paternal aversive parenting interacted with child behavioral regulation in predicting children's early language and mathematics outcomes and behavior problems.

To better understand the interactions, simple slope analyses were performed. Specifically, the relations between behavioral regulation and children's outcomes were observed at three levels of paternal supportive parenting: 1 *SD* above and below the mean ("high" and "low") and at the mean ("mean"), controlling for other predictors in the model. As presented in Fig. 1, at a high level of paternal supportive parenting (dotted lines), children's behavioral regulation was positively related to their number competence ($B = .151$, $p = .001$) and negatively to externalizing problems ($B = -.008$, $p = .011$). At a mean level of paternal supportive parenting (dashed lines), children's behavioral regulation was positively associated with number competence ($B = .074$, $p = .039$), but unrelated to externalizing problems ($B = -.002$, $p = .228$). At a low level of paternal supportive parenting (solid lines), children's behavioral regulation was no longer related to number competence ($B = -.003$, $p = .961$) or externalizing problems ($B = .003$, $p = .322$).

Mediation Effects of Behavioral Regulation on the Relations between Parenting and Child Outcomes

Mediation analyses were conducted in Mplus 7.0 under maximum likelihood estimation, in order to examine whether maternal and paternal parenting behaviors were indirectly related to children's early learning outcomes and behavior problems via children's behavioral regulation. Figure 2 presents the mediation model, in which behavioral regulation was predicted by maternal and paternal parenting behaviors and child outcomes were predicted by maternal and paternal parenting and behavioral regulation. Table 4 presents specific path coefficients. The model was just identified, which means that all possible path parameters in the model were estimated, and thus the model fit was perfect. We used the "MODEL INDIRECT" solution in Mplus to test whether children's behavioral regulation significantly mediated the relation between parenting behavior and child outcomes. This solution utilizes the Sobel test, a widely used method to examine the significance of mediation effects (Sobel 1982). However, neither fathers' nor mothers' parenting behaviors had significant indirect effects on child outcomes through children's behavioral regulation. Thus, behavioral regulation did not mediate the relations between parenting and child early competencies.

Discussion

The current study was based on data collected from a group of children approximately three years of age living in Hong Kong. The findings demonstrated that children with higher behavioral regulation generally had higher levels of number competence, receptive vocabulary, and phonological awareness. However, behavioral regulation was not related to child internalizing or externalizing problems. In addition, fathers' supportive parenting moderated the relations

Table 3 The associations among child behavioral regulation, parenting and child early outcomes

	Number competence	Vocabulary	Phonological awareness	Internalizing problem	Externalizing problem
Step 1					
Program	−.001 (.096)	−.119 (.094)	.099 (.098)	.030 (.101)	.050 (.099)
Child age	.165 (.109)	.069 (.109)	.012 (.104)	.053 (.109)	−.024 (.109)
Child gender	.040 (.091)	.190* (.088)	.028 (.093)	−.056 (.097)	−.142 (.094)
Parental education	−.079 (.136)	.071 (.124)	−.058 (.141)	−.151 (.139)	−.129 (.134)
Family income	.219 (.114)	.077 (.116)	.245* (.107)	−.055 (.119)	−.130 (.116)
Behavioral regulation (BR)	.232* (.094)	.242* (.097)	.212* (.094)	−.068 (.099)	−.105 (.097)
R^2	.135*	.137*	.099	.037	.081
Step 2					
Mother supportive	−.026 (.101)	−.031 (.102)	−.060 (.101)	−.031 (.104)	.001 (.100)
Mother aversive	−.148 (.098)	−.009 (.099)	−.041 (.100)	.208* (.100)	.255** (.095)
R^2	.156*	.132*	.099	.085	.152*
Step 3					
Father supportive	−.031 (.100)	−.110 (.099)	−.035 (.101)	−.138 (.107)	−.219* (.097)
Father aversive	−.144 (.104)	.004 (.104)	−.091 (.104)	.163 (.109)	.233* (.099)
R^2	.167*	.147*	.106	.124*	.234**
Step 4					
Mother supportive × BR	.031 (.103)	.052 (.108)	.103 (.102)	.199 (.114)	.113 (.094)
Mother aversive × BR	.003 (.113)	.121 (.117)	.002 (.112)	.120 (.111)	.106 (.103)
Father supportive × BR	.215* (.106)	.041 (.112)	.176 (.105)	−.145 (.109)	−.243* (.100)
Father aversive × BR	.167 (.149)	.173 (.155)	−.095 (.142)	.005 (.145)	−.127 (.136)
R^2	.215**	.222*	.159*	.212**	.315***

