Linking parental scaffolding with self-regulated learning in Chinese kindergarten children

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Abstract

The current study aimed to examine the relationships between dimensions of parental scaffolding and children's self-regulated learning (SRL). One hundred and thirty Chinese kindergarten children participated in a range of problem-solving tasks with their parents and independently. Parent-child interactions and child-alone behaviours were video-recorded for an in-depth observational analysis. Parental cognitive support, emotional support, and contingency were coded in parent-child interactions. Children's cognitive, metacognitive, and motivational strategic behaviours and task performance were coded and assessed within the context of child-alone tasks. Results showed that contingency was particularly important for children's SRL. Parental contingency was the only independent predictor of children's SRL among the three aspects of parental scaffolding and mediated the effect of parent education levels on children's SRL.

Keywords: Parental scaffolding; Self-regulated learning; Contingency; Chinese kindergarten children

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1. Introduction

Since the 1980s, the term self-regulated leaning (hereafter abbreviated as SRL) has become widely used and is broadly defined as "learning that results from students' self-generated thoughts and behaviours that are systematically oriented toward the attainment of their learning goals" (Schunk, 2001, p. 125). Children's development of SRL has been identified as an important socialisation process beginning in early childhood (Suchodoletz, Trommsdorff, & Heikamp, 2011). As self-regulatory abilities are learnt and highly teachable, parenting plays a key role in kindergarten children's learning of SRL strategies within problem-solving situations (Whitebread & Basilio, 2012). A small number of studies have suggested that parental scaffolding, as one of the primary parental behaviours during parent-child interactions, is related to children's SRL (e.g. Neitzl & Stright, 2003; Pino-Pasternak, Whitebread & Tolmie, 2010).

Much of the existing research concerning children's SRL has centred on school-age children and has suggested the importance of children's effective use of SRL strategies to their learning outcomes in academic tasks (e.g. Pino-Pasternak et al., 2010), whereas less attention has been given to kindergarten children's strategic behaviours in problem-solving contexts. Moreover, the predominance of Caucasian participants in this research area calls for further studies in different cultural contexts. No studies of which we are aware have linked parenting with children's use of SRL strategies in China. The current study aimed to expand the literature by shedding light on the role of parental scaffolding in kindergarten children's SRL in the Chinese context.

1.1 Early development of SRL

As SRL has consistently been related to academic performance in school settings, most researchers have focused on school-aged children's self-regulatory competence in specific academic tasks (e.g. Throndsen, 2011). In fact, children's learning begins long before they enter school and before anyone intentionally teaches them (Vygotsky, 1978). Whitebread (2012) emphasised that young children's self-regulatory abilities can be significantly promoted within playful contexts characterised by emotional support, appropriate levels of cognitive challenges, and opportunities for children to explore their learning processes and that methodological limitations in prior studies have led to the underestimation of kindergarten children's SRL performance. An over-reliance on verbal-based methodologies is evident in many of the earliest studies on children's metacognitive abilities (Winne & Perry, 2000). Cognitive constructivists, following Flavell's (1979) influential work, tend to argue that young children's incapacity for self-regulation during learning activities results from limitations of their

metacognitive competence (Zimmerman, 2001). Studies set in naturalistic settings, however, have shown that young children's ability to demonstrate their metacognitive competence can be negatively affected by contextual factors during experiments (Perry, 1998). The ecological validity of research tasks is therefore essential in investigating young children's strategy use, which is demonstrated more accurately when the tasks are meaningful and age-appropriate (Whitebread et al., 2009).

Despite limited research on young children's SRL, evidence has identified the emergence and development of SRL behaviours in children as young as 3 years old. Bronson (2000) provided a comprehensive review of kindergarten children's development of self-regulation and its relations to environmental support. She concluded that, compared to infants and toddlers, kindergarten children are more organised in their control of attention, monitoring behaviours, and adoption of strategies. Further, with regard to motivational aspects of SRL, kindergarten children are increasingly interested in taking challenges and their focus gradually moves from exploring the task to achieving goals. The kindergarten period is a crucial time for children's development of SRL due to children's significant advances in cognitive awareness, effortful control, language, etc., which allow children to choose appropriate strategies to solve problems (Bronson, 2000).

1.2 Socialisation of SRL: The importance of parental scaffolding

The construct of scaffolding is introduced to explicate an interactive process by which an experienced adult instructs a child to complete a difficult task that the child finds difficult or cannot complete independently (Wood, Bruner, & Ross, 1976). Relying on the "scaffold" of instructional and socioemotional strategies created by parents, the child can not only successfully tackle the task but also gradually become an independent learner (Robinson, Burns, & Davis, 2009). A few studies have shown a tendency towards multidimensional approaches, exploring the contribution of different scaffolding behaviours to indicators of children's SRL (e.g. Pino-Pasternak et al., 2010). Parental scaffolding behaviours which have been found to be related to children's SRL can be categorised into three main aspects as cognitive support, emotional support, and contingency.

1.2.1 Parental cognitive support and children's SRL

Parents provide cognitive support during joint problem-solving tasks by conveying information about task management techniques and strategies (Vygotsky, 1978). Previous research has indicated the predictive role of parents' provision of cognitive support in children's SRL during child-alone and classroom activities. Robinson et al. (2009) provided new insights into the importance of parental cognitive support by

investigating the associations between children's performance with mothers' assistance and child-alone performance in a similar task. The findings suggested that for children with mothers who demonstrated more cognitive support in the task, higher proportions of self-regulated attention in the parent-child task were related to higher accuracy in the child-alone task. In contrast, for children with mothers who provided minimal scaffolding instructions, the attention regulation skills observed in the parent-child task were not associated with performance in the child-alone task. As Vygotsky (1978) suggested, children's learning can be viewed as a process of moving from other-regulation to self-regulation.

Neitzel and Stright (Neitzel & Stright, 2003; Stright, Neitzel, Sears, & Hoke-Sinex, 2001) examined the influences of two indicators of maternal cognitive support, the provision of metacognitive information and manner of instruction, on children's SRL in classroom activities. The results of both studies demonstrated that mothers' manner of instruction moderated the relationships between parents' provision of metacognitive information and children's SRL behaviours in the classroom such as metacognitive talk, task persistence, and self-monitoring. Both studies suggest that parents need to not only provide adequate metacognitive information, but also convey the information in an understandable way and at an appropriate pace. However, although both studies highlighted the importance of the manner of instruction, they focused entirely on mothers' behaviours, but did not assess their contingency that is the degree to which mothers were able to adjust their manner of scaffolding in response to children's ongoing evidence of task understanding.

