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Patterns of parent screen use, child screen time, and child socio-emotional problems at 5 years

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Abstract

Digital media screens have become an essential part of our family life. However, we have insufficient knowledge about parental screen use patterns and how these affect children's socio-emotional development. In total, 867 Canadian parents of 5-year-old children from the TARGet Kids! Cohort (73.1% mothers, mean ± SD age = 38.88 ± 4.45 years) participated in this study from 2014 to the end of 2019. Parents reported parental and child time on television (TV) and handheld devices and completed the Strengths and Difficulties Questionnaire (SDQ). Latent profile analysis identified six latent profiles of parent screen use: low handheld 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; $n = 11$). Parents that were more likely to belong to P6 were also more likely to be living in single-parent households compared to P1 (estimate = −1.49 ± 0.70), $p = .03$). High membership probability for P2 (estimate = −0.67 ± 0.32, $p = .04$) and P4 (estimate = −1.42 ± 0.40, $p < 0.001$) was associated with lower household income compared to P1. Children of parents with higher P4 ($\chi^2 = 12.32$, $p < 0.001$) or P5 ($\chi^2 = 9.54$, $p = .002$) membership probability had higher total screen time compared to P1. Finally, a higher likelihood to belong to P6 ($\chi^2 = 6.82$, $p = .009$) was associated with a higher SDQ Total Difficulties Score compared to P1. Thus, patterns of parent screen use were associated with child screen use and child socio-emotional problems. The emerging link between parental screen use profiles and child behaviors suggests the need for more research on parent screen time.

KEYWORDS
child socio-emotional development, handheld devices, latent profile analysis, parenting and digital media, television

Katherine T. Cost and Eva Unternaehrer contributed equally to this work.

1 | INTRODUCTION

From the introduction of television (TV) in the mid-twentieth century to the introduction of the iPhone (Apple Inc.) in 2007, screens have become increasingly powerful, portable, and prevalent in our everyday life. Although 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] 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 face-to-face social interactions.

In the family environment, parental distraction by screens (parental technoference, phubbing) 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 mental well-being.[10–16] Despite findings on the detrimental associations of parental TV,[17] parental handheld devices[9,17] or total screen time[18] with child screen time and developmental outcomes, the link between parents' *patterns* of TV and handheld device use is poorly understood. Although it might seem hard to disentangle activities on TV and handheld devices (ie., one could stream movies together on both screen modalities), similar to other adults, parents are often more immersed in handheld compared to TV screen content, even when their child shows risky attention seeking behaviors.[19,20] Parents also show decreased responsiveness and increased harshness toward their child's bids for attention when engaged on a handheld device compared to other distracting tasks.[8,19,20] Additionally, content on handheld devices is typically consumed alone.[5] Indeed, a nationally representative study in the UK assessing time diary data found that mobile device use was common during alone-together time,[21] suggesting that parents and children use handheld devices individually, rather than together. A recent study has examined typologies of families based on both parent and child screen time taking into account time spent on TV, tablet/smartphone, computer/laptop, and electronic gaming.[22] Three classes of families emerged, including (1) relatively low users; (2) high users of computers for homework and leisure; and (3) high users of TV as well as tablets/smartphones for homework and leisure. These profiles were in turn associated with factors from the physical, parenting, and policy environment. This previous study examined children of around 11 years old, included both parent and child screen time as indicators for classes, and used binary indicators. However, it is important to also study families with younger children because screen exposure often begins before school age.

Both prolonged and frequent screen use have been linked to mental well-being in the user, including parents. For example, excessive or problematic screen use, particularly on smartphones (i.e., constant checking behavior) has been associated with higher levels of depression, stress, anxiety, externalizing symptoms, and sleep disturbances,[1–3,23] as well as reduced emotion regulation skills, lower mindfulness, certain personality characteristics,[24] stress, or loneliness.[25] These associations with mobile screen use are important to consider in parents because they might also contribute to changes in parenting.[7,8,19,20]

Because handheld use has very specific impacts on parent–child interactions as compared to TV use,[8,19,20] we need to examine screen time patterns considering different devices, and not only total screen time quantity per se. A handheld device is commonly more distracting compared to a TV because it is used more actively and individually instead of passive (co-)viewing.[26] Accordingly, we need to contrast handheld device use with TV screen use. Additionally, we need to investigate how these patterns are linked to demographic factors and child outcomes, aiming to develop guidelines for parent screen time and plan targeted prevention and harm-reduction programs for parents.[27] Understanding how parents are using screens and how these patterns of use are linked with parent-, child- and family characteristics may facilitate more productive interventions when indicated.

