Does Parental Smartphone Use Predict Parents' Perceptions of Family Life?

An examination of momentary associations between parental smartphone use, parental experiences of quality time, and parental perceptions of difficult child behavior.

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Highlights

- We explored whether and to what extent parents' co-present smartphone use associates with their perceptions of quality time and child restlessness.
- At the between-person level no associations were found between parents' co-present smartphone use and the outcome measures.
- Within-person, duration and frequency of co-present smartphone use positively predicted perceptions of time displacement and technoference.
- Within-person, perceptions of technoference negatively predicted experiences of quality time, but time displacement was a positive predictor.
- Heterogeneity was found, suggesting that effects manifest differently for different parents.

Abstract

This article reports the findings of a multi-method study that explored whether frequency and duration of parental smartphone use in the presence of children is associated with parents' perceptions of quality time and child restlessness, an indicator of difficult child behavior. Additionally, the study explored whether parental perceptions of technoference, respectively time displacement, mediate the association between frequency of use, respectively duration of use, and the outcome measures. We collected experience sampling and smartphone log data among parents of children aged 4-10 to assess momentary between- and within-person-level associations between the frequency and duration of co-present parental smartphone use and parents' perceptions of quality time, their child's restlessness, technoference and time displacement. We gathered 1484 observations from 56 participants. Multilevel mediation analysis revealed no between-person associations between our two measures of parental smartphone use and the outcome measures. At the within-person level, no associations were found with child restlessness. However, smartphone frequency did predict perceptions of greater technoference, and smartphone duration predicted time displacement. Technoference in turn negatively predicted parental experiences, although the hypothesized mediation did not reach statistical significance. Time displacement predicted parental experiences of quality time in the opposite direction of what was hypothesized. Some heterogeneity was found in the observed within-person associations, suggesting that there is person-specificity. We discuss the theoretical and practical implications of our findings.

Keywords: technoference, displacement, child phubbing, parental smartphone use, child behavior, quality time

Does Parental Smartphone Use Predict Parents' Perceptions of Family Life? An examination of momentary associations between parental smartphone use, parental experiences of quality time, and parental perceptions of difficult child behavior.

Family life comprises a range of activities with varying levels of interaction between parents and children (Daly, 1996). Some of these activities are specifically aimed at fostering a sense of belonging between family members, others represent more ordinary daily routines (Christensen et al., 2000). Both parents and children benefit from engaging in family life.

Smartphones have become important tools in the lives of parents of pre-adolescent children: They offer opportunities for communication and social networking, and enable better personal organization (Bury et al., 2020). As such, smartphones allow parents to simultaneously manage their professional, social and parental roles. However, despite the many benefits of the smartphone, concerns have emerged about whether and to what extent family life may be negatively affected by parental smartphone use (e.g., Hiniker et al., 2016; Moser et al., 2016). After all, studies suggest that parental smartphone use during family time is highly common (Kildare & Middlemiss, 2017; Meeus et al., 2021): American parents use their phone for approximately four hours per day, checking it 66.8 times on average (Yuan et al., 2019).

Concerns about parental smartphone use and family life revolve among others around the impact of parental co-present smartphone use on parents' experiences of quality time with their child (e.g., Dwyer et al., 2018; Kushlev & Leitao, 2020; Mullan & Chatzitheochari, 2019), as well as on its (perceived or observed) effect on difficult child behavior (e.g., McDaniel, 2019; McDaniel & Radesky, 2018; Poulain et al., 2019; Vanden Abeele et al., 2020). Interestingly, however, although extant research provides early evidence for these potential negative effects, to date few studies have explored the mechanisms presumed responsible for them.

From a theoretical point of view, smartphone interference and smartphone time displacement are two central, complementary mechanisms that are likely to play a role (Kushlev & Leitao, 2020). Smartphone interference, also known under the term smartphone technoference, refers to the potential of parental co-present smartphone use to *interrupt* parent-child interactions (the 'technoference hypothesis', McDaniel & Coyne, 2016)[1]. Time displacement refers to the potential of parental co-present smartphone use to *displace* time spent on these interactions ('displacement hypothesis').

This study contributes to the emerging field of research on the implications of co-present parental smartphone use by examining whether these two mechanisms can indeed explain associations between parental co-present smartphone use and parents' perceptions of family quality time, and child restlessness, which is a common indicator of difficult child behavior. To examine the role that these mechanisms play, our study adopts a novel approach that overcomes a number of methodological shortcomings of extant research. To date, researchers have mostly used cross-sectional survey designs (e.g., Poulain et al., 2019) or observational methods (e.g., Kiefner-Burmeister et al., 2020; Radesky et al., 2015; Radesky et al., 2014). Cross-sectional survey methods, however, fail to account for potential fluctuations in parents' momentary experiences (e.g., Wolfers et al., 2020). Moreover, they often rely on self-reported data, which comes with limitations in terms of the reliable assessment of actual smartphone use (see Scharkow, 2016; Sewall et al., 2019). Observation studies overcome some of these issues, but have low ecological validity, as they provide just one snapshot in a specific location (e.g., a lab, a playground). Given that parents' smartphone use, their perceptions of quality time and of child restlessness, and their perceptions of time

[1] Please note that the concept of technoference is often used in a broader sense, referring to interference stemming from all forms of media devices, including also the radio, tv, laptop, … (McDaniel & Coyne, 2016). In the current manuscript, however, technoference covers smartphone interference only.

displacement and technoference are all experiences that may manifest in the moment, it is important to assess them 'in situ' in parents' daily lives.