1.2.2 Parental emotional support and children's SRL

While parental cognitive support contributes more to children's cognitive and metacognitive behaviours, emotional support has been found to be related more strongly to children's motivational and emotional regulatory process, particularly children's persistence on the task, motivation to continue the task and emotional responses to the task (Pino-Pasternak et al., 2010). Without appropriate and timely emotional support from parents, children may lack motivation to learn cognitive strategies or to practice newly acquired knowledge when solving problems independently (Stright et al., 2001).

Early studies have paid attention to both positive and negative aspects of parental emotional behaviours and their relations to children's motivational behaviours of SRL. For instance, Salonen, Lepola, and Vauras (2007) examined the role of parents' positive and negative emotional responses in children's task orientation. The findings indicated that parents of task-oriented children adjusted their emotional responses

more sensitively to their children's emotional expressions, compared to parents of non-task oriented children. In addition, parents of task-oriented children emitted more positive emotional signals than parents of non-task oriented children.

1.2.3 Parental contingency and children's SRL

The concept of contingency is also termed as "the shift rule". It refers to a parental shift in scaffolding following the rule of providing less specific instructions and higher cognitive demand after a child's success and more specific instructions and lower cognitive demand after a child's failure (Wood & Middleton, 1975). For instance, a parent who is able to provide contingent scaffolding will use a more challenging question to promote his or her child's thinking when the child demonstrates a good understanding and provides a more manageable instruction when the child shows a poor understanding of the task. Children's SRL in problem-solving tasks have been shown to be associated with parental contingent scaffolding behaviours. Wood and Middleton (1975) firstly showed that the sensitivity of parents' instructions contingent on children's level of task ability was related to children's independent performance in a post-instruction task. In contrast, the actual frequency of parent's instructions had no relation with children's post-instruction performance. These findings reveal a clear distinction between quantity and quality of parental scaffolding.

Inspired by Wood and his colleagues' work with young children, later studies have further corroborated the significance of varying levels of intervention contingent on children's reactions, but have paid more attention to school-aged children's performance in homework-type activities. Pratt and Savoy-Levine (1998) examined the relationships between contingent tutoring and children's performance on long-division mathematics homework. Both studies found that mothers' use of "the contingent shift rule" was related with children's level of learning gains from a tutoring session to an independent post-testing task. Consistently, a fine-grained analysis of parental contingency based on parents' demand levels and children's understanding levels showed that medium- and high-level cognitive demands contingently conveyed by parents were positively related to children's SRL behaviours in homework tasks (Pino-Pasternak et al., 2010).

1.2.4 Parental education

Parental education has been identified as an important resource for scaffolding in problem-solving situations. Specifically, more educated parents are more likely than less educated parents to provide children with useful cognitive instructions (Supplee, Shaw, Hailstones, & Hartman, 2004), positive emotional responses (Stright et al.,

2009), and respond more contingently with less directive behaviours (Carr & Pike, 2012). Parents with more education have greater exposure to cognitive knowledge, strategies, and practice which enable them to provide more effective support when assisting their children in problem-solving situations (Neitzel & Stright, 2004). However, the role of parental education in the relations between parental scaffolding and children's SRL has not been studied thoroughly. In Neitzel and Stright (2003), it was assumed that mothers' education might impact their scaffolding behaviours, which in turn, might influence children's SRL behaviours. But due to its modest sample size, this study did not test this assumption.

1.2.5 Parental scaffolding and children's SRL in the Chinese context

Although no studies have linked parental scaffolding with Chinese kindergarten children's SRL, some distinctive characteristics of Chinese parenting have been found in limited cross-cultural studies. For example, Wu et al. (2002) found that Chinese mothers laid different emphases on parenting practices, displaying more behaviours than American mothers in terms of encouragement of modesty, protection, directiveness, and shaming/love withdrawal when interacting with preschool-age children. In a study by Ng, Pomerantz, and Lam (2007), laboratory observations indicated that Chinese mothers' negative statements (e.g. "You only got 6 out of 12?") predicted children's improvement in children's school performance, possibly because they conveyed useful strategic resources without display of annoyance and hostility, which did not dampen children's motivation but rather pointed out what children could improve. Whether Chinese parents show unique features when interacting with their children, and whether the relationship between parental scaffolding and children's SRL found in Western cultures holds in Chinese children remains unknown and warrants further studies.

1.3 The present study

The present study aimed to take an initial step to shed light on the relationships between parental scaffolding and Chinese kindergarten children's SRL in problem-solving situations. The study examined the following research questions:

(a) Are children's SRL strategic behaviours associated with their task performance?
(b) Do parental scaffolding behaviours relate to children's SRL strategic behaviours and task performance?
(c) Do parental scaffolding behaviours mediate the relationship between parental education and children's SRL?
(d) Are the relationships between parental scaffolding and children's SRL found in existing Western research evident in the Chinese context?

Given existing evidence (Dermitzaki, Leondari, & Goudas, 2009), the hypothesis was that children's cognitive and metacognitive strategic behaviours would predict children's task performance, while motivational strategic behaviours would not independently predict task performance (H1). But as the first two dimensions were combined together and found to jointly predict children's task performance in Dermitzaki et al. (2009), the magnitude of the effect respectively exerted by cognitive and metacognitive strategic behaviours remains unclear.

With regard to the role of parental scaffolding in children's SRL, we only made a general hypothesis that parental scaffolding would be related to children's SRL but did not hypothesise specific relationships between the dimensions of scaffolding and SRL strategic behaviours due to the lack of evidence in Chinese research in this area. But given early Western studies that have highlighted the importance of contingency (e.g. Pino-Pasternak et al., 2010), it was expected that contingency would be a unique predictor of Chinese children's SRL strategic behaviours (H2).

On the basis of the untested assumption in Neitzel and Stright (2003), it was hypothesised that parental education levels would have an indirect influence on children's SRL through the mediation of parental scaffolding behaviours (H3).

