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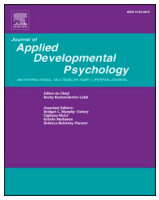

Relations of parental play beliefs with children's executive functions, reading, and mathematics

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ABSTRACT

This study examined how parental play support and academic focus differentially predicted kindergarten children's longitudinal development in executive functions, word reading, and mathematics skills. Participants were 150 Hong Kong kindergarten children (47.3 % girls; mean age of 4.4 years at Time 1 and 5.4 years at Time 2) and their parents. At Time 1, parents reported demographic information and rated children's executive functions through questionnaire. Children were administered behavioral tasks assessing their word reading and mathematics. One year later, at Time 2, the parents rated children's executive functions, and children completed the same behavioral tasks again. Results from a path analytic model revealed the indirect relation between parental play support at Time 1 and word reading at Time 2, mediated through executive functions at Time 1, was positive and significant. However, parental academic focus was unrelated to children's academic skills. The results suggest fostering parental play support might facilitate kindergarten children's cognitive skills, academic learning, and holistic development.

Introduction

Parents' beliefs in the roles of play in early childhood learning and development are vital factors shaping children's holistic development (Fung & Chung, 2024a, 2025). Parental play beliefs, consisting of the dimensions of parental play support (i.e., believing play is important to children's early learning and development) and parental academic focus (i.e., believing play is a mere entertainment without additional benefits to children's learning compared with academic activities) (Fogle & Mendez, 2006), can determine children's household play experiences (Metaferia et al., 2020a). Parental play support indicates parents' levels of endorsement, understanding, enjoyment, and involvement in household play (Fogle & Mendez, 2006). As children can develop their executive functions through play (Eberhart, Paes, Ellefson, & Marcovitch, 2023), evidence has demonstrated how parental play support positively predicted children's executive functions (e.g., Metaferia et al., 2020a, 2020b, 2021). Given the pivotal role of executive functions in early academic learning (i.e., the psychobiological framework of school readiness; Blair & Raver, 2015), parental play support may indirectly facilitate kindergarten children's academic skills through executive functions. Conversely, parental academic focus indicates the extent to which parents value structured academic activities over play (Fogle & Mendez, 2006). Therefore, parental academic focus determines the amount of household academic activities, potentially influencing children's academic skills.

Although parental play beliefs are conceptually linked with kindergarten children's academic learning, prior research has seldom examined their interrelations. Given the prominent roles of executive functions in children's early academic learning (e.g., Liu et al., 2020; Liu, Chung, & Fung, 2019), several recent studies explored how parental play beliefs predicted children's executive functions (e.g., Metaferia et al., 2020a, 2020b, 2021; Rudnova, Kornienko, Gavrilova, & Shvedchikova, 2024). Nevertheless, this line of research did not consider whether and how executive functions would mediate the relations between parental play beliefs and children's academic skills development. The primary aim of this study was to examine the longitudinal relations of parental play beliefs with kindergarten children's executive functions, word reading, and mathematics development. Based on the cross-lagged panel design, the secondary aim was to understand whether executive functions and academic skills would co-develop among children between four and six years old. Importantly, findings from this study can inform early childhood education (ECE) policy and practice, particularly

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concerning the implementation of play-based pedagogy. Although the play-based approach has been advocated for decades (Curriculum Development Council of HKSARG, 2017), its effective implementation in the Hong Kong ECE sector is debatable (Bautista, Yu, Lee, & Sun, 2023). Parents and practitioners are still ambivalent about the efficacy of play in supporting children's academic learning (Bautista, Yu, Lee, & Sun, 2021; Fung & Cheng, 2012). The present results can illustrate how parental play beliefs would be associated with children's early cognitive and academic skills, informing the long-held debate between learning and play among ECE stakeholders.