Hence, for this study we collected both experience sampling (ESM) data and smartphone log data from parents of children aged 4 to 10 to explore how objectively monitored smartphone behavior and parental experiences associate within individual parents. Using these data, we can assess both at the between- and within-person level (1) whether frequency and duration of co-present parental smartphone use predict parental perceptions of quality time and child restlessness, and (2) whether perceived technoference and time displacement function as two complementary explaining mechanisms of these associations, with frequency of parental smartphone use predicting parents' perceptions of technoference, and duration of co-present smartphone use predicting their perceptions of time displacement.

Literature Review

Frequency of co-present smartphone use and technoference

In this study, we conceptualize co-present parental smartphone use as parental smartphone use behavior that takes place while the child is near. Recent literature shows that this behavior may have beneficial effects, for instance when it buffers against stress (Wolfers, 2020). However, there may also be negative associations, which are the focus of this study.

We explore two complementary mechanisms that may explain why co-present parental smartphone use might negatively affect parent-child interactions. A first mechanism is smartphone technoference. Technoference concerns the interfering potential of technologies, when their presence and/or use interrupts people during their everyday activities (McDaniel & Coyne, 2016). Prior research has revealed that when parental smartphone use is experienced as interfering, it is associated with a lower sense of connection with the child (Kushlev & Dunn, 2019). There is reason to assume that the experience of these interruptions may be especially linked with the *frequency* of co-present parental smartphone use (see also

Hall, 2020). After all, when parents use their smartphone more frequently in the co-presence of the child, they may be more likely to regularly switch attention between their child and their smartphone, and this may elicit smartphone-induced distractions that might reduce the ability to derive pleasure from the ongoing parent-child interaction (Dwyer et al., 2018), which according to Mullan and Chatzitheochari (2019), has implications for parents' own experience of the quality of parent-child interactions.

Altogether, given that prior research has found direct associations between parental smartphone use and perceptions of the quality of parent-child interactions (Mullan & Chatzitheochari, 2019), we expect at both the within- and between-person level, that frequency of co-present parental smartphone use negatively predicts parental perceptions of quality time **(H1a)**. Moreover, we hypothesize that experienced technoference mediates this relationship **(H1b)**.

Furthermore, attention-switching between the child and the smartphone may also affect child behavior. Children may try to regain their parents' attention by acting out (McDaniel & Radesky, 2018). Vanden Abeele et al. (2020), for instance, observed that children appeared to 'work harder' and increased their bids for attention when parents were using their phone in the presence of their child. Similar observations were also made by Hiniker et al. (2015) and Birnholtz et al. (2017). Research suggests that, under such circumstances, children show more difficult child behavior, such as restless behavior (e.g., Achenbach, 2017), in order to garner their parents' attention. For instance, a longitudinal survey of McDaniel and Radesky (2018) found that self-reported smartphone technoference predicted small but significant increases in parental perceptions of children's behavioral difficulties, including the child's restlessness, at the following time points. Alternatively, the directionality of this association may also be reversed; it is also possible that parents use their smartphone more as a means to cope with their restless children (e.g., Wolfers, 2021).

Altogether, we may expect at both the within- and between-person level, that frequency of parental co-present smartphone use positively predicts the child being restless **(H2a)**, and that experienced technoference mediates the relationship between the frequency of parental co-present smartphone use and parental perceptions of the child being restless **(H2b)**.

Duration of co-present smartphone use and time displacement

The 'displacement' hypothesis (Kushlev & Leitao, 2020) is concerned with how time spent on the smartphone might displace time that would otherwise be spent in face-to-face interactions (Hall, 2020). This hypothesis differs from the 'technoference' hypothesis, in that technoference occurs when technology use hampers the flow of an ongoing interaction, whereas displacement occurs when interactions are prevented from 'happening' in the first place, or are shorter than planned because parents allocate time to their phone rather than to their child. Given that the displacement hypothesis emphasizes the time spent on the phone (Kushlev & Leitao, 2020), we may expect experiences of time displacement to be especially predicted by the *duration* of co-present parental smartphone use: When more time is spent on a smartphone while in the presence of a child, less time remains for quality interactions with them (Kildare & Middlemiss, 2017; McDaniel, 2019).

Prior research suggests that displacement may hinder parental experiences of quality time. After all, parents' needs for quality interactions may not be fulfilled, as they simply experience fewer interactions with the child (Dwyer et al., 2018). Consequently, we may expect at both the within- and between-person level, that duration of co-present parental smartphone use negatively predicts their perceptions of quality time **(H3a)** and that parental experiences of smartphone time displacement mediate this relationship between their screen time and their perceived quality time with their child **(H3b)**.

