Title Page

Title: Patterns of parent screen use, child screen time, and child socioemotional problems at 5 years

Short Title: Parents on Screens

Authors

Katherine T Cost^{1*}, Eva Unternaehrer^{2,3*}, Kimberley Tsujimoto¹, Leigh Vanderloo^{4,5}, Catherine Birken^{6,7,8}, Jonathon Maguire^{8,9}, Peter Szatmari¹⁰, Alice Charach¹

¹ Department of Psychiatry, The Hospital for Sick Children, Toronto, Canada

² Child- and Adolescent Research Department, Psychiatric University Hospitals Basel, University of Basel, Basel, Switzerland

³ University of Constance, Clinical Neuropsychology, Constance, Germany

⁴ School of Occupational Therapy, University of Western Ontario, London, Canada

⁵ ParticipACTION, Toronto, Canada

⁶ Child Health Evaluative Sciences, Hospital for Sick Children Research Institute, Toronto, Ontario, Canada.

⁷ Division of Pediatric Medicine, Hospital for Sick Children, Toronto, Ontario, Canada.

⁸ Department of Pediatrics, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada.

⁹ MAP Centre for Urban Health Solutions, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Unity Health Toronto

¹⁰ Centre for Addiction and Mental Health, Dept of Psychiatry University of Toronto

*equally contributing first authors

Corresponding Author:

Eva Unternaehrer, PhD
Child- and Adolescent Research Department,
Psychiatric University Hospitals Basel (UPK),
University of Basel,
Switzerland
Wilhelm Klein-Strasse 27
4002 Basel

Phone: +4179 409 00 24

Email: eva.unternaehrer@unibas.ch

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Abstract

Background:

Digital media screens have become an essential part of our family life. While most studies focus on children's screen use, we know less about parental screen use patterns and how these affect children's socio-emotional development.

Method:

867 Canadian parents of 5-year old children from the TARGet Kids! Cohort (73.1% mothers, mean age=38.88±4.45 years) participated from 2014 to 2020. Parents reported parental and child time on TV and handheld devices and completed the Strengths and Difficulties Questionnaire (SDQ). Latent profile analysis (LPA) was used to identify groups of parents with similar patterns of screen use and link these profiles with child screen time and SDQ.

Results:

We identified six latent profiles of parent screen use: low users (P1, reference; n=323), more TV than handheld (P2; n=261), equal TV and handheld (P3; n=177), more handheld than TV (P4; n=57), high TV and handheld (P5; n=38) and extremely high TV and handheld (P6; n=11). P6 were more likely to be living in single parent households compared to P1 (estimate=-1.49(0.70), p=0.03). P2 (estimate=-0.67(0.32), p=0.04) and P4 (estimate=-1.42(0.40), p<0.001) were more likely to have lower household income compared to P1. P4 ($\chi^2=12.32$, p<0.001) and P5 ($\chi^2=9.54$, p=0.002) have higher total child screen time compared to P1. P6 ($\chi^2=6.82$, p=0.009) had higher total SDQ compared to P1.

Interpretation:

Patterns of parent screen use were associated with child screen use and child socioemotional problems. The link between parental screen use profiles and child behaviours suggests a need for guidelines on parental screen time.

Introduction

From the introduction of television in the mid-twentieth century to the introduction of the iPhone in 2007, screens have become increasingly prevalent, powerful, and portable in our everyday life. While our screens offer many benefits, they also bear some risks (1-3). On the one hand, we use TV and handheld devices to entertain ourselves, relieve stress, work, or regulate boredom (4). On the other hand, many screen apps are designed to keep people engaged as long as possible (5) and although immediate access to virtual social networks can provide social support, strengthen social relationships and increase feelings of connectedness with family, friends and other people (6), screens can also decrease the time we spend in real-life social interactions. In the family environment, parental distraction by screens and parental screen-use modeling might be particularly detrimental for young children, because direct parent-child interactions are essential for healthy child development (7-9), and establishment of mental wellbeing (10-16). Despite findings on the detrimental effects of parental TV (17), parental handheld devices (9, 17) or total screen time (18) on child screen time and developmental outcomes, the impact of parents' *patterns* of TV and handheld device use is poorly understood. Moreover, a handheld device is commonly more distracting compared with a television (19), as it is used more actively and individually instead of passive (co-) viewing (20). Accordingly, we need to contrast handheld device use with TV screen use. Finally, we need to examine how these screen time patterns are linked to demographic factors and child outcomes, in order to develop guidelines for parental screen time and plan targeted prevention programs for parents.

