Parental technology use in the child's presence and health and development in the early years

A systematic review and meta-analysis

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Key Points

Question: What is the association between parental technology use in the child's presence and motor development, cognitive development, psychosocial health, physical activity, screen time and sleep in children aged under five?

Findings: This systematic review and meta-analysis found that parental technology use in the child's presence was significantly associated with poorer cognition and prosocial behaviour, lower attachment, higher levels of internalising and externalising problems, and higher levels of screen time.

Meaning: This phenomenon may negatively impact young children's health and development, highlighting the need for more longitudinal and experimental studies targeting this modifiable factor.

Abstract

Importance: Parental technology use in the child's presence, often referred to as technoference, is a growing concern in family dynamics, and no studies have quantitatively synthesised associations with children's health and development.

Objective: Systematically review and synthesise literature on associations between parental technology use in the child's presence and motor development, cognitive development, psychosocial health, physical activity, screen time and sleep in early childhood.

Data source: Peer-reviewed studies from MEDLINE, CINAHL, SPORTDiscus, PsycInfo, PsycArticles, Web of Science, Scopus and ProQuest published from inception to July 2024.

Study selection: 6,212 studies were initially identified. Studies were included if they examined associations between parental technology use in the presence of their apparently healthy children (birth to 4.9 years) and motor development, cognitive development, psychosocial health, physical activity, screen time or sleep.

Data extraction and Synthesis: PRISMA guidelines were followed. Random-effect models were conducted to determine the pooled estimates of the associations and moderating effects of the type of exposure (distraction/interruption). The risk of bias was assessed using JBI's critical appraisal tools.

Main outcomes and measures: Association between parental technology use in the child's presence and motor development, cognitive development, psychosocial health, physical activity, screen time and sleep.

Results: Twenty-one studies involving 14,900 participants from 10 countries were meta-analysed. Significant associations were found between parental technology use in the child's presence and cognition (r=-0.14; 95% CI=-0.23; -0.04), internalising behaviour and emotions (r=0.13; 95% CI=0.08, 0.19), externalising behaviour (r=0.15; 95% CI=0.09, 0.21), prosocial behaviour (r=-0.08; 95% CI=-0.13, -0.02), attachment (r=-0.10; 95% CI=-0.19, -0.01) and screen time (r=0.23; 95% CI=0.13, 0.32). No moderating effects of the type of PTU exposure on any associations were found. No study examined motor development, physical activity or sleep.

Conclusions and Relevance: Parental technology use in the child's presence was negatively associated with cognitive and psychosocial outcomes and screen time among young children, albeit the effect sizes were small. Further research focusing on potential impacts on physical activity, sleep, and motor skills is needed. Understanding these associations is crucial for informing research and guidelines aimed at minimising the potential negative effects of this phenomenon on early childhood development.

Background

The expectation that parents respond spontaneously to their child's bids for attention is a fundamental aspect of early childhood interactions, emotional security, and children's playful exploration of their surroundings.[1] When this responsiveness is lacking, children may be deprived of the benefits of sensitive and engaged parenting, which are important for promoting health and early development.[2–4] With the ubiquity of technological devices, parental technology use in the child's presence (PTU), often referred to as parental technoference[5] or phubbing,[6] has become prevalent with children exposed to PTU from an early age. Research indicates that over 70% of parents engage with technology while playing or during mealtime with their children,[7] and 89% report engaging in PTU at least once or more on a typical day.[8]

