

### **Systematic review on the use of digital screens in the child-adult-screen triadic interaction**

### *Revisão sistemática sobre o uso de telas digitais na interação triádica criança-adulto-tela*

### *Revisión sistemática sobre el uso de pantallas digitales en la interacción triádica niño-adulto-pantalla*

### *Revue systématique sur l'utilisation des écrans numériques dans l'interaction triadique enfant-adulte-écran*

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#### **Abstract**

The presence of screens in everyday family and school life has had repercussions on the interactional and communicational processes that are part of the triadic relationship between children, adults and digital screens. In this sense, the Pragmatic Theory of the Object reinforces the importance of the adult in the cultural insertion of the object and in the understanding of its use in front of the child. Therefore, we sought to understand how development processes occur in childhood, based on this triadic interaction. A systematic review of the literature was carried out with articles indexed in the Scopus, Virtual Health Library and APAPsycNet databases, published between January 2017 and December 2022. Nineteen articles were found and, after reading these studies, three categories were established of analysis: (1) Quality of triadic interactions; (2) Parental Mediation; and (3) The impact of screens on child development. It was observed that adult

mediation in the use of digital screens by children impacts the quality of triadic interaction. Digital screens are part of children's culture and parental mediation regarding the appropriate use of technology is essential, which favors the positive impact on child development. The absence of mediation can favor the problematic use of the screen, evidenced mostly in the literature found.

**Keywords:** digital screens, child development, triadic interactions.

### **Resumo**

*A presença das telas no cotidiano familiar e escolar tem repercutido nos processos interacionais e comunicacionais integrantes da relação triádica entre crianças, adultos e telas digitais. Nesse sentido, a teoria pragmática do objeto reforça a importância do adulto na inserção cultural do objeto e na compreensão do seu uso frente à criança. Buscou-se, portanto, compreender como ocorrem os processos de desenvolvimento na infância, a partir dessa interação triádica. Realizou-se revisão sistemática da literatura com artigos indexados nas bases de dados Scopus, Biblioteca Virtual de Saúde e APAPsycNet, publicados entre janeiro de 2017 e dezembro de 2022. Encontrou-se 19 artigos e, após a leitura desses estudos, foram estabelecidas três categorias de análise: (1) Qualidade das interações triádicas; (2) Mediação parental; e (3) O impacto das telas no desenvolvimento infantil. Observou-se que a mediação do adulto no uso das telas digitais por crianças impacta a qualidade da interação triádica. As telas digitais são parte da cultura infantil e é fundamental a mediação parental quanto ao uso apropriado da tecnologia, o que favorece o impacto positivo no desenvolvimento infantil. A ausência da mediação pode favorecer o uso problemático da tela, evidenciado majoritariamente na literatura encontrada.*

**Palavras-chaves:** telas digitais, desenvolvimento infantil, interações triádicas.

### **Resumen**

*La presencia de las pantallas en la vida cotidiana familiar y escolar ha repercutido en los procesos interaccionales y comunicacionales que forman parte de la relación triádica entre niños, adultos y pantallas digitales. En este sentido, la Teoría Pragmática del Objeto refuerza la importancia del adulto en la inserción cultural del objeto y en la comprensión de su uso frente al niño. Por lo tanto, buscamos comprender cómo ocurren los procesos de desarrollo en la infancia, a partir de esta interacción triádica. Se realizó una revisión sistemática de la literatura con artículos indexados en las bases de datos Scopus, Biblioteca Virtual en Salud y APAPsycNet, publicados entre enero de 2017 y diciembre de 2022. Se encontraron diecinueve artículos y, luego de la lectura de estos estudios, se establecieron tres categorías de análisis: (1) Calidad de las interacciones triádicas; (2) Mediación de los padres; y (3) El impacto de las pantallas en el desarrollo infantil. Se observó que la mediación de los adultos en el uso de pantallas digitales por parte de los niños impacta la calidad de la interacción triádica. Las pantallas digitales forman parte de la cultura infantil y la mediación de los padres en cuanto al uso adecuado de la tecnología es fundamental, lo que favorece el impacto positivo en el desarrollo infantil. La ausencia de mediación puede favorecer el uso problemático de la pantalla, evidenciado mayoritariamente en la literatura encontrada.*