The overall aims of this cross-sectional study were (1) to identify patterns in parental TV versus handheld screen use, (2) to identify parent sociodemographic characteristics associated with variation in patterns, and (3) to examine associations between patterns of parent screen use profiles and screen time and socioemotional problems among children. Because absorption of

attention may be higher for handheld devices leading to reduced parent-child interactions in contrast to TV, we hypothesized that profiles characterized by higher use of handheld devices would be associated with higher screen time and higher socioemotional problems among children. These aims were achieved by using a latent profile analysis (LPA) on data from the TargetKids cohort, which measured screen time of parent and child, sociodemographic characteristics, as well as child developmental health outcomes.

Materials and Methods

Participants

This prospective, cross-sectional study sample ($N = 867$) was drawn from families participating in the TARGet Kids! cohort (21), an ongoing registry of children living in Toronto, Canada at well-child visits. Inclusion criteria for the present study were parents of children aged 5 years, with no associated health conditions affecting growth (e.g., failure to thrive, cystic fibrosis), children with no chronic condition(s) except for asthma, children with no diagnosis of autism or severe developmental delay, and families who are fluent in English. Data were collected January 01, 2014 through December 30, 2019. The earliest data collection date, January 01, 2014, was selected to control for the market penetration of smart phones in the Canadian population. By 2014, smart phone market penetration reached more than 80% of the mobile phone market, compared to 73% in 2013 and 53% in 2012 (22, 23). All participants indicated owning at least one handheld device and answered at least one question about parent screen use. The latest collection date, December 31, 2019, was selected to exclude the impact of the COVID-19 pandemic (24) on screen usage (25) (Figure 1). The study was approved by the Research Ethics Boards at participating sites and families provided informed consent.

Measured variables

Demographics. Child and family level sociodemographic characteristics were measured using the TARGet Kids! data collection instruments adapted from the Canadian Community Health Survey (CCHS) (26).

Parent screen time by screen modality. Daily parent screen use by modality and average total child screen time were measured in minutes using validated parent-completed questions from the Canadian Health Measure Survey (CHMS) (27). Parents reported screen use on TV, DVD, handheld devices, computer/laptop, and gaming consoles, for themselves and for their child on a typical weekday and weekend day. We combined TV and DVD minutes as both are typically passive-consumption without active human-machine interface. Parent screen use was calculated by multiplying weekday minutes by five, weekend minutes by two for TV/DVD and for handheld. The two products were summed then divided by seven for average use per day per screen modality.

Total child screen time. To assess child total screen time, the same procedure as described above was applied, but summed across all screen modalities (27).

Child socioemotional problems. The Strengths and Difficulties Questionnaire (SDQ) is a validated parent-report that identifies socioemotional problems in children 4 to 16 years (28). We used the SDQ Total Difficulties score, which ranges from 0 to 40, where population norms from the USA and the UK indicate scores ≤ 11 -12 are within normal range (29).

Data analysis

Data preparation and descriptive statistics. Data were prepared using R version 3.6.0 (30) and RStudio version 1.2.1335 (31) with *tableone* (32), *pastecs* (33), *tidyverse* (34), and *lubridate* (35) to prepare the data for analysis and obtain descriptive statistics (Table 1). Data missing on profile indicators were handled with the maximum likelihood estimator in Mplus.