Devices can play a valuable role in helping parents navigate the complexities of modern life by providing access to information, fostering connections with peers or offering relief from the demands of parenting.[9,10] However, when parent-child interactions are disrupted by their devices, it may foster a sense of being ignored or lead children to feel they must compete for their parent's attention. Such intrusions may disrupt the natural flow of interactions, which is particularly important as young children are acquiring critical social and language skills – and in parallel, motor, psychosocial, and cognitive skills[11] – and establishing their movement behaviour patterns (e.g., physical activity, sedentary screen time and sleep).[12] Evidence of PTU on young children's health and development has been summarised through scoping reviews,[13,14] narrative reviews[15,16] and systematic reviews.[17–20] However, most have focused on psychosocial outcomes, the quality of parent-child interactions, and parental outcomes (e.g., sensitivity and responsiveness). A systematic quantitative synthesis of associations between PTU and a broad range of health and developmental outcomes is therefore needed to elucidate the patterns of associations of this

behaviour on health and development during early childhood. Further, it has recently been proposed that PTU can be operationalised into distinct behavioural mechanisms[21]: 1) distraction – where parents are distracted by using a device while their child is present; and 2) interruption – where a device abruptly interrupts an ongoing parent-child interaction through a call, message, email or notification. However, the potential variations in these different mechanisms and their impacts on children are not yet well understood, representing an important area for further investigation.

Our systematic review and meta-analysis synthesised existing literature on the associations between PTU and motor development, cognitive development, psychosocial health, physical activity, screen time and sleep in children aged under 5 years. A secondary aim of this study was to explore whether the observed associations differed based on the type of PTU exposure (i.e., distraction versus interruption).

Methods

Search strategy

This review was registered in PROSPERO (CRD42023418164) and reported following the PRISMA guidelines[22] (eTable 1 in Supplement 1). Eight electronic databases (MEDLINE, CINAHL, SPORTDiscus, APA PsycInfo, APA PsycArticles, Web of Science, Scopus and ProQuest) were initially searched from inception to December 28, 2023, with no language restrictions. The search was subsequently updated to July 31, 2024. The search strategy was developed by referring to a previous review,[14] discussions among research team members and consultation with a research librarian. One reviewer (MTV) also screened the reference lists of included studies and relevant reviews to identify additional records that were not captured through the database searches. The full search strategy can be found in Supplement 1.1.

Inclusion criteria

Studies were included if they met the following criteria: 1) Explored a direct cross-sectional or longitudinal association between the frequency of PTU (parental technoference, media/technology use while parenting, or during routines or interactions) in any context and at least one outcome of interest (motor development, cognition, psychosocial health, physical activity, screen time or sleep) in apparently healthy children aged from birth to 4.9 years; 2) published or accepted/in-press in a peer-reviewed journal. Qualitative studies, dissertations, books, reviews, study protocols, grey literature, editorials, commentaries and conference abstracts were excluded.

All search records were exported from databases and uploaded into Covidence (Veritas Health Innovation, Melbourne, Australia), where duplicates were identified and removed. Two reviewers (MTV, CIM) independently screened the titles and abstracts of all retrieved studies against the eligibility criteria (97.3% agreement). Studies that met the initial screening were included in the full-text screening, and two reviewers (MTV, CIM) independently assessed for final inclusion (95.8% agreement). Discrepancies were discussed, and if necessary, a third reviewer (ADO or KHC) was consulted for resolution.

Data extraction

Two reviewers (MTV, CIM) independently extracted data from each included study using Covidence. Data extracted included general study characteristics (e.g., year of publication, country where the study was conducted, study design, sample size), measurement methods (e.g., tools or instruments), outcomes examined and study findings (e.g., associations reported with statistical results). Disagreements were discussed or consulted with a third reviewer if

needed (ADO or KHC). When required, corresponding authors were contacted to request additional or missing data.

Risk of bias

The JBI's critical appraisal tools[23] were used to assess the risk of bias (ROB) of each included study. Each study was assessed twice independently among four reviewers (MTV, CIM, KHC, ADO) using the checklist specific to the study design. Discrepancies were discussed to reach a consensus or resolved by a third reviewer. Each checklist item could be rated as "Yes", "No", "Unclear" or "Not Applicable" (refer to Supplement 1.2 for assessment and details). No studies were excluded based on their ROB assessment.