As existing evidence mentioned in section 1.2.5 has indicated that compared to American mothers, Chinese mothers tend to display more negative statements regarding children's academic performance, which however predict heightened performance of children (Ng et al., 2007), it was hypothesised that parental emotional support would not be as important as found in Western research to Chinese children's SRL in problem-solving tasks (H4).

2. Method

2.1 Participants

One hundred and thirty Chinese family dyads consisting of kindergarten children and their parents participated in the study. The participants were recruited from three kindergartens in Beijing. Recruitment advertisements were given to teachers in the kindergartens, who assigned copies to children's parents. The children, 59 girls and 71 boys, ranged in age from 59 to 79 months; the mean age was 71.6 months. The parents, 39 fathers and 91 mothers, ranged in age from 23 to 45; the mean age was 35.7 years. With regard to parental education, 11% of the parents had less than a high school education, 18% had high school certificates, 16% had college diplomas, 28% had college degrees, 27% had Master's degree or above.

2.2 Procedures

Data was collected successively in the three kindergartens. Each parent-child dyad was visited in a playroom of the kindergarten. In each of the kindergartens, the process of data collection was divided into two stages. First, each parent-child dyad completed two parent-child interaction tasks. Second, after approximately three weeks when the measurement of all the parent-child dyads' interaction in the kindergarten was completed, each child was asked to do two-child alone tasks for the assessment of their SRL. The researcher sat in a corner of the playroom and remained a good distance from the participants in order to provide them with a relaxing atmosphere. Parents were asked to play with their children as naturally as they would at home. All the tasks were video-recorded for an in-depth behavioural analysis. This process was repeated in each of the three kindergartens.

Two parent-child problem-solving tasks, a puzzle-matching task and an origami paper-folding task, were used to assess parental scaffolding. The puzzle and origami tasks were used due to cultural and age appropriateness. Empirical evidence (e.g. Robinson et al., 2009; Hane, Cheah, Robin, & Fox, 2008) and a pilot study conducted prior to the main data collection has shown that puzzle and origami tasks are appropriate for investigating parental behaviours in the context of problem solving. In the puzzle task, each parent-child dyad was given a set of twenty puzzle blocks and target pictures as a model, with which to reproduce pictures within ten minutes. Each puzzle block had six faces, which allowed the parent-child dyad to complete up to six pictures. Each parent-child dyad had the freedom to decide how many pictures they would like to produce. In the origami task, each parent-child dyad was given an origami pig model, an instruction showing eight steps, and two pieces of origami paper to reproduce either one or two origami pigs within ten minutes. In both tasks, the parent was instructed to play with the child as naturally as they would at home.

Children's SRL in terms of their strategic behaviours and task performance was assessed using two child-alone tasks, which were similar to the parent-child tasks. In the child-alone puzzle task, the child was asked to complete a thirty-piece jigsaw puzzle in ten minutes. In the child-alone origami task, the child was asked to make an origami house in ten minutes following six steps in the instructions. The primary difference between the parent-child tasks and child-alone tasks was in the difficulty level. Parent-child tasks were beyond kindergarten children's abilities to complete independently, highlighting the necessity for parental scaffolding. In contrast, the child-alone tasks were challenging but not beyond kindergarten children's capacities. Success at the child-alone tasks required children to adopt SRL strategies. It has to be noted that although the parent-child puzzle task involved fewer pieces than the

child-alone one, it was more challenging for the child due to the multiple faces on each puzzle block.

2.3 Measures

2.3.1 Demographic questionnaire

A demographic questionnaire was used to collect basic information of the participants. Questions included parental age, gender, and educational levels, and children's age and gender.

2.3.2 Parental scaffolding

Parental scaffolding in the two parent-child tasks was assessed in terms of cognitive support, emotional support, and contingency. Cognitive support and emotional support were coded by an adapted version of the Parental Scaffolding Coding Manual by Neizel and Stright (2003). To ensure sufficient sensitivity and accuracy in the analysis of parents' scaffolding behaviours, each 10-minute task was divided into five 2-minute segments for coding each item. Compared to coding in shorter time segments which were tried in a pilot study, the use of 2-mintute segments provided enough information and allowed for more room for variability in the data. Each aspect of scaffolding was rated on a 5-point scale from 1 (low) to 5 (high). Parental cognitive support includes parents' provision of metacognitive information that facilitated the thinking behind the problem-solving process. Specifically, parents' suggestions of task management strategies (e.g. "Shall we observe this picture carefully?"), explanations about how the task works (e.g. "Our goal is to follow the steps here.") and rationale for the use of a particular strategy (e.g. "It would be easier if we could first find all the pieces for this picture.") were counted as metacognitive information. Two aspects of emotional support were coded. Encouragement includes the parent's positive reactions towards the child, such as words of encouragement, supportive comments, and positive nonverbal behaviours. Rejection refers to the parent's negative reactions such as criticism, disapproval, dismissal of the child's efforts, and negative non-verbal behaviours. Parental manner of instruction and transfer of responsibility in the original Neitzel and Stright's coding framework were removed and replaced with separate measures of contingency.

To examine parental contingency referring to the extent to which parents were able to provide or withhold instructions contingent on their children's success or failure of understanding, parental instructional demand and children's ongoing evidence of task understanding were firstly assessed. Two coding schemes were modified from the *Coding of parental instructional demand* and the *Coding of children's evidence of task understanding* used by Pino-Pasternak (2014) and Pino-Pasternak, et al. (2010).

As the play-based problem-solving tasks in the present study and homework-like activities in Pino-Pasternak's study were different in nature, original coding items were modified in order to make them relevant to the current tasks. Specifically, parental instructional demand was conceptualised as three levels representing low demand (level 1, D1), medium demand (level 2, D2), and high demand (level 3, D3) embedded in parents' instructions (Pino-Pasternak, 2014). Low demand refers to the situation where the parent asks the child to do the easy part of the task, models the application of strategies and simply asks the child to follow, and poses low-level yes/no questions. Medium demand refers to the situation where the parent provides detailed and manageable instructions to reduce the level of difficulty and breaks the task into manageable sub-goals and relates the sub-goals to the overall goal of the task. High demand refers to the situation where the parent uses questions or comments to activate prior knowledge and encourage planning, performance monitoring, and strategy use. Children's evidence of task understanding was coded at five levels of understanding representing no clear evidence of understanding (level 0, U0), poor understanding (level 1, U1), partial understanding (level 2, U2), clear understanding (level 3, U3), and independent understanding not prompted by parental support (level 4, U4). The coding for parental instructional demand and children's task understanding was utterance by utterance.