The overall aims of this cross-sectional study were:

1. To identify patterns of TV and handheld screen use by parents of children aged 5–6 years.

2. To identify parent sociodemographic characteristics associated with variation in these patterns.

3. To examine associations between patterns of parent screen use profiles and screen time and socio-emotional problems among children.

Given that absorption of attention may be higher for handheld devices leading to reduced parent–child interactions in contrast to TV,[26] we hypothesized that profiles characterized by higher use of handheld devices would be associated with higher screen time and more socio-emotional problems among children. These aims were achieved by using a latent profile analysis (LPA) on data from the TARGet Kids! cohort, which measured screen time of parent and child, sociodemographic characteristics, and child developmental health outcomes.

2 | METHODS

2.1 | Participants

This prospective, cross-sectional study sample (n 867) was drawn from families participating in the TARGet Kids! cohort,[28] an ongoing registry of children living in Toronto, Canada, recruited 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 1, 2014, through December 30, 2019. The earliest data collection date, January 1, 2014, was selected to control for the market penetration of smartphones in the Canadian population. By 2014, smartphone market penetration reached more than 80% of the mobile phone market, compared to 73% in 2013 and

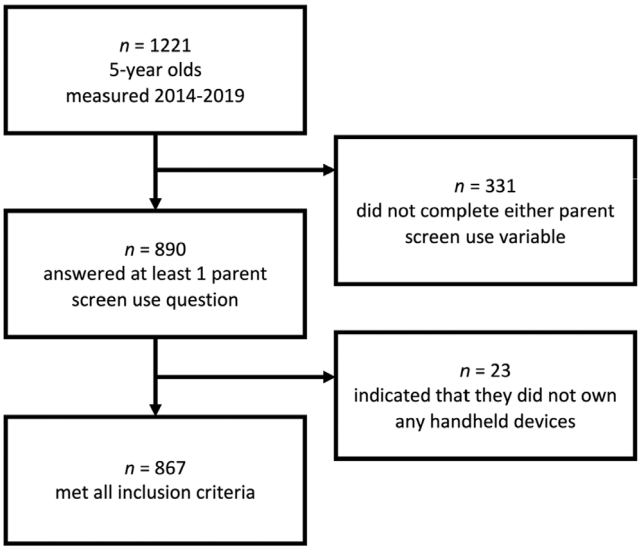

FIGURE 1 Flow diagram for participant inclusion and reasons for exclusion.

53% in 2012.[29,30] All participants indicated owning at least one handheld device and answered at least one question about parent screen use. A study flow chart is provided in Figure 1. The latest collection date of this cross-sectional study was December 31, 2019, which was selected to exclude the impact of the COVID-19 pandemic[31] on screen usage.[32] The study was approved by the Research Ethics Boards at participating sites and families provided informed consent.

2.2 | Measured variables

2.2.1 | Demographics

Child and family-level sociodemographic characteristics were measured using the TARGet Kids! data collection instruments adapted from the Canadian Community Health Survey (CCHS).[33] Sociodemographic measures included child and parent sex assigned at birth (male vs. female), household income category based on provincial tax-credit low-income cut-offs (< 60,000 CAD vs. ≥ 60,000 CAD), ethnicity/ancestry of mother and father, data collection year (2014 to 2019), living arrangements (single vs. two-parent household), and maternal education level (less than College/University degree vs. College or University degree).

2.2.2 | 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).[34] Parents reported screen use on TV, digital video disc (DVD), handheld

