

Research Article

Digital Devices Use and Language Skills in Children between 8-36 Month

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Abstract:

Background: Over the past decade, the use of digital tools has grown and research evidence suggests that traditional media and new media offer both benefits and health risks for young children. The abilities to understand and use language represent two of the most important competencies developed during the first 3 years of life through the interaction of the child with people, objects, events, and other environmental factors. The main goal of our study is to evaluate the relationship between digital devices use and language abilities in children between 8-36 month, considering also the influence of several variables..

Materials and Methods: We conducted a cross-sectional observational study on 260 healthy children (140 males = 54%) aged between 8-36 months (mean=23.5±7.18 months). All the parents completed a self-report questionnaire investigating the use of digital devices by their children, and a standardized questionnaire for the assessment of language skills (MacArthur). Multiple linear regression was used to evaluate the relationship between different variables. Subsequent moderation analysis were performed to verify the influence of other factors.

Results: We found a statistically significant negative correlation between the total daily time of exposure to digital devices and the Actions and Gestures Quotient ($\beta=-0.397$) in children between 8-17 months, and between the total daily time of exposure to digital devices and Language Quotient ($\beta=-0.224$) in children between 18-36 months. Sex, level of education/job of parents, modality of use/content of digital device do not significantly affect these relationships.

Conclusion: In our study we found that a longer time of exposure to digital devices was related to lower mimic-gestural skills in children from 8-17 months and to lower language skills in children between 18-36 months, regardless of age, sex, socio-economic status, content and modality of use. Further studies are needed to confirm and better understand this relationship, but parents and pediatricians are advised to limit the use of digital devices by children and encourage the social interaction to support the learning of language and communication skills in this age group.

Keywords: digital devices; digital media; toddler; children; language abilities.

1. Introduction

The abilities to understand and use language represent two of the most important competencies developed during the first 3 years of life [1-5] through the interaction of the child with people, objects, events, and other environmental factors in everyday settings [6-8]. This time is a great period of plasticity in which the brain is sensitive to the quantity and quality of the linguistic input heard from both people and object input sources. In fact, children's language skills rapidly unfold over the first three years of life [9] and during this time, language acquisition is determined by the total number of words heard in children's everyday environments and by the syntactic richness and complexity of language expressed in the home environment [10].

Infants and toddlers are also capable of learning from screen media. This learning is dependent upon the confluence of three distinct but interrelated factors: attributes of the child; characteristics of the screen media stimuli; and the varied environmental contexts surrounding the child's screen media use [5].

In the last years, the market for infant-directed media products is increased and researchers are trying to understanding whether and how screen media impact language development.

This increased use reflects both the increasing use of screen media by families and society [11] and the growing marketing of cable TV channels, digital devices, and applications (apps) to young children [12] even to those from disadvantaged households [13].

There is considerable evidence that children under two who watch educational Television do learn media-presented vocabulary and then are able to transfer specific learning to more generalized language gains [5,14-19] but specifically, Linebarger and Walker (2005) find that outcomes were program specific [20]. Programs that had a strong narrative, such as *Dora the Explorer*, were positively associated with greater vocabulary and expressive language, whereas, programs that had little narrative structure and spoken language, such as *Teletubbies*, were negatively associated with vocabulary and expressive language.

This suggest that not only does the amount of Television exposure influence language development, but also there are other important factors to consider. A determinant role in the screen exposure is played by parents. Parents can offset some of the potential harmful effects of media exposure on their children for example stimulating an active use rather than a passive one.

However, it would appear that the quality and quantity of parents' interactions with their children tend to be reduced by the presence of Television [21-23].

Kabali and colleagues (2015), in a study conducted in a low-income urban pediatric clinic, showed as almost all (97%) 0 to 4 year olds had used a mobile device, and three-quarters owned their own device. The 92% of 1 year olds had exposure to mobile devices and they were primarily using mobile devices for entertainment, not educational, purposes. Many parents report that mobile devices, which are handheld and usually used individually, are more difficult to monitor in terms of what the child is playing or downloading as well as where and when they are using media [13]. Instant accessibility means that children can demand preferred programs at any time or place and Hiniker and colleagues (2016) found that context-based rules (i.e., where children are allowed to use digital media, such as the dinner table) were the hardest to enforce compared with rules about time limits and content [24,25]. (Radesky and Christakis, 2016). Mobile devices are used to placate or distract

children or to manage children's behavior. Studies revealed that parents often give children devices when doing house chores, to keep them calm in public places, during meals and/or at bedtime to put their child to sleep [13,26-28].