Parental play beliefs and children's executive functions and academic skills

Classic developmental theories, including constructivism (Piaget, 1976) and socio-constructivism (Vygotsky, 1967), highlighted that play is essential for acquiring knowledge and skills. Through play, children not only actively manipulate their immediate environment to build up their schemas (Piaget, 1976) but also interact with social partners to expand their knowledge of the world (Vygotsky, 1967). In the family context, parental play beliefs are important factors determining children's household play experiences (Hyun, McWayne, Guetterman, Dubow, & Pérez-Edgar, 2022; Hyun, McWayne, & Mendez Smith, 2021). Parental play beliefs are multidimensional concepts reflecting parents' attitudes toward the importance of play in children's early learning and development, constituting parental play support and parental academic focus (Fogle & Mendez, 2006). Parents with higher parental play support are likelier to endorse children's play orientations and ideas, participate in and enjoy parent-child play, understand how play facilitates children's growth, and prioritize play in daily family schedule (Fogle & Mendez, 2006; Fung & Chung, 2024a). Therefore, parental play support can influence children's learning and development through nurturing household play. Previous research has investigated how parental play support relates to children's social-emotional learning. For example, parental play support was associated with kindergarten children's peer play interaction positively (e.g., Fogle & Mendez, 2006; Hyun et al., 2021, 2022) and their peer problems negatively (Fung & Chung, 2022).

Parental play support may also contribute to early cognitive development. In particular, sociodramatic play can facilitate children's executive functions (Eberhart et al., 2023; Fung & Chung, 2024b; Vygotsky, 1967), including their abilities to hold and manipulate information mentally (working memory), restrict inappropriate responses (inhibition), direct attention flexibly (attention shifting), and other higher-order skills like planning and regulation (Thorell & Nyberg, 2008). Parents supporting household play may better develop their children's executive functions through increased play opportunities and participation. Consistently, recent evidence has revealed positive relations among parental play support, household pretend play, and children's executive functions (Metaferia et al., 2020a, 2020b, 2021). Nevertheless, a recent study reported a null relation between parental play support and children's inhibition (Rudnova et al., 2024).

The relation between parental play support and executive functions may also spill over into kindergarten children's academic skills. Theoretically, the psychobiological framework of school readiness underscores executive functions as the foundational skills supporting children's academic learning (Blair & Raver, 2015). Children with different temperamental reactivity to contextual stimuli in school (e.g., challenging academic tasks, multi-step teacher instructions) tend to show differing levels of stressful response, leading to individual differences in higher-order cognitive functions (e.g., attention, executive control, or working memory; Blair, 2002; Blair & Raver, 2015). In a kindergarten classroom, children who can better regulate their emotions and fully engage their executive functions are usually regarded as more ready to learn (Fung, Chung, Lam, & Li, 2020). Indeed, concurring evidence has demonstrated the facilitative role of executive functions in kindergarten children's reading and mathematics development (e.g., Liu et al., 2019; Morgan, Farkas, Hillemeier, Pun, & Maczuga, 2019; Yang, Chung, & McBride, 2019). Despite the sound theoretical and empirical bases, prior research has rarely explored how parental play support would be related to children's prospective executive functions and academic skills. The present study filled this gap by examining their longitudinal relations.

Apart from the possible impact of parental play support, parental academic focus can also link with children's academic development. Parents with a higher academic focus tend to be concerned with children's early academic skills; they regard play as merely a fun-seeking activity and a displacement of valuable household teaching time (LaForett & Mendez, 2017). Therefore, these parents often arrange more academic activities in their daily routine (e.g., enrichment program, shared reading, academic exercise; Hyun et al., 2021, 2022), potentially impacting children's academic skills. Surprisingly, no prior research examined how parental play support and parental academic focus collectively predict kindergarten children's academic skills. The primary aim of this study was to investigate how parental play support and parental academic focus would jointly predict children's development in executive functions, word reading, and mathematics skills using a cross-lagged panel design.

Bidirectional relations among executive functions and academic skills

As the secondary aim, this study further explored the bidirectionality between kindergarten children's executive functions, word reading, and mathematics skills. Considering the theoretical perspectives that there can be domain-general cognitive processes underpinning early reading and mathematics (e.g., executive functions) and that the two academic domains may have skill transfer (Bailey et al., 2020), research has explored the cross-domain prediction between children's reading and mathematics over time. Duncan et al. (2007) reported that, in early childhood, the predictive effect from early mathematics to later reading was relatively stronger than from early reading to later mathematics. Several studies put forth concurring findings. For example, Cameron, Kim, Duncan, Becker, and McClelland (2019) reported that the predictive relation between United States children's prekindergarten mathematics score and kindergarten letter word identification was stronger than the one between prekindergarten letter word identification and kindergarten mathematics score. Findings from Kwok, Bull, and Muñez (2021) also revealed that the predictive relation between Singapore children's kindergarten K1 mathematics and K2 word reading was stronger than that of K1 word reading and K2 mathematics. Schmitt et al. (2017) further reported a significant predictive relation between early mathematics and later literacy in a sample of United States preschool children, while the link between early literacy and later mathematics was non-significant. Nevertheless, McKinnon and Blair (2019) found that the predictive link from United States children's kindergarten fall letter word identification to their kindergarten spring mathematics score was stronger than the reverse cross-domain prediction.