**Palabras clave:** pantallas digitales, desarrollo infantil, interacciones triádicas.

### **Resumé**

*La présence des écrans dans la vie quotidienne des familles et des écoles a impacté les processus interactionnels et communicationnels dans la relation triadique entre les enfants, les adultes et les écrans numériques. En ce sens, la théorie pragmatique de l'objet renforce l'importance de l'adulte dans l'insertion culturelle de l'objet et dans la compréhension de son utilisation face à l'enfant. Par conséquent, nous avons cherché à comprendre comment les processus de développement se manifestent chez l'enfant à partir de cette interaction triadique. Une revue systématique de la littérature a été menée avec des articles indexés dans les bases de données Scopus, Bibliothèque virtuelle de santé et APAPsycNet, publiés entre janvier 2017 et décembre 2022. Nous avons trouvé 19 articles et, après les avoir examinés, trois catégories d'analyse ont été établies : (1) la qualité des interactions triadiques ; (2) la médiation parentale ; et (3) l'impact des écrans sur le développement de l'enfant. Il a été observé que la médiation des adultes dans l'utilisation des écrans numériques par les enfants a un impact sur la qualité de l'interaction triadique. Les écrans numériques font partie de la culture des enfants, et la médiation parentale quant à leur utilisation appropriée est essentielle pour favoriser un impact positif sur le développement de l'enfant. L'absence de médiation peut favoriser une utilisation problématique des écrans, comme le souligne principalement la littérature retrouvée.*

**Mots-clés :** écrans numériques ; développement de l'enfant ; interactions triadiques.

The communication phenomenon involves interaction between people and/or groups, occurring in person or through the media, which implies attempts at rapprochement that may face challenges arising from the otherness of the participants, the complexity of the world and the communication processes themselves. Communication can be understood as a complex social interaction process that requires the participants (sender and receiver) to reach a consensus that involves a qualitative character (Braga et al., 2017).

With the rise of digital technology at the end of the 20th century, society began to interact in an expressive, dynamic way, with communication flows mediated by electronic devices connected to the internet, which contributed to the establishment of new terminologies such as cyberculture (Santos et al., 2021). The place of digital interaction thus comes to be called cyberspace, and children who are born with technology in their lives, *speaking* the digital language expressed on computers and in different internet environments, are defined as “digital natives” (Cruz, 2022; Prensky, 2001).

In view of this, the toys and games of contemporary generations have changed, and digital media has become an element of children’s culture, expressed in games on devices such as *video games* and *smartphones*. of children under seven years of age (Cotonhoto & Rossetti, 2016). In this new situation, the educational context was also affected by the need for innovation in teaching strategies and methods, through the combination of digital games and learning, which is called gamification. Therefore, the changes resulting from technological advances raise the need for additional research on the impact of devices and their content on child development (Campos et al., 2022).

The inclusion of new technologies in everyday life provides opportunities for significant changes in structural aspects of society, such as the relationship between education, teaching, and learning. This implies reconfigurations in the family and school education process and results in improved proactivity, cooperation, and child protagonism (Santos et al., 2021). In this scenario, the reality has provoked questions from parents, educators, and researchers. One of the results is the increase in research that addresses the relationship between games, childhood, and learning, with an emphasis on the area of education. However, research that seeks to analyze the implications of new technologies on child development is still in its infancy, with emphasis on the contributions in *developmental psychology* (Cotonhoto & Rossetti, 2016).

With the characterization of digital screens as objects of great relevance to culture and child development processes, the *pragmatic theory of the object* (TPO) has much to contribute. TPO is the result of the work of researcher Cíntia Rodríguez and her study group. She emphasizes that child development occurs through triadic interactions between the child, the object and the mediator, who can be another more experienced child or an adult. In the triad, objects are defined as any and all materials produced by humans to meet their needs. They can be a toy, a sheet of paper, a cup or a piece of clothing (Rodríguez & Moro, 1999).

From this perspective, development is understood as a sociocultural process, since it inserts the child into culture and teaches them about the use and function of the objects that surround them in everyday life. The adult, then, has a fundamental role in this process, since it is he who intentionally inserts the child into the cultural world, in a triadic relationship: child, adult and object. In this triad, objects configure not only the scenario of the communicative event, but are also powerful instruments of communication between people, especially during the first years of life (Rodríguez, 2022).

The triadic interactions between child, adult and object are the basic unit from which it is possible to understand the development of semiotic processes that occur in the socio-historical and cultural context. TPO is dedicated to understanding the responsiveness of the adult, when sharing his/her reality with the young child through semiotic elements such as rhythm, symbols, gestures, vocalizations and demonstrations. In this process, the adult intentionally shows the child functions and possible uses of the objects that make up this material reality. As these experiences deepen, the child develops his/her agency in the process and can also demonstrate his/her responsiveness to the other based on the semiotic elements present in the communicative chains in the dialogues established (Rodríguez, 2009).