Statistical analysis

Studies that provided a valid effect size (correlation coefficient) were included in the meta-analyses. Anticipating some degree of heterogeneity, a series of random-effects meta-analyses were conducted using the restricted maximum likelihood estimation. Pearson's correlation coefficients (r) were extracted from the included studies to calculate the pooled effect size between PTU and each outcome. If unavailable, the first step was contacting the corresponding authors to request the information. Where no response was received, standardised beta coefficients within the range of -0.50 and 0.50 were imputed to Pearson's correlations.[24] If unstandardised coefficients (B) were reported from simple linear regression, we used the following equation to impute the Pearson's correlation: r = B x standard deviation of PTU variable / standard deviation of the outcome variable. Spearman correlations were treated as estimates of Pearson's correlations and included in the analyses. Refer to Supplement 1.3 for imputations. Where a study provided more than one effect size for the same outcome, we conducted a multivariate random-effects meta-analysis with a

three-level approach. This method accounts for the potential bias introduced by the correlation of different measurements nested within the same study.[25] Correlations were converted into Fisher-z transformed correlations for analysis and then converted back for reporting. The pooled effect sizes were classified as very small (<0.1), small (0.1-0.29), moderate (0.3-0.49), and large (0.5-1).[26] A sensitivity analysis was performed to assess whether the use of associations adjusted for covariates led to considerable changes to the pooled estimates. Heterogeneity among the included studies was assessed using the I^2 statistic (<25% low; 25% to 75% moderate; > 75% high).[27] The Egger's test and funnel plots are not recommended for assessing the publication bias when fewer than 10 studies are included in the meta-analysis.[28] However, to provide a visual insight into potential publication bias, we included both funnel plots and Egger's test results for all outcomes in Supplement 1.4: eFigures 1-7. These results should be interpreted cautiously given the limited number of studies, which reduces the power of Egger's test and the reliability of conclusions drawn from the funnel plots. For the analysis, outcomes were categorised into seven groups (eTable 2 in Supplement 1). Meta-regression analyses were conducted to explore the moderating effect of type of PTU exposure (i.e., distraction, interruption) on the association (eTable 3 in Supplement 1 for categorisation and rationale), acknowledging that the results may be biased in analyses based on fewer than 10 studies. Analyses were conducted in R (version 4.3.3) using the *metafor* package.[29]

Results

The initial search retrieved 6,212 records. After removing duplicates, 4,448 titles and abstracts were screened. Eighty-nine full-text articles were assessed for eligibility, of which 30 met the inclusion criteria for this review and 21 for the meta-analyses (Figure 1). The selected articles, published between 2017 and 2024, predominantly followed a cross-sectional

211 design and included 16,383 participants from 12 countries, of which all but four[30–33] were
212 high-income. Sample sizes ranged from 13 to 3,483 participants. None of the included studies
213 examined associations between PTU and physical activity or motor skills. Study
214 characteristics and findings of all included studies are provided in eTable 4 in Supplement 1.
215 According to the ROB assessment, observational studies lacked clear inclusion
216 criteria, and most exposure measurements were not validated or reliability was not assessed.
217 Experimental randomised studies failed to blind those delivering the interventions, and the
218 experimental non-randomised studies did not include a control group. The complete
219 assessment is available in Supplement 1.2.
220
221 *Narrative synthesis*
222 Among the studies not included in the meta-analysis (n=9),[34–42] five[36,37,39,41,42] followed a
223 similar protocol using a handheld device interrupting parent-child interactions. Two of
224 them[36,37] showed that children displayed more social bids during the interruption with a
225 phone compared to free-play, likely in the attempt to re-gain their parent's attention, while 3
226 of 4 studies[37,41,42] showed more negative affect. Three studies[37,39,42] reported that children
227 displayed less positive affect. In one experimental study,[40] toddlers demonstrated more
228 comprehension when teaching was uninterrupted. Other studies found no significant
229 association between PTU and infants' behaviours,[34] imitation learning[35] and talks or positive
230 emotions.[38]
231
232 *Meta-analyses*
233 Twenty-one studies involving 14,900 participants from 10 countries were included in the
234 meta-analyses. The results of the meta-analyses are presented in Table 1. A forest plot
235 summarises all meta-analyses (Figure 2; individual forest plots are provided in Supplement

