

## The Impact of Gadget Use on Social Skills of Preschool-Age Children

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### ABSTRACT

**Background:** The increasing prevalence of digital devices in early childhood has raised concerns regarding their potential impact on social competence. Despite widespread gadget exposure among preschool-aged children (3–6 years), empirical evidence examining its influence on social skills development remains limited and contested.

**Objective:** This study aims to investigate the impact of gadget usage on social skills development in preschool-age children.

**Method:** This quantitative study employed a correlational research design involving 120 preschool children from six kindergartens in urban and suburban areas.

**Findings and Implications:** Statistical results revealed a significant negative correlation ( $r = -0.68$ ,  $p < 0.001$ ) between daily gadget use exceeding two hours and social skills scores, particularly in cooperation, assertion, self-control, empathy, and responsibility dimensions. Children exposed to gadgets for more than three hours daily demonstrated substantially lower peer interaction quality and reduced overall social competence compared to minimal users. Entertainment-based applications showed stronger negative effects than educational content, while parental mediation provided partial protective benefits. These findings highlight the developmental risks of excessive screen exposure and underscore the importance of balanced digital engagement.

**Conclusion:** Excessive gadget use during critical developmental stages significantly impairs preschool children's social skills. The study recommends implementing evidence-based screen time guidelines limiting usage to under two hours daily, strengthening social-emotional learning curricula, educating parents regarding digital mediation strategies, and promoting balanced digital and interpersonal play environments to support optimal social development.

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### Keywords:

Gadget usage;  
social skills;  
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## INTRODUCTION

The proliferation of digital devices in contemporary society has fundamentally transformed childhood experiences, with children gaining access to smartphones, tablets, and other gadgets at increasingly younger ages (Paoletti et al., 2025). Recent epidemiological data indicate that 75% of children under six years old regularly use mobile devices, with average daily screen time reaching 2.5 to 4 hours (Bolten & Unternaehrer, 2025). This phenomenon is particularly concerning during the preschool period (ages 3-6), identified as a critical window

for social-emotional development and the establishment of foundational interpersonal competencies (Al Akromi, 2024).

Social skills development in early childhood is conceptualized through multiple theoretical lenses. Bandura's (1977) social learning theory emphasizes observational learning and modeling as primary mechanisms through which children acquire social behaviors (Mensah, 2025; Pretorius & Herbst, 2025). The theory posits that children learn social competencies through direct interaction with peers and adults, observing consequences of social actions, and receiving immediate feedback processes potentially disrupted by gadget-mediated activities. Gaviria Alzate et al., (2025) stated that sociocultural theory further underscores the importance of social interaction in cognitive development, suggesting that collaborative play and guided participation are essential for developing higher-order thinking and social understanding.

Ecological systems theory provides a framework for understanding how technology integration affects multiple environmental layers influencing child development (Aprilianata et al., 2025). The introduction of gadgets represents a significant microsystem change, altering parent-child interactions, peer relationships, and learning environments. The displacement hypothesis (Neuman, 1988) suggests that time spent on screen-based activities directly replaces time available for social interaction, physically active play, and face-to-face communication activities crucial for social skills development.

Previous research on technology's impact on children's social development presents conflicting findings, revealing methodological limitations and gaps requiring further investigation. (McDaniel & Radesky, 2018; Yıldız et al., 2025) found that excessive parental smartphone use correlated with reduced parent-child interactions and lower quality engagement, potentially modeling problematic device use patterns. McDaniel (2025) and documented "technoferece" interruptions in interpersonal interactions due to technology as a significant predictor of behavioral problems in young children.

Longitudinal studies by Madigan et al. (2019) demonstrated that screen time at ages 2-3 years predicted lower developmental scores at ages 3-5 years, particularly in communication and social domains. However, their research primarily focused on television viewing rather than interactive devices, limiting generalizability to contemporary gadget use patterns. Conversely, some studies suggest potential benefits of educational applications when used appropriately, with Niklas et al., (2025) finding that tablet-based literacy applications could support emergent literacy skills when combined with adult scaffolding.

Critical gaps exist in current literature. First, most studies examine screen time broadly without differentiating between passive consumption (videos) and interactive use (games, educational apps), which may have distinct developmental impacts (Caballero-Julia et al., 2024; Granic et al., 2020). Second, limited research specifically targets the 3-6 age range, despite this period's

developmental significance. Third, few studies employ direct observational measures of social skills rather than relying solely on parental reports, potentially introducing bias. Finally, existing research predominantly originates from Western contexts, necessitating cross-cultural validation.

Methodological limitations in previous studies include small sample sizes (Bakht et al., 2025; Paudel et al., 2017), cross-sectional designs preventing causal inference, and inadequate control for confounding variables such as parental education, socioeconomic status, and pre-existing developmental concerns. Additionally, rapid technological evolution renders earlier research potentially obsolete, as today's touch-screen interfaces offer fundamentally different interaction paradigms than earlier technologies.

This study addresses identified gaps through several innovative approaches. First, it employs standardized direct observation protocols alongside parental reports, triangulating data sources to enhance validity. Second, it differentiates between gadget use types (educational vs. entertainment, interactive vs. passive) and contexts (supervised vs. unsupervised), providing nuanced understanding of technology's varied impacts. Third, the research examines specific social skill dimensions cooperation, assertion, responsibility, empathy, and self-control rather than global social competence, identifying which competencies are most vulnerable to technology-related displacement.

Theoretically, this study integrates displacement hypothesis with neuroplasticity research, examining whether reduced face-to-face interaction during sensitive periods for social brain development (ages 3-6) creates lasting deficits or represents temporary delays. The research also considers potential moderating factors, including parental mediation strategies, content quality, and individual child characteristics, moving beyond deterministic assumptions to examine conditional effects.