Regarding adult mediation, it is worth noting that the educational role of the teacher differs from that of the parent, since school educational activities are intentionally planned for pedagogical purposes. Therefore, planned and consistent triadic interactions, in this context, can contribute significantly to the increasing insertion of children into a culture in which the teacher plays the role of partner and guide. Thus, triadic interactions carried out intentionally, whether in a family or school environment, contribute to qualitative leaps in the child development process (Gonçalves & Mietto, 2021).

In this context, as already described, the appropriation of objects by children is not a natural process or a result of mere exposure to objects. Since these, by themselves, do not express their functions and uses, responsive actions by adults are necessary in order to develop children’s agency in the face of the conventional use of objects, including digital screens. Given the current concerns of parents, teachers and researchers regarding children’s interaction with objects from children’s culture, such as digital screens, it becomes relevant to analyze how their use in contexts of triadic interactions can contribute to child development processes.

From this perspective, some relevant concerns in the field of this research and its application revolve around understanding the impacts that digital screens have on child development, in contexts of triadic interactions between child, adult and object. More specifically, it is about understanding important aspects of development promoted or affected by the interactions that

are established between the child, the adult and the world of digital screens. In view of this, it becomes necessary to ask: What are the impacts of the use of digital screens on child development, in contexts of triadic interactions?

## Method

This is a systematic review of the literature on the use of digital screens, given the triadic relationship between children, adults and screens. The use of this method makes it possible to explore the potential of searching for scientific evidence, in a numerous and organized way (Koller et al., 2014). The research was then prepared based on the items proposed by the Preferred Checklist Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). PRISMA seeks to assist researchers in qualifying review reports and facilitating critical analysis, although it is not an instrument for assessing the quality of the systematic review (Moher et al., 2015).

The research was carried out based on the following steps: (1) elaboration of the research question using the PICO strategy (which describes the participants, interventions, comparisons and results or outcomes to be investigated); (2) definition of descriptors in Portuguese, English and Spanish; (3) selection of databases; (4) definition of inclusion and exclusion criteria; (5) search and storage of results; (6) selection of articles by reading the abstracts; (7) full reading of the selected articles; (8) selection of the articles to be outlined; and (9) synthesis of the findings and interpretation of the results.

The descriptors were selected after formulating the research question and chosen through the Health Sciences Descriptors (DeCS), namely “criança”, “pais” and “adulto”, with their respective translations and alternative terms. The term “telas digitais” was not found in DeCS, however, it was included due to the research theme. Likewise, the term *mobile phone* was chosen, as it corresponds to the theme of the use of contemporary digital screens, which was selected in DeCS. The strategy also included the use of Boolean operators “OR” and “AND”.

The combinations were defined as follows: (“criança” OR “crianças” OR “child” OR “children” OR “niño”) AND (“telas digitais” OR “digital screens” OR “digital screen” OR “mobile phone” OR “cell phone” OR “pantallas digitales”) AND (“pais” OR “parents” OR “padres” OR “adultos” OR “adult”). The search was carried out in the Scopus, APA PsycNet and Biblioteca Virtual em Saúde (BVS) databases, accessed between November 2022 and January 2023. The databases were consulted remotely, through access to the CAFE Network, of the CAPES Journal Portal.

The Scopus database was chosen because it is multidisciplinary, with interdisciplinary subareas in the social and humanities areas, and indexed by journals. The BVS allows searches in the databases of the Latin American and Caribbean Center on Health Sciences Information, known as BIREME. Finally, the APA PsycNet was used because it is a database in the fields of psychology, education, psychiatry and social sciences (Koller et al., 2014).

The inclusion criteria for the research were defined as the selection of academic articles written in Portuguese, English, and Spanish; published between January 2017 and December 2022; with full texts available and that emphasize child development processes related to triadic interactions between children, adults, and digital screens. The choice of this time range is justified by the recent interest in research involving the understanding of child development in contexts of triadic interaction. Additionally, there has been a significant increase in research involving digital media and child development processes that emerged due to the pandemic caused by Covid-19, which began in 2019. In this sense, it is relevant to analyze the research carried out in the period before the pandemic (2017 and 2018) and during the pandemic (2019, 2020, 2021, 2022), to better understand how child development researchers discuss and what they point out about the topic of this research. The exclusion criteria established were articles that: were written in other languages; presented only the child-screen and adult-screen dyads, without triadic interactions; exclusively pointed to relationships with adolescents; and did not focus on child development processes in school and family contexts, based on the triadic relationship.