Program was dummy coded (0 = half-day, 1 = full-day). Child gender was dummy coded (0 = boys, 1 = girls). Only standardized coefficients are shown, and standard error coefficients are in parentheses

*$p < .05$, **$p < .01$, ***$p < .001$

between children's behavioral regulation and their number competence and externalizing problems.

Behavioral Regulation and Child Outcomes

Our findings confirmed prior work that connects behavioral regulation with learning outcomes during early childhood (McClelland et al. 2007; Ponitz et al. 2009; Sektnan et al. 2010; Wanless et al. 2011). Development in the cognitive domains related to behavioral regulation may help children to acquire early linguistic, literacy, and mathematics skills. At the time of the study, children had been in a classroom setting for about a year. Children can better engage in learning activities when they are able to regulate their classroom behaviors, such as focusing their attention, controlling automatic behavioral tendencies, and following instruction. In Hong Kong preschools, many activities in the classroom are aimed at stimulating children's language and mathematics learning, even for very young children like those in the current study. Thus, being able to regulate their behaviors in the classroom is important for acquiring these skills.

Similar to what we did in the current study, Wanless et al. (2011) also utilized the HTKS task and examined the relations between behavioral regulation and early mathematics and literacy skills among Chinese preschoolers. Children in this study were much younger than those in the study by Wanless et al. ($M = 3.17$ and 5.03, respectively). Additionally, we used a much more comprehensive measure of mathematics competence that captures skills beyond counting and calculation. Wanless et al. used a Chinese character recognition task to assess early literacy, while we measured both receptive vocabulary and phonological awareness to assess children's language skills. Thus, this study provides strong evidence that the role of behavioral regulation in early learning can manifest as early as 3-years old among Chinese children.

We also examined the relation between behavioral regulation and behavior problems, which have rarely been examined among Chinese preschoolers. McClelland et al. (2007) found direct relations between children's behavioral regulation and some aspects of social-emotional competencies. Research on executive function has also demonstrated relationships with children's social-emotional

