



Unlocking Young Minds: Investigating the Impact of Parent-Child Interaction on Cognitive Development in Preschoolers

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ABSTRACT

Background: Early childhood is a very critical stage in the development of mental capacities and the interaction between parents and children is an essential environmental factor. Parental responsiveness, scaffolding and verbal interaction during play and joint activities has been associated with better cognitive and executive performance among children but there is not much evidence that has been conducted among preschool-aged children.

Aim: The objective of the study was to determine how parent-child interaction quality affects cognitive development among preschoolers besides exploring whether parental reflective functioning mediates the relationship between parent and child.

Method: Quantitative correlational design was used with 200 parent child dyads whose children were between the ages of 3 and 5 years. The interactions between parents and children were videotaped when they were engaged in structured play and reading books and were coded with the help of standardized observational instruments. The Wechsler Preschool and Primary Scale of Intelligence-IV and Head-Toes-Knees-Shoulders (HTKS) task were used to test the cognitive abilities of children. Pearson correlations, hierarchical regression, and mediation analysis were used to analyze data.





Results: Results showed that parental scaffolding, responsiveness and children cognitive scores have significant positive correlations ($p < .001$). The quality of parent and child interaction accounted to 44 percent of the difference in cognitive outcomes when the demographics were factored out. The mediation analysis showed that

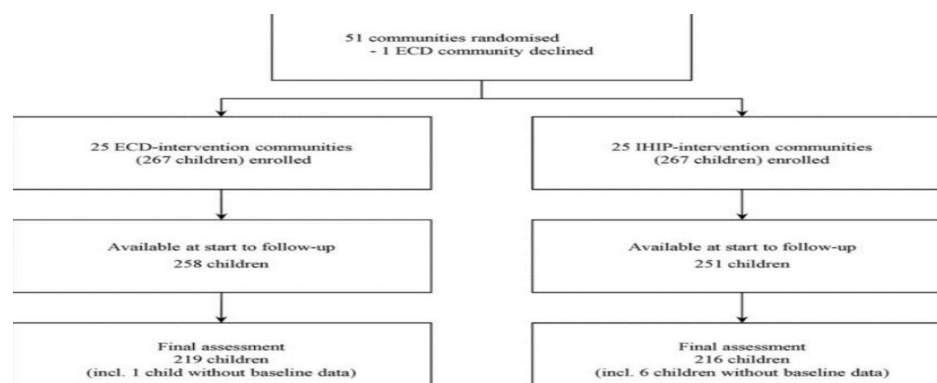
	<p>parental reflective functioning mediated, to some extent, the interaction between the quality of interaction and cognitive performance.</p> <p>Conclusion: Quality parent child interaction significantly improves cognitive development in preschoolers and this means that parent oriented interventions are required to facilitate pedagogical environments.</p>
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Introduction

Childhood is a formative stage in the life of a child and cognitive abilities are developed at a rapid pace in the form of language, memory, attention, and problem-solving (Batoool et al., 2022; Bashir et al., 2023; Akram et al., 2024; Hashmi et al., 2025).

Jean Piaget's Stages of Development

Stage	Age Range	Key Characteristics
Sensorimotor	0 – 2 years	<ul style="list-style-type: none"> Learns through senses and actions (touching, looking, mouthing) 
Preoperational	2 – 7 years	<ul style="list-style-type: none"> Develops language and uses symbols Thinking egocentric Difficulty understanding conservation and logic 
Concrete Operational	7 – 11 years	<ul style="list-style-type: none"> Thinks more logically about concrete events Understands conservation, 
Formal Operational	12 + years (adolescence – adulthood)	<ul style="list-style-type: none"> Develops abstract and hypothetical thinking Thinks about future and moral issues 



Historically, studies have been proposing that the level of interaction between the parent and child is an important factor in determining these abilities (Fu, 2023; Qadeer & Batoool, 2024; Fatmi et al., 2025). The joint activities, conversational turns, scaffolding and responsive feedback promote parent-child interaction which triggers cognitive development. In the case of preschoolers, home interactive environment is a central pre-school preparation to school readiness context. As a matter of fact, the maternal and paternal engagement in early shared book reading, dialogic play, and interactive storytelling has been found to foresee the improvement in the cognitive functioning of children, both executive functions and language comprehension