Data missing on antecedents and distal outcomes was imputed using the *missForest* (36) package in R.

Latent profile analysis (LPA). To identify profiles in parent screen use by screen modality, we used LPA. LPA is a person-centred analytic method to identify unobserved (latent) groups within a dataset based on similar patterns of responding to indicator variables (TV/DVD minutes; handheld minutes). LPA is an exploratory approach that provides greater real-world relevance as to how parent screen use manifests, beyond looking at a single screen modality or total screen use. Further, LPA allows consideration for how these latent profiles in parent screen use would be associated with child outcomes.

We selected the most likely model based on fit indices (BIC, ABIC, Lo-Mendell-Rubin (LMR) likelihood ratio test to indicate model fit improvement compared to k-1 profiles; Table 2), multivariate entropy values (wherein higher values indicate higher accuracy of classification), parsimony, and interpretability (37, 38). To improve parsimony and convergence, variance and covariance were constant across profiles. Indicator means for all classes from the best-fitting model were generated (Table 3; Figure 2). To determine parent-related sociodemographic variables associated with the probability of profile membership, we used Wald tests within the LPA (39).

To examine the association of parent screen use profile with child total screen time and with child total difficulties on the SDQ, we used the three-step BCH method employing posterior probabilities (40, 41). Wald tests evaluate differences between profiles on distal outcomes for both the omnibus test and for all pairwise comparisons (42). All LPA analyses were conducted in Mplus version 8.1 (43) and run with imputed datasets (see Results) and unimputed datasets (see Supplement S1).

Results

Participant characteristics. Our participants were on average 38.88 ± 4.45 years old, 73.1% female, 91.6% living in two-parent households, and 84.9% with income greater than 60,000CAD per year (Table 1). On average, parents viewed TV/DVD for around 1 hour per day and spent just over half an hour on a handheld device (Table 1). Total daily screen time for children was commonly between 1 and 1.5 hours per day (Table 1). Mean SDQ score was 7.3 (Table 1).

Latent profile analysis. Based on fit indices and parsimony, a 6-class model was the best fitting solution (Table 2). To guide interpretation, profile parameter estimates of minutes of screen use by modality, along with estimates of total minutes of parent screen use derived from profile parameters, are provided in Table 3. Figure 2 displays screen use by modality for each of the six profiles. Univariate entropy indicated that time spent on handheld devices (0.96) contributed to profile differentiation more so than time spent on TV/DVD (0.21).

P1 (*Low handheld users*) was characterised by just less than one hour TV/DVD time per day on average and very low use of handheld devices. P1 was the largest profile ($n=323$, 37.25%) and was the reference profile in all subsequent analysis. P2 (*More TV/DVD than handheld*) was characterised by around one hour of TV/DVD and 30-minutes of handheld devices per day on average. P3 (*Equal users*) was characterised by one hour spent on each modality per day on average. The remaining three profiles all had higher amounts of time spent on handheld devices compared to TV/DVD: P4 (*More handheld than TV/DVD*; 1 hours TV/DVD, 1.5 hours handheld, $n=57$, 6.57%); P5 (*High users*; 1.5 hours TV/DVD, 2 hours handheld, $n=38$, 4.38%); and P6 (*Extremely high users*; >1.5 hours TV, almost 3 hours of handheld, $n=11$, 1.27%). While the *Extremely high users* profile was quite small, it was distinct from all other profiles due to early emergence in the iterative model-fitting process and high mean posterior probability ($pp=1$).