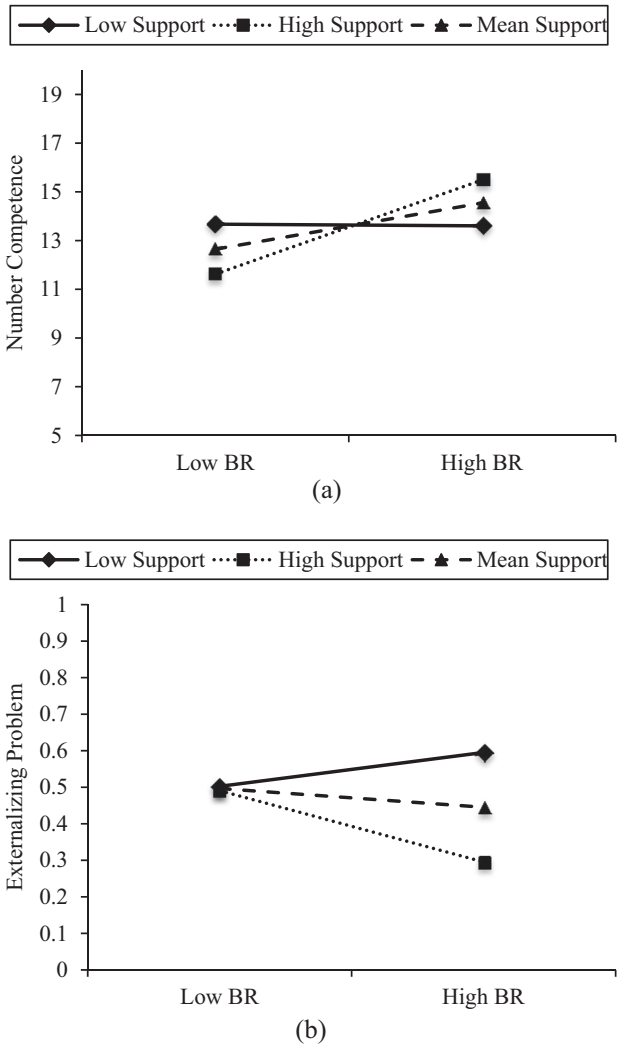

Fig. 1 The interaction effect between child behavioral regulation and fathers' supportive parenting on **a** child number competence, **b** externalizing problems. High/Low supportive parenting: 1 *SD* above/below the mean. High/Low behavioral regulation (BR): 1 *SD* above/below the mean

outcomes (e.g., Riggs et al. 2003; Semple et al. 2010). We thus expected associations between children's behavioral regulation and social-emotional functioning. However, consistent with the finding reported by Ponitz et al. (2009), we found no direct relations between children's performance on the HTKS task and their internalizing and externalizing problems after controlling for covariates. Behavior problems often emerge when children fail to modulate their emotions and impulses in emotion-laden social situations, such as lashing out when toys being taken away by peers. The HTKS task taps the "cool" cognitive side of self-regulation, but not the "hot" emotional side. Additionally, Ponitz et al. (2009) pointed out that the HTKS task might draw heavily on working memory and attentional focusing, but less so on inhibitory control, and working memory and attention are not as clearly linked to social-emotional competence as inhibitory control. However, we cannot conclude with certainty that behavioral regulation is irrelevant to the emergence of behavior problems. Children in the current study showed relatively low levels of internalizing and externalizing problems with small variability (see Table 1). Future research with more representative samples is needed to further clarify the relationships between behavioral regulation and behavior problems in young children.

Another noteworthy finding is that family income had significant effects on children's number competence and phonological awareness after controlling for other variables in the models (Table 3). Abundant evidence has demonstrated the positive effect of family socioeconomic status on child mathematics learning and language and literacy development (e.g., Jordan and Levine 2009; Mistry et al. 2004). Family income may affect child outcomes through its influence on family processes, neighborhood environment, and accessible resources (Mistry et al. 2004). In this study, children from higher-income families might have had more exposure to learning opportunities; for example, they might attend afterschool programs which are usually costly in Hong Kong.

Moderation Effects of Paternal Parenting

Based on the two theoretical frameworks that have guided research on the associations between parenting and children's self-regulation in relation to their social-emotional and academic outcomes (e.g., Karreman et al. 2009; Spinrad et al. 2007), we conducted both mediation and moderation analyses to examine the relations among parenting, behavioral regulation, and child outcomes. Path analyses resulted in no significant mediation effects of child behavioral regulation. However, the findings do not rule out the potential mediation effects of behavioral regulation on the relations between parenting and child outcomes, because the current study is cross-sectional, and temporal precedence was not established to make causal inferences. Rigorous tests of mediation require longitudinal data, and thus, longitudinal research is needed to further understand whether behavioral regulation may serve as an underlying mechanism through which maternal and paternal parenting affects young children's early competencies.

