

Association between electronic media use, development milestones and language in infants

Asociación entre el uso de medios electrónicos, hitos del desarrollo y lenguaje en infantes

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Se agradece a la Universidad Abierta Interamericana (UAI), Universidad de Buenos Aires (UBA), y al Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) por haber subsidiado este trabajo.

Universidad Abierta Interamericana (UAI), Universidad de Buenos Aires (UBA),
Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)
Buenos Aires, Argentina

Resumen

En los últimos años, el uso de medios electrónicos ha aumentado en la infancia temprana debido al creciente acceso a las pantallas y a la situación de aislamiento ocasionado por la pandemia de COVID-19. Por otro lado, durante la primera infancia, las habilidades de lenguaje y motrices son fundamentales para el desarrollo de otras habilidades cognitivas,

y se asocian con el rendimiento académico y habilidades sociales posteriores durante la niñez y adolescencia. Por ende, se vuelve fundamental estudiar cómo el contexto de estimulación en el hogar, específicamente el uso de pantallas, se asocia con estas habilidades importantes en los primeros años de vida. Si bien existen investigaciones sobre las asociaciones del uso de pantallas con habilidades cognitivas tempranas, son escasas las

que indagan este fenómeno en el ámbito latinoamericano, y nulas las que lo realizaron en el actual contexto de pandemia. El objetivo de esta investigación fue describir el uso de medios electrónicos (*i. e.*, TV, teléfono celular y *tablet*) y su asociación con el lenguaje y los hitos del desarrollo en los primeros años de vida. Los participantes fueron 253 cuidadores primarios de infantes de Latinoamérica (68.8 % de Argentina, y 31.2 % de otros países de la región) con edades entre 2 y 48 meses ($M = 30.17$ meses, $SD = 10.82$, femenino = 124), reclutados vía web a través de muestreo no probabilístico de tipo intencional y por bola de nieve. Se utilizaron los reportes de los padres sobre el uso de medios electrónicos (*i. e.*, tiempo de uso, edad de inicio y tipo de contenido), los hitos del desarrollo motor y del lenguaje, el Inventario de Desarrollo de Habilidades Comunicativas (CDI) (*i. e.*, densidad léxica y uso de oraciones) y la Encuesta Permanente de Hogares (EPH) para evaluar las variables sociodemográficas. Los resultados mostraron que, en promedio, los infantes comenzaron a usar pantallas durante el primer año de vida en un promedio de una hora por día, con la televisión como el medio más utilizado y la visualización de videos la actividad que más realizaban. El número de horas de uso de dispositivos se asoció positivamente con la densidad léxica y el uso de oraciones: a más horas de uso, mayor cantidad de palabras y oraciones reportadas. Además, cuanto más tardía era la edad de inicio de uso de dispositivos, más bajas eran las puntuaciones en los informes lingüísticos e hitos posteriores del desarrollo motor y del lenguaje. Los tamaños del efecto para estas asociaciones fueron de bajos a moderados, lo que indica que otras variables podrían estar contribuyendo al desarrollo de estas habilidades cognitivas. No se encontraron diferencias en las capacidades motrices y del lenguaje en función del tipo de contenido del dispositivo. Tampoco se observaron diferencias en el uso de pantallas en función del género de los infantes, la edad y las variables sociodemográ-

ficas, lo que podría indicar, tal como demostraron investigaciones anteriores, que durante el aislamiento por COVID-19 el uso de los medios electrónicos fue constante, independientemente del contexto del hogar. Los resultados indican que el uso excesivo de pantallas podría afectar, tanto de forma positiva como negativa, algunas habilidades tempranas, aunque es necesario investigar el contexto en el que se utilizan. Específicamente, para futuras investigaciones sería importante: (a) trabajar con diadas de cuidadores-infantes, para evaluar cómo los comportamientos parentales moderan las asociaciones entre uso de pantallas y cognición infantil; (b) realizar estudios longitudinales; y (c) evaluar estas variables en diferentes provincias del país y regiones de Latinoamérica, para estudiar cómo las idiosincrasias culturales modulan el uso de estos dispositivos.