Sociodemographic characteristics associated with parent screen use patterns. Per Wald tests, there were no significant associations with parent assigned sex, indicating that within our sample, mothers and fathers were equally likely to belong to each of the profiles identified. However, there were significant associations between probability of membership for *Extremely high users* (P6) and living arrangements, indicating that *Extremely high users* (P6) were more likely to be in single parent households compared to *Low handheld users* (P1; Table 4). There was also a marginal association between probability of being in *High users* (P5) and being in a single parent households compared to the *Low handheld users* (P1). There was a significant association between household income less than 60,000CAD and the probability of being in *More TV/DVD than handheld* (P3) compared to *Low handheld* (P1). There was also a significant association between low household income and the probability of being in *More handheld than TV/DVD* (P4) compared to *Low handheld* (P1). There was a marginal association between low household income and the probability of being in the *Extremely high users* (P6) compared to the *Low handheld* (P1), likely due to the small number of participants in this profile (Table 4). Results with unimputed data were largely the same (see Supplement S1).

Parent screen use patterns and screen use and socioemotional difficulties among children. Members of all three profiles with more handheld time than TV/DVD (*More handheld than TV/DVD* (P4), *High users* (P5), *Extremely high users* (P6)) had significantly higher total child screen time compared to *Low handheld users* (P1; Table 5).

With regard to child total difficulties score on the SDQ, members of the *Extremely high users* (P6) had significantly higher child SDQ scores compared to the *Low handheld users* (P1; Table 5). Results with unimputed data were largely the same (see Supplement S1).

Discussion

We identified six distinct profiles in parent TV/DVD and handheld screen use. Compared to a low screen use reference profile, some of the parental profiles with more time on screens were associated with the probability to be a single-parent household, or have low family income. In turn, parent profiles with elevated screen time were associated with more total *child* screen time. Moreover, the parent profile with the pattern of highest use on both handheld devices and TV/DVD was associated with more *child* socioemotional problems. Overall, 6% of parents reached or even exceeded the daily recommendation of Canadian guidelines of no more than three hours of recreational screen time per day (44). The limit was exceeded primarily due to the time that parents spent on their handheld devices.

With regard to antecedents, we found that compared to P1, parents with *More TV/DVD than Handheld* (P2), and to a lesser extent parents with *more Handheld than TV/DVD* (P4), were more likely to report low income. In addition, members of the *Extremely high user* (P6) profile were more likely to be single parents compared to P1. Thus, one might speculate that parents with lower resources available to them might have to juggle work- or private life or regulate stress using handheld devices and the applications or activities available within the device (45). However, whether and why these socioeconomic factors are linked to time spent on handheld devices should be confirmed in future studies.

We also found links between parental screen time profiles and child outcomes, including child total screen time and socioemotional problems. Increased child screen use might be explained by parental attitudes towards the use of screens, parents as role models, or parental mediation of screen use (17, 46). Increased child socioemotional problems might be explained by disrupted parent-child interactions (14), although there are many other risk factors for child socioemotional problems (47-49). However, one might argue that these “high user” profiles were

small. Nevertheless, to understand patterns of parental screen use and its impact on child outcomes, it is important to include these profiles because they represent a group of parents with problematic screen use patterns that might have a potential impact on parent-child interactions and child healthy development. Thus, this group of parents might be a potential target for interventions to address screen use through education, amelioration of stress, alternative coping strategies, and increased support.

Engaging with parents around their own screen use, particularly handheld use, and its potential effect on their children may help clinicians to sensitize parents and increase awareness of their own recreational use. Most parents are concerned with the effects of too much child screen use, but they are less inclined to question their own digital media use (45). Moreover, parents often underestimate their handheld use (50), which is not surprising considering that smartphone apps are designed to engage people as long as possible (19). Many app features include push notifications, colorful pictures, and rewarding sounds to increase usage time (19). In light of the link between parental screen time of approximately three hours and adverse child socioemotional outcomes, we suggest parents should follow the more restrictive US guidelines recommending a two-hour limit for daily recreational screen time.