For young children, focused interactions that are sensitive to the child's needs have a special developmental importance (Hsin & Felfe, 2014). When parents spend lengthy amounts

of time on their smartphone, however, they may be less sensitive to their children's needs which may in turn elicit problem behavior in the child. There is some early evidence that corroborates this assumption. A playground observation study of Wolfers, Kitzmann, et al. (2020) found that duration – and not frequency – of phone use was negatively associated with mothers' sensitivity to the child, a known predictor of difficult child behavior. A cross-sectional survey study by Poulain et al. (2019) found that the duration of maternal smartphone use was associated with emotional and conduct problems in the child. Also, a study of Kim et al. (2022) found that maternal smartphone dependency – a condition which might increase the chance of lengthier co-present parental smartphone use sessions – is correlated with several indicators of children's problem behavior. Hence, we may expect at both the within- and between-person level, that duration of co-present parental smartphone use positively predicts perceptions of the child's restlessness **(H4a)**.

A pertinent question is whether time displacement also explains the former association. The cross-sectional survey study of Poulain et al. (2019) found no support for such a displacement effect: Maternal screen time was unrelated to frequency of parent-child interactions, meaning that increased screen time did not displace interactions. But as the authors themselves indicate, their study was limited, in that it did not "explicitly assess media use during parent‐child interactions and investigate associations with quality and duration of interactions". In the current study, we explicitly assess parental perceptions of time displacement – which theoretically may be assumed to mediate the association between duration of use and its potential outcomes. Hence, we expect at both levels that parental experiences of time displacement mediate the relationship between parental screen time and perceptions of the child being restless **(H4b)**.

Altogether, during the confirmatory analyses, these different hypotheses[2] are tested at the between- and the within-person level. At the between-person level, we investigate how parents differ from each other. At the within-person level, we examine momentary associations among individual parents. During this hypothesis testing, fixed effects are investigated. However, it is not certain that these associations will be similar for each parent (Bolger & Laurenceau, 2013). Also, Livingstone & Blum-Ross (2019) state that research needs to avoid homogenizing parents, their smartphone use and potential consequences, as if they are all the same. Therefore, as an exploratory research question **(RQ)**, we investigate potential between-person variability around parents' average, i.e. heterogeneity in within-person associations (e.g., Beyens et al., 2020).

Method

Preregistration

This manuscript presents a study that was part of a larger research project. Both the full project (https://bit.ly/350LKCp) and the current study (https://bit.ly/3qDsQKf) were preregistered on the Open Science Framework (OSF) during the second phase of data collection, before analyzing the data. The study protocol was approved by the Ethics Committee of the Faculty of Political and Social Sciences of Ghent University.

Procedure

Recruited participants were on-boarded during an online intake session during which their informed consent was digitally collected. Participants installed two different applications: One for collecting smartphone log data, and one for collecting ESM data. During the installation procedure, the researchers supervised participants in entering their research ID to ensure that the different datasets could be properly linked.

[2] More details about the preregistered hypotheses: https://bit.ly/3rrWD7U.

At the end of the intake session, participants were directed to an online intake survey. This intake survey was used to collect demographic and other time-invariant data. Some of the participants were couples, as one study of the larger project concerned a dyadic study. In these cases, both participants were instructed to answer the questions independently, without discussing answers with their partner. During a period of 14 consecutive days, participants' smartphone was passively logged and ESM data were collected.

The smartphone log data provided us with information about the start and end time of each smartphone session and app event, and about whether or not an app event was preceded by a notification. The ESM surveys followed a time-contingent sampling design, as the participants were prompted to answer questions at fixed times (de Vries et al., 2020), namely at 8 AM, 6 PM and 7.30 PM. Our preliminary qualitative investigation[3] showed that these were the most likely times to have parent-child interactions in households. At each of these three measurement points, participants received a prompt, followed by up to three reminders during a time span of 60 minutes, after which the questionnaire expired. The ESM questionnaire asked parents to reflect on the past hour ("in the past hour, …").

The smartphone log data were matched to the ESM timestamps, so that each row of ESM responses in our dataset was supplemented with data about the participant's smartphone use in the hour prior to the ESM response. In this way, we were able to collect situational information about parental smartphone use in the co-presence of the child, and the linked parental experiences and perceptions.

Participants[4]

Participants had to meet certain criteria for participation. They had to (1) raise at least one child between the age of four and ten years, (2) be married or live together with their partner (relevant to other aims of the broader research project), and (3) use a smartphone with an Android

[3] More details about our preliminary qualitative investigation: https://bit.ly/3nAGUCf.
[4] More details about the descriptive analysis of the participants: https://bit.ly/3D4XsHu.

operating system, as participants had to install an Android-only smartphone logging application.

We retained data from 56 participants (30 female, 26 male) with an age range between 29 and 45 years old (M = 36.70, SD = 3.37). We initially aimed to recruit only dyads. However, because of recruitment difficulties we ultimately relaxed this constraint. As a result, the sample consisted of 15 dyads, plus 26 subjects participating individually. In total, 41 unique households participated. On average, these households included 4.17 members. In case parents had more than one child between 4 and 10 years old, we asked participants to answer the questionnaire for a child of their choice. Of the 41 different children of focus, half were boys (n = 21, 51.2%). These children were on average 7.12 years old (SD = 1.85). Table 1 shows descriptive statistics for the recruited sample.