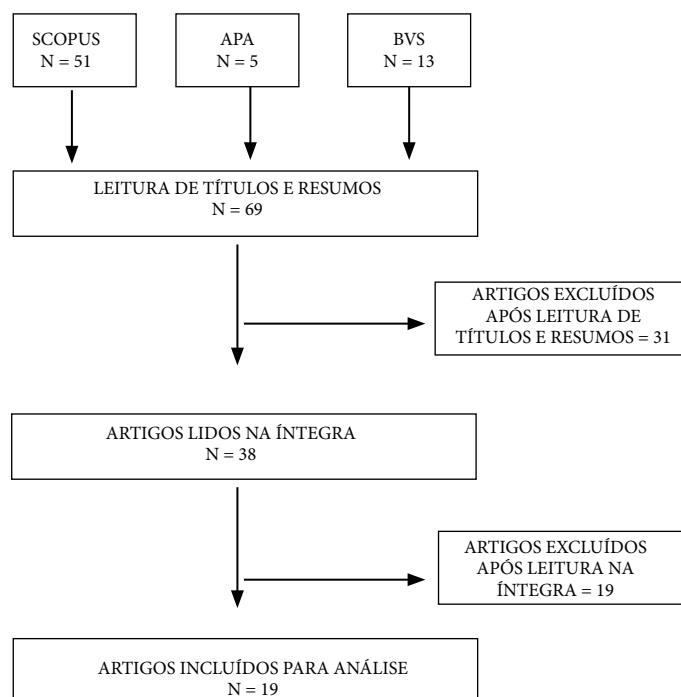
The articles included were analyzed and, based on the full and interpretative reading, indexed. The information found in them was organized in a table to explore the material and summarize for the treatment of the results. For the analysis of the documents, the following information was prioritized: research methodologies, relevant concepts or theories that addressed the triadic relationship between children, adults and digital screens; main results; and conclusions with an emphasis on the child development processes reported from these triadic interactions. The findings were categorized and three thematic units were identified from the content analysis (Bardin, 1977): 1. Quality of triadic interactions; 2. Parental mediation; 3. Impact of screens on child development.

## Results and discussion

A total of 69 articles were found in the selected databases, 5 in APAPsycnet, 13 in BVS and 51 in Scopus. After reading the titles and abstracts, 38 articles remained for full reading, of which 19 were selected, as shown in Figure 1.

**Figure 1**

Flow of collection and selection of articles in databases.



It is observed that, between 2017 and 2022, the highest concentration of research was in the years 2022 and 2021, respectively. This growing interest highlights the concern in investigating changes related to internet use before and during the Covid-19 outbreak, including prolonged and problematic use of *smartphones* to access social media and games. According to research by Chen et al. (2021), H. Sun et al. (2022) and Vaidyanathan et al. (2021), there was a significant increase in screen time among young children, with the definition of excessive time based on the recommendations of the American Academy of Pediatrics and the World Health Organization (WHO).

The results indicate that screen exposure, especially to cell phones, was higher than recommended. This practice is related to the need for social isolation due to the pandemic, parents' work, and children's school activities, which are carried out at home. This increased parental stress and the family's lack of availability for interaction, justifying the increase in screen time for children (Moyer, 2022).

Regarding the languages of the selected studies, English predominates, with only one article in Spanish. During the article selection phase, the research did not find any works by Brazilian researchers, not even in English. This corroborates what was pointed out by Santos et al. (2022), who state that the theme of the relationship between children and their guardians involving screens is still little explored in Brazil, in terms of scientific publications. The only research selected by authors from Latin America in this review highlights that the theme is little explored in the region.

As described in Table 1, there is a prevalence of research in the United States of America and China. Thus, according to the findings of Tang et al. (2022) and Xu et al. (2022), it is noteworthy that, in recent decades, there has been a concern on the part of researchers in Western countries in investigating digital screens and their effects on children's mental health. This is especially true in the United States of America, given the technological insertion in children's daily lives. However, although most research still focuses on Western countries, there is a growing concern among Chinese researchers in investigating the emerging virtualization in rural areas. In this context, research involving the issue of *left-behind children* stands out, that is, children living in rural areas in China who are left by their parents in the care of other relatives. This practice arises from the need for these parents to migrate to urban areas in search of better working conditions, consequently resulting in the need for *smartphones* for children to communicate with their parents.