In addition, we used a broad measure of supportive parenting, which captures a similar construct as authoritative parenting in the parenting styles literature. Darling and Steinberg (1993) proposed that parenting styles could be thought of as the general atmosphere in which parent–child interaction takes place. Existing studies that examined parenting as precursors of child self-regulation usually focused on specific parenting behaviors, such as

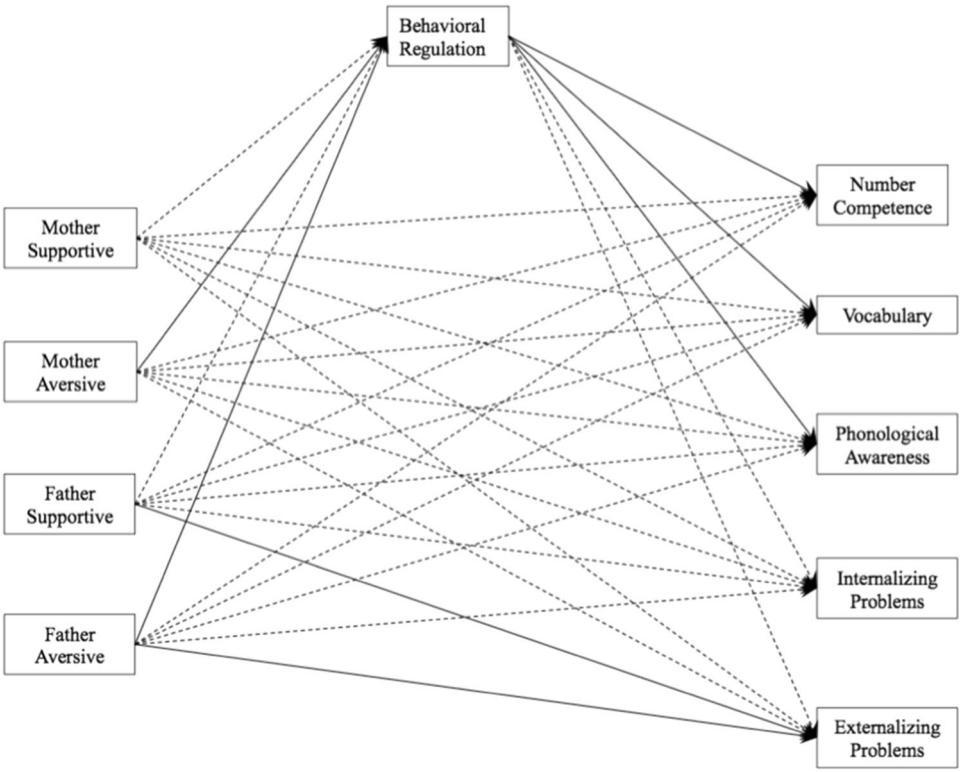

Fig. 2 Path model depicting the effects of parenting behavior on child outcomes via behavioral regulation. Solid lines represent significant paths and dotted lines represent nonsignificant paths at the $p = .05$ level

autonomy support (Bernier et al. 2010). Additionally, although child behavioral regulation continues to develop, the first two years of life seems to be the most critical period for children's frontal brain development that lays the groundwork for the subsequent development of EF and behavioral regulation (Bernier et al. 2012). McClelland et al. (2014) found that children's behavioral regulation showed high stability during the prekindergarten year, as indicated by a high correlation between children's fall and spring performance on the HTKS task. Thus, we suspect that parenting assessed in the first one or two years of children's life might be more predictive of children's behavioral regulation, compared to later years.

As described previously, children's behavioral regulation may show high stability during preschool years (McClelland et al. 2014). Thus, in the current study, a child's behavioral regulation assessed at 3 years of age can be thought of as his/her personal characteristic that constantly interacts with the context in influencing his/her early learning and social-emotional outcomes. Parenting is an essential component of the context in which young children develop (Bronfenbrenner 1979). We then examined the moderation role of parenting, and found that behavioral regulation was positively related to number competence at mean and high levels of paternal supportive parenting, but not at the low levels. The findings suggest that paternal support can enhance the positive effect of children's behavioral regulation on their early mathematics skills. In addition, behavioral regulation was negatively related to externalizing problems at high levels of paternal supportive parenting, but not at mean or low levels of paternal supportive parenting.