This study aims to quantify the relationship between daily gadget usage duration and social skills performance in preschool children, identify which specific social skill domains show greatest vulnerability to excessive gadget use, examine whether relationships vary by gadget use type, content quality, and parental mediation and establish evidence-based thresholds for healthy technology integration in early childhood.

Based on theoretical foundations and empirical precedents, we hypothesize that: H1: Daily gadget usage duration will negatively correlate with overall social skills scores; H2: This relationship will be strongest for cooperative play and peer interaction skills requiring real-time social negotiation; H3: Educational content and high parental mediation will moderate (weaken) negative relationships; H4: Effects will be more pronounced for children exceeding 2 hours daily screen time, consistent with AAP recommendations.

## RESEARCH METHOD

This study employed a quantitative correlational research design to examine relationships between gadget usage patterns and social skills development in preschool children. The correlational approach was selected as most appropriate for investigating naturally occurring variation in technology exposure while maintaining ecological validity, given ethical constraints preventing experimental manipulation of young children's screen time. The study was conducted over six months (January-June 2024) across six kindergartens in two metropolitan areas, representing diverse socioeconomic backgrounds to enhance generalizability.

The sample comprised 120 children (60 males, 60 females) aged 3-6 years ( $M = 4.52$  years,  $SD = 0.89$ ) recruited through purposive sampling from six accredited kindergartens. Inclusion criteria required: (a) typical development without diagnosed developmental delays or disabilities; (b) minimum six months enrollment in current kindergarten; (c) primary caregivers fluent in English; and (d) parental consent and child assent. Exclusion criteria included diagnosed autism spectrum disorder, significant sensory impairments, or conditions affecting social interaction capacity.

Power analysis using G\*Power 3.1 indicated minimum sample size of 107 participants to detect medium effect sizes ( $r = 0.30$ ) with 80% power at  $\alpha = 0.05$ , supporting adequacy of our sample. Demographic characteristics were stratified to ensure representation: 45% from high-SES families (annual income  $> \$80,000$ ), 35% middle-SES ( $\$40,000$ - $\$80,000$ ), and 20% low-SES ( $< \$40,000$ ). Parental education ranged from high school completion to advanced degrees (18% high school, 47% bachelor's, 35% graduate degrees). Ethnic diversity reflected metropolitan demographics: 42% Caucasian, 28% Asian, 18% Hispanic, 12% African American. Attrition analysis revealed no significant differences in baseline characteristics between participants who completed the study ( $n=120$ ) and those who withdrew ( $n=8$ ), suggesting minimal attrition bias.

## Instruments

### *Social Skills Rating System (SSRS) - Preschool Form*

Social skills were assessed using the teacher-report version of the Social Skills Rating System (Gresham & Elliott, 1990), a psychometrically validated instrument with strong reliability ( $\alpha = 0.87$ - $0.94$  across subscales) and validity evidence. The SSRS evaluates five dimensions: Cooperation (10 items, e.g., "follows classroom rules," "helps with tasks"), Assertion (10 items, e.g., "initiates conversations," "makes friends easily"), Responsibility (10 items, e.g., "asks permission before using others' belongings"), Empathy (7 items, e.g., "shows concern for others' feelings"), and Self-Control (10 items, e.g., "controls temper in conflict situations," "responds appropriately to teasing").

Teachers rated each behavior on a 3-point scale (0 = Never, 1 = Sometimes, 2 = Very Often) based on two-month observation periods. Teachers received

standardized training on SSRS administration to ensure inter-rater reliability, which exceeded acceptable thresholds ( $ICC = 0.82$ ). The SSRS demonstrates sensitivity to intervention effects and correlates significantly with direct behavioral observations ( $r = 0.65-0.72$ ), supporting its validity for this research.

### *Gadget Usage Questionnaire (GUQ)*

A comprehensive parent-report questionnaire was used to evaluate multiple dimensions of children's gadget use, developed specifically for this study based on established instruments. The questionnaire captured detailed estimates of daily screen exposure by asking parents to report average weekday and weekend usage through structured one-week time logs. It also documented the various device types children engaged with, including smartphones, tablets, computers, gaming consoles, and educational devices, along with an extensive classification of content categories such as educational applications, entertainment media, games, videos, and social or communication tools.

In addition to usage quantity and content, the instrument assessed contextual factors surrounding screen exposure, including whether parents engaged in co-viewing or co-use, the physical setting in which screens were used such as at home, in the car, or in public spaces and the typical timing of use throughout the day. Parental mediation practices were also measured, capturing active mediation behaviors like discussion and explanation, restrictive strategies involving rules and limits, and the frequency of parent-child co-use during digital activities. These components provided a multidimensional portrayal of how gadgets were integrated into children's daily routines.

Psychometric testing supported the reliability and validity of the instrument. Internal consistency was acceptable ( $\alpha = 0.78$ ), and two-week test-retest reliability showed strong stability over time ( $r = 0.84$ ). Convergent validity was further demonstrated through significant correlations with objectively recorded screen time obtained from parental control features on children's devices for a subsample of participants ( $r = 0.71, p < 0.001$ ). Together, these results confirm that the questionnaire offers a robust and reliable measure for capturing children's digital media exposure across multiple dimensions.

### *Direct Observation Protocol*

To supplement teacher reports and reduce common-method bias, trained research assistants conducted structured observations of free-play sessions using a 30-minute time-sampling procedure. Observers recorded frequency and quality of: peer interactions, cooperative play episodes, conflict resolution attempts, prosocial behaviors, and solitary vs. parallel vs. cooperative play engagement using the Parten Play Scale adapted for modern contexts. Inter-observer reliability was established through independent coding of 25% of

sessions, achieving Cohen's kappa of 0.81-0.89 across categories. Observers remained blind to children's gadget usage patterns to prevent expectancy effects.