Four categories of parental contingency ("contingent", "non-contingent up", "non-contingent down", and "non-contingent off") were operationalised as combinations of parental instructional demand and children's task understanding. "Contingent" refers to parental demand that changes in agreement with the child's evidence of understanding; "non-contingent up" refers to parental demand that exceeds the child's level of understanding; "non-contingent down" refers to parental demand that underestimates the child's level of understanding; "non-contingent off" refers to when the parent takes over the task with no cognitive demand directed to the child. Categories of contingency were determined by the combination of coding of parental demand and children's understanding following the combination rules in Pino-Pasternak et al. (2010). Take the category "contingent" as an example. When the parent's demand was maintained at a high level or went up following children's clear understanding and independent understanding (e.g. D3-U3-D3 and D2-U4-D3), when the parent's demand was maintained at a medium level or went down following children's partial understanding (e.g. D2-U2-D2 and D3-U2-D2), or when the parent's demand was maintained at a medium level to provide more hints or went down from a high level following children's poor understanding (e.g. D2-U1-D2 and D3-U1-D2), the parent's behaviour was coded as "contingent".

The number of contingent behaviours and non-contingent behaviours was counted in every 2-minute segment in the parent-child tasks. According to the counts of contingency behaviours, the extent to which parents provided contingent instructional support in the parent-interaction tasks was rated on a 5-point rating scale from 1 (not contingent at all) to 5 (consistently contingent). Because not all parent-child dyads spent 10 minutes for each task, counts of contingent behaviours were not used directly as an indicator of parental contingency. Parents who spent less than 10 minutes with their children on the task would be given a score for contingency lower than their actual performance if counts instead of ratings were used. Less than 5% of parent-child dyads spent less than 10 minutes on each task, and among these parents, only two parent-child dyads spent less than 8 minutes on the origami task. One parent-child dyad who spent less than 5 minutes on each task was excluded from analyses.

2.3.3 Children's SRL strategic behaviours and task performance

Children's SRL strategic behaviours were coded using a coding framework adapted from the *Strategic Behaviour Observation Scale* (SBOS) in Dermitzaki et al. (2009) in the two child-alone tasks. Each 10-minute child-alone task was divided into five 2-minute time segments for coding. Children's cognitive, metacognitive, and motivational strategic behaviours were assessed in the child-alone tasks. Each aspect covers several coding items. As for cognitive strategic behaviours, children's effective use of the model was coded in both the puzzle and origami tasks; effective use of instruction was coded in the origami task. Metacognitive strategic behaviours included behaviours indicative of planning (e.g. The child talks to himself that "I have to put pieces of the lion together".), self-monitoring (e.g. The child pauses and talks to herself that "I have got two legs for the piggy and will make the other two".), and awareness of errors (e.g. The child observes what she made carefully and adjusts two pieces she wrongly puts together.) in the problem-solving procedure. Motivational strategic behaviours were coded in terms of children's concentration on the task (e.g. The child concentrates on the task and is not affected by external stimuli.), maintaining motivation (e.g. The child talks to herself during the task that "I like this game. It's lots of fun!"), and initiative (e.g. The child initiates each step himself and does not ask the researcher for help.). The degree to which the child was able to adopt SRL strategies was assessed using 4-point ratings from 1 (low) to 4 (high). Take children's effective use of model as an example. Whether the child effectively referred to the target pictures provided in the puzzle task and the origami house model in the origami task was rated from 1 (does not utilise the model at all) to 4 (utilises the model sufficiently and effectively).

The coding system was slightly modified in accordance with the characteristics of the tasks used in the present study. For instance, two coding items concerning children's abilities to choose between main and trivial information and analysing and combining activities were not examined in the study, because these behaviours were not relevant in these tasks.

Children's task performance in the two child-alone tasks was respectively measured by two 5-point ratings from 1 (low) to 5 (high). Children's performance was rated given how many pieces they correctly completed in the puzzle task, and how many steps they correctly completed in the origami task. For instance, the child who completed less than 1/3 (less than 10 pieces in the puzzle task and less than 2 steps in the origami task) was given 1; the child who completed the whole task (30 pieces in the puzzle task and 6 steps in the origami task) correctly was given 5.

2.3.4 Reliability

To assess the interrater reliability of these coding schemes, a second coder with a Psychology degree, blinded to the study hypotheses, was carefully trained and independently coded 20% of the videos that were selected at random. Both the first and second coder were native speakers of Mandarin and were proficient in English. The observational measures of parental scaffolding and children's SRL were double coded. Because all the videos were divided into five 2-mintue segments for coding, the degree of agreement was assessed at the level of individual segments and computed using Cohen's kappa. The average Kappa coefficients across time segments for parent and child codes ranged from .78 to .92, which showed good levels of agreement.

3. Results

3.1 Preliminary analyses

Due to the constraints on the number of predictors for achieving the desired statistical power, data reduction through the construction of aggregate measures was necessary for the main analyses. Table 1 shows descriptive statistics for the aggregate scores of the observational measures. To create the aggregates of parent and child observational measures, two analyses were conducted. The first step was to calculate Cronbach's alpha to examine the stability of parental scaffolding behaviours and children's SRL strategic behaviours across the puzzle task and the origami task. Given good internal consistency shown by Cronbach's alpha (ranged from .71 to .88), the ratings for parent and child measures were averaged to create aggregates on the puzzle and origami tasks.

Thereafter, the second step was to calculate aggregate scores for sub-dimensions that had more than one coding item in the coding schemes. In the coding scheme for parental scaffolding, ratings of encouragement and rejection (reversed scoring) were averaged to create an aggregate for emotional support, which showed good internal consistency (Cronbach's alpha= .7). In the coding scheme of children's SRL behaviours, ratings of sub-dimensions of each aspect of SRL strategic behaviours were averaged to create three aggregates for cognitive strategic behaviours, metacognitive strategic behaviours, and motivational strategic behaviours. Cronbach's alpha coefficients for the three composite measures were .76, .86 and .82, which showed high internal consistency. Children's performance scores for the puzzle and origami tasks were averaged for subsequent data analyses, supported by significant correlations between the puzzle task score and origami task score, r= .30, p<.001.