Separately, as children with higher academic skills may engage more in future academic activities and exercise their executive functions (Liu et al., 2019), research has also examined the co-development between children's executive functions and academic skills. For example, the findings from Cameron et al. (2019) and McKinnon and Blair (2019) suggested that United States children's prekindergarten or kindergarten mathematics (Cameron et al., 2019; McKinnon & Blair, 2019) positively predicted their subsequent executive functions development. Likewise, Liu et al. (2019) found that Hong Kong kindergarten children's word reading reciprocally predicted their future levels of executive functions during the formal school transition. The present study further investigated the reciprocal relations among kindergarten children's executive functions, word reading, and mathematics skills before their formal school transition.

The present study

This study investigated the longitudinal relations of parental play beliefs (parental play support and parental academic focus) with kindergarten children's executive functions and academic skills (word reading and mathematics). It also examined the reciprocal associations between children's executive functions and academic skills across two time points separated by one year. Based on the literature review and studies (e.g., Cameron et al., 2019; Kwok et al., 2021; Liu et al., 2019; McKinnon & Blair, 2019; Metaferia et al., 2020a, 2020b, 2021; Morgan et al., 2019; Yang et al., 2019), it was hypothesized that parental play support at Time 1 would be indirectly related to children's academic skills at Time 2 via executive functions at Time 1, and that the direct relations between parental academic focus and children's academic skills at Time 1 would be positive and significant. It was also expected that children's executive functions, word reading, and mathematics skills would predict each other positively across Times 1 and Time 2.

Method

Participants

The participants were 150 Hong Kong Chinese kindergarten children (47.3 % girls; mean age of 4.4 years at Time 1 and 5.4 years at Time 2) and their parents from nine kindergartens located in three low to middle socioeconomic areas. All participants took part in both Time 1 and Time 2 data collection. Parents indicated their age and educational levels: (1) primary, (2) lower secondary, (3) upper secondary, (4) diploma, (5) undergraduate, (6) master, and (7) doctoral. 16 % of the parents obtained an undergraduate degree or above, 16 % completed a diploma, 48 % attained upper secondary level, and 19 % finished lower secondary level. For parents' age, 16 % were between 21 and 30, 52 % were between 31 and 40, and the remaining 32 % were between 41 and 50. Mothers completed the majority of the questionnaires (>80 %).

Procedure

Ethical approval was granted by the university's ethics board (blinded for review). The principals of the nine kindergartens also consented to participate. At Time 1 (beginning of the school year), informed consent and questionnaire forms were sent to the parents of second-year children (kindergarten K2) to invite their participation. Participating parents reported demographic information and their play beliefs, and rated children's executive functions by completing a questionnaire that took around 10 min. Participating children were administered behavioral tasks to measure their Chinese word reading and mathematics skills by experienced research assistants in a quiet area of the kindergartens. Verbal consent was obtained from the children before the assessment. The assessment took around 30 min, with a short break in between. One year later, at Time 2 (beginning of the school year), participating children (kindergarten K3) completed the same behavioral tasks on word reading and mathematics, whereas parents reported children's executive functions by completing a questionnaire again.

Measures

Parental play beliefs at time 1

Parental play beliefs were assessed by the Parent Play Belief Scale (PPBS; Fogle & Mendez, 2006), which has been adapted to the Chinese community (e.g., Hyun et al., 2021, 2022) and was employed in research on Hong Kong kindergarten children (Fung & Chung, 2024a, 2025). The PPBS consists of the play support and academic focus subscales, with adequate reliability (Cronbach's alpha >0.70) and construct, convergent, and divergent validity (Fogle & Mendez, 2006). The play support subscale contains seventeen items (e.g., "Through play, my child develops new skills and abilities"), whereas the academic focus subscale includes eight items (e.g., "Playtime is not a high priority in my home"). Parents rated the items on a 5-point scale ranging from 1 (*disagree*) to 5 (*strongly agree*). The average scores of the play support and academic focus subscales represented parental play support and parental academic focus, respectively. The Cronbach's alphas of the play support and academic focus subscales were 0.95 and 0.87, respectively.