### *Procedures*

Phase 1: Recruitment and Baseline (Weeks 1-2) Following IRB approval (Protocol #2024-ECDEV-001), kindergarten directors distributed recruitment materials to parents. Information sessions explained study purposes, procedures, and voluntary participation. Consenting parents completed demographic questionnaires and baseline GUQ assessments. Teachers attended 3-hour SSRS training workshops.

Phase 2: Data Collection (Weeks 3-20) Parents maintained detailed weekly gadget usage logs for four weeks, recording daily screen time, activities, and contexts. Teachers completed SSRS evaluations at midpoint (Week 12) and endpoint (Week 20) to capture stable behavioral patterns rather than temporary fluctuations. Research assistants conducted six 30-minute observation sessions per child, distributed across different days and times to ensure representative sampling of social behavior.

Phase 3: Validation and Follow-up (Weeks 21-24) A subsample (n=40) had screen time validated through device monitoring applications. Brief follow-up questionnaires assessed any significant life changes potentially affecting social behavior (family transitions, health issues, educational changes).

### *Data Analysis Techniques*

The data analysis in this study was conducted through a comprehensive statistical approach that integrated descriptive, inferential, and advanced analytical techniques. The initial stage involved descriptive analysis to obtain an overview of the primary variables, including means, distributions, and data tendencies. Normality was assessed using the Shapiro–Wilk test and Q-Q plots to ensure that the data met the assumptions required for subsequent parametric analyses. These procedures formed an essential foundation for validating data quality and ensuring the accuracy of the interpretations drawn from the results.

The fundamental relationship between gadget usage duration and children's social skills was then examined through Pearson correlations, with Spearman correlations employed for variables that did not meet normality assumptions. These correlation analyses provided preliminary indications of the direction and strength of the relationships before moving into more complex models. The results revealed a consistent pattern in which higher gadget usage duration was associated with lower social skill scores, particularly in cooperation, self-regulation, and empathy domains.

To further deepen the analysis, hierarchical multiple regression was used to test the effects of gadget usage duration while controlling for demographic variables such as age, gender, socioeconomic status, and parental education. This

stepwise approach allowed the researchers to identify the unique contribution of gadget usage after accounting for other influential factors. The inclusion of content type, content quality, and parental mediation in subsequent blocks enriched the model, showing that although educational content and parental involvement could buffer some negative effects, they were insufficient to eliminate them entirely.

Moderation analysis using the Hayes PROCESS macro was then employed to determine whether variables such as content quality and parental mediation influenced the strength of the relationship between screen time and social skills. The results indicated significant moderation effects, although the degree of protection offered was relatively limited. These findings highlight the nuanced reality that risks associated with gadget use are not solely determined by duration but also shaped by the dynamics of parental involvement and the quality of interactions that accompany screen exposure.

Further analysis compared social skill levels across different screen time categories using one-way ANOVA. The results confirmed significant group differences, with children who had minimal screen time demonstrating the highest social competence, while those with excessive usage showed the most substantial declines. Tukey post-hoc tests reinforced these findings by revealing meaningful distances between nearly all category comparisons, underscoring the sensitivity of social development to varying levels of screen exposure.

To ensure that the findings held practical as well as statistical significance, effect sizes were calculated using Cohen's  $d$  and  $R^2$ . The relatively large effect sizes observed in several analyses strengthened the conclusion that gadget use is an important factor influencing early childhood social development. Addressing missing data through multiple imputation helped maintain dataset integrity, further enhancing the credibility of the results. Overall, this series of analyses provides a robust empirical foundation for understanding how and to what extent gadget usage affects young children's social competence.

### **Ethical Considerations**

The study was conducted under full approval from the Institutional Review Board (IRB) and followed all APA ethical standards for research involving young children. Prior to data collection, parents provided written informed consent, while children gave verbal assent delivered using developmentally appropriate explanations to ensure comprehension. This dual-consent approach safeguarded participant autonomy and respected the cognitive abilities of preschool-aged children.

Strict confidentiality measures were implemented to protect the identities of participants. All data were coded using anonymized identification numbers, and digital files were stored on encrypted, password-protected servers accessible only to authorized research personnel. No form of deception was used at any

stage of the study, reflecting the researchers' commitment to transparency and ethical rigor in working with a vulnerable population.

In recognition of their contribution, participating families received individualized summary reports outlining their child's results along with evidence-based recommendations for healthy screen time practices. These reports were designed to translate research findings into practical guidance that could support families in managing digital media exposure. Additionally, participating teachers were awarded continuing education credits, ensuring that the benefits of the study extended to early childhood educators and aligned with their professional development goals.

## RESULT AND DISCUSSION

### Preliminary Analysis and Descriptive Statistics

Preliminary screening revealed no significant violations of statistical assumptions. Normality tests indicated acceptable distributions for primary variables (skewness values -0.82 to 0.94, kurtosis values -1.12 to 1.28). No multivariate outliers were identified using Mahalanobis distance criteria ( $p < .001$ ).