Palabras clave: medios electrónicos, hitos del desarrollo, lenguaje, cuidadores, infantes

Abstract

The use of electronic media has increased in early childhood. During early childhood, language and motor skills are important for the development of other cognitive skills. Therefore, it becomes essential to study how the use of screens is associated with these important skills in the first years of life. The objective of the following research was to describe the use of electronic media (*i. e.*, TV, cellphone and tablet) and its association with language and developmental milestones in the first years of life. Participants were 253 primary caregivers of infants between 2 to 48 months ($M = 30.17$ months, $SD = 10.82$, female = 124). Parental reports of infant media use, motor and language development milestones, the MacArthur-Bates Communicative Development Inventory (CDI) and the Permanent Household Survey (EPH) for sociodemographic variables were used. The results showed that, on average, infants began to use screens during the first year of life at

an average of one hour per day with TV as the most used medium and video viewing as the activity they did the most. The number of hours of devices usage was positively associated with lexical density and sentence use. Furthermore, starting device use at a later age was associated with lower scores in language reports and later milestones of motor and language development. No differences were found based on the type of device content and sociodemographic variables. Results indicate that the excessive use of screens could affect some early skills, although it is necessary to investigate the context in which they are used. *Keywords:* electronic media, development milestones, language, caregivers, infants

Introduction

From the first years of life, development is modulated by a variable environment indirect to the infant's life (*e. g.*, culture, access to education, public policies), within an immediate context (*e. g.*, stimulation at home, parental styles). During development, these different levels of analysis are interrelated (Bronfenbrenner, 1986; Vygotsky, 1929) and contribute to differences in infant's cognitive development from the first years of life (Gago Galvagno et al., 2019, 2020a, 2020b; Luo et al., 2019; Tamis-LeMonda et al., 2019) suggesting these factors are a very important issue to consider when promoting public policies that favor ontogenetic development (Yoshikawa et al., 2018). The purpose of this study is to examine how a particular element of the immediate context related to stimulation at home—electronic media use—relates to cognitive development in developmental milestones in language, motor skills and sociodemographic during the first 4 years of life.

Language and motor skills during the first years

Developmental milestones in early childhood refer to foundational acquisitions. These

are explained as the progress of each infant in different areas and describe observable behaviors in the daily life of a child (Pauen, 2012). During development, the acquisition of the different milestones is not carried out in a rigid way. On the contrary, there is a wide variation in the time that each new skill is achieved that is impacted by the genetic and the social environment (Arteaga et al., 2017; Bedford et al., 2016).

Meeting each developmental milestone enables children to perform progressively more complex and sequential activities. The early acquisition of both motor and language developmental milestones are essential, since they are associated with greater achievements in early cognitive skills and later academic performance, and their delay could be related to the presence of developmental disorders (Arnett et al., 2020; Murray et al., 2007; Taanila et al., 2005). Early motor milestones are typically focused on gross and fine motor development; gross motor development is comprised of the control of the head, torso, legs, and movement, including balance, jumping, throwing and catching. Fine motor development is comprised of hand-body coordination, and holding and manipulating objects.

Regarding language, verbal communication can be one of the most important developmental milestones for parents, with children's first word usually spoken at the end of the first year of life. Babies usually start by saying single words, then two-word sentences, and later three-word sentences, until finally they can form more complex sentences (Cohen & Billard, 2018; Lahrouchi & Kern, 2018). Children acquire around five words daily. Around two years of age, the linguistic explosion takes place, in which children pronounce around fifty words, though there is variation in the time and extent of this explosion (Bates & Carnevale, 1993; Hirsh-Pasek et al., 2015).

Several researchers have dedicated themselves to identifying the content of babies' first words and the mechanisms by which they

are acquired. For example, the first words of babies are typically nouns with some arguing that early noun learning, compared to verbs, is a universal feature of human language (Hirsh-Pasek et al., 2015). The vocabulary and acquisition of grammar rules increases continuously after the third year (Navarro et al., 2017). Syntactic development refers to the rules of language, organization of words, formation of ideas, meaningful sentences and understanding of what is said. Further development in syntax (*i. e.*, related to grammatical rules), semantic meaning, and pragmatic understanding continue to develop across early childhood and is thought to emerge and develop within the interactive communicative context between children and their environment—especially tied to communication with adults (Gonzales, 2014; Tomasello, 2000).

Use of screens and associations with language and motor skills

Electronic media has become an ever-present element within children's indirect and immediate environments. The Argentinean Association of Pediatrics said in 2011 that 90 % of parents reported their children were using some form of touchscreen and have their own device by the age 3. One third of infants use electronic media before they even start walking (Melamuda & Waisman, 2019). During the COVID-19 quarantine, the use of screens in Argentina grew by more than 50 % for both adults, infants and children (Sociedad Argentina de Pediatría, 2020; Picco et al., 2020) and the American Academy of Pediatrics (2020) stopped advising against its use with infants under two years of age to focus more on factors involving the child, context and content.