Executive functions at times 1 and 2

Children's executive functions were assessed by the working memory, inhibition, planning, and regulation subscales of the Childhood Executive Functioning Inventory (CHEXI; Thorell & Nyberg, 2008). The CHEXI was employed in Chinese societies (Tsai, Thorell, Siu, Hsu, & Lin, 2020), with adequate reliability (Cronbach's alpha >0.80; Thorell, Veleiro, Siu, & Mohammadi, 2013) and convergent validity (Thorell & Nyberg, 2008). The working memory subscale consists of nine items (e.g., "Has difficulty thinking ahead or learning from experience"), the inhibition subscale includes six items (e.g., "Has difficulty refraining from smiling or laughing in situations where it is inappropriate"), the planning subscale has four items (e.g., "Has difficulty planning for an activity such as remembering to bring everything necessary for a field trip or things needed for school"), whereas the regulation subscale contains five items (e.g., "Seldom seems to be able to motivate him−/herself to do something that he/she doesn't want to do"). Parents rated the items on a 5-point scale ranging from 1 (*totally wrong*) to 5 (*totally right*). All ratings were reversely coded such that a higher score indicated better executive functions. The average score of the four subscales represented children's executive functions. The Cronbach's alphas at Time 1 and Time 2 were 0.95 and 0.96, respectively.

Mathematics at times 1 and 2

To ensure age-appropriateness and prevent ceiling or floor effects, children's mathematics skills were assessed with a series of mathematics tasks, including forward counting, backward counting, number word comparison, arithmetic addition, and arithmetic subtraction. The forward (e.g., "Can you count forward from 18 to 24?") and backward counting (e.g., "Can you count backward from 33 to 27?") tasks both include four items, with adequate reliability (Cronbach's alpha >0.80) and construct validity (Chung & McBride-Chang, 2011). Every correct sequence gained two marks, whereas one mark was given if one mistake was made in a sequence. Zero marks were given if two or more mistakes were noted in a sequence. The maximum scores for forward and backward counting were eight.

The verbal number comparison task was used for tapping children's number word comparison, which showed adequate reliability (Cronbach's alpha >0.80; Yang, Zhang, Huo, & Zhang, 2020) and construct validity (Honore & Noel, 2016). This task includes four items highlighting larger quantities (e.g., "Among 15 and 19, which is the larger number?") and another four items highlighting smaller quantities (e.g., "Among 10 and 12, which is the smaller number?"). The research assistant read aloud the items, and then the children verbally indicated their responses. A correct answer gained one mark, whereas a wrong answer gained zero marks, with a maximum score of eight.

The arithmetic addition (e.g., "Can you tell me the answer of 11 + 15?") and subtraction (e.g., "Can you tell me the answer of 12 – 4?") tasks both contain five items, with adequate reliability (Cronbach's alpha >0.80) and construct validity (Liu et al., 2020). The items were visually and verbally presented to the children by a research assistant. Draft papers, a pencil, and a rubber were available for children to work out the answers and verbally present their responses. A correct answer gained one mark, whereas a wrong answer gained zero marks. The maximum scores for arithmetic addition and subtraction were five.

The total score aggregating all five tasks represented children's mathematics skills; the maximum was 34. The Cronbach's alphas at Time 1 and Time 2 were 0.87 and 0.90, respectively.

Word Reading at times 1 and 2

Children's word reading skill was assessed using the Chinese word reading subset from The Hong Kong Reading Ability Screening Test for Preschool Children (RAST-K; Ho et al., 2011), which is a locally validated measure with adequate reliability (Cronbach's alpha >0.80) and content validity (Ho et al., 2011; Zheng, Cheng, Sonuga-Barke, & Shum, 2022). The RAST-K includes 55 one- or two-character words in increasing order of difficulty. Children were asked to read the words out. Every correct answer gained one mark, whereas an inaccurate pronunciation or a wrongly recognized word gained zero marks. The total score represented children's word reading; the maximum was 55. The Cronbach's alphas at Time 1 and Time 2 were 0.97 and 0.98, respectively.