***** insert Table 1 about here *****

Methodology and measures[5]

We collected measures via (1) an online intake survey, (2) mobile experience sampling, and (3) smartphone logging, and we subsequently combined these datasets. To do so, a series of decision rules were preregistered.[6]

Intake survey

We included two control variables in our study, parent-child closeness and a scale assessing 'child phubbing' behavior. Child phubbing can be described as the act of parents ignoring their child by paying attention to their smartphones (e.g., Pancani et al., 2020). The construct of phubbing shows strong conceptual and operational overlap with technoference – which is visible in the terms being used interchangeably in research (e.g., McDaniel & Wesselmann,

[5] Details about these methodology (https://bit.ly/3d4CON0) and measures (https://bit.ly/3lpP1QT). Details of the descriptive analysis of these methods and measures (https://bit.ly/3rtq7Cb).
[6] For a detailed overview of all decisions made during data cleaning and merging, see https://bit.ly/3GGA6dU.

2021). The 'child phubbing' measure can thus be understood as a more stable, trait-level measure of smartphone technoference during parental-child interactions.

Parent-child closeness. Parent-child closeness was examined with two items, based on Jensen (2017). Parents had to indicate on a 5-point Likert scale to what extent they feel close to their child (1 = totally not, 5 = very much). Higher scores indicated feeling closer to the child (M = 4.69, SD = 0.47, skewness = - 1.42, kurtosis = 1.46, correlation = 0.74).

Child phubbing. This phenomenon was investigated via seven items, based on Pancani et al. (2020). Respondents had to indicate on a 5-point Likert scale how often they find themselves in one of the following situations with the child (1 = never, 5 = very often), e.g. 'I get distracted by my smartphone when my child and I are doing something together'. Higher scores indicate a higher occurrence of situations linked to child phubbing by the parent (M = 2.72, SD = 0.73, skewness = -0.17, kurtosis = -0.41). Exploratory factor analysis of these seven items revealed one underlying construct. The internal consistency of the items was good ($\alpha = 0.86$).

Experience sampling method (ESM)

Presence of the child. At the start of each measurement burst, participants were asked whether their child of focus (4 – 10 year) was present during the past hour (1 = yes, 0 = no). As we focus on parental smartphone use in the co-presence of the child, 1484 valid observations were retained. In total, we collected a minimum of 11 and a maximum of 41 observations (M = 26.50, SD = 7.68) per parent, during on average of 12.64 days (SD = 2.54, min: 5 – 15). A majority (91.12 %) of observations was made at the targeted time interval (412 in response to the morning beep, 942 in response to the two evening beeps). The remainder of observations were initiated by participants themselves at a time of their choosing, an option we offered to participants for whom the chosen ESM time intervals did not match with their schedules (e.g., parents who did not work 9 to 5).

Parental perceptions of quality time. Participants were asked to rate the extent to which they experienced quality time with their child in the past hour on a five-point Likert scale (1 = disagree, 5 = agree). A higher score indicates higher perceived quality time during the previous hour (M = 3.69, SD = 1.02, skewness = -0.65, kurtosis = 0).

Restlessness. Participants were asked to rate on a five-point Likert scale (1 = (almost) never - 0 times, 5 = very often - 10 times or more) to what extent the child (1) disobeyed (M = 1.52, SD = 0.76, skewness = 1.77, kurtosis = 3.88), (2) cried (M = 1.12, SD = 0.38, skewness = 3.31, kurtosis = 12.14), and (3) had been calm (Reverse coded, M = 2.05, SD = 0.89, skewness = 0.73, kurtosis = 0.45) in the past hour. Higher scores indicate more difficult child behavior. The items were uncorrelated, however, and reports of disobedience and crying were rare. Because of the lower variability and high kurtosis of the items 'disobeyed' and 'cried', we only focused on the item 'being calm', which we reverse coded to align it with prior research on parental smartphone use and child restlessness, and to better represent the construct of difficult child behavior. Thus, a higher score indicates that the child had been more restless.

Technoference of child interactions. Similar to McDaniel and Coyne (2016), participants were asked to rate perceived technoference on a five-point Likert scale (1 = never, 5 = very often) by indicating "how often their smartphone disrupted interactions with the child in the past hour" (M = 1.21, SD = 0.54, skewness = 2.83, kurtosis = 9.36).

Displacement of child interactions. Based on the definition of Kushlev and Leitao (2020), participants were asked to rate perceived displacement on a five-point Likert scale (1 = never, 5 = very often) by indicating "to what extent they did *not* interact with their child because they were using their smartphone instead during the past hour" (M = 1.21, SD = 0.54, skewness = 3.23, kurtosis = 13.19). These values show that parents overwhelmingly answered that, during the past hour, it was *never* the case that they were *not* interacting with their child

because they were using their smartphone instead. In other words, smartphone use (almost) never displaced interactions with their child.