TABLE 1 Participant characteristics (*n* 867)

	n (%)		% Missing
Sex of the parent assigned at birth			
Female (1)	634 (73.1)		8.7%
Male (2)	158 (18.2)		
Sex of the child assigned at birth			
Female	411 (47.4)		0%
Male	456 (53.6)		
Data collection year			
2014	170 (19.6)		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			
< $60,000 (0)	101 (15.1)		23.0%
≥ $60,000 (1)	567 (84.9)		
Mother education level			
Less than University	53 (6.2)		1.3%
College or University degree	803 (93.8)		
	Mothers *n* (%)	**Fathers *n* (%)**	
Ethnicity/Ancestry			
European	496 (63.6)	500 (65.2)	
East Asian	58 (7.4)	31 (4.0)	
South Asian	82 (10.5)	85 (11.1)	
Southeast Asian	20 (2.6)	19 (2.5)	
Arab	11 (1.4)	7 (0.9)	
African	30 (3.9)	59 (7.7)	
Latin American	21 (2.7)	17 (2.2)	
Mixed	60 (7.7)	47 (6.1)	
Other	2 (0.3)	2 (0.3)	
Missing	120 (13.3)	133 (14.8)	

	n	Mean (SD)	Range	% Missing
Parent average daily screen use (min)				
TV or DVD	755 (87.1)	61.3 (43.8)	0 240	12.9%
Handheld device	855 (98.6)	35.1 (35.9)	0 197	1.4%
Child average daily screen use (min)	678 (78.2)	80.8 (56.5)	0 371	21.8%
Child total difficulties score (SDQ)	535 (61.7)	7.3 (4.6)	0 26	38.3%

Abbreviations: DVD, digital video disc; SDQ, Strengths and Difficulties Questionnaire; TV, television.

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 because both are typically consumed passively without an active human-machine interface. Parent screen use was calculated by multiplying weekday minutes × 5 and weekend minutes × 2 for TV or DVD and for handheld. The two products were summed and then divided by 7 for average use per day by screen modality. We did not examine computer/laptop use because whether parents used these devices for work or leisure was not assessed. In addition, gaming consoles were also not included in our analyses because only very few parents reported playing with video game consoles (2.5% of parents spent between 2–21 min per day^{-1}).

2.2.3 | Child outcome measures

Total child screen time. To assess child total screen time, the same procedure as described above was applied but durations were summed across all screen modalities.[34]

Child socio-emotional problems. The Strengths and Difficulties Questionnaire (SDQ) is a validated parentreport measure that identifies socio-emotional problems in children 4 to 16 years.[35] The SDQ consists of five subscales, including emotional problems, hyperactivity, conduct problems, peer problems, and prosocial behaviour. We used the SDQ Total Difficulties Score (sum of subscale scores except for prosocial behavior), which ranges from 0 to 40, where population norms from the USA and the UK indicate that scores ≤ 11–12 are within the normal range.[36] The SDQ subscales have a good internal consistency (Cronbach's alpha from 0.77 to 0.82) and test–retest-reliability (r_{12} 0.77).[37] Cronbach's alpha in our sample was 0.754 (95% confidence interval 0.716–0.787), indicating good internal consistency.

2.3 | Data analysis

2.3.1 | Data preparation and descriptive statistics

Data were prepared using R, version 3.6.0[38] and Rstudio, version 1.2.1335[39] with *tableone*, version 0.13.1,[40] *pastecs*, version 1.3.21,[41] *tidyverse*, version 1.3.2[42] and *lubridate*, version 1.9.0[43] to prepare the data for analysis and obtain descriptive statistics (Table 1). Data missing on profile indicators were handled using the full information maximum likelihood estimator in Mplus.[44] Data missing on antecedents and distal outcomes were imputed using the *missForest*, version 1.4[45] package in R. Graphical illustrations were created using *ggplot2*, version 3.4.0.[46]

2.3.2 | LPA

To identify profiles in parent screen use by screen modality, we used LPA in MPlus.[44] LPA is a person-centered analytic method to identify unobserved (latent) groups within a dataset based on similar patterns of responding to indicator variables (TV or 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. LPA has minimal assumptions for the data; however, indicators must be continuous and the method assumes a non-homogenous population (ie., there are unobserved subgroups). These assumptions were met because screen time duration was continuously measured in minutes per day and we observed variance in the amount of time spent on different devices (0–240 min on TV/DVD and 0–197 min on handheld). Furthermore, LPA allows consideration for how these latent profiles in parent screen use would be associated with sociodemographic characteristics and child outcomes considering continuous posterior probabilities of group membership, rather than discrete group assignment ("hard-calls"), avoiding the problem of unequal and small group sizes and discrete categorization.