Data analysis plan

Descriptive statistics and correlations were examined to understand the characteristics of and relations between the concerned variables. The variables were then subjected to a path analytic model to investigate their interlinks across time, with children's age, gender, and parental education levels statistically controlled. The path model was estimated with the lavaan package in R (version 4.2.0; R Core Team, 2024). Model fit was assessed with reference to Hu and Bentler (1999): non-significant Chi-square index ($\chi 2$), comparative fit index (CFI) above 0.95, Tucker–Lewis index (TLI) above 0.95, root mean square error of approximation (RMSEA) below 0.06, and standardized root mean square residual (SRMR) below 0.08. Indirect relations were tested using the bias-corrected bootstrapping with 1000 resampling (Hayes, 2009).

Results

Preliminary analyses

Table 1 displays the descriptive statistics, reliabilities, and bivariate correlations of the study variables at Times 1 and 2. Parental play support at Time 1 was significantly associated with parental academic focus ($r = -0.24, p < .01$) and executive functions ($r = 0.26, p < .01$) at Time 1, but not with the remaining variables. The concurrent relations of executive functions with word reading and mathematics at Time 1 were non-significant, whereas executive functions at Time 2 were positively correlated with word reading ($r = 0.19, p = .03$) and mathematics ($r = 0.25, p < .01$) at Time 2. The concurrent and longitudinal correlations between word reading and mathematics were all significant ($r = 0.33$ to $0.75, p < .001$). The percentages of missing data for the study variables ranged from 4.0 (parental play support at Time 1) to 9.3 % (mathematics at Time 1). The Little's (1998) test value was non-significant ($\chi 2$ (57) = 57.06, $p = .43$), indicating that the data were missing completely at random. Thus, path analysis was estimated using full information maximum likelihood with robust standard errors (i.e., estimator MLR), which is robust to non-normality.

Path analytic model predicting executive functions, word Reading, and mathematics

Figure 1 shows the parameter estimates and model fit statistics of the path analytic model of children's executive functions, word reading, and mathematics across Time 1 and Time 2, with parental play support and parental academic focus at Time 1 as the antecedents. The path model reveals an adequate fit to the data χ^2 ($df = 24, N = 150$) = 32.27, $p = .12$, CFI = 0.97, TLI = 0.95, RMSEA = 0.05 (90 % CI: 0.00, 0.09), SRMR = 0.06, $R^2_{\text{Time 2 Executive Functions}} = 0.15$, $R^2_{\text{Time 2 Word Reading}} = 0.64$, $R^2_{\text{Time 2 Mathematics}} = 0.45$.

The concurrent relation between parental play support and children's executive functions at Time 1 was significant ($\beta = 0.25$, $SE = 0.10$, $p < .01$), but the links between parental play support and academic skills were non-significant. Parental academic focus was unrelated to children's executive functions or academic skills. The autoregressive paths of executive functions ($\beta = 0.25$, $SE = 0.09$, $p < .01$), word reading ($\beta = 0.66$, $SE = 0.07$, $p < .001$), and mathematics ($\beta = 0.60$, $SE = 0.07$, $p < .001$) across time were all positive and significant. The path from executive functions at Time 1 to word reading at Time 2 was significant ($\beta = 0.17$, $SE = 1.24$, $p < .01$), but the one to mathematics at Time 2 did not reach statistical significance ($\beta = 0.12$, $SE = 0.83$, $p = .08$). In contrast, the paths from word reading or mathematics at Time 1 to executive functions at Time 2 were non-significant. Furthermore, the path from mathematics at Time 1 to word reading at Time 2 was significant ($\beta = 0.15$, $SE = 0.13$, $p < .01$), but the one from word reading at Time 1 to mathematics at Time 2 was non-significant. The indirect relation between parental play support at Time 1 and word reading at Time 2 mediated through executive functions at Time 1 was positive and significant (indirect effect: $\beta = 0.05$, $SE = 0.68$, $p = .04$, 90 % CI: 0.32, 2.94), but the one between parental play support, executive functions at Time 1, and mathematics at Time 2 failed to reach statistical significance (indirect effect: $\beta = 0.03$, $SE = 0.29$, $p = .15$, 90 % CI: −0.15, 1.00). The indirect relations between parental academic focus at Time 1 and word reading (indirect effect: $\beta = -0.01$, $SE = 0.40$, $p = .70$, 90 % CI: −0.94, 0.62) or mathematics (indirect effect: $\beta = 0.01$, SE

Table 1
Descriptive statistics, reliabilities, and bivariate correlations of study variables.