Smartphone logging

Smartphone log data consisted of timestamped app activities (start and end time), with (mostly) multiple consecutive app activities representing one smartphone session. The raw data were pre-processed on both the between- and within-person level. At the between-person level, we computed measures of participants' average daily smartphone use. Our participants used their smartphone for 129.19 minutes per day on average ('duration', SD = 65.67, min = 14.10, max = 277.56), and initiated 89.50 smartphone sessions ('frequency', SD = 72.48, min = 12.00, max = 460.75).

On the within-person level, smartphone use was investigated as a dynamic behavior. Given that the ESM-questions refer to the past hour, we calculated smartphone use of the participant in the hour prior to completing each ESM survey. This was done by matching the ESM timestamps with the timestamps of the logged data. Two measures were calculated for each participant: minutes of smartphone use during the previous hour ('duration', M = 9.74, SD = 11.23, min = 0, max = 60), and amount of smartphone sessions during the previous hour ('frequency', M = 6.42, SD = 7.73, min = 0, max = 143).

Analysis[7]

We used R studio (1.4.1717) to perform multilevel analyses. We specified four separate multilevel mediation models, in which observations were nested within participants. These four separate models were specified for the two independent variables (i.e., duration and frequency of co-present smartphone use), respectively linked with a mediator (i.e., displacement and technoference), and for two dependent variables (i.e., quality time and being restless). As some participants were additionally nested within dyads, couple id was included

[7] For the preregistered analysis plan, and the deviations conducted during analysis: see https://bit.ly/3GzAVFf.

as a control variable. Parent-child closeness and child phubbing[8] were also included as control variables. Additionally, participants' momentary smartphone duration was included as a control variable in the frequency models, and vice versa.

Confirmatory analyses were conducted to test H1 to H4. Each model was tested as a fixed effects model (i.e., no random slopes were specified), including both within- and between-person variables. Via the package "mediate" (Tingley et al., 2014), we conducted the multilevel mediation with bootstrapping (100 repetitions, via the quasi-Bayesian Monte Carlo method). It offered us 95% CI's: intervals of significant associations do not include 0. Control variables, predictors and mediators were centered and scaled, to effectuate convergence of the models.

After fitting the confirmatory models, exploratory analyses were performed to explore the additional research question of heterogeneity in within-person associations, by allowing random slopes instead of the fixed slopes implemented during the confirmatory analysis.

Results

Confirmatory analysis

The between-person and within-person correlations between our main study variables across all days of data are reported in Table 2[9]. We first examined whether there was an association between the two dependent variables: experiences of quality time and perceptions of child's restlessness. We only found a significant within-person correlation between experiences of quality time and perceptions of child's restlessness ($r = -0.10$, $p < 0.001$), indicating that when a parent perceived their child as more restless, the parent reported experiencing less quality time.

***** insert Table 2 about here *****

[8] We checked whether the exclusion of 'child phubbing' as a control variable affects results (see OSF: https://bit.ly/3MuF7bW). We found that our current analysis is somewhat more stringent than the analysis without this control variable, in that the effects found become somewhat more pronounced. We decided to stick to the model including this control variable as this was our original plan.

[9] Details of confirmatory analyses on OSF: https://bit.ly/3Ig8g8M.

Table 3 outlines the results for the two models including frequency as predictor, technoference as mediator, and respectively quality time and being restless as dependent variable. On the between-person level, we found that parents who use their smartphone more frequently, reported more technoference (95% CI [0.034, 0.136]). At the within-person level, the outlined hypotheses about the *direct* effect of frequency on both dependent variables were not supported (H1a: 95% CI [-0.057, 0.03], and H2a: 95% CI [-0.062, 0.01]). However, when parents used their smartphone more frequently compared to their own baseline level, they reported more smartphone technoference (95% [0.022, 0.070]). Parents who experienced more technoference, also reported experiencing less quality time (95% [-0.105, -0.012]), but not more restless behavior of the child (95% [-0.05, 0.023]). While the above results suggest a mediating role of technoference in the within-person association between frequency and quality time, this indirect effect did not reach statistical significance (95% CI [-0.005; 0.00], H1b not supported). Hypothesis 2b was also not supported (95% CI [-0.0024, 0.00]): technoference did not mediate the association between frequency and perceptions of child's restlessness.

***** insert Table 3 about here *****

Table 4 includes the results for the next two models, including duration as predictor, displacement as mediator, and respectively quality time and being restless as dependent variables. On the between-person level, duration was a significant positive predictor of displacement (95% CI [0.031, 0.147]): parents who on average use their smartphone longer, report greater displacement. On the within-person level, we found no direct association between duration and quality time (H3a not supported (95% CI [-0.033, 0.07]). However, when parents used their smartphone longer compared to their own baseline level, they reported more smartphone displacement (95% CI [0.094, 0.143]). Moreover, when parents experienced more displacement compared to their own baseline level, they reported less

quality time (95% CI [-0.14, -0.04]). Further, we found support for displacement as a mediator of the within-person association between duration and quality time (H3b supported; 95% CI [-0.017, -0.01]).