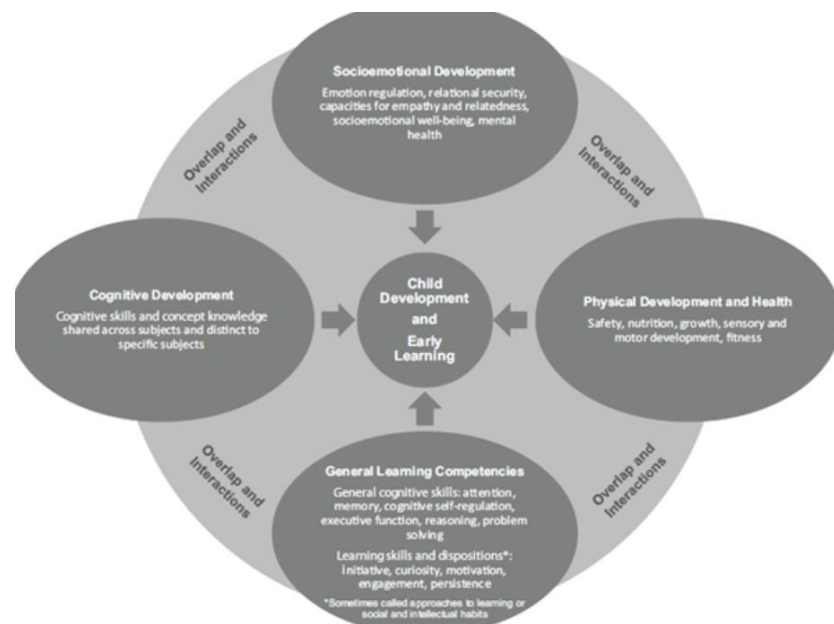
(Komanchuk et al., 2022; Mujeeb et al., 2025). Besides, recent longitudinal and cross-sectional studies underscore parent-child interaction as not only quantity but also quality - it is the nature of interaction (i.e. responsiveness, scaffolding, turn taking, etc.) that is most critical in cognitive outcomes (Ayaz et al., 2025). As an example, in an investigation of mother-child storytelling, children whose mothers used a more style of scaffolding as a storyteller scored higher on syntactic and perspective-taking scales than children whose mothers were less scaffolding in style (Al-Kubaisi et al., 2021; Kısa et al., 2023). Equally, home-learning conditions with active scaffolding of parents in conversations about number, text and meaning also anticipated improvements in counting and number transcoding abilities of children that were beyond and above non-verbal reasoning (Soto-Calvo et al., 2021; Rahman et al., 2024).

Cognitive development also depends on environmental and contextual moderation of the effectiveness of parent-child interactions. It has been revealed that the level and nature of mental-state talk and cognitive scaffolding that children obtain depend on their socio-economic status, parental education, and interaction context (Roby and Scott, 2022). Meanwhile, parental psychological resources like reflective functioning are also becoming important predictors of cognitive ability of children: mothers with higher reflective capacity attained more successful verbal comprehension and working memory in their preschoolers by controlling the quality of interaction, attachment, and socio-demographic indicators (Komanchuk et al., 2022; Ejaz et al., 2023).

In the perspective of developmental neuroscience, interactive synchrony between parents and children can also be an indication of neural attunement processes. As an example, studies involving dual EEG recorded mother-child dyads in role switching tasks were able to find that there was a difference in fractal and oscillatory synchrony between who was acting and who was watching, and that this synchrony was linked to child attachment (Li et al., 2023). These results