This study has several strengths: first, we have harnessed data from a large dataset to examine patterns in parental screen use, considering antecedents and child outcomes, using appropriate statistical methods. However, the results need to be interpreted in light of some limitations, such as parental-reports, which may be subject to bias (50). This issue could be overcome by getting data directly from devices (e.g., see 51). Another limitation is the use of cross-sectional data, which may obscure bidirectional effects between parent screen use and difficult child behaviours (14). Further, findings on the *Extremely high users* profile requires

replication with a larger sample or one specifically selected for high screen use. Finally, the sample consisted of mostly high income, bi-parental families.

These results indicate that some parents have problematic screen use, primarily driven by time on handheld devices. Screen use may represent a novel coping mechanism under conditions of low resources, such as low income or single-parent households. Parent screen time can be assessed along with child screen time during well child visits to increase awareness, provide opportunities for parent education, and improve child outcomes.

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The authors declare no conflicts of interest relevant to this manuscript.

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Table 1. Participant characteristics (*n* = 867).

	<i>n</i> (%)	<i>Mean (SD)</i>	<i>% Missing</i>
Parent assigned sex			
Female (1)	634 (73.1)		8.7%
Male (2)	158 (18.2)		
Data collection year			
2014	170 (19.6)		0.0%
2015	152 (17.5)		
2016	182 (21.0)		
2017	154 (17.8)		
2018	137 (15.8)		
2019	72 (8.3)		
Living arrangements			
Single parent household (0)	73 (8.4)		0.2%
Two-parent household (1)	792 (91.6)		
Income			
< \$60K (0)	101 (15.1)		23.0%
\$60K + (1)	567 (84.9)		
Mother education level			
Less than university	53 (6.2)		1.3%
College or university degree	803 (93.8)		
Mother ethnicity/ancestry			
European ancestry	478 (63.5)		13.1%
Non-European ancestry	275 (36.5)		
Father ethnicity/ancestry			
European ancestry	481 (65.0)		14.6%
Non-European ancestry	259 (20.4)		
Parent average daily screen use (min)			
TV/DVD	755	61.3 (43.8)	12.9%
Handheld device	855	35.1 (35.9)	1.4%
Child average daily screen use (min)	678	80.8 (56.5)	21.8%
Child total difficulties score (SDQ)	535	7.3 (4.6)	38.3%

Table 2. Model selection fit indices with starts = 2000 500

# of profiles	BIC	aBIC	Multivariate		aLMR (LRT)		BLRT	BLRT p
			Entropy	comparitors	aLMR (LRT)	p		
2	16280.417	16258.2	0.91	2 vs 1	157.5	0.0000	-8199.2	0.0000
3	16193.094	16161.3	0.84	3 vs 2	102.6	0.0011	-8116.5	0.0000
4	16140.84	16099.6	0.88	4 vs 3	69.1	0.0002	-8062.7	0.0000
5	15927.446	15876.6	0.94	5 vs 4	222.7	0.0039	-8026.4	0.0000
6	15730.701	15670.4	0.96	6 vs 5	206.8	0.0029	-7909.6	0.0000
7	15695.823	15626.0	0.95	7 vs 6	52.6	0.3408	-7801.1	0.0000

Anything we should add here in the notes section?

Table 3. Estimated means for indicators in each identified profile.

Profile #	Profile Name	TV/DVD (min)	Handheld (min)	n	%	Total time (hours/mins)
1	Low handheld users (reference)	54.8	1.9	323	37.3%	0h57
2	More TV/DVD than handheld	61.8	30.0	261	30.1%	1h32
3	Equal users	64.6	59.6	177	20.4%	2h04
4	More handheld than TV/DVD	63.6	84.3	57	6.6%	2h28
5	High users	87.3	119.5	38	4.4%	3h27
6	Extremely high users	96.8	173.6	11	1.3%	4h30

Table 4. Demographic characteristics associated with probability of profile membership with missing values imputed in R *missForest* package.