We selected the most likely model based on fit indices (Bayes information criterion, adjusted Bayes information criterion, and Lo–Mendell–Rubin likelihood ratio test to indicate model fit improvement compared to k – 1 profiles; Table 2), multivariate entropy values (where higher values indicate higher accuracy of classification), and model parsimony and interpretability.[47–49] To improve parsimony and convergence, variance and covariance were held constant across profiles. Indicator means with individual data points for all classes from the best-fitting model were generated (Figure 2 and Table 3). To determine parent-related sociodemographic variables associated with the probability of profile membership, we used Wald tests within the LPA.[50]

To examine the association of parent screen use profile with child total screen time and with child total difficulties on the SDQ we used Wald tests to evaluate differences between profiles on distal outcomes for both the omnibus test and for all pairwise comparisons.[51]

All LPA analyses were conducted in Mplus, version 8.1[43] and run with imputed datasets (see Results) and unimputed datasets (see Table S1 and Table S2, in Appendix). All testing of associations between profile membership probabilities and sociodemographics and child outcomes was conducted using the three-step BCH method employing posterior probabilities (measurement error as part of the latent construct to avoid discrete group assignment).[52,53] MPlus analysis scripts can be found in the Supporting information (MPlus Script S3). All MPlus output is available upon request. Data for this study is not available due to ethical considerations.

3 | RESULTS

3.1 | Participants characteristics

Our participants were 38.88 ± 4.45 years old (mean ± SD), 73.1% female, with 91.6% living in two-parent households and 84.9% with an income greater than 60,000 CAD per year (Table 1). On average, parents viewed TV or DVD for around 1 h day^{-1} and spent just over 30 min on a handheld device (Table 1). Total daily screen time for children was commonly between 1 and 1.5 h day^{-1} (Table 1). Mean Total SDQ score was 7.3 (Table 1). A correlation heatmap of all bivariate associations between study variables can be found in the Supporting information, S4, in Appendix S1.

TABLE 2 Model selection fit indices (model starts 2000 500[a])

Number of profiles in Model	BIC	aBIC	Multivariate Entropy	Comparison	aLMR (LRT)	aLMR (LRT) *p*	BLRT	BLRT *p*
2	16280.417	16258.2	0.91	*2* vs. *1*	157.5	.0000	−8199.2	<.0001
3	16193.094	16161.3	0.84	*3* vs. *2*	102.6	.0011	−8116.5	<.0001
4	16140.84	16099.6	0.88	*4* vs. *3*	69.1	.0002	−8062.7	<.0001
5	15927.446	15876.6	0.94	*5* vs. *4*	222.7	.0039	−8026.4	<.0001
6	**15730.701**	**15670.4**	**0.96**	***6* vs. *5***	**206.8**	**.0029**	**−7909.6**	**<.0001**
7	15695.823	15626.0	0.95	*7* vs. *6*	52.6	.3408	−7801.1	<.0001

Note: Lower (a) BIC indicates better model fit. Higher multivariate entropy indicates better separation of classes. A lower adjusted Lo Mendell Rubin (aLMR) indicates that the present model (*k* classes) better fits the data than the one in the comparison column (*k* 1 class). A lower BLRT indicates that the model is superior to the one in the comparison column. One needs to consider all fit indices in evaluating which model best fits the data. Here, the model with six classes (bold font) has the best overall fit considering multiple indices simultaneously.
Abbreviations: aBIC, adjusted Bayes information criterion; BLRT, Bayes likelihood ratio test; LRT, likelihood ratio test.
[a]Refers to the number of model starts to find the maximum log Likelihood Value (2000) and the number of models permitted to run to completion to generate a log Likelihood Ratio (500). A higher number of starts increases the confidence in a global solution as opposed to a local solutions.

TABLE 3 Estimated means for TV/DVD and handheld use and number of parents and total screen use time for each of the profiles identified in the latent profile analysis

Profile #	Profile name	TV or DVD (min)	Handheld (min)	*n*	%	Total time (h and min)
P1	Low handheld users (reference)	54.8	1.9	323	37.3%	0 h 57
P2	More TV/DVD than handheld users	61.8	30.0	261	30.1%	1 h 32
P3	Equal users	64.6	59.6	177	20.4%	2 h 04
P4	More handheld than TV/DVD users	63.6	84.3	57	6.6%	2 h 28
P5	High users	87.3	119.5	38	4.4%	3 h 27
P6	Extremely high users	96.8	173.6	11	1.3%	4 h 30

Abbreviations: DVD, digital video disc; P, profile; TV, television.