In Italy a recent survey described that 20% of children used a Smartphone for the first time during his first year of life. Moreover, 80% of children from 3 to 5 years old is able to use their parent's Smartphone. In addition, parents often use media as pacifiers, giving mobile devices to their child to keep them calm during the first (30%) and the second (70%) year of life [29-30]. The majority of the studies in literature are on the US population but there are very few studies on Italian infant, toddlers and preschoolers. For that reason we believe it is important to explore how mobile devices are managed by parents and how much this affects language development in Italian children under three years old.

The main goal of the present study is to evaluate the language development in children between 8 to 36 months assuming that the use of electronic devices adversely affects language development but this happen considering the influence of several variables.

We hypothesize that co-viewing and characteristics of the screen media stimuli influence the relationship between digital devices use and language development. In particular, we consider that there is a difference between children that use devices in active interaction with parent and children that use devices alone. We do not expect socioeconomic status differences as each child has full access to devices.

2. Materials and Methods

2.1 Sample selection

We conducted a cross-sectional observational study on 260 healthy children (140 males = 54%; 120 female = 46%) aged between 8-36 months (mean= 23.5±7.18 months), recruited from twelve kindergartens and nursery schools of the city of Salerno.

All the children younger than or equal to 36 months were included; the exclusion criteria were the presence of medical or neuropsychiatric conditions that could affect language or neuropsychomotor development, and poor parental compliance to take parte into the study.

All the parents were invited to a preliminary meeting with a specialist in Child Neuropsychiatry, in order to explain the methods and purposes of our research. Subsequently, two different self-report questionnaires were administered to the parents who provided their written informed consent.

The first questionnaire aimed to investigate the use of DD by the children, while the second one was a standardized questionnaire for the assessment of language abilities (Il primo vocabolario del bambino PVB - Italian adaptation of the MacArthur-Bates Communicative Development Inventory - CDI).

All the data were collected and examined by a single investigating neuropsychiatrist.

This study was performed in accordance with the Helsinki declaration and was approved by the Campania Sud Ethics Committee (protocol number = N.0033986 March,01 2019).

2.2 Digital Devices Questionnaire (DDQ)

Digital Devices questionnaire consisted of two parts:

a first section that collected general information, socio-demographic data and medical history (age, sex, family members, number of siblings, educational level and job of the parents, pregnancy, childbirth, psychomotor development, diagnosed pathologies); a second section, consisting of 12 items, exploring the use of DD by children, as follows:

- DD available at home (Smartphone, Tablet, Computer, Television, Videogames);
- children's favorite DD (Smartphone, Tablet, Computer, Television, Videogames);
- age of start using DD (Smartphone, Tablet, Computer, Television, Videogames);
- mean time of daily use (Smartphone, Tablet, Computer, Television, Videogames);
- modality of use (with or without parents' supervision);
- preferred content (with or without dialogues);
- content selection (independent choice or choice guided by the parent);

- behaviors implemented by DD use (frustration level, name response, social attention)
- parental motivation for allowing DD to the child (to entertain, to calm down, during meal time, to fall asleep);
- parents' awareness of the risks for their children associated with the DD use;
- parents request to the pediatrician for advice on DD use by children;
- Time spent by the child in recreational activities with peer.

2.3 Il primo vocabolario del bambino (PVB) - Italian adaptation of the MacArthur-Bates Communicative Development Inventory (CDI)

The language skills of the children were assessed through a standardized questionnaire.

PVB is a standardized questionnaire for parents of children aged between 8 and 36 months, used both in research and in clinical practice for assessing communication and language in children with typical and atypical development. Given the physiological changes in language development between the first and third year of age, two forms have been created: the "Gestures and Words" Form, for children between 8 and 17 months, and the "Words and Phrases" Form, for children between 18 and 36 months.