With regard to child restlessness, a *direct* within-person effect of duration was found on perceptions of the child being restless (95% CI [-0.12, -0.04]): when parents used their smartphone longer compared to their own baseline level, they reported that their child was **less** restless. The significance of this association is contrary to the hypothesized direction in H4a. Displacement did not mediate the within-person association between duration and being restless (H4b not supported; 95% CI [-0.003, 0.01]).

***** insert Table 4 about here *****

Exploratory analysis

Between-person heterogeneity[10] can be expected in the strength and direction of significant within-person associations. To test for this, a model for each significant within-person association was re-run with random slopes[11]. We examined chi-square values to explore whether the random slope model fitted the data significantly better than the fixed slope model. If heterogeneity was found, we calculated the person-specific associations, to obtain the number of participants with positive and negative associations.

The results of the heterogeneity tests investigated via the chi-square test are shown in the left part of Table 5. One random slope model did not fit the data significantly better than its fixed slope model, offering no evidence for heterogeneity (displacement → quality time). Heterogeneity is found in the other four within-person associations, indicating that these four

[10] Details of exploratory analyses on OSF: https://bit.ly/3tCaRpt.

[11] The M and Y models, previously needed as input for the mediate function in R, were re-run and we always added as random slope one significant within-person association found in the M or Y models. To detect potential heterogeneity in the within-person associations, chi-square tests were conducted via the anova () function. The person-specific associations were calculated, and cleaned by leaving out missing and impossible values (i.e., smaller than -1 and larger than 1). For some individuals, the person-specific association could not be calculated because of insufficient variability. This explains differences in the reported N per model.

associations differ from participant to participant. The right-hand part of Table 5 outlines the amount and percentage of participants linked to the strength (non-existent to small, weak, moderate or strong) and the direction (negative or positive) of the four significant within-person associations.

***** insert Table 5 about here *****

The coefficients of the within-person association between frequency and technoference ranged from -0.59 to 0.99. For 18 participants (36%), the association was non-existent to small, while it was positive for 26 (52%), and negative for 6 participants (12%). Next, the coefficients of the within-person association between technoference and quality time ranged from -0.62 to 0.68. For 13 participants (28.26%), the association was non-existent to small, while a third of participants (N = 14, 30.43%) showed a positive association, and a majority showed a negative association (N = 19, 41.30%). Third, we found that the coefficients of the within-person association between duration and displacement ranged from -0.35 to 0.90. For 21 participants, the association was non-existent to small (38.89%), but for 28 participants the association was positive (51.85%) while it was negative for the remaining 5 participants (9.26%). To end, the coefficients of the within-person association between duration and being restless ranged from -0.75 to 0.75. For 19 participants, the association was non-existent to small (35.85%), but for the other 34 participants, 7 showed a positive association (13.21%), whereas 27 (50.94%) showed a negative association. Concluding, the above findings indicate that there is substantial variability, supporting a person-specific approach to the associations under investigation.

Discussion

Summary of Results and Implications

The aim of this study was to assess both at the between- and the within-person level (1) whether the frequency and duration of objectively measured co-present parental smartphone use predicts parental perceptions of quality time and child restlessness, and (2) whether perceived technoference and time displacement function as two explaining mechanisms of these associations. To that end, we collected data from parents of children aged 4 to 10 via an intensive, multimethod research design that combines ESM and smartphone logging.

Overall, the descriptive statistics of this study indicate that parental experiences of smartphone technoference and displacement of parent-child interactions are rare. Given the 'in situ' nature of this study, these descriptive findings thus suggest that fear mongering over contemporary parents prioritizing their phones over their children is unwarranted.

The confirmatory analyses of our preregistered hypotheses show some important take-aways. First, we were not able to offer evidence that duration and frequency of co-present parental smartphone use directly predicts parental perceptions of quality time and the child being restless: No significant direct between-person associations were found and hypotheses H1a to H4a were not supported at the within-person level. However, we did find a negative rather than the hypothesized positive within-person association between duration of co-present smartphone use and perceptions of the child's restlessness, suggesting that when parents use their smartphone longer than their baseline use behavior, children were perceived as **less** restless rather than more.

A tentative explanation is that reversed causality may be at play here: Parents might not be able to use their smartphone when children are more restless, as this child behavior might require them to be more responsive than usual. Hence, moments during which children are calm and keep themselves occupied, may serve as ideal moments for parents to use their phones to

experience some alone-time while in the co-presence of their child, potentially using the phone for beneficial purposes, such as to cope with stress (e.g., Wolfers, 2021). From this perspective, co-present smartphone use might offer parents a welcome and important respite from their daily life hassles and stresses. Another explanation might be that there is co-use of the parent's smartphone with the child: When parents and children use the smartphone together for watching movies, playing video games, etc. children may potentially be perceived as less restless, while the smartphone is also used for longer periods of time. In addition to research designs that can reveal causality, future studies could also offer more details about how the smartphone is used, as hypotheses such as the above provide valuable suggestions for future research.