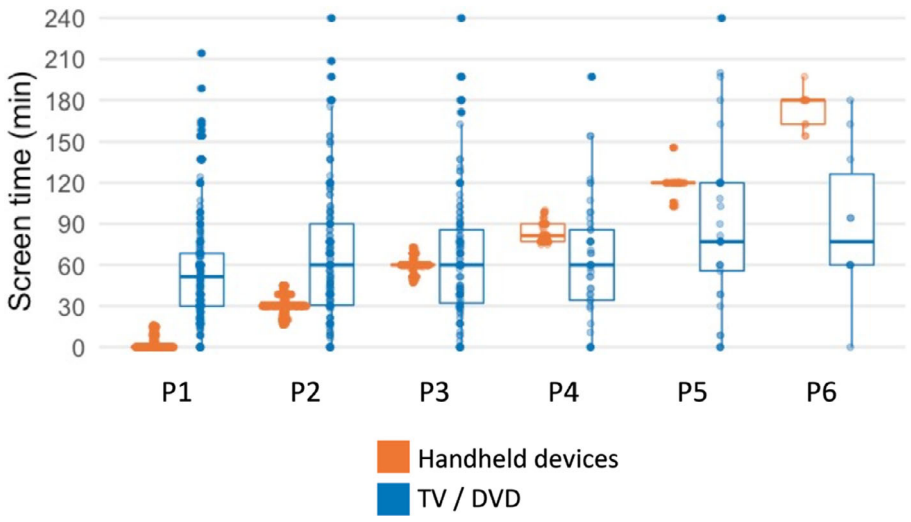

FIGURE 2 Parent duration of screen use by latent profiles and screen modality. P1, low handheld users (reference group); P2, more television (TV) or digital video disc (DVD) than handheld users; P3, equal handheld and TV/DVD users; P4, more handheld than TV or DVD users; P5, high users; P6, extremely high users.

3.2 | LPA

Based on fit indices and parsimony, a six-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 shows screen use time 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 or DVD (0.21).

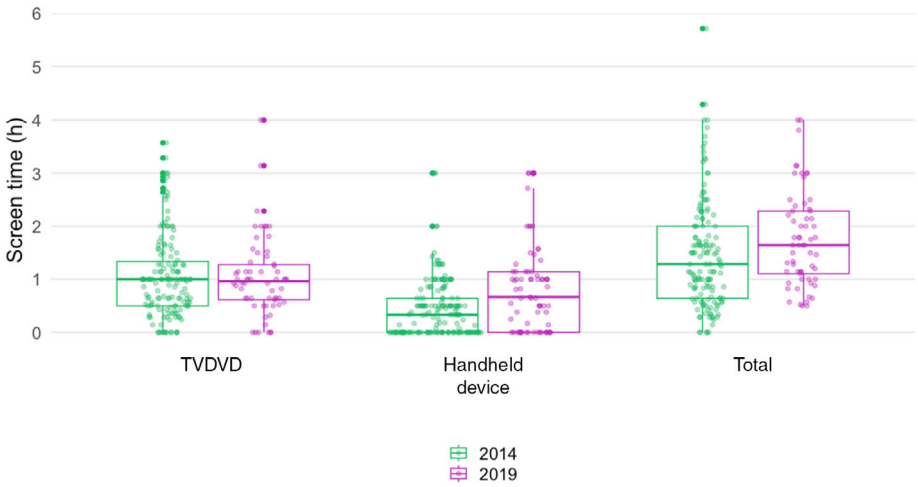

FIGURE 3 Screen time (in hours) on television or digital video disc (TV/DVD) and handheld devices, as well as total screen time in 2014 compared with 2019.

P1 (*Low handheld users*) was characterized by just less than 1 h day^{-1} of TV or DVD time 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 analyses. P2 (*More TV or DVD than handheld*) was characterized by approximately 1 h day^{-1} of TV or DVD and 30 min day^{-1} of handheld devices on average. P3 (*Equal users*) was characterized by 1 h day^{-1} spent on each modality on average. The remaining three profiles all had higher amounts of time spent on handheld devices compared to TV or DVD: P4 (*More handheld than TV or DVD*; 1 h day^{-1} of TV or DVD, 1.5 h day^{-1} of handheld, n 57, 6.57%); P5 (*High users*; 1.5 h day^{-1} of TV or DVD, 2 h day^{-1} of handheld, n 38, 4.38%); and P6 (*Extremely high users*; > 1.5 h day^{-1} of TV or DVD, almost 3 h day^{-1} of handheld, n 11, 1.27%). Although the *Extremely high users* profile was quite small, it was distinct from all other profiles because of the early emergence with the same subsample of parents (n 11) in the iterative model-fitting process (i.e., model solutions with fewer profiles also yielded this distinct group) and high mean posterior probability (pp 1). Therefore, we decided to retain this small but meaningful profile.