In a descriptive parent-report study in children aged 6 to 36 months old, 69.2 % of parents allowed infants to use screens. The mean age of first use was 11 months and 72.2 % of infants and children used touchscreen devices 2-3 times a week or more. Consump-

tion time increased with age and male infants used more screen games than females. The most common reasons parents cited for touchscreen use in infants were to learn (73.9 %) and entertain (66.3 %). Finally, parents had a positive attitude towards the use of these devices for educational purposes at an early age (Pempek & McDaniel, 2016). Thus, this research found that most parents and caregivers do not comply with the recommendations of national and international health organizations (American Academy of Pediatrics, 2020), although it is important to note that screen use is not consistent across all families. For instance, less recreational screen consumption is associated with higher levels of mother education, likely also related to facilitating or promoting certain family and environmental dynamics (Melamuda & Waisman, 2019; Stienwandt et al., 2020). However, it is important to note more work and consideration of other factors and context is needed, as other studies show conflicting results suggesting parents with a higher education had children engage in more screen time during quarantine due to COVID-19 (Aguilar-Farias et al., 2021; Jauregui et al., 2021).

There have also been a number of studies examining the links between screen time use and milestones in language and motor development, and results are equivocal. With respect to language there has been some work showing negative associations with screen use. Zimmerman et al. (2007) evaluated a total of 1 008 parents of toddlers between 2 to 24 months, who were surveyed by telephone. They were asked questions about child and parent demographics, parent-child interactions, and viewing of various types of TV and DVD/video content. Parents were also asked to complete the MacArthur-Bates Communicative Development Inventory (CDI). Results indicated that in children 8 to 16 months of age, each hour per day of DVD/video viewing was associated with a 16.99-point decrease in CDI score. However, among children 17 to 24 months, there were no associations between

any exposure to media and CDI scores.

Other work has shown null or even suggest positive associations between language and motor milestones and screen use. In a study that examined association between the use of tablets and the achievement of motor milestones and linguistic development of children between 6 and 36 months it was observed that the number of users of touchscreens, as well as the time of use, increased with infants' age. Between 6 and 12 months, infants' use was approximately 9 minutes per day and toddlers between 2 and 3 years of age used approximately 44 minutes per day. Although this study showed that the use of touchscreens increases rapidly during the first 3 years of life (Cristia & Seidl, 2015), no associations were found between the use of touchscreens and gross motor and language milestones, though there was a negative association between the age of initiation of use of the first device (specifically screen scrolling), and achievements in fine motor skills (Bedford et al., 2016). In another study with a sample of infants from Chile, no associations were found between the amount of time spent on technological screens and receptive and expressive language scores during the first three years of life (Alarcón et al., 2018). Research has even suggested a positive association between screen use and language and motor development. For instance, Terras & Ramsay (2016) suggest that, at an early age, touchscreens allow children to explore and get in touch with various content, even before saying their first words. It was observed that children who had not yet developed their motor skills and were not able to turn on a TV or choose which programs to watch, used mobile devices to watch videos, interactive games and other entertainment (Terras & Ramsay, 2016).

Currently, the use of touch devices in childhood faces a dilemma. On the one hand, the promotion of digital technology in children has evidence that its use prepares them for the future, and this is reinforced in times of the pandemic (Aguilar-Farias et al., 2021;

Ramsay, 2016). On the other hand, pediatric organizations advocate the minimal use of mobile devices by young children as a result of concerns about the effects on physical, cognitive, emotional, social, well-being, and developmental health (Desmurget & Harlé, 2012). The data provided shows that society has been incorporating touchscreens in its daily life, and this does not exclude children and newborns. However, the Argentine Association of Psychiatry (AAP) has recommended that children under 2 years of age do not use this type of devices. This is because the possibility of receiving commercial advertising or exposure to violent or pornographic content. By participating in the networks without any type of supervision, they can provide inappropriate information, be subjected to grooming or harassment and, in turn, can be actors of these same actions (Melamuda & Waismanb, 2019).

Present study

There is a clear need for better evidence to support psychologists and educators in the role and use of screens during early childhood. This research is important at a theoretical, practical, and social level and can lead to a better understanding of how electronic media, so present in the daily lives of most children today, relates to development. The objectives of the following research were to: (a) describe the age of initiation of the electronic media and the hours of daily use by infants from 2 to 48 months; (b) study the relationship between the age of initiation, the time of use of screens and the acquisition of the motor and language milestones; (c) associate electronic media use and sociodemographic variables. A presence of use of screens early in this age range that increased with age, a negative correlation between time of use of touchscreens with language measures (*i. e.*, lexical density and use of sentences) and acquisition of developmental milestones, and greater amount of screen use time and earlier initiation in fami-

lies with a lower educational level and with less independent types of occupations were expected. However, given the mixed results it was also possible that this research would not find relations, and this was meant to provide more data in this area.