Second, while the frequency and duration of actual phone use did not have the hypothesized effect as we had expected based on literature (e.g., Hiniker et al., 2016; Moser et al., 2016), we gained preliminary evidence that perceived technoference and displacement may function as two explaining mechanisms of the within-person association between these indicators of co-present parental smartphone use and the experience of quality time: Objectively measured frequency and duration significantly predicted, respectively, feelings of technoference and time displacement, both at the between- and the within-person level, and on the within-person level perceptions of technoference and displacement were linked with an experience of less quality time. This finding is in line with prior research of among others Mullan and Chatzitheochari (2019), who stated that smartphone-induced parental distractions may have implications for parents' own experiences of parent-child interactions, and Dwyer et al. (2018), who suggested that when smartphone use leads to fewer interactions, parental needs for quality time may not be fulfilled.

It is important to draw attention here to our finding that parental perceptions of quality time were influenced by *perceptions* of displacement and/or technoference rather than by actual smartphone use behavior. What we may be witnessing here, is a potential self-effect of

smartphone use: When parents perceive their own smartphone use as interfering and/or time displacing, these experiences might keep them from deriving pleasure from their interactions. This hypothesis has two important implications going forward. First, it suggests that the subjective experience of one's smartphone use may be a more important indicator to gauge a person's digital well-being than their actual behavior (e.g., Vanden Abeele, 2020). Second, it suggests that parents themselves may be internalizing the prevailing narratives surrounding parental smartphone use in public discourse, which mostly emphasize a negative, moral-panic perspective that may guilt-trip and shame them for using their phone (see also Torres et al., 2021; Wolfers, 2021). To avoid a potentially unjustified internalization of such narratives, a more balanced and valid approach may be to inform parents about both harms and benefits – such as coping, and to mostly provide them with tools to become more mindful of their own technology behaviors and how they impact family life (e.g., Lippold et al., 2022).

We could not find evidence for a mediating role of technoference and displacement in the association between parental smartphone use and the child's restlessness. One explanation for this lacking effect may be the increasing normative nature of co-present smartphone use during parent-child interactions (e.g., Wolfers, 2021). Indeed, in a recent experiment embracing a smartphone-induced still face paradigm, children appeared not to be affected by their parents' smartphone at all. One in four of the participating parents reported that such interruptions were typical daily events for their children (Konrad et al., 2021), and therefore not particularly upsetting to the child.

Altogether, an important contribution of our multimethod study design consists in its higher ecological validity: We have gathered 'in situ' information from parents in the presence of their child during their everyday life. Moreover, by investigating associations both at the between- and the within-person level, we have been able to provide a more in-

depth understanding of the phenomena of interest, as findings may differ between those two levels of analysis (e.g., McDaniel et al., 2020; Verduyn et al., 2021).

Finally, thanks to our multimethod study design, we were also able to conduct an exploratory analysis, investigating the level of heterogeneity between parents. We found four significant within-person associations that differ between parents, revealing the person-specific nature of media effects (Bolger & Laurenceau, 2013; Valkenburg et al., 2019). These patterns reveal that we cannot formulate a one-size-fits-all answer on the central question: "does parental smartphone use affect family life", as the effect appears to play out differently for different individuals.

Nonetheless, this study is not without its limitations. On the level of research infrastructure, it should be mentioned that our multimethod study design was preregistered[12]. This practice of preregistration meets the need for confirmatory research within the social sciences. Transparency about the hypotheses and the analysis before and during data collection minimizes flexibility in analysis to increase the reliability of the findings (Johannes et al., 2021). We deviated from our pre-registration, however, in a number of respects. Most importantly, we did not include analyses with the 'notifications' variable obtained from the smartphone log data. It was not possible to calculate this variable for enough participants, as notifications were not logged for several participants, who had adjusted their smartphone settings so as to disable notifications.

Also, the use of the experience sampling method within the family context has limitations. As participants were asked to use the application for fourteen days, this prolonged use may have resulted in awareness and, thus, in important changes of the investigated behavior (Swendeman et al., 2020). Also, the prompts of the ESM survey were programmed

[12] Preregistration of the current study (https://bit.ly/3qDsQKf) on the Open Science Framework (OSF). The deviations from the preregistered hypotheses, variables and analysis plan are always indicated in an additional document, linked to the relevant sections.

to attract the participants at moments when they were in the presence of their children. It can be asked whether the use of the ESM application does not provoke technoference during the research period. This raises an important ethical question about our intensive multimethod study design that has recently also been raised by other researchers who used ESM to track parenting behaviors and child development (van den Heuvel et al., 2021).

Third, we cannot be conclusive about the causal direction of the observed associations. A suggestion for future research could be to implement more daily measurement bursts at random intervals, so that the Granger causality of lagged relationships could be explored. However, this design choice would make participation more burdensome for parents, and might lead to further technoference of parent-child interactions. Next, it cannot be excluded that parents filled out the daily ESM surveys in a socially desirable way, as quality time has a positive connotation. This may result in a lower answer reliability. Lastly, a limitation of our study is that the diversity of the sample in terms of educational level and ethnicity was limited; hence, our results cannot be generalized.