All the raw scores, are converted into age-weighted scores. In the "Gestures and Words" Form three age-weighted scores are considered: the Actions and Gestures Quotient (AGQ), the Language Understanding Quotient (LUQ) and the Language Production Quotient (LPQ). In the form "Words and Phrases" is considered only the Language Quotient (LQ). The age-weighted scores have mean=100 and standard deviation (SD)=15; scores below 70 (-2SD) are considered below the norm.

2.4 Statistical analysis

All data were expressed as mean, standard deviation and proportions/percentage, and subjected to descriptive statistics analysis.

A preliminary normality test was performed in order to verify the data distribution (Shapiro-Wilk Normality Test). Multiple linear regression analysis was used to evaluate the relationship between different variables. Subsequent moderation analysis were performed to verify the influence of other factors. Bonferroni correction for multiple comparisons has been applied.

All data were analyzed using the Statistical Package for Social Science, version 23.0 (IBM Corp, 2015); p-values less than or equal to 0.0025 were considered statistically significant.

3. Results

3.1 Sample characteristics

Our sample included 260 children (140 males=54% and 120 females=46%) aged between 8-36 months (mean=23.5±7.2months). The sample was subsequently divided into two sub-groups: 72 children between 8-17 months (mean=13.8 ±3.5) and 188 children between 18-36 months (mean=27.1 ±4.4), based on the typical differences in language competences of the two group age and, therefore, on the different standardized questionnaires administered. Socio-demographic and clinical data suggests that the sample is representative of a population with a typical psychomotor development (first steps mean age =12.6±2.0 months; first words mean age =12.8±4.2 months) and the two subgroups appeared homogeneous for the main characteristics analyzed. The socio-demographic characteristics of the sample are summarized in Table 1.

	Total Sample	8-17 months	18-36 months
Sample Size	260	72	188
Sex			
male	140 (54%)	44 (61%)	96 (51%)
female	120 (46%)	28 (39%)	92 (49%)
Age - m±SD	23.5 ±7.2 months	13.8 ±3.5	27.1 ±4.4

Pregnancy problems	38 (15%)			7 (10%)			31 (16%)					
Birth problems	27 (10%)			3 (4%)			24 (13%)					
Perinatal problems	25 (10%)			7 (10%)			18 (10%)					
Birth week - m±SD	38.9 ±1.9			39.1 ±1.4			38.8 ±2.0					
Birth weight - m±SD	3.2 ±0.5 kg			3.3 ±0.5			3.2 ±0.5					
Crawling	36 (14%)			10 (14%)			26 (14%)					
First step age m±SD	12.6 ±2.0 months			12.3 ±1.9			12.7 ±2.0					
First word age m±SD	12.8 ±4.2 months			10.8 ±3.0			13.4 ±4.3					
Medical pathologies	18 (7%)			4 (5%)			14 (7%)					
Family members	4.0 ±1.0			3.7 ±0.9			4.1 ±1.2					
Siblings - m±SD	1.1 ±0.9			1.0 ±0.7			1.2 ±0.9					
M/F age - m±SD	34.7 ±5.1/ 37.7 ±5.7 years			34.9 ±4.7/ 37.3 ±6.4			34.7 ±5.3/ 37.8 ±5.4					
Educational level	MS	HS	UN	MS	HS	UN	MS	HS	UN			
Mother	27(11%)	116(45%)	114(44%)	4(6%)	28(39%)	39(55%)	23(12%)	88(47%)	75(41%)			
Father	50(20%)	118(47%)	81(33%)	11(16%)	32(47%)	25(37%)	39(22%)	86(47%)	56(31%)			
	U/H	SW	OW/T	SE	U/H	SW	OW/T	SE	U/H	SW	OW/T	SE
Mother	67(27%)	55(22%)	57(23%)	71(28%)	17(24%)	14(19%)	17(24%)	24(33%)	50(28%)	41(23%)	40(22%)	47(27%)
Father	14(6%)	87(35%)	70(28%)	77(31%)	2(3%)	25(36%)	15(22%)	27(39%)	12(7%)	62(34%)	55(31%)	50(28%)

Table 1. Sample characteristics. m=mean; SD=standard deviation; M=mother; F=Father; MS=middle school; HS=High School; UN=University; U/H=unemployed / housewife; SW=skilled worker; OW/T=office worker, teacher; SE=self-employed.