Table 1

Descriptive Statistics for Aggregate Scores of Observational Measures

	M	*SD*	Range
Parental scaffolding behaviours			
Cognitive support	2.44	.82	1.1-4.5
Emotional support	3.20	.31	2.3-4.05
Contingency	3.59	1.03	1.1-5
Children's SRL strategic behaviours			
Cognitive strategic behaviours	2.36	.51	1-4
Metacognitive strategic behaviours	2.98	.75	1-4
Motivational strategic behaviours	3.56	.49	1.4-4
Children's task performance	3.02	1.19	1-5

The Shapiro-Wilk test (the S-K test) was used to test whether the measures were normally distributed, revealing that the distributions of parents' emotional support and children's motivational strategic behaviours were not normal. To deal with the problem of skewed data, non-parametric statistical methods and the bootstrap method in parametric tests were used in the study. Specifically, Mann-Whitney U tests and Spearman's correlations were used to examine mean differences in and bivariate correlations between measures. To further reveal the complexity of relationships between different variables, the bootstrap method was used with parametric tests, including ANOVA, partial correlations, and regression tests. The bootstrap approach was also used for examining the mediating effects of parental scaffolding on the relationships between parental education and children's SRL. Bootstrapping is a robust method and does not rely on normality assumptions. As an alternative to parametric estimates when assumptions of normal distribution shape are violated, bootstrapping allows robust estimates of the properties of the sampling distribution by

treating the sample data as a population from which smaller samples are taken (Field, 2013). Given the lack of normality in two variables in the study, the bias corrected and accelerated confidence intervals (reported as BCa CI for later analyses) were taken into consideration more than the significance value per se. Unlike the significance values that might be affected by data distributions, the bootstrapped confidence intervals are unaffected and therefore can be trusted (Field, 2013). If the confidence interval crosses zero, the population value could be zero, which suggests no effect in the population. For data analysis in the study, SPSS 22.0 that incorporates an add-on bootstrapping module was used.

Preliminary analyses were also conducted to determine whether gender and age of parents and children had effects on parent and child measures. The results of Mann-Whitney U tests suggested that mothers and fathers did not differ in any of the parent measures and children did not differ by parent gender in any of the child measures. The results of partial correlations between parent age, parent measures, and child measures showed that parental age was not related to any of the parent and child measures when the effect of parental education was controlled.

Significant differences between boys and girls were found in their SRL strategic behaviours but not in task performance. Compared to boys, girls showed more cognitive strategic behaviours (U=1540.50, p<.01), metacognitive strategic behaviours (U=1637.50, p<.05), and motivational strategic behaviours (U=1501.50, p<.01), but did not outperform boys in terms of task performance (U=1710.50, p>.05). The results of Spearman's correlations showed that children's age was significantly related to metacognitive strategic behaviours (ρ=.19, p < .05), motivational strategic behaviours (ρ=.22, p < .05), and task performance (ρ=.24, p < .01). Significant effects identified in above analyses were controlled for in later analyses.

3.2 Are children's SRL strategic behaviours associated with their task performance?

To test whether children's cognitive, metacognitive, and motivational strategic behaviours would each be significant and independent predictors of children's task performance, partial correlations with the bootstrap method were conducted controlling for child gender and age. Children's task performance was significantly related to cognitive strategic behaviours, r=.59, p<.001, to metacognitive strategic behaviours, r=.83, p<.001, and to motivational strategic behaviours, r=.48, p<.001.

Table 2 reports the results for hierarchical multiple regression analysis using the bootstrap method, which was conducted to better understand the relative roles of

children's different SRL strategic behaviours in predicting task performance. In the regression equation, child gender and age were entered in Step 1. Previous studies have revealed that although motivational strategic behaviours are important, cognitive and metacognitive strategic behaviours have stronger effects on problem-solving achievement (e.g. Dermitzaki et al., 2009). Therefore, children's cognitive and metacognitive strategic behaviours were entered at Step 2 and children's motivational strategic behavior was entered at Step 3 of the regression equation.

The overall regression model was significant, R^2=.72, F (5, 124) =62.36, p<.001. At Step 1, child age and gender accounted for 7% of the variance, F (2, 127) =4.5, p<.05. However, at Step 2, the contribution of child age diminished when children's cognitive and metacognitive strategic behaviours were entered in the regression equation and a significant change in the value of R^2 was noted, ΔR^2=.64, F (4, 125) =75.85, p<.001. At Step 3, children's motivational strategic behaviours only accounted for an additional 1% of the variance in children's task performance, indicating an insignificant change. Interestingly, among the three aspects of children's SRL strategic behaviours, only children's metacognitive strategic behaviours significantly predicted task performance, t (124)=11.24,p<. 001.

Table 2

Summary of a Hierarchical Regression Analysis Predicting Children's Task performance from Children's SRL Strategic Behaviours, with 95% Bias Corrected and Accelerated Confidence Intervals for B Reported in Parentheses. Confidence Intervals and Standard Errors based on 1000 Bootstrap Samples

	Variable	*B*	*SE B*	*β*
Step1	Gender	0.33 (-0.05, 0.73)	0.20	.14
	Age	0.05 (0.01, 0.09)	0.02	.21*
Step2	Gender	0.01 (-0.21, 0.25)	0.12	.00
	Age	0.02 (-0.01, 0.04)	0.01	.06
	Cognitive strategic behaviours	-0.17 (-0.51, 0.13)	0.16	-.08
	Metacognitive strategic behaviours	1.39 (1.19, 1.60)	0.10	.88***
Step3	Gender	0.02 (-0.20, 0.26)	0.12	.01
	Age	0.02 (-0.01, 0.39)	0.01	.07

Cognitive strategic behaviours	-0.15 (-0.47, 0.14)	0.16	-.06
Metacognitive strategic behaviours	1.51 (1.31, 1.71)	0.11	.95***
Motivational strategic behaviours	-0.29 (-0.59, -0.01)	0.15	-.12

Note. R^2=.07* for Step 1; ΔR^2=.64*** for Step 2; ΔR^2=.01 for Step 3.
*p<.05. *** p < .001.