**Table 1**

*Demonstration table with title, country, authors and year*

<b>Title</b>	<b>Country</b>	<b>Author(s)</b>	<b>Year</b>
Manuscript: You have a message from Illi! The mobile diary in researching children’s daily experiences	Finland	Rönkä, A., Sevón, E., Räikkönen, E., & Hintikka, T.	2017
Digital disruption? Maternal mobile device use is related to infant social-emotional functioning	United States of America	Myruski, S., Gulyayeva, O., Birk, S., Pérez-Edgar, K., Buss, K.A., & Dennis Tiwary, T.A.	2018
Maternal mental representations of the child and mobile phone use during parent-child mealtimes	United States of America	Radesky, J., Leung, C., Appugliese, D., Miller, A.L., Lumeng, J.C., & Rosenblum, K.L.	2018
Digital screen time limits and young children’s psychological well-being: Evidence from a population-based study	India	Przybylski, AK & Weinstein, N.	2019
Maternal digital media use during infant feeding and the quality of feeding interactions	United States of America	Ventura, A.K., Levy, J., & Sheeper, S.	2019
Are parents less responsive to young children when they are on their phones? A systematic naturalistic observation study	Netherlands and Norway	Abeele, M.V., Abels, M., & Hendrickson, A.T.	2020
Exploring the reliability and validity of the TechU -Q to evaluate device and purpose specific screen use in preschool children and parents	Australia and United States of America	Howie, E.K., McNally, S., & Straker, L.M.	2020
Problematic phone use, depression, and technology interference among mothers	United States of America	Newsham, G., Drouin, M., & McDaniel, B.T.	2020
Do young children of the “selfie generation” understand digital photos as representations?	United States of America	Johnson, C.R., Flores, I., & Troseth, G.L.	2021
Parental mediations and internet use by Colombian children and adolescents	Colombia	Moreno-Carmona, ND, Marín-Cortés, A., Cano-Bedoya, VH, Sanabria-González, JA, Jaramillo-Suarez, Á. M., & Ossa-Ossa, JC	2021
Problematic internet-related behaviors mediate the associations between levels of internet engagement and distress among schoolchildren during COVID-19 lockdown: A longitudinal structural equation modeling study	China	Chen, IH, Chen, CY, Pakpour, AH, Griffiths, MD, Lin, CY, Li, XD, & Tsang, HW	2021
Quality of mother-child interaction before, during, and after smartphone use	United States of America and Germany	Konrad, C., Hillmann, M., Rispler, J., Niehaus, L., Neuhoff, L., & Barr, R.	2021
Screen time exposure in preschool children with ADHD: A cross-sectional exploratory study from South India	India	Vaidyanathan, S., Manohar, H., Chandrasekaran, V., & Kandasamy, P.	2021
Are mobile phone ownership and age of acquisition associated with child adjustment? A 5-year prospective study among low-income Latinx children	United States of America	Sun, X., Haydel, K.F., Matheson, D., Desai, M., & Robinson, T.N.	2022
Personal cell phones among children: Parental perception of content-related threats and attempts to control them in a Lithuanian sample	Lithuania	Austys, D., Sprudzanaitė, A., & Stukas, R.	2022
Problem mechanism and solution strategy of rural children’s community inclusion—The role of peer environment and parental community participation	China	Xu, Y., Wang, L., Yang, W., Cai, Y., Gao, W., Tao, T., & Fan, C.	2022
The bright side of digitization: Assessing the impact of mobile phone domestication on left-behind children in China’s rural migrant families	China	Tang, J., Wang, K., & Luo, Y.	2022
The development of a parental questionnaire (QQ-MediaSEED ) on bilingual children’s quantity and quality of digital media use at home	Singapore	Sun, H., Lim, V., Low, J., & Kee, S.	2022
What’s in a distraction? The effect of parental cell phone use on parents’ and children’s question-asking	United States of America	Gaudreau, C., Hirsh-Pasek, K., & Golinkoff, R.M.	2022

Another correlation identified regarding the prevalence of studies refers to the United States, China, and India not only as populous countries, but also as the three largest *smartphone markets* in the world (Newzoo, 2022). In addition, the United States and China have a complex relationship of cooperation and rivalry in the technological field (Jiménez et al., 2022). This can directly influence the academic production of these countries and the consequent volume in the findings of the present research.

Regarding the methods shown in Table 2, the variety of methodological strategies can be seen, which can be a strong indicator of the interdisciplinary nature of the area. Added to this is the prevalence of empirical approaches, with emphasis on observational studies and the use of interviews, reinforcing the authors' concern in addressing everyday issues, expressed in the way individuals relate to each other. Such issues correlate with triadic relationships and TPO. Both the use of interviews and observation precede the analysis of verbal expressions, attitudes, relationships and contexts, procedures used in the analysis of triadic relationships in school and family contexts, in expressions of parental mediation and in influences linked to child development (Minayo & Costa, 2018).