1.5: eFigures 8-14). In most cases, the assessments of publication bias remained inconclusive due to the limited number of studies (Supplement 1.4: eFigures 1-7). For internalising behaviour problems and emotions (n=11), visual inspection of the funnel plot and the results of Egger's test (p=0.437) did not suggest clear evidence of publication bias. The sensitivity analysis showed that the inclusion of adjusted effect sizes considerably reduced the number of eligible studies and increased the statistical heterogeneity in the estimates, leading to reduced significance in the pooled effect sizes. The increase in study-level heterogeneity was likely caused by discrepancies in covariates used for adjustments across studies (Supplement 1.6).

Cognition

The association between PTU and children's cognition was investigated in three studies.[33,43,44] A small but statistically significant effect size was found (r = -0.14; 95% CI = -0.23, -0.04; p = 0.006). Children whose parents reported a higher frequency of PTU had lower cognitive performance (e.g., on assessments of attention, executive function and cognitive self-regulation). The model presented moderate heterogeneity (I^2 = 64.4%).

Language

Three studies[43,45,46] reported associations between PTU and children's language development, resulting in a non-significant pooled effect size of r = -0.09 (95% CI = -0.31, 0.14; p = 0.463). There were moderate levels of heterogeneity (overall I^2 = 67.7%).

Internalising problems and emotions

Eleven studies[8,33,43,47–54] reported associations between PTU and children's internalising problems and emotions. Two studies analysed the same dataset;[41,50] the one with the smaller

analytical sample size[41] was excluded from the analysis. A small but statistically significant pooled effect size (r = 0.13; 95% CI = 0.08, 0.19; p < 0.001) with high heterogeneity (I^2 = 80.9%) was found, indicating that a higher frequency of PTU was associated with more internalising problems and negative emotionality.

Externalising problems

Five studies[8,30,43,52,54] reported associations between PTU and children's externalising problems. A small but statistically significant pooled effect size was found (r = 0.15; 95% CI = 0.09, 0.21; p < 0.001), indicating that a higher frequency of PTU was associated with more child externalising behaviour. Moderate heterogeneity was observed in the model (I^2 = 63.2%).

Prosocial behaviour

Three studies[31,43,52] were included in the analysis of children's prosocial behaviour. The results indicated that PTU was significantly associated with less prosocial behaviour (r = -0.08; 95% CI = -0.13, -0.02; p = 0.006). The model presented low heterogeneity (I^2 = 15.1%).

Attachment

Three studies[30,31,55] identified associations between PTU and children's attachment. A small but statistically significant pooled effect size of -0.10 (95% CI = -0.19, -0.01; p = 0.026) was found, indicating less secure parental attachment at higher levels of PTU. The model showed high heterogeneity (I^2 = 82.7%).

Screen time

Nine studies[8,32,33,44,45,54,56–58] examined the associations between PTU and children's screen time. Frequency of PTU was significantly associated with child screen time (r = 0.23; 95% CI = 0.13, 0.32; p < 0.001), such that more PTU was related to more children's screen time. The model presented high heterogeneity (overall I^2 = 94.6%).

The moderating effect of the type of PTU exposure

The influence of the type of PTU exposure (distraction and interruption) was examined across all associations. No statistically significant moderating effect was found (all ps > 0.05), indicating that both forms of PTU had similar associations with the measured outcomes (eTable 5 in Supplement 1).

Discussion

This systematic review and meta-analysis examined the literature on the associations between PTU and various health and development outcomes in early childhood. The main findings revealed that PTU was associated with poorer cognition, prosocial behaviour and attachment, and higher levels of internalising problems, externalising problems and screen time. Effect sizes were classified as very small to small and were not moderated by whether PTU was a distraction or an interruption, suggesting that distractions or interruptions by technological devices may have an equal impact on the outcomes studied.