Method

Participants

The participants in this study were 310 primary caregivers; 56 were excluded because their infants were older than 48 months. The final sample consisted of 253 primary caregivers of children from 2 to 48 months ($M = 30.17$ months, $SD = 10.82$, female = 124), contacted via social media.

The type of sampling was non-probabilistic, intentional, and snowballing. The study was carried out in Argentina, since the families lived in this country. Of the total, 68.8 % children were born in Argentina, and 31.2 % were foreign nationals, born in Peru, Mexico, Colombia, Chile, Costa Rica, and Bolivia. As for caregivers, 73 % were born in Argentina and the rest were from other Latin American countries. All families had Spanish as their native language. Of the total number of caregivers who completed the survey, the majority ($n = 230$) were the mothers of the infants.

Regarding the sociodemographic variables, the infants' parents had an average level of higher education and were professionals (see Table 1).

To carry out the inferential analysis with the CDI inventory and the development milestones, a sample of 171 participants was used ($M = 32.26$ months, $SD = 8.93$, female = 87); 139 cases were excluded from the final sample because the language measurements were not for infants younger than 12 months ($n = 20$), older than 48 months ($n = 56$) and because of prematurity ($n = 63$).

Measures

Permanent Household Survey (EPH, INDEC, 2018). Information was collected on the nationality, age and gender of the child, as well as the educational level (from 1 = *incomplete primary school* to 10 = *complete post-graduate*) and profession (1 = *unemployed*, 2 = *housekeeper*, 3 = *not qualified*, 4 = *operator*, 5 = *employee*, 6 = *technician*, 7 = *professional*) of the mother and father.

Questionnaire on the use of ad-hoc screens. Information was collected on what type of touchscreens the infants were using. These included tablet, TV, and cellphones. It was also asked how many hours per day they used each of these devices (1 = *does not use*, 2 = *between 0 and 1 hour per day*, 3 = *between 1 and 2 hours per day*, 4 = *between 2 and 3 hours per day*, 5 = *between 3 and 4 hours per day*, 6 = *more than 4 hours per day*), age of initiation of different activities (*i. e.*, screen scrolling, viewing a video, play with a device, watch photos) (1 = *between 0 and 5 months*, 2 = *between 6 and 11 months*, 3 = *between 12 and 18 months*, 4 = *between 19 and 25 months*, 5 = *between 26 and 36 months*, 6 = *does not use*) and what content they consumed (*i. e.*, music, YouTube, cartoons, news, interactive games, photos, reading books/stories). A total score of Age of initiation and Hours of use was calculated by the average of the starting age of the different activities of the screens and the hours of use of the different screens respectively.

Developmental milestones (Bedford et al., 2016). To assess developmental milestones, critical milestones from the motor and language domains were chosen. The seven questions were as follows: "At what age did the infant..." and data from motor and language milestones were used: "sat without support" and "walked independently", "picked up a small object with a clamp, that is, with his thumb and forefinger", "stacked at least three small blocks or other small objects", "said his first word", "said two or more words together", "made a whole sentence, meaningful".

To reply, the caregiver had to indicate their response on a Likert scale, with age ranges (0 = *between 0 to 5 months*, 1 = *between 6 and 11 months*, 2 = *between 12 and 18 months*, 3 = *between 19 and 25 months*, 4 = *between 26 and 36 months*, 5 = *still not performed*). Variables of motor and language developmental milestones were generated by the average of each development milestone.

Communicative Development Inventory Form II (Resches et al., 2021). This inventory evaluates the development of language in children through the reporting of a significant caregiver. It is made up of two inventories. Part 1 (CDI 1, lexical density) measures children's use of words. It includes a vocabulary list of 23 semantic categories with 699 items. Parents reported the amount of words their children know. Part 2 (CDI 2, sentence use) inquires about the way in which the infant uses language, specifically about the evocation of past and future events, places or people that are not present, detaching language from its immediate context (symbolic competence). Five questions with examples were asked with 3 options each (0 = *not yet*, 1 = *sometimes*, 2 = *many times*), scoring a total on a scale of 0 to 10 points: (1) "Does the child talk about past situations?"; (2) "Does the child talk about objects or people that are not present?"; (3) "Does the child talk about things that are going to happen in the future?"; (4) "Does the child understand when they asked to bring something from another place?"; (5) "When pointing to or grasping an object, does the infant say the name of the person to whom the object belongs even though that person is not present?". For this sample, a Cronbach's Alpha of .96 was obtained for CDI 1 and of .84 for CDI 2. About families not from Argentina ($n = 97$), a Cronbach's Alpha of .96 was obtained for CDI 1 and of .88 for CDI 2.