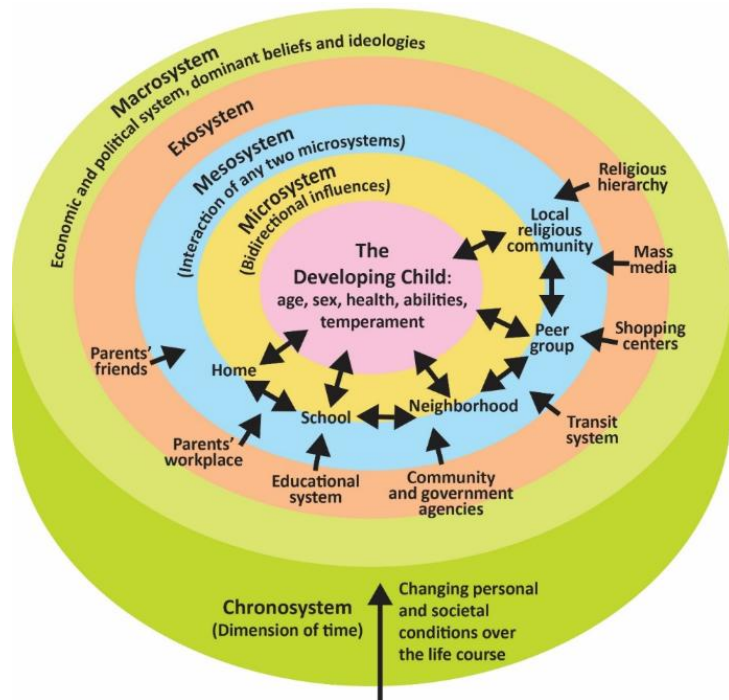
imply the process of parent child interaction during interaction is based not just on observable behavior but also temporal coordinated neural processes that could influence cognitive development pathways.

Although a significant part of the research has been done in infancy or early toddlerhood, preschool ages (3-5) are a very important but under-represented transition period. This is the time of day when children move away, as much as they have been enjoying sensorimotor and the simple symbolic play, to the more elaborate representational and narrative activities, as well as, executive functions. Considering that parent-child interactive pattern can change (e.g. to more



peer-like interaction, more independent problem-solving, yet by the adult), it is high time to examine the effect of such interactive pattern on cognitive development in preschoolers. The pilot study by Rai et al. (2023) that connects the quality of parent-child interaction when reading a story-book, performing screen-based tasks and cognitive outcomes is the first indication that the relationship is still salient during preschool.

Against this backdrop, this research aims to make a contribution towards this body of work by taking the further step and exploring the nature of parent child interaction features (ex: responsiveness, scaffolding, verbal interactions, play contexts) as they apply to cognitive development among preschool children (Amjad et al., 2023). Coupling the measures of interaction quality with cognitive ones by tracking a preschool cohort, the study is expected to enhance the comprehension of how the quality of early relational processes can be transformed into cognitive development and school-readiness. Taken together, the literature proves that parent-child interaction provides one of the most flexible environmental elements that impact the cognitive development of preschoolers.



Problem Statement

Even though many studies have reported associations among the quality of parent-child interaction and early cognitive performance, limited empirical studies have specifically investigated the effects of varying patterns of parent-child interaction in the preschool years (age 3-5) on a variety of dimensions of cognitive performance (e.g., working memory, vocabulary, executive functioning) in diverse contexts and would not control by socio-demographic factors.

Significance of the Study

The current study is of significant importance because it focuses on a rather unexplored stage of preschool age-group, the time when central cognitive processes are consolidated, and attempts to trace how particular qualities of parent-child interaction are linked with cognitive development, thus, informing the policy of the early childhood education process, parent-training courses, and intervention development to support the best developmental pathway.

Aim of the Study

This paper will focus on the effect of parent-child interaction factors on cognitive development among preschoolers, by analyzing how quality of interaction (e.g., scaffolding, meaningful verbal exchange, play responsiveness) is related to cognitive development areas (understanding language, working memory and executive functioning) and confounding factors (socio-demographic and contextual).

Method

In the current research, the correlational design will be used, in the form of quantitative research that will be used to analyze the relationship between parent-child interaction quality and cognitive development in preschoolers. About 200 parentchild dyads whose children are between 3 and 5 years will be recruited through purposive sampling of the preschools and early learning centers. The inclusion criteria will be the presence of at least one biological or adoptive parents and the absence of known developmental or neurological diseases in the child. The design of the selected study is consistent with previous developmental studies that examine the family factors affecting cognitive outcomes during early childhood (Qin et al., 2025; Eseyin and Benjamin, 2025). Structured observational assessment and standardized cognitive testing will be used in data collection. The interactions between parents and children will be monitored and documented when free playing a task is assigned to them (10 minutes) and when reading a storybook together is assessed (they will read a storybook together, 10 minutes).