3.3 Do parental scaffolding behaviours relate to children's SRL strategic behaviours and task performance?

To test whether parental cognitive support, emotional support, and contingency would each be significant and independent predictors of children's SRL strategic behaviours and task performance, partial correlations and hierarchical multiple regression analyses controlling for parents' and children's demographic measures were conducted. Parental cognitive support was significantly associated with children's cognitive strategic behaviours, r=.32, p<.001, and metacognitive strategic behaviours, r=.27, p<.01, but not with motivational strategic behaviours and task performance. Parental emotional support was significantly associated with children's cognitive strategic behaviours, r=.23, p<.01, metacognitive strategic behaviours, r=.18, p<.05, and motivational strategic behaviours, r=.18, p<.05, but not with task performance. Parental contingency was significantly associated with children's cognitive strategic behaviours, r=.54, p<.001, children's metacognitive strategic behaviours, r=.68, p<.001, children's motivational strategic behaviours, r=.50, p<.001, and task performance, r=.58, p<.001. The bootstrap confidence intervals for the relationships did not contain zero, indicating that the relationships were genuine.

Four hierarchical multiple regression analyses were then conducted in turn to examine the role of parental scaffolding behaviours as predictors of children's SRL strategic behaviours and task performance. In each of the regression equations for children's cognitive, metacognitive, and motivational strategic behaviours, a 4-step analysis was conducted. Demographic variables were entered in Step 1 to control their effects. Then parental scaffolding behaviours were entered into the regression equation in the sequence suggested by Neitzel and Stright (2003). As cognitive support provides the foundation of parental scaffolding in problem-solving processes, it was entered in Step 2, followed by parental contingency in Step 3. Step 4 assessed the contribution of parental emotional support to children's use of SRL strategic behaviours.

Table 3 summarises the regression results. The four overall models respectively,

predicted children's cognitive strategic behaviours, F (7, 122) =11.44, p<.001, metacognitive strategic behaviours, F (7, 122) =21.76, p<.001, motivational strategic behaviours, F (7, 122) =7.98, p<.001, and task performance, F (7, 122) =14.95, p<.001. However, among the three aspects of parental scaffolding behaviours, only parental contingency was an independent predictor of children's SRL strategic behaviours and task performance. In each of the four regression models, there was a substantial change in the magnitude of the regression coefficients of parental cognitive support when parental contingency was introduced into the equation. When parental contingency was introduced in each regression equation in Step 3, it accounted for an additional 17% of the variance in cognitive strategic behaviours, 32% of the variance in metacognitive strategic behaviours, 20% of the variance in motivational strategic behaviours, and 29% of the variance in task performance.

Table 3

Hierarchical Regression Analyses Predicting Children's SRL Strategic Behaviours and Task performance from Parental Scaffolding Behaviours. Standard Errors based on 1000 Bootstrap Samples

	Variable	Cognitive strategic behaviours			Metacognitive strategic behaviours			Motivational strategic behaviours			Task performance		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Step1	Parent gender	-0.02	0.10	-.01	-0.07	0.14	-.04	-0.12	0.08	-.10	0.09	0.21	.03
	Parent education	0.09	0.03	.24**	0.16	0.05	.31***	0.03	0.03	.08	0.26	0.08	.31***
	Child gender	0.23	0.09	.22**	0.24	0.01	.16*	0.17	0.08	.18*	0.30	0.20	.12
	Child age	0.01	0.01	.10	0.02	0.13	.11	0.01	0.01	.13	0.03	0.02	.14
Step2	Parent gender	-0.01	0.10	-.01	-0.06	0.13	-.03	-0.11	0.08	-.10	0.09	0.22	.04
	Parent education	0.02	0.04	.06	0.08	0.06	.15	-0.02	0.04	-.04	0.21	0.09	.25
	Child gender	0.23	0.01	.22**	0.24	0.12	.16*	0.18	0.08	.18*	0.30	0.20	.12
	Child age	0.01	0.08	.11	0.02	0.01	.12	0.01	0.01	.14	0.04	0.02	.14
	Cognitive support	0.22	0.07	.35***	0.27	0.10	.30**	0.14	0.07	.22*	0.18	0.17	.13
Step3	Parent gender	0.00	0.09	.00	-0.03	0.10	-.02	-0.10	0.07	-.09	0.03	0.19	.01
	Parent education	-0.01	0.03	-.02	0.03	0.04	.05	-0.04	0.04	-.12	0.13	0.07	.15
	Child gender	0.11	0.01	.11	0.01	0.10	.01	0.06	0.08	.06	-0.07	0.17	-.03
	Child age	0.01	0.08	.08	0.01	0.01	.08	0.01	0.01	.11	0.03	0.02	.11
	Cognitive support	0.08	0.06	.13	-0.01	0.08	-.01	-0.01	0.07	-.02	-0.25	0.13	-.17
	Contingency	0.25	0.04	.51***	0.51	0.06	.70***	0.26	0.05	.55***	0.78	0.08	.67***
Step4	Parent gender	0.00	0.09	.00	-0.03	0.10	-.02	-0.10	0.07	-.09	0.03	0.19	.01
	Parent education	-0.01	0.03	-.02	0.03	0.04	.06	-0.04	0.04	-.12	0.13	0.18	.15
	Child gender	0.11	0.08	.08	0.01	0.10	.01	0.06	0.08	.06	-0.07	0.17	-.03
	Child age	0.01	0.01	.11	0.01	0.01	.06	0.01	0.01	.10	0.02	0.02	.10
	Cognitive support	0.09	0.07	.14	0.04	0.09	.04	-0.00	0.08	-.00	-0.22	0.15	-.15
	Contingency	0.26	0.04	.52***	0.54	0.06	.74***	0.27	0.06	.56***	0.80	0.10	.69***

Emotional support	-0.03	0.10	-.03	-0.20	0.12	-.13	-0.04	0.10	-.04	-0.13	0.20	-.05

Note. 95% bias corrected and accelerated confidence intervals for B were calculated in the regression analyses and confirmed that all the significant effects in the table were genuine.

For the model of cognitive strategic behaviours as the dependent variable, R^2=.14*** for Step 1; ΔR^2=.09*** for Step 2; ΔR^2=.17*** for Step 3, ΔR^2=.00 for Step 4.