Procedure

The questionnaire was administered virtually. Participants completed a Google

Forms that was shared on Facebook, Instagram, and WhatsApp. It could be completed from a cellphone, tablet or PC.

Before beginning the evaluation, all participants completed an informed consent. None received financial compensation, and all completed the scales individually at home. General objectives of the study were reported, and participants were invited to participate anonymously, confidentially and voluntarily to avoid bias in their answers.

All questionnaires were administered in the same order: first the EPH was administered, then the questionnaire on developmental milestones, followed by the CDI, and finally the questionnaire on the use of touchscreens. The data was collected from March 21 to November 11, 2020.

Data analysis

SPSS software version 26 was used. First, a pre-processing of the data was carried out to evaluate the presence of outliers in the sample. A descriptive analysis was then carried out on the start and average number of hours of use of touch devices, lexical density, use of sentences, developmental milestones, and sociodemographic variables.

The distribution of the variables was calculated using the Shapiro-Wilk test and the homogeneity of variances with Levene test. Most of the variables presented a non-normal distribution, so non-parametric tests were used.

First, a variable description was made. Then, use of electronic media, CDI scores, developmental milestones, and sociodemographic variables were correlated using the Spearman Rho test. Device use was compared according to content type and gender of infants using the Kruskal-Wallis H and Mann-Whitney U tests respectively. Finally, a multiple linear regression test was carried out, inserting the variables of device use as input and those of milestones and language as outcomes.

Results

Description of variables

Table 1 summarizes the main descriptive statistics. On average, infants began to use screens and carry out activities with them from the first year of life. Regarding age of initiation of different activities, only video viewing average occurrence was before the first year. The latest used content was with tablets, as the activities of zooming to a screen and playing games with the devices were used

for the first time at age three or not at all. About tablets, 76.8 % ($n = 238$) of the infants sampled did not use them, and 42.6 % ($n = 132$) did not use cellphones. The amount of time of tablet and cellphone use was less than one hour on average for this sample, with both variables showing a floor effect reflective of lower scores indicating lack of use (symmetry > 1.40 ; West et al., 1999). TV was the most widely used device with children watching on average more than one hour per day, and only 12 % of all infants did not use it ($n = 37$).

Table 1.
Descriptive statistics of measured variables

Measures	M (SD)	Median	95 % IC	Range	N
Age (months)	30.17 (10.82)	31.20	[28.87, 31.51]	2-48	253
> 12 months	6.90 (3.06)	7.30	[5.42, 8.38]	2-12	19
12-24 months	19.79 (3.12)	20.50	[19.11, 20.84]	12-24	52
24-36 months	30.26 (3.59)	30.30	[29.56, 30.97]	24-36	101
36-48 months	41.82 (3.58)	42.35	[41.03, 42.61]	36-48	81
<i>Age of initiation average</i>	3.91 (1.06)	3.85	[3.78, 4.04]	1.28-6	253
Cellphone use	3.56 (1.62)	3	[3.36, 3.76]	1-6	253
Tablet use	5.15 (1.41)	6	[4.98, 5.33]	1-6	253
Screen scrolling	3.29 (1.39)	3	[3.12, 3.47]	1-6	243
Viewing a video	2.87 (1.41)	3	[2.69, 3.05]	1-6	243
Play with a device	4.63 (1.53)	6	[4.42, 4.84]	1-6	208
Watch photos	3.30 (1.52)	3	[3.11, 3.50]	1-6	238
Zoom to a screen	4.55 (1.55)	5	[4.34, 4.75]	1-6	218
<i>Use time average</i>	1.99 (0.70)	2	[1.90, 2.08]	1-4.5	253
Tablet use time	1.35 (.74)	1	[1.26, 1.44]	1-6	250
Cellphone use time	1.72 (.82)	2	[1.62, 1.83]	1-6	241
TV use time	2.96 (1.36)	3	[2.79, 3.13]	1-6	250
<i>Language</i>					
Lexical density (CDI 1)	171.79 (198.80)	77	[141.78, 201.80]	0-670	171
Sentence use (CDI 2)	3.87 (2.43)	4	[3.50, 4.23]	0-8	171
<i>Motor development milestones average</i>					
Sit unsupported	4.28 (.55)	4	[4.20, 4.36]	1-5	171
Walked independently	3.08 (.85)	3	[2.95, 3.21]	0-4	171