Parent-child interaction sessions will also be videotaped and later analyzed with the ParentChild Interaction System (PARCHISY) and Dyadic ParentChild Interaction Coding System (DPICS) frameworks which have proven to be very reliable in the study of early development (Li et al., 2023; Wang et al., 2025). Ratings will be done by trained coders who are unaware of the cognitive data on dimensions like parental scaffolding, parental sensitivity, parental responsiveness, parental verbal elaboration and parent-child reciprocity. The inter-rater reliability will be determined by intraclass correlation coefficients (ICCs), where a coefficient of 0.80 or higher is contemplated as a good interaction coding best practice (Roby and Scott, 2022). Besides observational data, there will be demographic questionnaires that will include the parental education, socioeconomic status, frequency of daily interactions, and reflective functioning - variables, known to affect the cognitive outcomes of children (Fu, 2023; Soto-Calvo et al., 2021). The standardized instruments that will be used to assess the cognitive abilities of children include the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV) and Head-Toes-Knees-Shoulders (HTKS) task to evaluate the executive functioning and working memory (Afifah, 2022; Chen, 2025).

Data analysis will commence by the descriptive and reliability statistics and then Pearson correlations of variables will be used to test the relationships between variables. Then, a series of hierarchical regressions will be performed to identify the predictive role of parent of child interaction quality on cognitive outcomes of children and controlling such covariates as age, gender, and socioeconomic background (Ikje et al., 2022). Mediation analysis will be conducted to address the possibility of an indirect pathway by testing the relationship between parental reflective functioning to the connection between the quality of interaction and cognitive performance (Komanchuk et al., 2022; Wang et al., 2025). All tests will be done using the SPSS (v29) and AMOS to perform the structural modeling, where the level of significance will be $p < 0.05$. The institutional review board will be approached to provide the ethical approval, and informed consent will be gathered among all participating parents. This rigorous design guarantees the methodological rigor and replication, in line with the recent methodological requirements of conducting research in the field of developmental psychology (Li et al., 2023; Rai et al., 2023).

Result

Table 1 *Demographic Characteristics of Participants (N = 200)*

Variable	Categories	n	%	M	SD
Child age (years)	—	—	—	4.32	0.67

Child gender	Male	102	51.0	—	—
	Female	98	49.0	—	—
Parental education	High school	42	21.0	—	—
	Bachelor's	101	50.5	—	—
	Postgraduate	57	28.5	—	—
Monthly household income (USD)	—	—	—	2200	780
Daily parent-child interaction (hours)	—	—	—	2.85	1.21

Note. Data are presented as means \pm standard deviations or frequencies (%).

The demographic data of a sample in terms of equal gender representation and average age of children (4.32 years). The parents had the majority of a bachelors degree and it means that the sample is moderately educated families with consistent daily parent-child interaction with an average of approximately three hours a day.

Table 2 *Bivariate Correlations among Major Variables*

Variable	M	SD	1	2	3	4	5	6
1. Parent scaffolding	4.21	0.68	—	.69**	.61**	.63**	.54**	.48**
2. Parental responsiveness	4.08	0.73	—	—	.65**	.67**	.58**	.52**
3. Verbal elaboration	3.94	0.81	—	—	—	.60**	.46**	.44**
4. Dyadic reciprocity	4.16	0.70	—	—	—	—	.59**	.55**
5. Cognitive composite	105.37	12.21	—	—	—	—	—	.63**
6. Executive function	25.68	6.10	—	—	—	—	—	—

Note. $p < .01$ (two-tailed). Significant positive correlations indicate that higher-quality interactions are associated with stronger cognitive and executive outcomes.

Strong positive associations between all key variables, indicating that those parent to child interaction dimensions that are of higher quality correlate with greater cognitive and executive functioning outcomes. The closest relations are observed between parental responsiveness and scaffold and cognitive composite scores of children followed by the importance of involvement and supportive interaction in cognitive development.

Table 3 *Hierarchical Regression Predicting Preschoolers' Cognitive Scores (WPPSI-IV Composite)*

Predictor	β	SE β	t	p	ΔR^2
Step 1: Controls					
Child age	.18	.07	2.64	.009	.16
Parental education	.22	.06	3.54	< .001	
Household income	.11	.05	1.89	.060	
Step 2: Interaction quality					
Parent scaffolding	.28	.06	4.32	< .001	.28
Parental responsiveness	.23	.06	3.68	< .001	
Dyadic reciprocity	.17	.05	2.97	.003	
Total R²					.44

Note. All predictors entered simultaneously within steps; all variance inflation factors < 2.0.