To our knowledge, this is the first meta-analysis to examine the effects of PTU on various health and development outcomes during early childhood. Our findings align with previous literature that identified detrimental associations of PTU with psychosocial and cognitive outcomes in children aged birth to three,[20] birth to five,[19] birth to 10[17] and birth to 18,[14,15] one of which also reported detrimental associations with preschoolers' screen time.[14]

Our results extend this by providing quantitative analyses and identifying additional outcomes that may be negatively impacted by PTU.

The negative association between PTU and children's cognition may be attributable to a decrease in the quality of parent-child interactions and lack of contingent responding. High-quality, sustained and reciprocal interactions – particularly within the home environment, where young children spend the most time – are essential for cognitive development in young children.[59] When parents frequently engage with screen-based devices in the presence of their children, the children's efforts to interact or seek attention may be met with delayed, dismissive, shallow or absent responses. This inconsistency in social feedback and responsiveness may lead to fewer opportunities for children to engage in mentally stimulating activities that foster the development of foundational cognitive skills, such as executive functions. The reverse is also possible; screen-based devices are often used as a temporary reprieve to address challenges in the home. While we do not anticipate this to be the primary chain of effect, evidence suggests that parental use of digital media to help manage children's problematic emotions can contribute to exacerbating later problematic media use and emotional extremes.[60] Still, low social-cognitive reciprocity during PTU – which creates fewer opportunities for adult-child interaction and scaffolding and potentially leads children to expect and seek less interaction over time – can be expected to confer minimal, if any, benefit to children. Instead, this situation almost certainly represents missed developmental opportunities.

The unfavourable findings for psychosocial outcomes may also be explained by children feeling ignored in attempts to engage their parents.[61] Parents are children's first and most important teachers, and child frustration can arise from inconsistent responses, regardless of whether these inconsistencies are attributed to PTU.[62,63] Our meta-analysis suggests that PTU is negatively associated with children's behaviours, emotions, and

attachment to their parents. The specific mechanisms and pathways of this association need to be better understood (e.g., through children's interpretations of PTU, consequences for the parent-child relationship, behavioural adjustments by the child). Nonetheless, even in its absence, our findings suggest the importance of minimising PTU during early childhood and promoting awareness and parental responsiveness.

The observed association between PTU and increased screen time may be attributable to several factors. For instance, parents might allow their children to use screens for entertainment while they are engaged with their own devices. Research has indicated that parents may use digital devices to escape and manage stress,[64,65] and additionally, they are likely to rely on these devices to calm their children during moments of distress.[66] During PTU, parents also model acceptable use for their child – whether intentionally or not – which may stimulate more requests for digital activity from the child.[67] Further, observing their parents engage in extensive periods of sedentary screen time may lead children to imitate this behaviour and limit parents from engaging in shared activities that could facilitate opportunities for physical activity and enhance children's motor skills. This association may also be influenced by parents who are not concerned about their own screen time and, consequently, may be less attentive to their children's screen time. These findings have implications for public health attempts to reduce sedentary screen time in young children since most children under five do not meet the screen time recommendations.[68]

Meta-regression analyses revealed no significant moderating effect of the type of PTU exposure (distraction vs. interruption) on any association examined. Regardless of whether parents are momentarily interrupted or actively distracted by technology, the impact on children appears to be equally negative. Future research should more precisely define and specify the devices and mechanisms involved to obtain more robust conclusions. Similarly, further research is needed to explore whether a similar pattern exists with motor

development, physical activity and sleep, considering their co-dependence with screen time.[69,70]

Only one validated questionnaire has been used in the included studies to measure PTU.[71] A comprehensive and validated tool that accounts for the context and type of device is needed to assess this behaviour more accurately. Future studies should examine the frequency of use (how much time is excessive), context (location and type of content/task), devices involved (handheld devices, laptops, television, video games), and duration of distractions/interruptions. Studying both the short and long-term impacts of PTU and developing interventional studies could provide valuable insights. Additionally, it is crucial to systematically examine other variables that could influence or explain the associations between PTU and children's outcomes, such as parental mental health[7,64] or problematic device use.[7,72] We emphasise that these results do not imply that technological devices are inherently harmful; they can serve as valuable tools for parents.[10,73] However, regulating and controlling device use around children may help mitigate potential negative effects. Co-viewing/co-using devices may offer a strategy to alleviate this, as it is positively associated with cognitive outcomes in young children.[19,73]