			Correlations						
Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. T1 parental play support		–							
2. T1 parental academic focus		−0.24**	–						
3. T1 executive functions		0.26**	−0.10	–					
4. T1 word reading		−0.05	−0.01	0.07	–				
5. T1 mathematics		0.06	−0.04	0.13	0.51***	–			
6. T2 executive functions		0.11	0.07	0.28***	0.11	0.14	–		
7. T2 word reading		0.07	−0.16	0.25**	0.75***	0.51***	0.19*	–	
8. T2 mathematics		0.15	−0.05	0.21*	0.33***	0.63***	0.25**	0.40***	–
	Mean	4.18	2.04	3.34	10.46	10.85	3.31	23.38	21.27
	Standard deviation	0.56	0.73	0.68	12.19	7.20	0.63	16.15	8.14
	Skewness	−0.41	0.95	−0.01	2.21	0.83	0.08	0.55	−0.64
Descriptive statistics	Kurtosis	0.21	1.05	0.22	4.88	0.38	0.11	−0.94	−0.31
	Minimum	2.06	1.00	1.33	0.00	0.00	1.54	0.00	0.00
	Maximum	5.00	4.75	4.88	55.00	34.00	4.79	55.00	34.00
	Cronbach's alpha	0.95	0.87	0.95	0.97	0.87	0.96	0.98	0.90

* $p < .05$; ** $p < .01$; *** $p < .001$; T1 = time 1 and T2 = time 2. Parental play support and parental academic focus were assessed by the Parent Play Belief Scale, executive functions were assessed by Childhood Executive Functioning Inventory, word reading was assessed by The Hong Kong Reading Ability Screening Test for Preschool Children, whereas mathematics skills were assessed by a battery of tasks including forward counting, backward counting, number word comparison, arithmetic addition, and arithmetic subtraction.

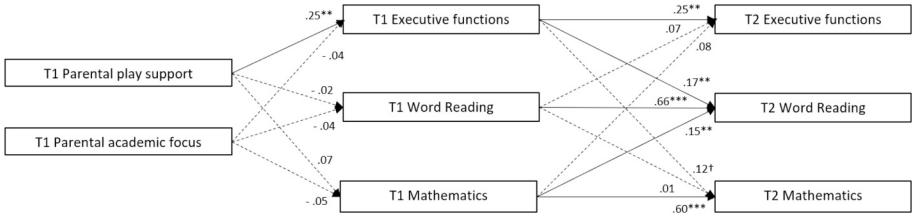

Fig. 1. A path analytic model of kindergarten children's executive functions, word reading, and mathematics across Time 1 and Time 2 with parental play beliefs (parental play support and parental academic focus) at Time 1 as the antecedents. Parental play support and parental academic focus were assessed by the Parent Play Belief Scale, executive functions were assessed by Childhood Executive Functioning Inventory, word reading was assessed by The Hong Kong Reading Ability Screening Test for Preschool Children, whereas mathematics skills were assessed by a battery of tasks including forward counting, backward counting, number word comparison, arithmetic addition, and arithmetic subtraction. Control variables include children's age, gender, and parental education levels. Covariances between parental play beliefs and executive functions, word reading, and mathematics at Time 1 and Time 2 were modeled but not shown for clarity. Standardized coefficients are reported. Solid paths are statistically significant. Dashed paths are non-significant. T1 = time 1 and T2 = time 2. † $p = .08$; * $p < .05$; ** $p < .01$; *** $p < .001$. Fit indices: χ^2 ($df = 24$, $N = 150$) = 32.27, $p = .12$, CFI = 0.97, TLI = 0.95, RMSEA = 0.05 (90 % CI: 0.00, 0.09), SRMR = 0.06, $R^2_{\textit{Time 2 Executive Functions}} = 0.15$, $R^2_{\textit{Time 2 Word Reading}} = 0.64$, $R^2_{\textit{Time 2 Mathematics}} = 0.45$.

= 0.14, $p = .69$, 90 % CI: −0.33, 0.22) at Time 2 mediated through executive functions at Time 1 were both non-significant.

Discussion

This study investigated the longitudinal relations of parental play beliefs (i.e., parental play support and parental academic focus) with kindergarten children's executive functions and academic skills, and it also examined whether the executive functions and academic skills predicted each other across time. The findings highlighted the mediating role of executive functions in the indirect relation between parental play support and children's word reading. The results also revealed the cross-domain association between early reading and mathematics skills. These findings have expanded the existing evidence (e.g., Fung & Chung, 2022, 2024a; Metaferia et al., 2020a, 2020b, 2021; Rudnova et al., 2024) by demonstrating how parental play beliefs can be associated with kindergarten children's subsequent academic skills.