Measures	M (SD)	Median	95 % IC	Range	N
Raised small object	4.10 (.74)	4	[3.99, 4.21]	0-5	171
Stacked two or more objects	3.47 (.95)	4	[3.33, 3.62]	0-5	171
Language development milestones average	2.56 (.98)	3	[2.41, 2.71]	0-4.33	171
Said first words	3.53 (.89)	4	[3.39, 3.66]	0-5	171
Said two or more words	2.43 (1.30)	3	[2.23, 2.62]	0-4	171
Made a meaningful sentence	1.74 (1.39)	2	[1.53, 1.95]	0-4	171
<i>Sociodemographic variables</i>					
Mother education	6.49(2.10)	7	[6.20, 6.77]	2-10	253
Parent education	5.83(2.19)	6	[5.53, 6.13]	1-10	253
Mother occupation	4.97(2.27)	6	[4.66, 5.28]	1-7	253
Parent occupation	5.41(1.62)	6	[5.19, 5.63]	1-7	253

Note: CDI: Communicative Development Inventory.

Associations between screen use and language and motor milestones

Age of initiation for screen use and activities carried out with the screens. Results are summarized in Table 2. For language measured with the CDI, lexical density was positively associated with a later initiation age of watching videos. These results indicated that later initiation age with the activity of watching videos was associated with higher vocabulary use. In the other hand, lexical density and use of sentences showed a negative relationship with tablet use and zoom to a screen, indicating that a later initiation age with tablets and zooming on a screen was associated with lower language measures reports by parents.

Regarding both motor and language development milestones, the age at which the developmental milestones were reached was negatively associated with the initiation age for the different screens and with activities linked to them (*i. e.*, moving/touching, zooming and playing interactive games), with moderate effect sizes ($.15 < \rho < .27$). In other words, as the age of initiation with screens was delayed, developmental milestones were acquired earlier according to the

parents' report.

Screen usage time. Positive associations were found between the sum of hours of different screens and language measures, with small effect sizes ($.21 < \rho < .51$). This suggested that as the number of hours of use of electronic devices increased the scores on lexical density and sentence use did also. No general associations were found between each screen usage and the sum of screen hours with developmental milestones ($p > .05$). Only with the language milestone of saying two or more words positive associations were found.

Screen initiation and usage links to sociodemographic variables. No associations were found between hours of screens use and age of initiation with respect to sociodemographic variables (*i. e.*, educational level and type of occupation of the parents), and neither with respect to the content (*i. e.*, music, YouTube, cartoons, news, interactive games, photos, reading books/stories) they consumed using the Kruskal-Wallis H test ($p > .05$). Finally, a Mann Whitney U test was applied to compare the number of hours of screen use based on gender. No evidence was found that suggested that boys and girls used these devices differently in terms of time ($p > .05$).

Table 2.

Associations between the variables corresponding to CDI, use of touch devices and development milestones

	Language CDI		Developmental milestones									
	Lexical density	Sentence use	Motor develop. milestone avg.	Language develop. milestone avg.	Sit unsupported	Walk independent	Raise small object	Stack 2+ objects	Say first word	Say 2+ words	Made sentence	
Age of initiation												
Avg. across all devices	-.064	-.145	-.359**	-.414**	-.193*	-.121	-.275**	-.275**	-.165*	-.429**	-.377**	
Cell phone use	-.014	-.120	-.217**	-.238**	-.079	-.060	-.227**	-.164*	-.159*	-.278**	-.159*	
Tablet use	-.181*	-.176*	-.060	-.185*	-.088	-.008	-.078	-.081	-.073	-.248**	-.164*	
Screen scrolling	.106	.037	-.245**	-.247**	-.166*	-.047	-.239**	-.117	-.086	-.280**	-.231**	
Viewing a video	.163*	.058	-.277**	-.154*	-.130	-.116	-.242**	-.207**	-.095	-.226**	-.114	
Playing with a device	-.096	-.080	-.212*	-.509**	-.051	-.090	-.181	-.151	-.112	-.464**	-.534**	
Watch photos	.124	-.023	-.364**	-.208**	-.170*	-.130	-.273**	-.281**	-.093	-.254**	-.165*	
Zoom to a screen	-.185*	-.178*	-.390**	-.396**	-.226**	-.145	-.220**	-.300**	-.103	-.390**	-.388**	
Usage time												
Avg. across all devices	.236**	.275**	.053	.073	.036	.064	-.088	.032	-.067	.095	.087	
Tablet	.226**	.211**	-.026	.083	.027	-.093	.011	.051	-.009	.172*	.066	
Cellphone	.153*	.206**	.011	.133	.041	-.005	-.047	-.047	.027	.167*	.089	
TV	.129	.179*	.049	-.009	.008	.110	-.125	.019	-.100	-.044	.044	