**Table 2**

*Demonstration chart with methods, child development processes and triadic interactions.*

Methods used	Researched child development processes and theoretical assumptions	Triadic interactions (adult, child and digital screens)
Ethnographic approach	Communication processes/affective expression; expanding communication skills and playful-affective experiences; domestication theory.	Interaction: adults (parents, with emphasis on the social role of the mother), children and cell phone.
Focus groups	Improved fine motor, linguistic and cognitive skills; increased playful and emotional experiences with family or friends.	Children, digital screens ( <i>smartphones</i> and <i>tablets</i> ) and caregivers (parents mediating use).
Questionnaire on threats associated with the use of personal mobile phones among children and parental control measures	Contact with <i>cyberbullying</i> , <i>sexting</i> , commercial exploitation or collection of personal data without informed consent.	Children, cell phones and parents (mediators of use).
Semi-structured interviews	Virtualization weakens the village's sense of identity, community belonging and collective memory; childhood ecology and developmental niche theory.	Children, adults (parents – with emphasis on the social role of the mother and community members) and cell phone.
Longitudinal study	Slower recovery from depressive symptoms and affectation of sleep time; neoecological theory.	Children, cell phones and parents (facilitators of acquisition and mediators of duration and frequency of use).
Systematic observation	Promotes children's understanding of pictorial images as representations of real events through active adult mediation; 1990 theory – young children's pictorial experience and " <i>selfie generation</i> ".	Children, parents (mediators of use) and <i>smartphones</i> .
Systematic observation	Technoference affects mother/baby interaction, harming language development and emotional exchanges; still face paradigm and technoference.	Mothers, babies (20 to 22 months) and <i>smartphones</i> .
Structured interview	Children with attention deficit hyperactivity disorder (ADHD) when exposed to excessive screens, have problems with linguistic-cognitive development and sleep.	Children, screens (television, cell phones, <i>tablets</i> and <i>notebooks</i> ) and parents (mediators of screen time).
Longitudinal study	internet use among schoolchildren was associated with greater psychological distress; person-affect-cognition-execution interaction (I-PACE) model.	Children, screens ( <i>smartphone</i> , social media and games) and adults (parents mediating use and teachers co-participating in the research).
Correlational study through the application of questionnaires	Psychological well-being, academic performance and cognitive development of children: executive functions, working memory, cognitive flexibility and behavioral inhibition. As well as the development of social skills such as empathy.	Parental mediation regarding children's use of mobile devices: <i>smartphones</i> and <i>tablets</i> .
Questionnaire	<i>Tablet</i> use can have physical effects on young children's activity and posture; it has also been linked to sleep disturbances in preschoolers. Parents and educators see both positive and negative aspects of using the devices.	Adults directing and monitoring children's use of different types of devices: TV, <i>smartphone</i> , <i>tablet</i> and <i>video game</i> .

Observation	Strengthens the emotional bond between parents and children.	Parents, children and phones.
Observation	During breastfeeding, the use of digital media can serve as an external source for the development of emotional self-regulation.	Use of digital media ( <i>iPad</i> ) during breastfeeding.
Interview	Well-being	Parents, child, screen.
Still Face Paradigm (SFP)	Emotional self-regulation.	Mom, baby, <i>iPod touch</i> .
Longitudinal study and interview	It negatively impacts the development of autonomy, language, speech and emotional exchanges between parents and children.	Mother, children and digital media (TV and mobile devices).
Observation and questionnaire of language skills – QUILS (Quick Interactive Language Screener)	It harms communication and speech development and interactions between parents and children.	Adults, children and cell phones (as a distraction for parents).
Application of the Technology Interference in Parenting Scale (TIPS) with modifications	Interference of technology at mealtime with problematic use of cell phones; interference of maternal psychopathology; technological interference in raising children; technofeference.	Mothers, children and screens (interference of technology in meals and play).
Observational study	It positively impacts the development of language, speech and emotional exchanges between children and their families when they use it together or discuss its use.	Interaction through the app in which children and adults responded about the child's mood.

The child development processes and theoretical assumptions reported in the articles, in accordance with Table 2, present a greater prevalence of those that address *neoecological theory* (H. Sun et al., 2022), *technofeference* (Konrad et al., 2021; Newsham et al., 2020), the *domestication theory* (Tang et al., 2022) and the *person-affect-cognition-execution-I-PACE interaction model* (Chen et al., 2021). When Navarro and Tudge (2022) refer to the neoecological theory, they start with the new concept that addresses child development with the influence of technology present in the microsystem, now virtual, in a situation that does not occur individually: there is a complex, bidirectional and non-individual system. The authors highlight how the Covid-19 pandemic changed the functioning of society with the insertion of activities in a virtual format. When correlated to the TPO, it is clear how much the presence of screens in the child's microsystem demands the adult's directional action, evidencing the complexity of the triadic interaction in the use of screens (Rodríguez, 2009).