Indirect relations between parental play beliefs, executive functions, and academic skills

As expected, parental play support was positively related to children's concurrent levels of executive functions. This finding aligned with Metaferia et al.' evidence (2020a, 2020b, 2021) that parental play support is a prominent factor linking with children's household play experiences and executive functions. Although Rudnova et al. (2024) reported that parental play beliefs were unrelated to children's inhibition, they assessed parental beliefs with a self-developed measure without conveying its reliability and validity, which may explain the inconsistency. Importantly, the current study considered both aspects of parental belief when investigating their relations with children's executive functions, and the results underscored the positive role of parental play support over and above parental academic focus. Although parental academic focus is conceptually linked with increased household academic activities that may also engage children's executive functions (e.g., parent-child shared reading; Howard, Powell, Vasseleu, Johnstone, & Melhuish, 2017), parental academic focus did not predict individual differences in executive functions in the present results. Taken together, the findings converged upon the proposition that parental play support uniquely associates with children's executive functions in early years, aligning with Piaget's (1976) and Vygotsky's (1967) ideas about the role of play in children's early cognitive development.

Unexpectedly, parental academic focus was unrelated to children's academic skills. Parents with a higher academic focus value academic achievement. Thus, parental academic focus may influence the amount of household academic activities, which might further impact children's reading and mathematics competence. However, parental academic focus may also lead to increased stress among parents and children. For instance, parents focusing on kindergarten children's academic performance showed elevated levels of parental stress compared with those valuing children's mastery of concepts (Tang, Cheng, & Fung, 2021). Achievement pressure from parents may also be linked with children's academic stress, potentially hampering children's well-being and academic skills development (Kim, Kwak, & Lee, 2016). Future research exploring the longitudinal links between parental academic focus and children's academic skills, with parental stress or children's academic stress considered, is needed to address the speculations.

Despite the lack of concurrent relations between parental play beliefs and children's academic skills, the present results revealed a longitudinal indirect relation between parental play support and children's word reading mediated through their executive functions. To the best of our knowledge, this is the first evidence showing how parental play beliefs would be associated with children's prospective academic skills, with their pre-existing skill levels statistically controlled. This finding concurred with the psychobiological framework of school readiness, highlighting the importance of executive functions in children's early academic skills, such as word reading (Blair & Raver, 2015). Although the relation between executive functions at Time 1 and mathematics at Time 2 failed to reach significance (at a trend level, $p = .08$), the number of participants may have impacted the strength of the path coefficient. Alternatively, other early cognitive skills not considered in this study (e.g., visual-spatial skills; Fung, Chung, & Lam, 2020) might also explain the possible link between parental play support and mathematics skills. Future research involving a larger sample size and additional mediating factors, such as visual-spatial skills, should be conducted to test these assumptions.

Reciprocal links from academic skills to executive functions

Contrary to the hypotheses, the reciprocal paths between word reading or mathematics at Time 1 and the executive functions at Time 2 were insignificant. Prior research has demonstrated the co-development between children's executive functions and academic skills (e.g., Cameron et al., 2019; Liu et al., 2019; McKinnon & Blair, 2019) during their formal school transition (from 5 to 7 years), whereas the present study investigated children's development from 4 to 6 years. Children with better academic skills may be more willing to engage in corresponding academic activities, benefitting their future levels of executive function, but academic activities at upper kindergarten levels often have a heavier load on children's executive functions compared with those activities at lower levels (Liu et al., 2019). In Hong Kong, the focus of kindergarten curricula has changed progressively from basic skills to more complicated skills over the three years (K1 to K3). For example, the introduction to reading often starts from meaning-based tasks (e.g., theme-based storytelling and shared reading). It proceeds to skill-based tasks (e.g., decomposition of words, phonological and morphological

awareness)(Rand & Morrow, 2021). Mathematics content also progresses gradually from basic concepts (e.g., number concept, counting) to arithmetic operations (e.g., addition, subtraction). Therefore, the gradual shifts in pedagogical approaches and academic content across years come with increasing demands on children's executive functions, which might explain why reading and mathematics skills can predict executive functions development during but not before children's formal school transition.