Contribution of screen use to infant cognition

Three multiple regressions were performed on lexical density, sentence use, and motor and language developmental milestones,

inserting the age of initiation and the sum of screen time averages as predictors. Table 3 summarizes the results of the regressions. For the four dependent variables, the general model was significant.

Table 3.

Prediction of lexical density, sentence use, and developmental milestones through the use of screens

	F	B	Beta	R²
<i>Lexical density</i>	3.491			.040*
Usage time		53.53	.191*	
Age of initiation		-4.918	-.025	
<i>Use of sentences</i>	6.764			.075**
Usage time		.721	.210**	
Age of initiation		-.295	-.123	
<i>Motor development milestones</i>	10.07			.107**
Usage time		-.022	-.032	
Age of initiation		-.163	-.335**	
<i>Language development milestones</i>	14.08			.144**
Usage time		-.006	-.004	
Age of initiation		-.371	-.380**	

Note: CDI: Communicative Development Inventory. * $p < .05$. ** $p < .01$.

Screens usage time positively predicted the language outcomes, indicating that as the time of screen usage increased, so did the lexical density and the use of sentences. About age of initiation for the screen devices and activities, they negatively predicted motor and language development milestones, with moderate effect sizes. This indicates that as the age of initiation increased, developmental milestones were acquired earlier according to the parents' report.

Discussion

The objective of the present research was to describe the initiation and hours of use for electronic devices by infants aged 2 to 48 months, and to associate these variables

with developmental milestones, language, and sociodemographic variables. The TV was found to be the most used device and watching videos was the activity executed the most. On average infants began to use screens after their first year of life and their use time was on average one hour per day, except for the TV which was higher. Surprisingly, a positive association between screen usage hours and lexical density and sentence use parent reports was found, although the effect sizes were small. Further, it is important to note that some age of screen and activities use initiation (*i. e.*, tablet use and zooming on a screen) were negatively associated with language, indicating that delaying screen usage was associated with low language report scores, except

for watching videos, where the longer it was delayed, the better vocabulary reported scores were obtained. In addition, negative associations were found between the age of initiation of screen use and motor and language developmental milestones with moderate effect sizes for this age range: as the age of initiation with screens was delayed, developmental milestones were acquired earlier according to the parents' report. No associations were found between developmental milestones and language outcomes scores with the type of content that infants consumed on the screens. Also, no associations between screens and sociodemographic variables were found (*i. e.*, infants' gender, age, and parental educational level and occupation). Results demonstrate several surprising relations suggesting that age of initiation and usage may not always relate to negative outcomes in language, and suggest more work is needed in this area of research. But the age of initiation could negative relate with the age that different motor and language development milestones are acquired.

Regarding the descriptive data, although use time was on average low (one hour) for the electronic media measure, their age of initiation was early (from the first year of life), which goes against what the different pediatric associations recommend during early childhood (Asociación Argentina de Pediatría, 2019; Melamuda & Waisman, 2019; Waisman et al., 2018). These results replicate those carried out in samples from Argentina (Waisman et al., 2018) and the United States (McClane & Pempek, 2015), where it was found that in this age range children used devices at least one hour per day. This amount of use may also be reinforced by quarantine, which could lead parents to use technological devices as a means of regulating or appeasing infants during their work routines (Chauhan et al., 2021; Ribner & McHarg, 2021). On the other hand, it is necessary to highlight that the tablet was hardly used at home, and the device that was used the most was TV. This could be because TV offer is more varied than

other devices, and, at the same time, it is the only one that does not require active contact and interaction on the part of the infant, which facilitates its use (Melamuda & Waisman, 2019; Ribner & McHarg, 2021).