3.3 | TV/DVD and handheld device use by year

Handheld time increased from 2014 with an average duration of 26.9 min day^{-1} to 2019 with an average duration of 48.2 min day^{-1} ($t_{97.93}$ −3.502; p < .001), in contrast to TV/DVD time that remained stable with 61.8 min day^{-1} in 2014 and 61.6 min day^{-1} in 2019 ($t_{119.73}$ 0.026; p .979). The data for handheld and TV/DVD time for each year can be found in the Supporting information (Figure S5 in Appendix S1). Furthermore, 9.6% (95% CI 5.5%–15.9%) of parents exceeded the suggested 3 h day^{-1} screen time limit in 2014 compared to 14.8% (95% confidence interval 7.4%–26.7%) in 2019. The levels in 2014 and 2019, comprising the first and last year of data collection included in this analysis, are illustrated in Figure 3.

3.4 | Sociodemographic characteristics associated with parent screen patterns

Per Wald tests, there were no significant associations of profile membership probabilities 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 the probability of membership for *Extremely high users* (P6) and living arrangements, indicating that parents with high membership probability for the *Extremely high users* profile (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 the probability of being in the *High users* profile (P5) and being in a single-parent household compared to the *Low handheld users* (P1). We found a significant association between household income of less than 60,000 CAD and the probability of being in the *More TV or DVD than handheld* profile (P2) compared to the reference profile (P1). Likewise, there was a significant association between low household income and the probability of being in the *More handheld than TV or DVD* profile (P4) compared to the reference profile (P1). Finally, there was a marginal association between low household income and the probability of being in the *Extremely high users* profile (P6) compared to the reference profile (P1; Table 4). These data indicate that low-income parents were more likely to belong to P2 or P4, suggesting that family income might not be linearly associated with parent screen time. The results with unimputed data were largely similar (see Supporting information, Table S1 in Appendix S1).

3.5 | Parent screen patterns and screen use and socio-emotional difficulties among children

Children of parents with high membership probability for the profiles with more handheld time than TV or DVD (*More handheld than TV or DVD users* [P4], *High users* [P5] and in unimputed data also the *Extremely high users* [P6]) had significantly higher total child screen

TABLE 4 Associations between demographic characteristics and probability of parent screen profile membership obtained from the latent profile analysis (missing values imputed)

Statistical Parameter	P1 low handheld users (reference)	P2 more TV OR DVD than handheld	P3 equal TV OR DVD & handheld	P4 more handheld than TV or DVD	P5 high users	P6 extremely high users
Sex of the parent assigned at birth						
Estimate (SE)		−0.46 (0.2)	0.06 (0.2)	0.18 (0.4)	0.07 (0.4)	−0.69 (1.1)
p (against reference class)		.06	.79	.62	.87	.52
Living arrangements						
Estimate (SE)		−0.01 (0.4)	0.02 (0.4)	0.50 (0.6)	−0.85 (0.5)	**−1.49 (0.7)**
p (against reference class)		.98	.96	.38	.09	**.03**
Income						
Estimate (SE)		**−0.67 (0.3)**	−0.55 (0.3)	**−1.42 (0.4)**	−0.33 (0.5)	−1.31 (0.7)
p (against reference class)		**.04**	.10	**< .001**	.53	.06

Note: Depicted are effect sizes in log odds with SEs for each profile including *p* values comparing against the reference profile (P1). Values in bold are significant.
Abbreviations: DVD, digital video disc; P, profile; TV, television.