Equally possible, different approaches to measuring executive functions may have led to inconsistent findings. The present study employed a parent-reported instrument to assess children's executive functions. In contrast, behavioral tasks were used in other studies, such as Head-Toes-Knees-Shoulders tasks (Cameron et al., 2019), computerized tasks (McKinnon & Blair, 2019), or digit span tasks (Liu et al., 2019). Further studies may recruit children across a wider age range and employ more direct types of executive function measures to investigate the nuanced relations.

Cross-domain associations between word reading and mathematics skills

Partially concurring with the hypotheses, the path model revealed that mathematics at Time 1 positively predicted word reading at Time 2. However, the reverse pathway from word reading at Time 1 to mathematics at Time 2 was non-significant. The findings concurred with Duncan et al.' (2007) proposition that early mathematics predicts future academic skills more than early reading. Indeed, several cross-lagged panel studies (e.g., Cameron et al., 2019; Kwok et al., 2021; Schmitt et al., 2017) reported that the cross-domain pathway from early mathematics to later reading is stronger than the one from early reading to later mathematics. Nonetheless, Bailey et al. (2020) challenged Duncan et al.'s (2007) conclusion, stating that the cross-domain predictive effects between reading and mathematics skills can vary significantly if a broader range of unmeasured confounding factors are accounted for. As this study only included data collected at two time points separated by one year, the findings do not preclude the possibility that word reading can predict subsequent mathematics skills, for example, during formal school transition. Caution should be taken in the present interpretation.

Limitations

The present study has at least three limitations. First, although children's academic skills were directly assessed, parental play beliefs (i.e., parental play support and parental academic focus) and children's executive functions were measured using parent-reported surveys and, thus, the results may be biased due to social desirability (Krumpal, 2013) or common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Future work may use alternative assessments of executive functions such as Head-Toes-Knees-Shoulders (McClelland et al., 2014) or NIH Toolbox computerized tasks (Zelazo, 2006) to validate the present findings. Further research may tap into parental play support using observational approaches (e.g., observation of parent-child dyadic play behaviors) to triangulate with the self-reported ratings. Second, the current sample was adequate but small (post hoc analysis of power = 0.81; Moshagen & Erdfelder, 2016) and culturally homogeneous. Further research with a large and socio-culturally diverse sample can verify the robustness and generalizability of the present findings. Lastly, this correlational study cannot make causal inferences. A legitimate longitudinal mediation should be tested with parental play beliefs, executive functions, and academic skills measured repeatedly at three different time points to ensure their temporal order with autoregressive effects controlled (Cole & Maxwell, 2003; MacKinnon, Fairchild, & Fritz, 2007). Future experimental or longitudinal studies with multiple data collection points are needed to inform the direction of effects.

Conclusions and implications

Despite its limitations, this study contributed to the literature by showing the indirect relation of parental play support with kindergarten children's executive functions and word reading skills over time. Theoretically, the findings demonstrated that parents believing in the benefit of play might foster their children's executive functions that further support early academic pursuit in reading and, possibly, mathematics. Practically, the results emphasized the utility of promoting parental play support to foster kindergarten children's early cognitive development and academic learning. Parents' attitude toward play influences whether play-based pedagogy can be implemented effectively in early years settings (Bautista et al., 2021). Paradoxically, parents are often ambivalent about the use of play in early childhood education, recognizing the positive role of play in early development yet concerned with how play displaces teaching and learning opportunities for acquiring academic knowledge and skills (Fung & Cheng, 2012). The present finding revealing that parental academic focus did not associate directly or indirectly with children's word reading or mathematics is particularly insightful, suggesting how parents should best arrange the household environment and support children's learning through play in the family context. Considering further evidence showing the interlinks of parental play support with children's social-emotional competence, school readiness (e.g., Fung & Chung, 2022, 2023, 2024a), and creativity (Fung & Chung, 2025), promoting parental play support might benefit kindergarten children's holistic development and formal school transition. Workshops targeting parents of kindergarten children are a promising way to disseminate the ideas about parental play support, resulting in better home-school collaborations and implementation of the play-based pedagogy.

Declararion of competing interest

None.

CRediT authorship contribution statement

Wing Kai Fung: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Kevin Kien Hoa Chung:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Informed consent

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

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Compliance with ethical standards

This manuscript was prepared in accord with the ethical standards of the American Psychological Association.

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Data availability

All data are available upon reasonable request.

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