3.2 Digital Devices questionnaire

Most of the parents reported the use of at least one DD by their children (252/260, 97%); in younger children this percentage was slightly lower (64/72, 89%), while it reached 100% in the group of older children (188/188).

The DD preferred by children in both groups were the Smartphone (171/252, 66%) and the Television (157/252, 60%), with a slight preference for the Smartphone in older than in younger children (71% vs 53%). The Tablet ranked third (44/252,17%), with a greater preference in older children (21% vs 6%).

The parents reported that the DD used as first by the children were Television (mean age=11.3±5.2 months) and Smartphone (15.6 ±5.8months), followed by Tablet (18.5±6.1 months), PC (18.8±7.9 months) and Videogames (22.3±3.2 months). In the group of younger children, the mean age of the first use of any DD considered was always earlier, compared to the group of older children.

In the total sample, the mean time spent on DD by the children was 2.13±2.04 h/day. The most used DD were once more Television (1.27±1.39 h/day) and Smartphone (0.62±0.85 h/day). Older children used DD more than younger (2.34±2.09 vs 1.57±1.79 h/day).

Most of the children used DD mainly in presence of parents/caregivers (188/252, 75%), or of brother/sister (23/252, 9%), while a 5% of children used DD without any supervision (13/188); a scheduled digital parent-control was reported in 11% (28/252).

The children's favorite DD contents were video with dialogues (190/252, 75%). More in detail the content of DD were driven by the parent in 89% of younger children (57/64, 89%), while only in 41% (110/188) of older one.

In both groups the main reasons why parents allowed their children to use DD were “to entertain” (104/252, 42%) or “to calm the child” (91/252, 36%). The DD were frequently also used during meal time (94/252, 37%) or before the child went to sleep (23/252, 9%).

In few children, with a slightly prevalence in the older group, the parents reported that they did not respond to the their name when called (6/252, 2%), or didn’t interacted with others (12/252, 5%) during DD use. A further 6% (16/252) appeared frustrated, with stubborn crying, if the DD was taken off.

Overall, the parents also reported sleep problems (including difficulty falling asleep and/or frequent nighttime awakenings) in about 33% (86/260) of the children, with a slightly prevalence in younger group (45% vs 33%).

Finally, 53% of parents (134/260) expressed concern about the health consequences of the DD use in their children, although only 19% of the parents (47/260) had already asked their pediatrician for advice on this topic.

	Total Sample	8-17 months	18-36 months
Sample Size	260	72	188
Use of DD by children (at least one)	252 (97%)	64 (89%)	188 (100%)
DD available at home			
Smartphone	191 (74%)	43 (60%)	148 (79%)
Tablet	86 (33%)	13 (18%)	73 (39%)
Personal Computer	52 (20%)	19 (26%)	33 (18%)
Television	230 (85%)	59 (82%)	171 (91%)
Videogames/console	12 (5%)	2 (3%)	10 (5%)
Children’s favorite DD			
Smartphone	171 (66%)	38 (53%)	133 (71%)
Tablet	44 (17%)	4 (6%)	40 (21%)
Personal Computer	12 (5%)	5 (7%)	7 (4%)
Television	157 (60%)	40 (56%)	117 (62%)
Videogames/console	4 (2%)	1 (1.4%)	3 (1.6%)
Age of start using DD	months (m±SD)	months (m±SD)	months (m±SD)
Smartphone	15.6 ±5.8	11.1 ±3.1	16.4±5.9
Tablet	18.5±6.1	15.3±3.1	18.6±6.2
Personal Computer	18.8±7.9	14.0±3.1	16.8±12.9
Television	11.3±5.2	8.4±3.7	12.2±5.3
Videogames/console	22.3±3.2	16.0±0.0	23.6±1.3
Time of use DD	hours/day (m±SD)	hours/day (m±SD)	hours/day (m±SD)
Smartphone	0.62±0.85	0.41±0.62	0.70±0.91
Tablet	0.19±0.55	0.06±0.23	0.25±0.62
Personal Computer	0.04±0.28	0.05±0.21	0.03±0.30
Videogames	0.01±0.05	0.01±0.06	0.01±0.04
Television	1.27±1.39	1.04±1.36	1.36±1.39
Total Time	2.13±2.04	1.57±1.79	2.34±2.09