	<i>Low Handheld users (reference)</i>	<i>More TV/DVD than Handheld</i>	<i>Equal TV/DVD & Handheld</i>	<i>More Handheld than TV/DVD</i>	<i>High users</i>	<i>Extremely high users</i>
Parent assigned sex						
<i>mean (SE)</i>	-	-0.46 (0.2)	0.06 (0.2)	0.18 (0.4)	0.07 (0.4)	-0.69 (1.1)
<i>p (against reference class)</i>	-	0.06	0.79	0.62	0.87	0.52
Living arrangements						
<i>mean (SE)</i>	-	-0.01 (0.4)	0.02 (0.4)	0.50 (0.6)	-0.85 (0.5)	-1.49 (0.7)
<i>p (against reference class)</i>	-	0.98	0.96	0.38	0.09	0.03
Income						
<i>mean (SE)</i>	-	-0.67 (0.3)	-0.55 (0.3)	-1.42 (0.4)	-0.33 (0.5)	-1.31 (0.7)
<i>p (against reference class)</i>	-	0.04	0.10	< 0.001	0.53	0.06

Table 5. Child attributes associated with probability of profile membership with missing values imputed in R *missForest* package.

	<i>Low handheld users (reference)</i>	<i>More TV/DVD than Handheld</i>	<i>Equal users</i>	<i>More handheld than TV/DVD</i>	<i>High users</i>	<i>Extremely high users</i>
Total child screen time (mins/day)						
<i>mean (SE)</i>	72.1 (2.7)	77.8 (4.3)	79.9 (4.3)	117.2 (12.4)	115.5 (13.9)	117.0 (29.7)
<i>p (against reference class)</i>	-	0.28	0.13	> 0.001	0.002	0.13
SDQ total score						
<i>mean (SE)</i>	7.5 (0.3)	7.0 (0.2)	7.0 (0.3)	7.4 (0.5)	7.9 (0.5)	13.0 (2.1)
<i>p (against reference class)</i>	-	0.14	0.20	0.73	0.51	0.009

Figure 1. Flow diagram for participant inclusion.

Figure 2. Parent screen use profiles by screen modality.

Supplement

Table S1. Antecedents of parent screen use profiles with unimputed data.

	1	2	3	4	5	6
	Low Handheld users (reference)	More TV/DVD than Handheld	Equal TV/DVD & Handheld	More Handheld than TV/DVD	High users	Extremely high users
Parent assigned sex						
<i>estimate (SE)</i>	-	-0.44	0.03	0.50	0.03	0.43
<i>p (against reference class)</i>	-	0.13	0.91	0.25	0.96	0.70
Living arrangements						
<i>estimate (SE)</i>	-	-0.10	-0.19	0.14	-0.90	-2.81
<i>p (against reference class)</i>	-	0.80	0.64	0.81	0.10	< 0.001
Income						
<i>estimate (SE)</i>	-	-0.63	-0.61	-1.57	-0.48	-1.19
<i>p (against reference class)</i>	-	0.06	0.08	< 0.001	0.36	0.14

Table S2. Child variables associated with parent screen use profiles with unimputed data.

	1	2	3	4	5	6
	Low Handheld users (reference)	More TV/DVD than Handheld	Equal TV/DVD & Handheld	More Handheld than TV/DVD	High users	Extremely high users
Total child screen time						
mean (SE)	69.83 (3.63)	78.14 (5.64)	79.61 (5.86)	118.28 (13.95)	113.18 (11.22)	145.22 (35.90)
<i>chi-square</i>	-	1.34	2.05	10.48	13.54	4.39
<i>p (against reference class)</i>	-	0.25	0.15	0.001	> 0.001	0.036
SDQ total score						
mean (SE)	7.57 (0.38)	7.08 (0.49)	6.72 (0.41)	7.05 (0.74)	8.00 (0.70)	9.57 (2.06)
<i>chi-square</i>	-	0.523	2.361	0.384	0.293	0.939
<i>p (against reference class)</i>	-	0.470	0.124	0.535	0.588	0.333

Figure S1. Profiles in parent screen use relative to (A) total child screen time and (B) child total SDQ score.