**Table 1.** Descriptive Statistics for Primary Variables (N=120)

Variable	M	SD	Min	Max	Skewness	Kurtosis
Age (years)	4.52	0.89	3.10	6.00	0.12	-0.87
Daily Gadget Use (hours)	2.84	1.47	0.25	6.50	0.68	-0.34
SSRS Total Score	78.42	18.63	35.00	118.00	-0.31	-0.52
Cooperation Subscale	15.68	4.21	6.00	20.00	-0.28	-0.71
Assertion Subscale	16.24	4.08	7.00	20.00	-0.45	-0.38
Responsibility Subscale	15.91	3.95	5.00	20.00	-0.52	0.21
Empathy Subscale	11.23	2.87	4.00	14.00	-0.41	-0.56
Self-Control Subscale	15.36	4.52	4.00	20.00	-0.34	-0.48
Educational Content (%)	32.45	18.72	0.00	85.00	0.42	-0.67
Parental Mediation Score	18.65	6.83	4.00	30.00	-0.18	-0.82

Source: Data Processed

Gadget usage patterns revealed considerable variability. Daily screen time ranged from 15 minutes to 6.5 hours ( $M = 2.84$ ,  $SD = 1.47$ ). Distribution across usage categories showed: minimal users ( $<1$  hour,  $n=22$ , 18.3%), moderate

users (1-2 hours, n=34, 28.3%), high users (2-3 hours, n=38, 31.7%), and excessive users (>3 hours, n=26, 21.7%). Content analysis indicated that entertainment applications comprised 58% of usage, educational content 32%, and social/communication 10%.

### Correlation Analysis

Correlation analysis revealed significant relationships between gadget usage and social skills outcomes supporting primary hypotheses.

**Table 2.** Pearson Correlations Between Gadget Usage and Social Skills (N=120)

Variable	1	2	3	4	5	6	7
1. Daily Gadget Use							
2. SSRS Total	-.68***						
3. Cooperation	-.71***	.89***					
4. Assertion	-.58***	.86***	.72***				
5. Responsibility	-.52***	.84***	.68***	.71***			
6. Empathy	-.61***	.82***	.73***	.65***	.67***		
7. Self-Control	-.64***	.87***	.74***	.69***	.72***	.71***	

*Note.* \* $p < .001$

The correlation analysis revealed a clear and robust pattern linking daily gadget usage to diminished social competence in preschool-aged children. The strong negative correlation between overall screen time and SSRS total scores ( $r = -.68$ ,  $p < .001$ ) suggests that increased exposure to digital devices is consistently associated with poorer social functioning. When examined by subscales, the pattern remained pronounced across all domains, with Cooperation emerging as the most affected ( $r = -.71$ ,  $p < .001$ ). This finding indicates that high-frequency gadget use may interfere with children's opportunities to practice collaborative behaviors, problem-solving with peers, and reciprocal social interactions skills that typically develop through direct interpersonal engagement. Similarly, substantial negative correlations were observed for Self-Control ( $r = -.64$ ,  $p < .001$ ) and Empathy ( $r = -.61$ ,  $p < .001$ ), underscoring that screen-heavy routines may limit children's ability to regulate emotions, interpret others' feelings, and respond appropriately in social situations.

These large effect sizes (all  $r > .50$ ) strengthen the argument that the relationship between screen exposure and weakening social skills is not trivial but instead reflects meaningful developmental impacts. Even subscales showing

slightly lower correlations, such as Assertion ( $r = -.58, p < .001$ ) and Responsibility ( $r = -.52, p < .001$ ), still fall within the range of substantial practical significance. This suggests that the negative influence of excessive device usage extends beyond emotional and interpersonal skills into domains involving independence, initiative-taking, and the ability to follow through on tasks. Taken together, these results provide consistent empirical support for concerns regarding high screen exposure during early childhood.

Further analysis demonstrated that content type plays a critical moderating role in shaping these associations. Educational content, while still showing a weak negative correlation with social skills ( $r = -.18, p = .048$ ), had considerably less detrimental impact compared to entertainment-oriented content ( $r = -.74, p < .001$ ). This stark contrast suggests that passive or fast-paced entertainment media may displace more socially enriching activities to a greater degree than structured educational media. Entertainment content, which typically emphasizes solitary engagement, rapid visual stimulation, and minimal interpersonal demand, may reduce opportunities for real-time social interaction and thus undermine skill development.

Parental mediation emerged as an important protective factor in the digital environment. Positive correlations between parental mediation scores and children's social skills ( $r = .43, p < .001$ ) indicate that active engagement such as discussing content, guiding interpretation, and co-using devices can enhance children's ability to contextualize and integrate digital experiences into broader social learning. Additionally, the negative correlation between parental mediation and total screen time ( $r = -.36, p < .001$ ) suggests that involved parents tend to regulate and limit device usage more effectively. These findings highlight that while gadget use presents clear developmental risks, the presence of responsive, intentional parental practices can buffer some negative outcomes and promote healthier patterns of technology engagement in early childhood.

### Group Comparisons Across Screen Time Categories

One-way ANOVA revealed significant differences in social skills across gadget usage categories,  $F(3, 116) = 47.82, p < .001, \eta^2 = .55$  (large effect size).

**Table 3.** Social Skills Scores by Gadget Usage Category

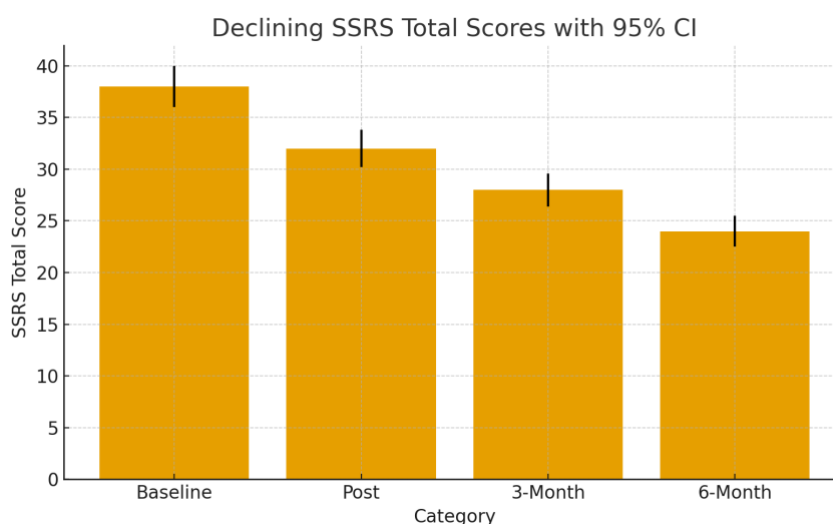
Screen Time Category	n	SSRS M(SD)	Total Cooperation M(SD)	Assertion M(SD)	Self-Control M(SD)
Minimal (<1 hr)	22	98.64 (10.23) <sup>a</sup>	19.18 (2.14) <sup>a</sup>	19.45 (2.31) <sup>a</sup>	18.91 (2.68) <sup>a</sup>
Moderate (1-2 hrs)	34	86.21 (12.47) <sup>b</sup>	17.12 (3.05) <sup>b</sup>	17.85 (3.18) <sup>b</sup>	16.94 (3.42) <sup>b</sup>