Modality of use									
with parent/caregiver	188 (75%)			56 (87%)			132 (70%)		
with brother/sister	23 (9%)			4 (6%)			19 (10%)		
with parent-control	28 (11%)			3 (5%)			25 (13.5%)		
alone	13 (5%)			1 (2%)			12 (6.5%)		
Favorite contents									
with dialogue	190 (75%)			44 (69%)			146 (78%)		
without dialogue	22 (9%)			12 (19%)			10 (5%)		
Videogames	40 (16%?)			8 (12%)			32 (17%)		
Contents selection									
independent choice	117 (46%)			7 (11%)			110 (59%)		
choice guided by parents	135 (54%)			57 (89%)			78 (41%)		
Reasons for granting DD									
to entertain	105 (42%)			24 (38%)			81 (43%)		
to calm down	91 (36%)			20 (31%)			71 (38%)		
to fall asleep	23 (9%)			6 (9%)			17 (9%)		
during meal time	94 (37%)			24 (38%)			70 (37%)		
Concerns about DD use									
Yes	134 (53%)			38 (59%)			96 (51%)		
No	118 (47%)			26 (41%)			92 (49%)		
Request to the pediatrician									
Yes	47 (19%)			5 (8%)			42 (22%)		
No	205 (81%)			59 (92%)			146 (78%)		
Behavior during DD use									
	absent	partial	immediate	absent	partial	immediate	absent	partial	immediate
response to name	6 (2%)	92 (37%)	154 (61%)	0 (0%)	14(22%)	50 (78%)	6 (3%)	78(42%)	104(55%)
	absent	partial	adequate	absent	partial	adequate	absent	partial	adequate
social attention	12(5%)	30 (12%)	210 (84%)	4 (6%)	4 (6%)	56 (88%)	8 (4%)	26(14%)	154(82%)
	high	medium	low	high	medium	low	high	medium	low
frustration	16(6%)	113(45%)	129 (51%)	4 (6%)	16(25%)	44 (69%)	12(6%)	99(53%)	77(41%)
Social activities*									
less than once a week		16 (7%)			4 (8%)			12 (6%)	
about once a week		72 (31%)			8 (17%)			56 (30%)	
several times a week		93 (39%)			16 (34%)			75 (40%)	
often- every day		55 (23%)			10 (21%)			45 (24%)	
Sleep problems		86 (33%)			32 (45%)			54 (29%)	

Table 2. Digital Devices Questionnaire; m=mean; SD=standard deviation; DD=digital devices; *(only for children ≥ 12 months, total sample size=236)

3.3 Relationship between Digital Devices use and language skills in children

In the group of younger children, a statistically significant negative relationship was found between the total daily time of exposure to DD and the Actions and Gestures Quotient (AGQ) scores, through linear regression analysis ($\beta=-0.397$; $R^2=0.158$; $p=0.001$; Table 3; Figure 1).

Through subsequent moderation analyzes emerged that other factors such as sex, level of education/job of parents, modality of use/content of DD, and frequency of social activities do not significantly affect this relationship (Table 4).

On the other hand, no statistically significant relationship was found between the total daily time of exposure to DD and the Language Understanding Quotient (LUQ) and Language Production Quotients (LPQ) scores (Table 3).

The relationship between age of the first use of the DD and AGQ, LUQ and LPQ scores was also tested, but no statistically significant correlation was found (Table3).

In the group of older children a statistically significant negative relationship was found between the total daily time of exposure to DD and the Language Quotient (LQ) scores, through linear regression analysis ($\beta=-0.224$; $R^2=0.060$; $p=0.001$; Table 3; Figure 2).

Also in this case, we found that the variables considered in the subsequent moderation analysis did not significantly affect this relationship (Table 4).

No statistically significant relationship was found between the start age of use of the DD and the LQ scores (Table3).