From the understanding of technology in the child's microsystem, technofeference (McDaniel & Radesky, 2018) is one of the theoretical assumptions that point to interference with potential risk to childhood. This can also be found in the *still face paradigm*, which deals with the repeated disconnections between social partners that resemble a classic still face mentioned in the studies by Konrad et al. (2021) and Newsham et al. (2020). Other theoretical assumptions were also found, such as the *domestication theory*, indicated by Tang et al. (2022) and defined as the adoption of new technologies in the social process as if it were a member of the family, that is, the screen as a device becomes another constituent element of the family, while the *ecology of childhood* (Przybylski & Weinstein, 2019) suggests that socio-environmental factors are the main determinants of children's well-being and psychosocial outcomes. The problematic use of screens was identified based on the person-affect-cognition-execution-I-PACE interaction model, which postulates that past psychological distress can induce problematic use of internet-related activities and, subsequently, result in excessive screen use as pointed out by Chen et al. (2021). Considering the findings related to child development processes, from content analysis (Bardin, 1977), three categorical units were identified: 1. Quality of triadic interactions; 2. Parental mediation; and 3. Impact of screens on child development.

### Quality of triadic interactions

Regarding the characteristics of the triadic interactions identified in the selected documents, as shown in Table 2, it is possible to highlight: the relevance of the *cell phone* as an object of interaction, compared to television, *notebook*, *tablet*, *video game* and *iPod*. In relation to the mediating adult, the relevance of the family context is noted, compared to the school context. The highlight is the maternal figure, when the person responsible is identified.

The studies by Chen et al. (2021), Konrad et al. (2021), Tang et al. (2022) and Vaidyanathan et al. (2021) indicate, as shown in Table 2, that the use of digital screens can interrupt typical interactions between parents and children. On the other hand, it can also favor affective exchanges and strengthen bonds and dialogues, which highlights the dependence on adult mediation and the quality of interactions that are established using these screens and corroborates the TPO (Rodríguez, 2022). It is also worth highlighting the need for parents to limit their own use of screens to instigate this behavior in their children. This fact refers to the importance of adult mediation regarding the use and function of objects (in this context, the *smartphone*), with the need to reflect on the object as an instrument of communication between people, especially in early childhood (Rodríguez, 2022).

Technofence has been highlighted in several studies and is a new finding in terms of theoretical perspectives, as previously mentioned. It concerns the interruptions that occur due to the use of mobile devices, whether in activities that involve the use of screens or not. This interference has resulted in a decrease in the quality of interactions between children and adults, as demonstrated by Konrad et al. (2021) and Newsham et al. (2020), when they reveal that the association of maternal depression with problematic cell phone use is reflected in child rearing. Another study carried out by McDaniel and Radesky (2018) corroborates these results, pointing out the maternal relationship and children's externalizing and internalizing behaviors affected by screen use.

It is worth noting that this review did not seek to understand issues related to gender, but rather the interaction processes related to parents, which corresponded to technofence. In this sense, the adult, according to TPO (Rodríguez, 2009), needs to be responsive when exercising the role of mediator in triadic interaction, regardless of gender. This highlights an important gap in the present study and the need for further research with this focus, including when related to maternal psychological distress.

The quality of triadic interactions was also observed in a school context in a study by Rönkä et al. (2017), with the participation of teachers in the evaluation of children's daily lives in the educational environment, using a mobile diary application on their cell phones. The results showed that children were able to mention daily fatigue, which was confirmed by family members and guardians in the educational context. It is important to emphasize that the study was published in 2017, before the COVID-19 pandemic. At the time, school demands were still entirely in-person. With the pandemic, activities began to be developed at home, which explains the presence of more studies in the family context.

### Parental mediation

The results in Tables 1 and 2 point to an emphasis on issues related to the family context, compared to the school context, highlighting the mediating role of responsible adults regarding the use of digital screens by children. Among the authors Austys et al. (2022), Chen et al. (2021), Howie et al. (2020), Johnson et al. (2021), Moreno-Carmona et al. (2021), H. Sun et al. (2022), X. Sun et al. (2022), Tang et al. (2022) and Vaidyanathan et al. (2021), the prevailing understanding is that digital screens are part of children's daily lives. This corroborates the ideas of Cotonhoto and Rossetti (2016) and Cruz (2022).

There is a consensus among authors that, instead of the prohibitionist perspective, the best path is that of parental mediation, according to Rodríguez (2009). This can contribute to the appropriate use of the Internet and social networks by children, and parental mediation includes: making agreements and monitoring the child's routine in terms of duration (daily time); intensity of use (weekly frequency); type of content; communication contacts; acquisition of the mobile device; choosing specific times to use it together; and privacy permissions.