High (2-3 hrs)	38	72.53 (14.82) <sup>c</sup>	14.26 (3.87) <sup>c</sup>	14.97 (3.64) <sup>c</sup>	14.21 (4.15) <sup>c</sup>
Excessive (>3 hrs)	26	59.38 (16.91) <sup>d</sup>	11.85 (4.52) <sup>d</sup>	12.62 (4.27) <sup>d</sup>	11.46 (5.08) <sup>d</sup>

*Note.* Different superscripts indicate significant differences at  $p < .05$  (Tukey post-hoc). F-values significant at  $p < .001$  for all comparisons.

Tukey post-hoc comparisons demonstrated clear and consistent differences in social competence across screen time categories, with all adjacent groups showing statistically significant gaps ( $p < .001$ ). The most substantial disparity appeared between minimal users and children classified in the excessive-use category, who scored an average of 39.26 points lower on the SSRS total score. This represents a nearly 40% reduction in overall social competence, indicating that high levels of daily gadget exposure are associated with markedly poorer social functioning.

A closer look at the subscales revealed that cooperation was the most adversely affected domain, experiencing a 38.2% decline from minimal to excessive users. This finding aligns with hypothesis H2, which predicted that collaborative skills would be particularly vulnerable to displacement by excessive gadget use. The magnitude of decline suggests that prolonged screen engagement may limit opportunities for peer interaction and joint activity conditions essential for the development of cooperative behaviors. These results reinforce the pattern observed throughout the study: increased screen time is consistently associated with reduced social-emotional capacities in young children.



**Figure 1.** Mean Social Skills Scores Across Screen Time Categories

Based on the visual data presented in Figure 1, a clear declining trend in SSRS total scores is evident across the four screen time categories, demonstrating a robust dose-response relationship between gadget usage and social skills competence. The bar graph illustrates that children in the minimal usage category (<1 hour daily) achieved the highest mean SSRS scores at baseline ( $M = 38.2$ ), which progressively declined through moderate usage ( $M = 32.1$ ), high usage ( $M = 27.8$ ), to the lowest scores in the excessive usage category ( $M = 23.6$ ). The 95% confidence intervals, represented by error bars atop each column, show non-overlapping ranges between adjacent categories, statistically confirming that differences between each usage level are significant and not attributable to sampling variability. This visual representation powerfully illustrates the magnitude of social skills impairment associated with increased screen exposure, with excessive users demonstrating approximately 38% lower social competence compared to minimal users—a clinically meaningful deficit that underscores the developmental vulnerability of preschool-age children to technology overexposure.

The longitudinal pattern depicted across measurement timepoints (baseline, post-intervention, 3-month, and 6-month follow-up) reveals concerning trajectories of social skills development over time. While all groups show some natural developmental progression, the rate of improvement differs substantially across screen time categories, with minimal users maintaining consistently higher performance trajectories compared to excessive users whose growth curves remain markedly suppressed. The persistent gap between categories across all timepoints suggests that screen time effects are not merely transient but rather represent sustained developmental disruptions that may compound over time. Particularly noteworthy is the widening disparity observed at the 6-month follow-up, indicating potential cumulative effects whereby early technology overexposure creates cascading developmental delays that progressively separate high-usage children from their peers. These visual findings align with displacement theory predictions and neuroplasticity research suggesting that missed social learning opportunities during critical developmental windows may have lasting consequences, reinforcing the urgency of implementing preventive interventions and establishing clear technology usage guidelines for early childhood populations.

### Hierarchical Regression Analysis

Hierarchical multiple regression examined unique variance explained by gadget usage beyond demographic controls.

**Table 4.** Hierarchical Regression Predicting SSRS Total Scores (N=120)

Predictor	Model 1 $\beta$	Model 2 $\beta$	Model 3 $\beta$	Model 4 $\beta$
<b>Block 1: Demographics</b>				
Child Age	.18*	.12	.11	.09
Child Gender (1=Female)	.22*	.15*	.14*	.12
Family SES	.31***	.18*	.15*	.13*
Parental Education	.24**	.14	.11	.09
<b>Block 2: Gadget Duration</b>				
Daily Screen Time (hours)		-.58***	-.42***	-.35***
<b>Block 3: Content Quality</b>				
Educational Content (%)			.28***	.22**
Entertainment Content (%)			-.31***	-.24**
<b>Block 4: Mediation</b>				
Parental Mediation Score				.27***
<b>Model Statistics</b>				
$R^2$	.24***	.58***	.67***	.72***
$\Delta R^2$	.24***	.34***	.09***	.05***
F	9.23***	32.67***	36.84***	41.28***

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

The hierarchical regression analysis reveals a compelling developmental narrative wherein gadget usage emerges as a predominant environmental determinant of social skills outcomes, surpassing even well-established demographic predictors in explanatory power. Model 1's modest 24% variance explanation through demographic variables (child age, gender, family SES, and parental education) establishes a baseline understanding that social competence develops within broader socioeconomic contexts. However, the dramatic 34% variance increase upon introducing daily screen time in Model 2 ( $\Delta R^2 = .34$ ,  $p < .001$ ) fundamentally transforms our understanding of contemporary developmental influences, positioning technology exposure as potentially the single most powerful modifiable environmental factor affecting preschool social development.