Regarding the links between screen use and language, these results surprisingly demonstrate that the amount of time of media use was associated with higher scores in both lexical density and use of sentences, with low effect sizes. Similar positive results were found with the language development milestone of saying two or more words. There are several reasons for these results. For one, results have shown that when children are younger, they require the presence of a caregiver when consuming the screens (Nabi & Krcmar, 2016). A higher relation between screen use and language could be because a caregiver was present during the interaction with the screens. Results could also be because caregivers reported a greater extent of watching videos, which could promote interaction with adults or expand their lexical density (Ribner & McHarg, 2021; Terras & Ramsay, 2016). It is also necessary to highlight that although usage time of devices was associated with better language outcomes, age of initiation with tablet and zooming on a screen was negatively related. This could be because these are activities that require the presence of an adult and an active interaction with the children (Bedford et al., 2016). This is reinforced by the correlation found between a later age of initiation watching videos and higher reported language scores. This could be because watching videos on screens in early childhood is a passive activity, and promotes the absence of interactions with adults, or through books and traditional toys, which reinforces passivity in the infant (Kostyrka-Allchorne et al., 2017; Waisman et al., 2018). It may be useful for future works to consider how time engaged with screens relates to other interactions at home and how this may change across age.

Regarding developmental milestones, although no general associations were found with screen use time there were relations to

age of initiation. Specifically, when children initiated screen use later in life, developmental milestones were acquired earlier. These negative associations of screen consumption and motor and language milestones could be interpreted with the displacement hypothesis (Strasburger et al., 2012), which states that the time a child spends engaged with a screen limits the time they have to do other activities, leading to reduced physical activity or face-to-face communication (Ribner & McHarg, 2021). On the other hand, no associations were found between these developmental milestones and usage time, which aligns with Bedford et al.'s (2016) neutral effects but goes against their positive results with fine motor skills, suggesting that the screens could involve the infants' motor movement and their language in an exchange with other adults.

Finally, no associations were found between the use of devices and sociodemographic variables such as the educational level and occupation of the parents and the age and gender of the infants. This lack of associations could be interpreted from the homogeneity of the parent's sample based on its characteristics. On the other hand, the equal use of screens according to the infant's gender is consistent with other studies (Lin et al., 2020; McHarg et al., 2020). However, the lack of associations with the age of infants is contradictory with other results found (McHarg et al., 2020; Melamuda & Waisman, 2019) and counterintuitive. This may be since on average the use of technologies was low for this sample due to the age range. In turn, during the COVID-19 quarantine, the use of screens was present independently of the age of the children (Chauhan et al., 2021; Ribner & McHarg, 2021), which could make the associations with age disappear.

Conclusion

This research shows the importance of continued research on this topic since most of the children in the sample use some type of

touch device, and they use them an average of one hour per day. Infants likely start to use screens early in life and the amount of time of use of electronic media is approximately one hour per day because: (1) the community is not aware of the possible negative effects that these devices can generate on cognitive development, because of the average time that children spent with the screens; (2) as a means of regulate and distract infants; (3) due to the quarantine condition derived from the COVID-19 pandemic.

However, affirming that the use of screens in early childhood is associated with the acquisition of developmental and language milestones represents the first step in the study of this issue in Argentina and other Latin American countries. Although these results are not consistent with previous research on the subject, which states that there is no evidence to support a negative association between the age of initiation of use of the first touch device and developmental and language milestones (Bedford et al., 2016; Melamuda & Waisman, 2019), it is essential to highlight that these investigations were not carried out within the local environment. Based on the results obtained, interventions can be generated within the area of clinical psychology in early childhood, giving guidance to primary caregivers and generating public policies within the educational field.

Limitations and future directions

The present study presented a series of limitations. One of them was that the data was collected through parental reports, which could bias the results obtained. In turn, the type of sampling was non-probabilistic, therefore, the results cannot be generalized. In addition, the questionnaire was not directly validated for the small part of the evaluated sample that was not from Argentina. Thirdly, there was a lack of measurement of parental activity during the infant's screen consumption. Finally, having carried out a cross-section

tional study does not allow us to visualize the development trajectories of these skills in each child.

For future research, it would be beneficial to expand the sample and recruit participants from different provinces of Argentina and other Latin American countries. Similarly, it would be recommended to carry out a probabilistic sampling, based on a direct measurement of the infants' behavior. In turn, measure the interactions of the caregiver-infant dyad during screen consumption to analyze whether they mediate the use of the devices and their associations with infant cognitive skills. Finally, carry out a longitudinal study, to be able to compare the same sample over time and thus observe the development lines of infants. This would lead, in a second moment, to generate specific interventions that consider the development of infants and the incidence of social and individual factors to promote their cognition in the first years of life.

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Recibido: 27 de septiembre de 2021

Aceptado: 10 de agosto de 2022