TABLE 5 Association of child screen time and the SDQ Total Difficulties Score with the probability of parent screen profile membership obtained from the latent profile analysis (missing values imputed)

Statistical Parameter	P1 Low handheld users (reference)	P2 More TV or DVD than Handheld	P3 Equal users	P4 More handheld than TV or DVD	P5 High users	P6 Extremely high users
Total child screen time (min day^{-1})						
Estimate (SE)	72.1 (2.7)	77.8 (4.3)	79.9 (4.3)	**117.2 (12.4)**	**115.5 (13.9)**	117.0 (29.7)
p (against reference class)		.28	.13	**< .001**	**.002**	.13
SDQ total score						
Estimate (SE)	7.5 (0.3)	7.0 (0.2)	7.0 (0.3)	7.4 (0.5)	7.9 (0.5)	**13.0 (2.1)**
p (against reference class)		.14	.20	.73	.51	**.009**

Note: Depicted are the mean ± SEM for child total screen time and SDQ Total Difficulties Score per profile including *p* values comparing against the reference profile (P1). Values in bold are significant.
Abbreviations: DVD, digital video disc; P, profile; SDQ, Strengths and Difficulties Questionnaire; TV, television.

time compared to children of parents with high membership probability for *reference profile* (P; Table 5; see also Supporting information, Figure S6A in Appendix S1). In addition, we found that a total of 23.1% of children exceeded the screen time limit for 5-year-olds at the time of data collection (more than 2 h day^{-1}). Moreover, the proportion of children exceeding the limit was 17.4% in profile 1 and increased steadily to 51.4% in P5 and 66.7% in P6, suggesting that, the more time parents spend on screens, and handheld devices in particular, the higher the risk that children were exceeding their screen time limits.

With regard to child total difficulties on the SDQ, a higher probability of membership in the *Extremely high users* profile (P6) was associated with a significantly higher child SDQ Total Difficulties Score compared to a higher probability of membership in the *Low handheld user* profile (P1) (Table 5; see also Supporting information, Figure S6B in Appendix S1). Again, results in unimputed data were largely similar (see Supporting information, Table S2 in Appendix S1).

4 | DISCUSSION

We identified six distinct profiles in parent TV/DVD and handheld screen use. In comparison with a low screen use reference profile, a higher profile membership probability for some of the parent profiles with more time on handheld screens compared to TV or DVD screens was associated with living in a single-parent household or having a low family income. In turn, high membership probability for parent profiles with elevated handheld screen time compared to TV or DVD screen time was associated with more total *child* screen time. Moreover, high parent profile membership probability for the profile with the pattern of highest use on both handheld devices and TV or DVD was associated with more *child* socioemotional problems. However, this result needs to be interpreted with caution because only a few parents had a high membership probability for this profile (*n* 11). Overall, only 6% of parents reached or even exceeded the daily recommendation of Canadian guidelines of no more than 3 h day^{-1} of recreational screen time.[54] The limit was exceeded primarily because

of the time that parents spent on their handheld devices. The data in the present study represent parent usage from 2014 to 2019, specifically aiming to provide a benchmark of usage prior to the drastic increase in technology use during the COVID-19 pandemic.[55] Handheld time has increased markedly from 2014 to 2019, in contrast to TV/DVD time, which has remained stable (Figure 3). This change might be a result of unlimited data plans, access to free WiFi, and a vast increase in monetized mobile applications designed to keep users engaged.[5] Accordingly, today, more parents might exceed the daily recommendations and future research should re-examine the effects that this has on child screen use and well-being.

Regarding antecedents, we found that low-income parents had a higher probability of belonging to the *More TV or DVD than handheld* profile (P2) and, to a lesser extent, the *more handheld than TV or DVD* profile (P4) compared to high-income parents. This is in contrast to some previous studies that found a linear association between socioeconomic variables and screen time,[22] but might be explained by limited funds in some low-income families with respect to affording the more expensive data plans. This non-linear association should be investigated in future studies.

In addition, participants in single-parent households had a higher probability of being in the *Extremely high user* (P6) profile compared to participants in two-parent households. Thus, one might speculate that parents with lower social resources available to them might juggle work- or private life or regulate stress using handheld devices and the applications or activities available on these devices.[56] However, whether and why these social and economic factors are linked to time spent on handheld devices should be confirmed in future studies.