Strengths and limitations

This is the first known study to review and quantify the association of PTU with a broad range of health and developmental outcomes in early childhood using a solid quantitative approach. We attempted a novel classification to understand the potential difference between being distracted or interrupted by a technological device. There are also some limitations. First, analyses included a small number of studies, mostly from high-income countries, limiting the statistical power and generalisability. Second, our study only included correlations, further limiting causal interpretations and direction. Third, the

outcomes were categorised into broader domains, which may misrepresent the true association with specific outcomes.

Conclusions

This systematic review and meta-analysis found that PTU was negatively associated with cognition, diverse psychosocial outcomes and screen time, in children under five years. While correlational in nature, triangulation of these results is at least suggestive that PTU may be a factor influencing children's health and development. This review highlights the lack of research on outcomes other than psychosocial health, such as physical activity, sedentary behaviour, sleep, motor development, and additional cognitive outcomes. Given the ubiquity of handheld and other screen-based devices and the frequency at which PTU can and does occur, it is essential to further investigate this phenomenon using methods to measure PTU more precisely in different contexts.

Author Contributions: Toledo-Vargas had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Toledo-Vargas, Chong, Howard, Okely.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Toledo-Vargas, Chong, Howard, Okely.
Critical review of the manuscript for important intellectual content: All authors.
Statistical analysis: Toledo-Vargas, Wakefield.
Administrative, technical, or material support: Toledo-Vargas
Supervision: Chong, Okely.

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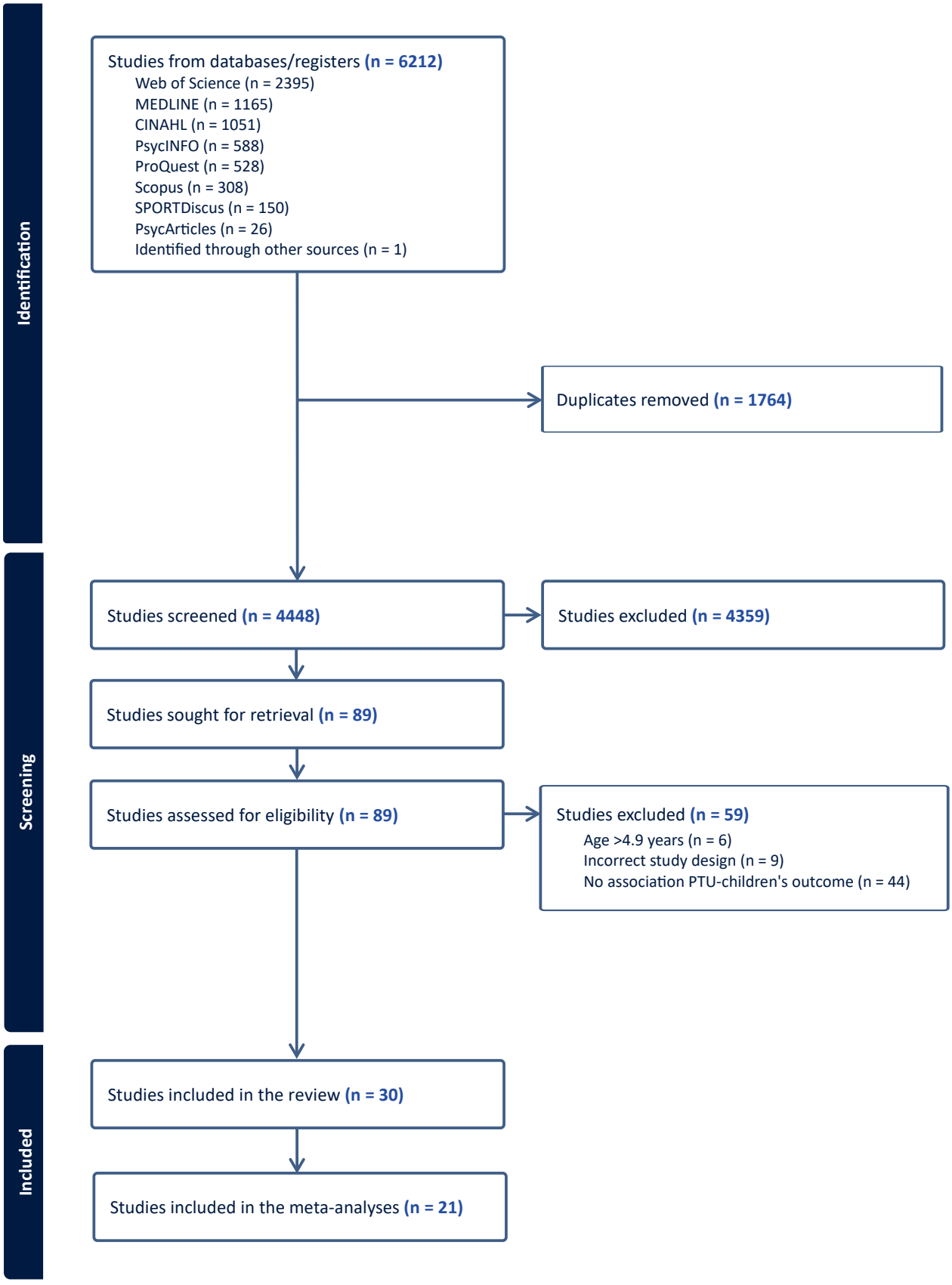
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633 Figure 1. PRISMA Flow Diagram