The findings suggest that high levels of support from fathers may provide a benevolent atmosphere that strengthens children's abilities to effectively utilize their behavioral regulation skills in learning activities related to mathematics, as well as in social situations that behavior problems are likely to emerge. When a father grants his child more support by expressing affection, providing reasoning and guidance, and showing respect to the child's views, the child may feel more confident and comfortable in managing his behaviors by retrieving and utilizing his regulatory skills. This may be particularly true for very young children, as their regulatory abilities are relatively low, and they may need guidance and support from adults in order to employ the regulatory skills they possess in maintaining engagement in learning activities and dealing with intense social situations. In addition, fathers who showed high levels of support to children might have also provided more learning opportunities to children during interactions, and children with high levels of behavioral regulation were able to take advantage of these learning opportunities and develop mathematics skills.

Additionally, literature on fathering suggests that fathering is particularly susceptible to contextual factors such as marital quality, social support, and maternal

Table 4 Unstandardized and standardized path coefficients in the path model shown in Fig. 1 (standard errors in parentheses)

Predictors	Behavioral regulation		Number competence		Vocabulary		Phonological awareness		Internalizing problem		Externalizing problem	
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)
Mother supportive	2.558 (4.827)	.050 (.095)	−1.768 (1.576)	−.105 (.093)	−.450 (1.616)	−.027 (.096)	−1.026 (.805)	−.122 (.095)	−.049 (.068)	−.068 (.094)	.021 (.092)	.020 (.090)
Mother aversive	8.765* (3.493)	.253** (.097)	−1.023 (1.178)	−.089 (.102)	.085 (1.208)	.007 (.105)	−.376 (.599)	−.065 (.103)	.028 (.051)	.057 (.103)	.047 (.069)	.067 (.097)
Father supportive	.198 (3.962)	.005 (.099)	−.683 (1.291)	−.052 (.098)	−.651 (1.319)	−.050 (.101)	−.227 (.656)	−.034 (.099)	−.091 (.056)	−.162 (.098)	−.199** (.075)	−.247** (.091)
Father aversive	−7.858* (3.165)	−.251* (.099)	−1.416 (1.063)	−.137 (.102)	−.029 (1.084)	−.003 (.105)	−.661 (.538)	−.128 (.103)	.078 (.046)	.175 (.102)	.155* (.062)	.247** (.096)
Behavioral regulation	–	–	.088** (.033)	.267** (.098)	.077* (.036)	.234* (.107)	.034* (.017)	.208* (.099)	.001 (.001)	−.026 (.100)	−.001 (.002)	−.067 (.095)

Child gender was dummy coded (0 = boys, 1 = girls)

*$p < .05$, **$p < .01$, ***$p < .001$

parenting (Cummings et al. 2004). Thus, supportive fathering may indicate a constellation of positive factors in the childrearing environment, such as marital harmony. The constructive environment may help young children "activate" their self-regulatory skills to engage in early mathematics learning and management of social behaviors. In addition, fathering is also susceptible to child characteristics, such as gender, age, and temperament (Cabrera et al. 2007). Children equipped with better behavioral regulation may elicit more support from fathers, which exacerbated the effect of behavioral regulation on child learning outcomes and reduced behavior problems.

Unexpectedly, maternal supportive parenting did not interact with child behavioral regulation in relation to child early outcomes. It might be that mothers generally reported very high levels of supportive parenting, and the variation in mothers' reports is not large enough to detect significant interactions. The lack of any interaction effects of aversive parenting × behavioral regulation on child outcomes may be due to two reasons. First, it is likely that the variances of maternal and paternal aversive parenting were not large enough for the interaction effects to be manifested. Our participants were mostly from middle- to high-SES families, and both mothers and fathers reported relatively low levels of aversive parenting. Future research should use a more heterogeneous sample. Second, items loaded on the "aversive parenting" factors seemed to capture various types of negative parenting practices, such as punitive disciplining, directiveness, and negligence. Different kinds of negative parenting behaviors may relate to child behavioral regulation differently in influencing child early learning and social-emotional functioning. Further research needs to better differentiate different dimensions of parenting to better understand how parenting and child behavioral regulation interplays.