Hierarchical regression findings that suggest that, at the point of age adjustment by the parent education as well as parent income, parent-child interaction quality are significant predictors of cognitive performance in preschoolers. The last model accounts 44 percent of the variance of cognitive outcomes with scaffolding and responsiveness as the most predictive factors.

Table 4 Mediation Analysis: Parental Reflective Functioning as Mediator Between Interaction Quality and Cognitive Outcome

Path	Un-standardized B	SE	95% CI (LL–UL)	p
Interaction → Reflective Functioning	0.48	0.09	[0.30, 0.65]	< .001
Reflective Functioning → Cognitive Outcome	0.36	0.08	[0.20, 0.52]	< .001
Direct Effect (Interaction → Cognitive Outcome)	0.27	0.07	[0.14, 0.40]	< .001
Indirect Effect (Bootstrapped)	0.17	0.05	[0.09, 0.28]	< .001

Note. Bootstrap = 5000 samples. Mediation significant as CI does not include 0 (Komanchuk et al., 2022; Wang et al., 2025).

The parental reflective functioning mediates the relationship between the quality of interaction and cognitive development partially. The suggestion of high indirect influence denotes that more sensitive parents to their own mental conditions as well as those of their children generate better quality relations that later result in better cognitive advancement of preschoolers.

Discussion

The results of the current study establish that more superior parent child engagements characterized by responsiveness, scaffolding and relative dyadic reciprocity are positively correlated with cognitive improvement in pre-schoolers. These findings align with previous studies that indicate that language and cognitive outcome of children are facilitated by rich conversational input of caregivers (e.g., Yogi et al., 2023).

Additionally, hierarchical regression analyses showed that the interaction quality, despite adjustment of demographic variables (parental education and household income), explained a significant percentage of diversity in cognitive results (~44 percent). This confirms the perception that the relational context of learning represents a strong factor of the cognitive pathways (Qin, Yu and Qiu, 2025).

The mediation analysis that mentions that parental reflective functioning partially mediates the relationship between interaction quality and cognitive outcomes highlights the process through which parental mentalizing ability helps parents to interact effectively. This is consistent with previous results that reflective maternal functioning is a predictor of children on cognitive performance (Komanchuk et al., 2022).

Notably, the data provided in the current study support the fact that the preschool years are a critical phase during which the quality of interaction is still important. Most of the literature has focused on the area of infancy and early toddlerhood; however, these findings resonate with developing literature that indicates the quality of interaction to be relevant in age 3-5 (Rai et al., 2023).

The current research also incorporates the neuroscience lens, which implied that the dynamic interaction can be traced to neural processes of synchrony, which are at the core of cognitive development (Li et al., 2023). This way, it can offer a balance between observational behavioural work and neuroscientific results in support of the plausibility of a biologically based route between the engagement of relations and cognition.

Lastly, the research paper is a part of an emerging literature that highlights the non-stated fact that the home relational environment is not only a nice to have situation but one that can be manipulated to have quantifiable cognitive results. This research has implications in early childhood programmes, parent-training interventions as well as educational policies which have the intention of maximizing the developmental readiness of preschoolers to school and even further.

Future Directions

Future studies ought to utilize longitudinal and experimental lines of investigation to be able to tell causal pathways between the quality of parent-child interaction and the cognitive development, likely moderators (e.g., cultural context, sibling number, childcare hours), and mediators (e.g., neural synchrony, executive function growth) among different populations.

Limitations

The authors are also restricted by the cross-sectional nature of the study that limits the possibility of causal inference and opens the possibility of bidirectional or third-variable effects (such as children with better cognitive abilities could attract better-quality interactions). Also, the sample might not be fully representative in terms of socio-economic and cultural diversity and this can restrict extrapolation to other situations.

Conclusion

this paper highlights that the issue of quality parent-child interaction at the preschool age is a crucial predictor of cognitive development. Proving that quality of interaction is also relevant beyond and on top of demographic variables, identifying parental reflective functioning as one of the possible mediating variables, the study helps to recognize the significance of the emphasis on relationships in the early childhood, which can be applied to practice by practitioners, educators, and parents alike.

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