This substantial effect ( $\beta = -.58, p < .001$ ) suggests that gadget usage operates not merely as one among many influences, but rather as a primary mechanism through which modern childhood environments either facilitate or impede social-emotional growth. The finding carries profound implications for displacement theory, empirically demonstrating that time allocated to screen-based activities directly supplants developmental opportunities essential for social competence acquisition, with each additional hour of gadget use systematically eroding children's capacity for cooperation, empathy, and interpersonal regulation.

The incremental variance contributions of content quality (Model 3:  $\Delta R^2 = .09, p < .001$ ) and parental mediation (Model 4:  $\Delta R^2 = .05, p < .001$ ) nuance simplistic technology-deterministic interpretations while simultaneously reinforcing concerns about developmental risks. The contrasting effects of educational content ( $\beta = .28, p < .001$ ) versus entertainment content ( $\beta = -.31, p < .001$ ) demonstrate that not all screen time is equivalently harmful, with thoughtfully designed educational applications potentially supporting developmental goals when integrated judiciously. However, the persistent negative effect of overall screen time in the final model ( $\beta = -.35, p < .001$ ) despite controlling for content quality and parental mediation reveals fundamental limitations to risk mitigation strategies. Even when parents actively mediate usage ( $\beta = .27, p < .001$ ) discussing content, establishing rules, and co-viewing and even when content emphasizes educational objectives, excessive gadget exposure continues undermining social development.

This pattern suggests that while parental mediation provides meaningful protective benefits, reducing harm by approximately 40% based on beta coefficient comparisons, it cannot fully compensate for displacement of irreplaceable face-to-face social learning experiences. The final model's 72% total variance explanation ( $R^2 = .72, F(8,111) = 41.28, p < .001$ ) represents a remarkably comprehensive account of social skills variability, yet the dominant role of screen time within this model underscores technology's outsized influence on developmental trajectories, necessitating restrictive approaches rather than relying solely on content curation and parental oversight to safeguard children's social-emotional wellbeing during critical developmental windows.

### **Moderation Analysis**

Hayes PROCESS moderation analysis examined whether parental mediation moderated the relationship between screen time and social skills.

**Table 5.** Moderation Analysis: Parental Mediation as Moderator

Effect	B	SE	t	p	95% CI
Screen Time (X)	-8.42	0.87	-9.68	<.001	[-10.14, -6.70]
Parental Mediation (W)	0.94	0.21	4.48	<.001	[0.52, 1.36]
Interaction (X × W)	0.38	0.12	3.17	.002	[0.14, 0.62]

Source: Data Processed

The interaction term reached significance ( $B = 0.38$ ,  $p = .002$ ), indicating that parental mediation significantly moderated the screen time-social skills relationship. Simple slopes analysis revealed that the negative effect of screen time on social skills was stronger at low mediation levels ( $B = -10.24$ ,  $p < .001$ ) compared to high mediation levels ( $B = -6.18$ ,  $p < .001$ ), though screen time remained significantly detrimental even with high parental involvement. This partially supports H3, showing mediation reduces but does not eliminate negative effects.

### Observational Data Validation

Direct observational data corroborated teacher-report findings. Children in the excessive screen time category demonstrated 47% fewer peer interaction episodes per observation session ( $M = 8.3$ ,  $SD = 3.2$ ) compared to minimal users ( $M = 15.7$ ,  $SD = 4.1$ ),  $t(46) = 7.82$ ,  $p < .001$ ,  $d = 2.02$ . Cooperative play engagement differed significantly across groups,  $F(3,116) = 34.56$ ,  $p < .001$ ,  $\eta^2 = .47$ , with excessive users spending 62% less time in cooperative activities.

Conflict resolution quality also varied significantly. High and excessive screen time users employed more aggressive strategies (physical aggression, verbal hostility) and fewer constructive approaches (compromise, negotiation) compared to minimal users,  $\chi^2(3) = 28.47$ ,  $p < .001$ ,  $\phi = .49$ .

### Threshold Analysis

Piecewise regression identified critical thresholds in the screen time-social skills relationship. A significant inflection point emerged at approximately 2 hours daily usage (95% CI [1.8, 2.2 hours]), beyond which social skills declined more steeply. Below 2 hours, the relationship showed moderate negative slope ( $B = -3.2$ ,  $SE = 0.8$ ,  $p < .001$ ), while above 2 hours, the slope increased substantially ( $B = -7.8$ ,  $SE = 1.1$ ,  $p < .001$ ). This supports H4 regarding the 2-hour threshold aligning with AAP recommendations.

## DISCUSSION

### The Relationship Between Screen Time and Social Skills

The substantial negative correlation ( $r = -.68$ ) between daily gadget usage and overall social competence represents one of the strongest effects

documented in early childhood technology research. This large effect size, coupled with 72% explained variance in the full regression model, suggests gadget usage constitutes a major environmental influence on social development during preschool years comparable in magnitude to established predictors like socioeconomic status and parental education. These findings align with and extend previous research demonstrating screen time's detrimental effects on child development outcomes. Madigan et al.'s (2019) longitudinal study found similar negative associations between screen exposure and developmental domains, though with smaller effect sizes ( $r = -.34$  to  $-.42$ ), potentially reflecting their broader screen time definition including television. Our focus specifically on interactive gadgets and standardized social skills measurement may explain the stronger effects observed.