Limitations and Suggestions for Future Research

This study has several limitations. First, the study sample was a relatively homogeneous and low-risk sample. Children had relatively low levels of internalizing and externalizing problems with small variability. Parents' reports of their own parenting practices also showed small variation, and the levels of supportive parenting were relatively high. Second, we asked mothers and fathers to report their own parenting practices instead of using observational measures of parenting. Parents might have overrated positive parenting behaviors and underrated negative behaviors due to the social desirability bias. Third, this study is cross-sectional. Although we tested the mediation model (i.e., behavioral regulation mediates the relations between parenting and child outcomes), causal inferences cannot be drawn without temporal precedence. Longitudinal research

is needed to understand how parenting and child behavioral regulation function together in influencing child early learning outcomes and social-emotional functioning. Finally, we only focused on children's behavior problems and did not assess positive aspects of children's social-emotional functioning, such as prosocial behaviors and coping skills.

Despite the limitations, this study has important implications for future research. Our findings suggest that behavioral regulation may play a significant role in very young Chinese children's early learning of mathematics and language skills. Emphasis on behavioral regulation is particularly important for Chinese preschool education, considering the context of Chinese preschools. Chinese preschool classrooms often have a large class size, and the student–teacher ratio is usually higher than that in the US and many other Western countries. With the demands of running a large class, teachers may render limited amount of help to individual children in regulating their behaviors and attention. Children may have to rely on themselves to stay engaged in classroom activities that contain rich learning opportunities. Many comprehensive preschool interventions have included self-regulation components and shown positive effects on children's academic achievement and social-emotional competence (see Schmitt et al. 2015). Interventions specifically targeted children's behavioral regulation have also been proven effective in promoting children's early learning (Schmitt et al. 2015). Thus, training of self-regulation may be integrated into preschool curriculum. For example, the PATHS curriculum has been found to be effective in improving children's regulatory abilities in the US (Bierman et al. 2008; Domitrovich et al. 2007), and it may be adapted and used in Chinese preschool classrooms. In addition, teachers may design games that can purposefully train children's abilities to regulate their behaviors, such as the "Red Light, Purple Light" game used in a self-regulation intervention (Schmitt et al. 2015). Future research is needed to examine how well these programs may help improve children's behavioral regulation and their subsequent learning and social-emotional outcomes in the Chinese context.

Our findings also imply the importance of paternal supportive parenting in helping children utilize their regulatory skills in learning and preventing behavior problems. Future research is needed to examine how to promote parents' understanding of behavioral regulation, as well as ways to support their children's acquisition and utilization of behavioral regulation skills in learning activities and social situations. Parents may play games that integrate attention and inhibitory control with children. Engaging children with challenging socio-dramatic roles that require them regulating their behaviors may also help promote children's behavioral regulation skills (Sektnan et al. 2010). Empirical studies are needed to examine the effectiveness of parent education programs aimed at improving young children's behavioral regulation in the Chinese context.

Author Contributions L. R. conducted most of the data analyses, wrote most of the sections in the initial draft of the manuscript, and coordinated the revision process. X. Z. carried out the big project in which the current study was part of, and wrote the initial Methods section. W. Y. conducted additional analyses in the revision process of the manuscript, and revised the Results section. Z. S. revised part of the Introduction section and provided helpful thoughts for the Discussion section in the revision process of the manuscript.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no competing interests.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. IRB approval was provided by The Education University of Hong Kong.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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