	<i>Daily Time of Use DD</i>				<i>Start Age of Use DD</i>			
	<i>R²</i>	<i>β</i>	<i>t</i>	<i>p-value</i>	<i>R²</i>	<i>β</i>	<i>t</i>	<i>p-value</i>
<i>Understanding Quotient</i>	0.033	-0.182	-1.515	0.135	0.053	-0.230	-1.495	0.143
<i>Production Quotient</i>	0.000	0.000	0.003	0.997	0.051	-0.225	-1.461	0.152
<i>Actions and Gesture Quotient</i>	0.158	-0.397	-3.542	0.001**	0.034	-0.185	-1.192	0.240
<i>Language Quotient</i>	0.060	-0.244	-3.291	0.001**	0.001	-0.032	-0.411	0.681

Table 3. Linear regression analysis

	<i>Actions and Gestures Quotient</i>	<i>Language Quotient</i>
<i>sex</i>	<i>p=0.622</i>	<i>p=0.528</i>
<i>parents' educational level</i>	<i>p=0.132</i>	<i>p=0.251</i>
<i>parent's job</i>	<i>p=0.261</i>	<i>p=0.475</i>
<i>co-viewing</i>	<i>p=0.659</i>	<i>p=0.728</i>
<i>contents</i>	<i>p=0.969</i>	<i>p=0.601</i>
<i>social activities</i>	<i>p=0.403</i>	<i>p=0.177</i>

Table 4. Moderation analysis.

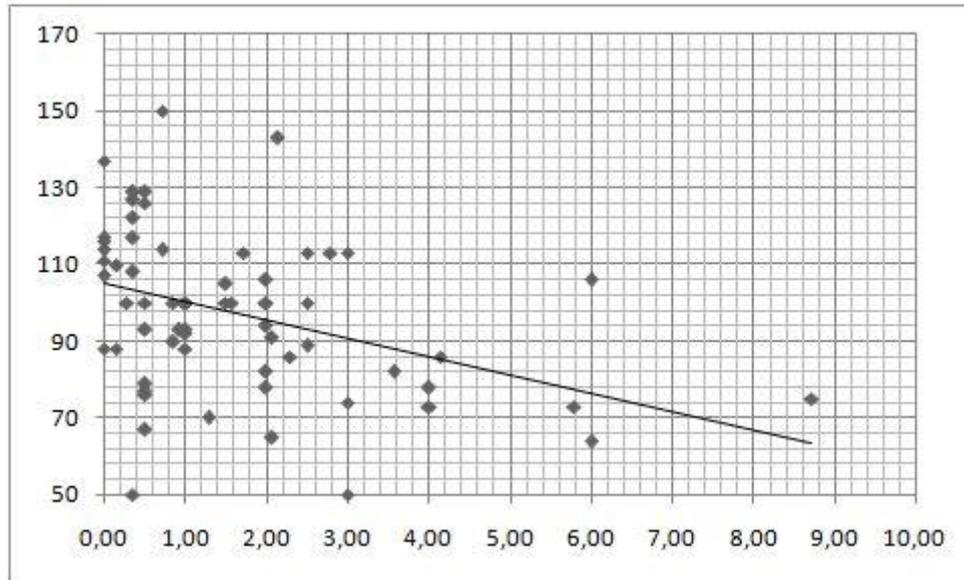


Figure 1. Linear regression between time of DD use by the children and *Actions and Gesture Quotient*.
x axis= hours/day of DD use; y axis = Actions and Gestures Quotient scores.