The use of information and communication technologies (ICTs) is considered an ally in the possibility of using methods to observe children's development. The use of the mobile diary carried out in the research by Rönkä et al. (2017) made this observation possible, although aspects of negative moments and episodes may not have appeared due to the children's unwillingness to report them, at times, or due to fear of responding to the application in the presence of adults. The playful format proposed in the application favored the children's adherence, which enabled the triadic child-adult-screen relationship, according to reports that the children made in their daily lives, whether they used the screen. The use of the application on the cell phone was accepted, easy and practical for the children, promoting engagement in responding to the character in the application and telling the adults about this character, while families gathered to listen to the messages of the character called "Illi". The results showed that it was easy to integrate this mobile diary method into everyday life, even with parents' irregular working hours; it is possible to maintain mediation, even when children use it alone.

### The impact of screens on child development

The findings in Table 2 show that screen use by children can be beneficial or harmful, and even maintain both qualifiers simultaneously. From a positive point of view, Chen et al. (2021), Konrad et al. (2021), X. Sun et al. (2022), Tang et al. (2022) and Vaidyanathan et al. (2021) are unanimous in stating that digital screens can favor the performance of activities such as family supervision, emotional care and playful interactions. It can, therefore, expand linguistic, cognitive, socio-emotional and motor skills, as well as provide children with access to social support, with opportunities to develop agency, autonomy and protagonism in academic performance. In the case of *left-behind children*, the use of *smartphones* has become essential for Chinese migrant mothers from rural areas to keep track of their distant children. Such reflections are ratified by Campos et al. (2022) by highlighting that technology enhances school education and promotes the development of skills that improve academic performance.

Regarding negative factors, Austys et al. (2022), Chen et al. (2021), Konrad et al. (2021), H. Sun et al. (2022), Vaidyanathan et al. (2021) and Xu et al. (2022) agree in stating that the lack of parental supervision can favor problematic

cell phone use. Such use involves receiving threatening messages from strangers; *cyberbullying*; *sexting*; commercial exploitation or collection of personal data without informed consent. In addition, it can weaken the sense of identity, community belonging and collective memory, as well as negatively impact sleep, generate depressive symptoms and impair linguistic, cognitive and socio-emotional development. Although, as shown in Table 2, researchers X. Sun et al. (2022) and Xu et al. (2022) point out theoretical assumptions that start from a systemic perspective on human development, such as *childhood ecology*, *developmental niche theory* and *neoecological theory*, the empirical data from their research point to a mostly pessimistic perspective on the influence of digital screens on child development.

Regarding the simultaneity of positive and negative aspects, Rönkä et al. (2017) point out that the benefits arise from interaction, communication and family participation in the use of mobile devices as diaries. The negative relationship occurs when children do not feel comfortable reporting negative feelings, which can result in embarrassment and poor recording of these feelings.

### Final Considerations

The COVID-19 pandemic has intensified research on children's exposure to digital technology. Nowadays, digital screens are part of children's culture, and prohibitionist measures are not appropriate. This makes parental mediation essential so that children make appropriate use of screens, which in turn has a positive impact on children's learning and development. The influence that digital screens have on children, in contexts of triadic interactions, is due to the quality of mediation by adults, whether in the context of family, school or even scientific research. The problem is not children's interactions with digital screens. However, the occurrence of these interactions outside the triadic context in which the adult plays a responsive role, that is, as a guide, advisor and part of the entire process.

The prevalence of empirical approaches is observed, with emphasis on observational studies and the use of interviews, contemplating the expression of triadic relationships in family and school contexts. In the case of this study, although it presented several important findings on the influence of digital screens on child development, it is necessary to consider that these studies are mostly by foreign authors and that, for the most part, they portray interactions in the family environment. It is worth highlighting the scarcity of Brazilian researchers investigating this topic with scientific articles indexed in the chosen databases. In this sense, there is only one study in Latin America, which demonstrates the need to fill the gap in research carried out in the Brazilian context. Another point is related to the context of the Covid-19 pandemic, in which school demand was carried out at home and mediated by digital technologies, which allows for expansion in future research on the role of digital screens in the school context.

Furthermore, few studies have shown a balanced perspective, simultaneously pointing out positive and negative effects of the use of digital screens on child development. It is therefore suggested that future research address how the management of digital screens can help responsible family members, children and the school community to enjoy these objects. It is also suggested that we broaden our understanding of the impact of digital screens on adult human development, since these individuals also need to be guided regarding the problematic use of these objects. It also points out an important gap in the present study regarding gender issues and the need for further research with this focus, including when related to maternal psychological distress. Another point worthy of note is the importance of making cuts in social segments, since in Brazil, many children enrolled in public schools use their parents' *smartphones* when they get home from work in the evening. So, how can we expect parents to carefully manage their screens if they arrive home tired and if, often, they may not have been properly instructed on how to do so?

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