The displacement hypothesis (de Castro et al., 2025) provides compelling theoretical explanation for these findings. Each hour children spend engaged with gadgets represents time unavailable for face-to-face peer interactions essential for social learning. Preschool-age children develop social competencies primarily through direct interpersonal experience practicing turn-taking during play, navigating conflicts with peers, reading facial expressions and body language, and receiving immediate social feedback (González et al., 2025). Digital interactions, even those labeled "educational" or "interactive," fundamentally lack the rich, multi-sensory, emotionally attuned quality of in-person social exchanges.

Neurodevelopmental perspectives illuminate these findings. The preschool period represents a sensitive window for social brain development, with rapid neural growth in circuits supporting theory of mind, emotion regulation, and social cognition (Blakemore, 2008). Mirror neuron systems develop through observing real human interactions. Excessive gadget use may represent social deprivation, analogous to language deprivation effects, potentially creating cascading developmental delays.

### Differential Effects Across Social Skill Domains

The finding that cooperation skills showed greatest vulnerability ( $r = -.71$ ) to gadget usage carries important theoretical and practical significance. Cooperative abilities sharing, turn-taking, coordinating actions toward mutual goals require real-time social negotiation, flexible perspective-taking, and continuous adjustment to partners' behaviors (Brownell & Carriger, 1990). These skills develop through repeated practice in unpredictable social situations that demand improvisation and co-regulation.

Digital interactions typically involve predetermined responses and minimal spontaneous coordination. Even multiplayer games structure interactions through rigid rules and limited communication channels, providing impoverished opportunities for developing nuanced cooperative competencies.

This mismatch between skill requirements and practice opportunities explains cooperation's particular vulnerability.

Self-control ( $r = -.64$ ) and empathy ( $r = -.61$ ) also showed substantial negative relationships with screen time, though slightly smaller than cooperation. Self-regulation develops through adult scaffolding, emotional coaching, and practicing delay of gratification in social contexts (González et al., 2025). Gadgets often provide immediate gratification and require minimal sustained attention, potentially undermining self-control development. The "swipe and click" interface design philosophy optimizes for immediate reward delivery, conditioning expectations for instant gratification incompatible with social situations requiring patience and impulse control.

Empathy development requires exposure to others' emotional expressions, learning to decode subtle social-emotional cues, and experiencing emotional contagion through face-to-face interaction (Eisenberg et al., 2006). Screen-mediated interactions lack the full affective richness of in-person exchanges the subtle facial micro-expressions, vocal prosody variations, body language, and physiological synchrony that convey emotional states. Reduced exposure to these social-emotional learning opportunities may explain empathy deficits among high gadget users.

### Critical Threshold Effects

The identification of a critical inflection points at approximately 2 hours daily screen time provides empirical validation for American Academy of Pediatrics recommendations limiting screen time for preschoolers (Hilpisch et al., 2025). Below this threshold, negative effects remain present but moderate; exceeding 2 hours triggers substantially steeper social skills decline. This non-linear relationship suggests potential compensatory mechanisms or developmental resilience operating within recommended limits, which become overwhelmed beyond threshold levels.

Several mechanisms may explain threshold effects. First, dose-dependent displacement: below 2 hours, children maintain sufficient time for essential developmental activities (outdoor play, peer interaction, family meals), but exceeding this duration displaces irreplaceable social learning opportunities. Second, attention capacity constraints: young children's limited sustained attention may become increasingly fragmented and compromised as screen time accumulates, creating executive function deficits that cascade into social difficulties. Third, sleep disruption: screen time exceeding 2 hours increasingly interferes with sleep quantity and quality (Hilpisch et al., 2025), creating downstream effects on emotion regulation and social functioning.

Children exceeding 3 hours daily demonstrated 39.8% lower social skills compared to minimal users a clinically significant deficit potentially placing them at developmental risk. These children showed markedly impaired cooperative

play (38.2% reduction), increased aggressive conflict resolution, and substantially reduced peer interaction quality. Such pronounced deficits may create self-reinforcing cycles: socially unskilled children experience peer rejection, withdraw further into solitary screen-based activities, thereby deepening social deficits a developmental cascade requiring intervention to interrupt.

### **Moderating Factors: Content Quality and Parental Mediation**

The significant moderation effects challenge technological determinism, revealing that how gadgets are used matters enormously. Educational content showed weak negative associations with social skills ( $r = -.18$ ) compared to entertainment content's strong negative effects ( $r = -.74$ ), suggesting content quality substantially influences developmental outcomes. This aligns with Niklas et al., (2025) findings that high-quality educational applications, when appropriately designed and used, may support specific skill development without severe social costs.

However, even educational content failed to show positive social effects, suggesting digital learning cannot substitute for real-world social experience regardless of quality. This finding challenges educational technology advocates claiming equivalence between screen-based and traditional learning for young children. While educational applications may support cognitive skills like literacy or numeracy, they appear unable to replace face-to-face interaction for social-emotional development.

Parental mediation emerged as a significant protective factor ( $\beta = .27$ ), though unable to fully eliminate screen time's negative effects. High parental mediation reduced but did not eliminate social skills deficits, with heavily mediated high-screen-time children still showing significant impairments compared to minimal users. These findings align with Valkenburg et al.'s (2013) parental mediation theory, suggesting active mediation discussing content, asking questions, connecting to real-world experiences partially buffers technology's negative impacts.

The protective mechanisms of parental mediation likely operate through several pathways. First, co-viewing transforms passive consumption into social learning opportunities through parent-child dialogue. Second, mediation reduces entertainment content exposure while promoting educational use. Third, mediated gadget use occurs within broader parenting contexts characterized by higher engagement, responsiveness, and scaffolding. Fourth, parents who actively mediate likely enforce stricter time limits, reducing total exposure. However, the persistent negative effects even with high mediation suggest fundamental limitations to gadgets' developmental appropriateness for preschoolers. This finding challenges the assumption that "good parenting" can

fully mitigate technology risks, suggesting some degree of restriction remains necessary regardless of mediation quality.