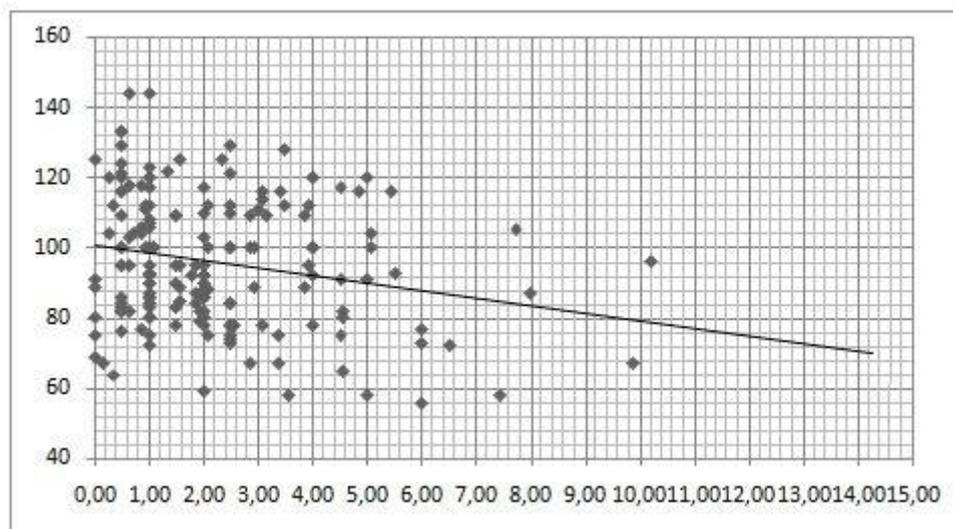


Figure 2. Linear regression between time of DD use by the children and *Language Quotient*.
x axis= hours/day of DD use; y axis= Language Quotient scores.

4. Discussion

The purpose of our study was to evaluate the use of digital devices in a population of children under 3 years old and correlate them with language skills. Our sample consisted of 260 children (54% male; mean age = 23.5 ± 7.2 months), that was divided into two subsamples of children aged 8-17 months ($n=72$) and 18-36 months ($n=188$), according to the physiological variations of language skills in the two different age groups. The two subgroups appeared homogeneous for the main socio-demographic and clinical characteristics analyzed, and both are representative of a typically developing population (the stages of psychomotor development were described in the norm and children with neuropsychiatric problems were not reported).

The first important result that emerged from our survey was that almost all of the children (97%) used at least one of the most popular digital device, with a slight difference based on age. In particular, all the children between 18-36 months (100%) used DD against 89% of the children

between 8-17 months. Our result is in line with the study of Zimmerman et al. (2007) in which 90% of parent reported that their children younger than 24 months use some form of electronic media [31]. The digital devices preferred by the children were the Smartphone (66%) and the Television (60%), with a slight preference for the Smartphone in the older than in the younger children group (71% vs 53%). The Tablet was in third place being preferred by 17% of the total sample and by 21% of children between 18-36 months.

This data confirms that the Smartphone and the Tablet, considered among "new" digital devices, have become part of everyday life, and that children, even very young, are increasingly familiar with these tools [32].

In addition, parents reported that the first digital device used by the children was television (mean age of first use =11.3±5.2 months) followed by Smartphone (15.6 ±5.8 months), Tablet (18.5±6.1 months), PC (18.8±7.9 months) and Videogames (22.3±3.2 months). In our opinion, it is also important underline that in the group of younger children the ages of first use of DD are always lower than in the group of older children, for all the digital devices analyzed. This data would suggest a sort of "anticipation" of the age to DD exposure, which would seem increasingly early [31,32].

The average daily used of DD was about 2 hours/day, with a slight difference between the two groups (1.57 hours in children between 8-17 months and 2.34 hours in children between 18-36 months), confirming what has already emerged from the previous literature data. Vandewater et al. (2007) reported that forty percent of children between 6-23 months used digital media 2 or more hours/day [33] and Zimmerman et al. (2007) reported that on average infants younger than 24 months watched Television for 1-2 hours/day [31].

The most of children used digital devices in the presence of the parent/caregiver (75%) or siblings (9%), and only a minority of children completely alone (5%); 11% of parents report the use of automatic parental-control.

In line with previous literature data, we also found that parents using DD as peacekeeper for their children while they are engaged in other activities [34,35]; in both groups the main reasons why parents allowed their children to use DD were to entertain (42%), to calm the child (36%), during meal time (37%) or before the child went to sleep (9%).

In a small percentage of children aged 18-36 months, parents reported some atypical behaviors during the DD use: this children did not respond to the their name when called (2%), or didn't interacted with others (5%) during DD use. A further 6% appeared frustrated, with stubborn crying, if the DD was taken off. This data suggests that the use of digital devices in some children can become totalizing and lead to a reduction in social interaction and a difficulty in emotional regulation, as already reported in previous studies [36,37].