For the model of metacognitive strategic behaviours as the dependent variable, R^2=.16*** for Step 1; ΔR^2=.06** for Step 2; ΔR^2=.32*** for Step 3, ΔR^2=.01 for Step 4.

For the model of motivational strategic behaviours as the dependent variable, R^2=.08* for Step 1; ΔR^2=.04* for Step 2; ΔR^2=.20*** for Step 3, ΔR^2=.00 for Step 4.

For the model of task performance as the dependent variable, R^2=.16 for Step 1; ΔR^2=.01 for Step 2; ΔR^2=.29*** for Step 3, ΔR^2=.00 for Step 4.

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

Following the above regression analyses, meditational analyses were conducted to further examine the relationships between parental scaffolding, children's SRL strategic behaviours, and task performance. The results showed that children's metacognitive strategic behaviours mediated the relationships between parental contingency and children's task performance, b=0.62***, BCa CI (0.47, 0.76), ab_{cs}=.54, BCa CI (0.43, 0.64). After the effect of children's metacognitive strategic behaviours was taking into account, the direct effect of parental contingency on children's task performance became insignificant.

3.4 Does parental education influence parental scaffolding and children's SRL?

Partial correlation analyses suggested that after the effects of parental scaffolding behaviours and parental age were taken into account, parental education was not significantly related to child outcomes except for children's task performance, r=.18, p<.05. This indicated that parental education might have an indirect effect on some child measures. To better understand the role of parent education, mediation analyses were conducted using an add-on PROCESS (version 2.15) tool developed by A.F. Hayes in SPSS.

Parental contingency mediated the relations of parental education to the three aspects of children's SRL strategic behaviours and task performance. In contrast, parental cognitive support and emotional support did not have a significant effect in the mediation models. Table 4 summarises the role of contingency in each mediation analysis. After the effect of parental contingency was taken into account, the effect of parental education on all the aspects of children's SRL strategic behaviours and task performance became insignificant. Even for children's task performance that was significantly related to parental education when parental scaffolding behaviours were controlled, the direct effect of parental education on children's task performance became insignificant when the effect of parental contingency was entered in the model.

Table 4

The Mediating Role of Parental Contingency in the Relationships between Parent Education and Child Measures, with 95% Bias Corrected and Accelerated Confidence Intervals (BCa CI) Reported. Confidence Intervals based on 1000 Bootstrap Samples

Mediation model	*b*	BCa CI	ab_{cs}	BCa CI
1. Parent education → parental contingency →children's cognitive strategic behaviours	0.08**	(0.05, 0.13)	.15	(0.06, 0.25)
2. Parent education → parental contingency → children's metacognitive strategic behaviours	0.14***	(0.07, 0.24)	.21	(0.08, 0.33)
3. Parent education → parental contingency → children's motivational strategic behaviours	0.07**	(0.03, 0.13)	.17	(0.07, 0.30)
4. Parent education →parental contingency → children's task performance	0.23***	(0.14, 0.36)	.27	(0.15, 0.40)

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

4. Discussion

Four main findings emerged from the current study. First, children's metacognitive strategic behaviours predicted their task performance. Second, parental contingency predicted children's SRL strategic behaviours. Third, parental contingency mediated the relations between parent education and children's SRL strategic behaviours and task performance. Fourth, based on the above findings, the present study indicated that in line with Western research, the relationship between parental scaffolding and children's SRL also exists in the Chinese context. Minor differences between the current results and Western findings were also found. Inconsistently with Western findings, parental emotional support was not an independent predictor of children's SRL in the present study.

4.1 Children's SRL strategic behaviours and task performance

The predictive value of metacognitive strategies for children's task performance found in the present study partially confirmed H1 and is in line with early work with school-age children (Veenman, Wilheim, & Beishuizen, 2004), which indicated that metacognitive skillfulness was the main predictor for children's learning outcomes. Particularly when learners are faced with a challenging task, metacognitive strategies help them handle task complexity step by step.

The results showed that children's cognitive strategic behaviours were not predictive of their task performance. Very few studies have examined the role of different SRL strategies in task performance. As mentioned earlier, although Dermitzaki et al. (2009) investigated cognitive, metacognitive, and motivational strategies respectively, the first two dimensions were combined together and found to jointly predict children's

task performance, which led to the magnitude of the effect exerted by cognitive strategic behaviours alone remaining unknown. In the present study, both the puzzle and origami tasks required children to effectively utilise the model and instructions. However, the possession of this basic cognitive skill was needed but not sufficient for achieving high levels of performance. For instance, some children referred to the model or instruction sufficiently but failed to plan their time and monitor their progress effectively. They gained useful information from the model and instructions by using cognitive strategies, but were unable to use the information productively due to deficiencies in metacognitive skills. This finding is consistent with the view that metacognitive strategic behaviours may occupy a central position in problem solving (Mayer, 1998). Similarly, previous findings have suggested that students who are more adaptive at monitoring the effectiveness of cognitive strategies are more likely to demonstrate good performance (Wolters, 2003). In short, acquisition of basic cognitive strategies may not be sufficient to predict successful task performance. Future research explaining the relationships between children's use of particular category of strategies and problem-solving performance in various kinds of tasks is warranted.

In relation to H1, the indirect contribution of children's motivational strategic behaviours to task performance found in the present study replicated the finding of Dermitzaki et al. (2009), while some other studies have indicated a direct influence of motivational behaviours on academic performance (e.g. Onatsu-Arvilommi, Nurmi, & Aunola, 2002). The inconsistency across the studies might result from substantial differences in methodology. In the present study, one possible reason for this particular finding is that most children showed high levels of motivational strategic behaviours. The low variability in this measure led to its insignificant influence on variability in children's task performance. One explanation for children's high levels of motivational behaviours may relate to Chinese culture. Influenced by Confucian teachings, Chinese children generally place a great emphasis on effort and its importance to satisfying performance (Chen, Lee, & Stevenson, 1996). This may enable them to motivate themselves in learning contexts. However, this assumption has only been examined among elementary school students in Chen et al. (1996). Additional comparative studies to explore kindergarten children's motivational strategic behaviours and its relation to task performance are needed.