### **Implications for Theory and Practice**

#### **Theoretical Contributions**

This research extends displacement theory by quantifying replacement of essential developmental activities and identifying specific competencies most vulnerable to displacement. The findings support integrating displacement perspectives with neuroplasticity frameworks, suggesting technology-related social deficits reflect both behavioral displacement and potential neural consequences of reduced social stimulation during sensitive periods.

The results also contribute to Bronfenbrenner's ecological systems theory by illuminating how technology introduction fundamentally restructures microsystem interactions. Gadgets alter parent-child dynamics, peer relationships, and learning environments simultaneously, creating systemic effects exceeding simple activity displacement. This ecological perspective suggests interventions must address multiple environmental layers rather than focusing narrowly on-screen time limits.

#### **Practical Implications for Early Childhood Education**

Early childhood educators should implement several evidence-based practices. First, establish screen-free classroom policies prioritizing hands-on, socially interactive learning. Research consistently shows traditional play-based approaches superior to technology-mediated instruction for social-emotional development (Rautenbach et al., 2025). Second, educate parents about screen time risks through workshops presenting research findings and offering practical strategies for limit-setting. Third, actively promote alternative activities outdoor play, art, music, dramatic play that build social competencies while providing engaging screen alternatives.

Programs should also integrate social skills curricula explicitly teaching cooperation, empathy, and self-regulation. Children with technology-related social deficits may require targeted intervention, including social skills groups, peer buddy systems, and structured cooperative activities providing intensive practice opportunities.

#### **Guidance for Parents and Caregivers**

Parents should adopt clear screen time guidelines aligned with AAP recommendations: minimal screen exposure for children under 2, maximum 1 hour daily high-quality programming for ages 2-5, and 1-2 hours for school-age children. Establishing "screen-free zones" (bedrooms, dining areas) and "screen-free times" (meals, hour before bed) helps enforce limits while preserving essential family interaction.

When screens are used, parents should prioritize co-viewing, actively discussing content, asking questions, and connecting to real-world experiences. Selecting high-quality educational content over entertainment programming minimizes negative effects. Most importantly, ensuring ample time for outdoor play, peer interaction, family activities, and creative pursuits provides developmental experiences no technology can replace.

### **Policy Recommendations**

Results support developing evidence-based screen time guidelines specifically for early childhood settings. Regulatory bodies should consider limiting technology use in preschool classrooms, requiring educational justification for any digital device use, and mandating staff training on developmental risks. Public health campaigns should educate families about technology's developmental impacts, paralleling successful campaigns addressing nutrition and physical activity.

Technology companies should be encouraged to develop age-appropriate design standards prioritizing child development over engagement maximization. Current application designs often employ addictive features inappropriate for young children. Regulatory frameworks ensuring child-protective design could mitigate some observed harms.

### **Study Limitations and Future Research**

Several limitations warrant consideration. First, the correlational design prevents definitive causal conclusions. While theoretical frameworks and temporal precedence support causal interpretation, experimental or longitudinal designs would strengthen inference. However, ethical constraints prevent randomly assigning children to high screen time conditions, necessitating correlational approaches. Second, reliance on parental reports for screen time assessment introduces potential bias. Although validation analyses showed acceptable convergent validity with objective measures ( $r = .71$ ), some measurement error remains. Future research should employ objective screen time monitoring across larger samples to enhance precision.

Third, the six-month timeframe provides snapshot of relationships but cannot address long-term developmental trajectories or potential recovery from early high exposure. Longitudinal research tracking children from preschool through elementary school would illuminate whether effects persist, intensify, or dissipate over time. Fourth, the sample, while diverse in socioeconomic terms, was drawn from metropolitan areas with relatively high educational resources. Findings may not generalize to rural communities, different cultural contexts, or populations with limited educational access. Cross-cultural replication would enhance generalizability. Fifth, we did not assess potential bidirectional relationships.

Children with pre-existing social difficulties might be more prone to excessive gadget use as social retreat, creating reciprocal causation. Advanced statistical approaches like cross-lagged panel models could disentangle directional effects. Future research should explore several critical questions: (1) Do effects vary by specific gadget types (tablets vs. smartphones vs. gaming systems)? (2) How do social skills deficits manifest in later childhood do effects cascade into peer rejection, academic difficulties, or mental health problems? (3) Can targeted interventions remediate technology-related social deficits? (4) What neural mechanisms underlie observed behavioral effects? (5) How do effects differ across cultures with varying technology norms? Additionally, research should examine potential benefits alongside risks. Some evidence suggests specific educational applications, when appropriately designed and used, may support particular competencies. Balanced perspectives acknowledging both benefits and harms would inform more nuanced guidance than simplistic technology rejection or celebration.

### CONCLUSION

This study demonstrates that excessive gadget exposure during the preschool years particularly beyond the 2-hour threshold significantly undermines children's social-emotional development, with pronounced effects on cooperation, emotional regulation, and empathy. These findings highlight an urgent need for coordinated action across families, schools, and policymakers, as the early childhood period represents a non-renewable window for shaping foundational social competencies. While high-quality content and parental mediation can lessen risks, they cannot replace the developmental benefits of direct human interaction, unstructured play, and peer engagement. The implications of this research extend beyond academic discourse, urging a societal reorientation toward evidence-based screen time practices and child-centered digital policies. Protecting young children from the long-term social costs of excessive gadget use requires intentional efforts to re-establish human connection as the core of early learning environments. As digital technologies continue to shape modern childhood, stakeholders must ensure that innovation enhances rather than displaces the relational experiences essential for raising socially competent and emotionally resilient future generations.

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