Overall, the parents also reported sleep problems (including difficulty falling asleep and/or frequent nighttime awakenings) in about 33% of the children, with a slightly prevalence in younger group (45% vs 33%). The association between sleep disturbance and excessive media use by children had already been reported. In particular, a recent cross-sectional study including 1117 toddlers showed that everyday use of a Tablet or Smartphone raised the odds ratio of a shorter total sleep time and a longer sleep onset latency regardless of other factors, such as temperament or type of screen exposure (TV or Videogames) [38].

Finally, 53% of parents expressed concern about the health consequences of the DD use in their children, although only 19% of the parents had already asked their pediatrician for advice on this topic.

The most important result of the study concerned the relationship between language skills and time spent on digital devices by the children.

In children aged 8-17 months, we found a negative relationship between the total daily time of exposure to DD and the Actions and Gestures Quotient scores. Therefore, the children who spent more time to use digital devices showed a repertoire less rich in communicative gestures. It is important to consider that gestural and mimic ability are the main indicators of the pre-verbal communication skills of children in this age group.

In children aged 18-36 months, we found a negative correlation between the Language Quotient and the time spent on DD. In this case, greater use of DD by children was associated with less production of words. In both cases the correlation found was weak but significant and sex, age and socio-economic status did not significantly affect these relationships.

For several years there has been a scientific debate about the association between the use of digital media and language skills in children. In terms of quantity of exposure, many authors suggest that the use of digital devices may represent a "passive" behavior that displaces fundamental learning opportunities for the child [37]. Population-based studies and a very recent meta-analysis showed associations between excessive TV viewing in early childhood and language, cognitive and socio-emotional delay; possible mechanisms responsible for this association would be inappropriate content, decrease in parent-child interaction and poor family functioning. Furthermore, earlier age of media use onset, cumulative hours of media use and contents were independent predictors of poor cognitive and linguistic skills [31,39-42].

In particular, evidence provides limited educational benefits of media use for children under 2 years and the American Academy of Pediatrics discourages media exposure under this age [43].

It would seem, indeed, that before the age of 24 months, interaction with parents/caregivers is more effective in teaching verbal and non-verbal problem solving strategies [44]. On the other hand, there would be a difficulty learning from 2D representations before the 30 months (video deficit) due to the poverty of symbolic thought, control of immature attention and insufficient flexibility to transfer knowledge to the real world [45]. Before the age of two, therefore, children would learn language, sensorimotor and socio-emotional skills more through hand-on exploration and social interaction.

Our study is in line with this evidence, showing that a higher use of digital media was associated with less language skills; however, some authors disconfirm these results, showing an absence of correlation between language skills and time spent by children on digital media [46]. Other studies suggest, on the other hand, that the use of digital devices is not exempt from bringing benefits to children, even if they depend on the age, the stage of development, the characteristics of the child, the methods of use (co-viewing) and content (educational applications). The use of educational applications and parent co-viewing would be associated with an improvement in language skills in children [47,48].

In our study the co-viewing and the digital contents did not seem to significantly affect the relationship between language and digital device use.

This result could be due to not specifically investigating the use of "educational applications" and not to distinguish between "active" or "passive" co-viewing; therefore we can further explore these two aspects in future researches.

However, we can also hypothesize that in the age group considered (8-36 months), these two factors are not as decisive as they are for older children, maybe because in this age group direct social interactions are the main source of language learning.

Another limitation of the study is to use indirect questionnaires aimed at parents. Further studies would be needed, to assess language and communication skills through standardized direct tests [49].

5. Conclusion

Over the past decade, the use of digital tools has grown and research evidence suggests that traditional media and new media offer both benefits and health risks for young children.

In our study we found that a longer time of use of digital devices was related to lower mimic-gestural skills in children from 8-17 months and to lower language skills in children between 18-36 months, regardless of age, sex, socio-economic status, content and modality of use. Further studies are needed to confirm and better understand this relationship, but parents and pediatricians are advised to limit the use of digital devices by children and encourage the social interaction to support the learning of language and communication skills in this age group.

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