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635 Figure 2. Findings from meta-analyses for the association of parental technology use in the

636 child's presence and children's outcomes


Identification
Studies from databases/registers (n = 6212)
Web of Science (n = 2395)
MEDLINE (n = 1165)
CINAHL (n = 1051)
PsycINFO (n = 588)
ProQuest (n = 528)
Scopus (n = 308)
SPORTDiscus (n = 150)
PsycArticles (n = 26)
Identified through other sources (n = 1)
Duplicates removed (n = 1764)
Screening
Studies screened (n = 4448)
Studies excluded (n = 4359)
Studies sought for retrieval (n = 89)
Studies assessed for eligibility (n = 89)
Studies excluded (n = 59)
Age >4.9 years (n = 6)
Incorrect study design (n = 9)
No association PTU-children's outcome (n = 44)
Included
Studies included in the review (n = 30)
Studies included in the meta-analyses (n = 21)

Outcome	No. of studies	No. of effect sizes	Overall I^2, %	I^2 between study, %	I^2 within study, %	Between−study variance ($\sigma^{2.1}$)	Within−study variance ($\sigma^{2.2}$)	Pooled effect size, r [95% CI]
Cognition	3	10	64.4	0.0	64.4	0.000	0.009	−0.14 [−0.23, −0.04]; p = 0.006
Attachment	3	3	82.7	−	−	−	−	−0.10 [−0.19, −0.01]; p = 0.026
Language	3	6	67.7	67.7	0.0	0.029	0.000	−0.09 [−0.31, 0.14]; p = 0.463
Prosocial behaviour	3	3	15.1	−	−	−	−	−0.08 [−0.13, −0.02]; p = 0.006
Internalising problems & emotions	11	23	80.9	0.0	80.9	0.000	0.012	0.13 [0.08, 0.19] ; p < 0.001
Externalising problems	5	9	63.2	0.0	63.2	0.000	0.004	0.15 [0.09, 0.21] ; p < 0.001
Screen time	9	25	94.6	80	14.6	0.019	0.003	0.23 [0.13, 0.32] ; p < 0.001