4.2 Parental scaffolding and children's SRL

In support of H2, parental contingency significantly predicted children's SRL strategic behaviours. Also, the results showed that parental contingency contributed to children's metacognitive strategic behaviours, which in turn predicted task

performance. Through examining contingency indicated by both the levels of parents' demand and children's understanding, the present study expanded work by Neitzel and Stright (2003) that only looked at parents' manner of providing instructions but did not consider children's ongoing evidence of understanding. The predictive value of parental contingency on children's SRL is in line with existing Western evidence. Parents' abilities to provide instructions contingent on children's levels of understanding enable children to effectively learn and used SRL strategies in problem-solving situations (Pino-Pasternak et al., 2010), which in turn lead to successful performance.

It is worth noting that children's SRL strategic behaviours were examined in the child-alone tasks approximately three weeks after the parent-child session. Parental contingency, therefore, seems to have an influence on children's SRL outcomes in the longer term. This finding is supported in work with school-age children. For instance, Pratt and Savoy-Levine (1998) suggested that children tutored in a contingent manner achieved better performance than those tutored by non-contingent parents in a one-month post-test. Mattanah et al. (2005) revealed a similar result that parents' contingent scaffolding was a unique predictor of children's task performance in the immediate term and school competence in the long term. It is possible that when provided support contingent on their abilities, children have the opportunity to practice acquired knowledge and develop novel skills, thereby allowing them to effectively internalise and generalise newly instructed strategies to independent problem-solving contexts over time. However, this finding needs to be tested in longitudinal studies.

In contrast, the results showed that parental cognitive support did not predict children's SRL strategic behaviours. A very small body of research has provided supporting evidence. For instance, parents' contingent behaviours were significantly related to kindergarten children's success on problem-solving tasks, while the amount of time spent in didactic teaching and the average level of parental intervention did not correlate with children's performance (Pratt, Kerig, Cowan, & Cowan, 1988). These findings underscored that the extent to which parental scaffolding leads to children's success on problem-solving tasks substantially depends on the level of contingency with which cognitive support is provided rather than the quantity of cognitive support.

In support of H4, parental emotional support did not have a predictive value for children's SRL strategic behaviours. In contrast to this result, early Western studies have established a connection between parental emotional support and different

aspects of children's self-regulatory behaviours. For example, parents' emotional support contributes to children's metacognitive talk and monitoring in the classroom (Stright et al., 2001) and children's task persistence (Salonen et al., 2007). In the present study, a low variability in the parental emotional support measure may have resulted in the absence of its influence on children's SRL outcomes. Most parents displayed encouragement behaviours infrequently but rarely showed rejection behaviours during interactions with their children. The low level of encouragement and rejection therefore produced a moderate aggregate score of emotional support for most parents. It is also possible that the infrequency of encouragement does not discourage children from employing SRL strategies and achieving a satisfying level of performance, as long as the overall problem-solving atmosphere is warm and caring.

The infrequent displays of encouragement may mirror specific features of Chinese parents' scaffolding. As Chinese parents place great value on achievement and incorporate children's accomplishments into their sense of worth (Ng, Pomerantz, & Deng, 2014), they tend to de-emphasise rather than emphasise children's success and emphasise rather than de-emphasise children's failure to help children improve their performance (Ng et al., 2007). It should be noted that in spite of Chinese parents' relatively infrequent expressions of encouragement, Chinese parents value highly the importance of love and affection in childrearing (Chao, 1995; Chao & Tseng, 2002). Confucianism advocates that benevolence, as a greatly regarded virtue emphasising showing affection to those closely related to us, should be shown in parenting practices (Hwang, 2001). Due to the overall caring atmosphere created by parents, children's SRL and learning in general are not necessarily affected by limited parental affective displays and encouragement during problem-solving processes. However, the insignificant association between Chinese parents' emotional support and children's SRL outcomes found in the present study needs to be interpreted with caution due to the lack of evidence in the literature, and requires further studies to explore the influences of cultural values on parents' emotional support in problem-solving contexts.

4.3 Parental education and children's SRL

In support of H3, the results indicated that parental education exerted indirect influences on children's SRL strategic behaviours and task performance through the mediation of parental contingency. It has to be noted that although the results suggested that parental contingency fully mediated the relationships between parental education and children's SRL, we did not claim full mediation in the study, as it is not recommended unless all possible mediators would have been measured, which seems

impossible (Hoyle & Kenny, 1999; Rucker, Preacher, Tormala, & Petty, 2011). In addition to contingency, other mediators between parental education and children's SRL, such as parental attitudes towards children's learning, may exist and need to be explored in future research.

Parents with more education tended to provide higher levels of contingent support, which in turn predicted higher levels of children' strategic behaviours and task performance. Education provides parents important resources to facilitate children's learning (Duckworth & Sabates, 2005). This finding is consistent with previous research which has suggested that higher levels of parental education predicted greater use of contingent instructions in problem-solving situations (Carr & Pike, 2012). Also, it expands the work by Neitzel and Stright (2003), confirming the assumption that parental scaffolding behaviours are more predictive of children's SRL than parental education. From a practical point of view, this finding may provide valuable insight into parenting interventions for less-educated parents. Educators may help parents improve children's educational outcomes by providing advice on contingent instructions.

5. Conclusions

The present study has limitations that should be taken into account when interpreting the findings. First, the correlational design of the study does not permit causal conclusions. Experimental studies are needed to explore the causal relationships between parental scaffolding and children's SRL. Second, the types of tasks used in the study are limited. It would be useful for future research to use other types of tasks to capture the richness of parent-child dynamics and children's self-regulatory processes. Third, in spite of our focus on Chinese kindergarten children, the sample does not represent the diversity in China. The parents, recruited from Beijing, had higher education levels than the national average. The role of parental scaffolding in children's SRL may be different in other socio-economic environments.

Overall, the present study provides the first evidence that in line with findings from Western cultures, parental support provided in a contingent manner is important for Chinese kindergarten children's SRL strategic behaviours and task performance. Furthermore, the study reveals an optimistic finding that it is parental scaffolding rather than education itself that has a direct effect on children's SRL outcomes. As the constructs of "scaffolding" and "contingency" remain unfamiliar to most Chinese parents, the results have valuable practical insights on how parents and educational practitioners can facilitate their children's SRL skills.

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