We also found links between parent screen time profiles and child outcomes, including child total screen time and socio-emotional 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.[17,57] Increased child socio-emotional problems might be explained by disrupted parent–child interactions,[14] although there are many other risk factors for child socio-emotional problems.[58–60] However, one might argue that only a few parents had a high membership probability for the "extremely high user" profile, although this profile was very robust. 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 excessive 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 with respect to addressing 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 parents' own recreational screen use. Most parents are concerned with the effects of too much child screen use, but are less inclined to question their own digital media use.[56] However, child and parent use not only correlate regarding total time on devices, but also regarding preferences for different devices.[22] Moreover, parents often underestimate their handheld use,[61] which is not surprising considering that smartphone apps are designed to engage people as long as possible.[5] Many app features include push notifications, colorful pictures, auto-play, and rewarding sounds to increase usage time.[5] In light of the link between membership probability of the extremely high user profile (P6) with approximately 3 h day^{-1} of screen use, but not of the high user profile (P5), and adverse child socio-emotional outcomes, we might want to consider advising parents to follow the more restrictive US guidelines recommending a 2 h limit for daily recreational screen time. Raising awareness for excessive parental screen use also appears necessary considering that the association between membership probability in the extremely high users profile (P6) and child behavioral problems was probably not mediated by children's own screen use because this was not robustly elevated in children of parents with high P6 membership probability.

The present 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. We have also demonstrated the meaningfulness and construct validity of these profiles through associations with parent characteristics and child developmental health outcomes. Moreover, using LPA allowed us to model probabilities rather than discrete categorizations, thereby better handling uncertainties in measurement and classification compared to more classical frequentist approaches.[49,53,62,63] Finally, we expand previous findings on screen time classes that econsidered parent and child screen time simultaneously,[22] by focusing on parents of young children, using profile analyses relying on membership probabilities rather than discrete group assignment, using continuous indicators reducing measurement error, and focusing on parents screen use on TV/DVD and handheld devices specifically.

The results need to be interpreted in light of some limitations. First, parental reports may be subject to different biases, including social desirability and difficulties in correctly estimating the duration spent on digital devices.[61] These issues could be overcome by obtaining data directly from the device itself.[64] We focused on data collected after market penetration of smartphones in Canada in 2013. Passive sensing apps only became available from June 2018 and later (representing only 18 months of data collection for the current study). We hope that our results lead to future research that exploits these more recent applications to measure digital device use more accurately. Second, we did not assess indicators of the parent–child relationship quality, nor if and how parents used screens together with their children. A third limitation is the use of cross-sectional data, which may obscure bidirectional effects between parent screen use and difficult child behaviors.[14] Fourth, findings on the *Extremely high users* profile require replication with a larger sample selected for high screen use. Nonetheless, small profiles (< 5%) are considered useful when the number of small classes is low (we have only one small class) and when the small class is interpretable and distinguished from other classes (P6 emerged early in the iterative process indicating that it is distinguished from other classes and we were able to interpret these values as being higher than all other profiles).[65] Moreover, a previous study also identified a group (25% of families) of high to very high

users with parents spending an average of 88 min day^{-1} on TV and 141 min day^{-1} on handheld devices, although they also simultaneously considered child screen use as indicators of latent classes.[22] Fifth, this community sample consisted of mostly high-income, biparental families with children scoring low on the SDQ Total Difficulties Score (2.6% above the clinical cut-off in line with other community samples[66]), decreasing the generalizability of the sample. Therefore, future studies should also investigate clinical samples. Finally, many variables were measured categorically, when in reality they have underlying continuous distributions. Also, we measured only maternal and not paternal educational levels.

These results indicate that some parents have very high 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 and provide opportunities for parent education aiming to improve child outcomes.

AUTHOR CONTRIBUTIONS

Katherine Tombeau Cost: Conceptualization; data curation; formal analysis; investigation; methodology; resources; software; visualization; writing – original draft; writing – review and editing. **Eva Unternaehrer:** Conceptualization; formal analysis; investigation; methodology; visualization; writing – original draft; writing – review and editing. **Kim Tsujimoto:** Conceptualization; formal analysis; methodology; writing – review and editing. **Leigh Vanderloo:** Conceptualization; writing – original draft; writing – review and editing. **Catherine Birken:** Conceptualization; funding acquisition; resources; writing – review and editing. **Jonathon Maguire:** Conceptualization; funding acquisition; resources; writing – review and editing. **Peter Szatmari:** Conceptualization; resources; supervision; writing – review and editing. **Alice Charach:** Conceptualization; funding acquisition; resources; supervision; writing – review and editing.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

Data for this article is restricted due to data privacy regulations by the Hospital for Sick Children.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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