Recommendations for Future Research

Based on the findings of this study, we can formulate a number of additional recommendations for future research. First of all, future research can further explore the self-effect hypothesis, among others by exploring potential mechanisms underlying this association, such as public norms, feelings of guilt, shame or parental inefficacy (e.g., Wolfers, 2021; Reinecke et al., 2014). These mechanisms can potentially influence perceptions of their own smartphone use, as Wolfers (2021) already stated that negative norms linked to parental smartphone use might hinder the positive effects of parental mobile device use. In line with this self-effect hypothesis, further research also need to explore how the found heterogeneity can be meaningfully explained, for instance through a moderator analysis of relevant socio-demographic, psychological, social, and cultural factors. We advise to explore the role of family members'

norms and attitudes linked to technology use, as well as the role of different parenting styles and different family compositions. Turvill et al. (2019), for instance, found that technoference prevalence disproportionately threatens a subset of children, depending on the technology use and parenting style of their parents. This finding suggests that parental smartphone use patterns may be symptomatic for broader parenting styles, possibly resulting in cumulated or aggravated negative outcomes.

Further, as parenting style may play a role, future research may explore the potential moderating role of parents engaging in 'mindful parenting', i.e. intentionally bringing moment-to-moment awareness to parent-child interactions (Liu et al., 2020). According to Duncan et al. (2009), mindful parenting has positive implications on a parents' ability to listen with full attention, i.e. showing responsiveness; mindful parents can better self-regulate their emotions and behaviors, and demonstrate emotional awareness, nonjudgmental acceptance and compassion for the self and the child. In other words, mindful parenting can be beneficial in the context of parental smartphone use as parents may be able to better evaluate their own smartphone behavior, and regulate it according to what they deem relevant to the context, albeit with compassion for their own needs in the moment – which may justify smartphone use over intensive parenting when the parent urgently requires social support. Hence, mindful parenting can be an important moderator and can be targeted by interventions in order to minimize negative perceptions linked to their smartphone use that might hinder positive outcomes of smartphone use.

Nonetheless, the moderating role of parents' executive functioning may also play a role (Zurcher et al., 2020). Although children are mostly accused of lacking the capacity to self-regulate their smartphone use, some parents may also suffer from self-control deficiencies, making it difficult for them to not constantly engage in habitual smartphone

checking behavior, even when they are in their child's co-presence. This lacking self-control can potentially be another reason for the heterogeneity found.

To end, future research might explore whether the perceptions of displacement and technoference can also be found when the provoking source is not technological, for instance when it concerns newspapers or doing house chores. In this way, we can examine whether the effects of smartphone interruptions differ from other non-digital interruptions present in daily life (Konrad et al., 2021).

Conclusion

Altogether, we did not find evidence that co-present smartphone use is directly affecting family life. However, we did find that frequency and duration of co-present parental smartphone use was linked to parental perceptions of – respectively – smartphone technoference and displacement of parent-child interactions. These experiences potentially disable parents from satisfying their psychological needs, as these two mechanisms were in turn linked with reduced experiences of quality time.

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Tables

Table 1.

Descriptives of the Study Sample of Parents and their Household.

	56 parents
Age in years (M/SD)	36.70 (3.37)
Gender (n/ %)	
Male	26 (46.4%)
Female	30 (53.6%)
Educational level (n/ %)	
Lower secondary education diploma	3 (5.4%)
Secondary education diploma	15 (26.8%)
Higher education diploma	38 (67.9%)
Belgian nationality (n/ %)	55 (98.2%)
Born in Belgium (n/ %)	56 (100%)
	41 households
Household members (M/SD)	4.17 (0.59)
Household children (n/ %)	
One	4 (9.8%)
Two	28 (68.3%)
Three	8 (19.5%)
Four	1 (2.4%)
Gender child of focus (n/ %)	
Male	21 (51.2%)
Female	20 (48.8%)
Age child of focus (M/SD)	7.12 (1.85)
Relation to child of focus (n/ %)	
Biological child, residing always with parent	38 (92.7%)
Non-biological child, residing always with parent	1 (2.4%)
Non-biological child, with co-parenting planning	2 (4.9%)

Table 2.

Correlation Table at Between – and Within – Person Level.

		1	2	3	4	5	6	7	8	9	10	11	12
1	Duration (state, between/within)	1											
2	Duration (trait, between)	-0.05	1										
3	Frequency (state, between/within)	0.00/ 0.05	0.04	1									
4	Frequency (trait, between)	0.16	0.40***	0.05	1								
5	Displacement (state, between/within)	-0.09/ 0.24***	0.02	0.03/ 0.04	-0.08	1							
6	Displacement (trait, between)	0.31*	0.34**	-0.10	0.19	-0.28*	1						
7	Technoference (state, between/within)	-0.03/ 0.21***	0.06	0.30*/ 0.10***	-0.03	-0.02/ 0.66***	0.08	1					
8	Technoference (trait, between)	0.38***	0.36**	0.04	0.30*	-0.20	0.89***	-0.04	1				
9	Quality Time (state, between/within)	0.15/ 0.00	-0.14	-0.01/ -0.03	0.02	-0.05/ -0.10***	-0.06	0.25/ -0.07***	-0.16	1			
10	Quality Time (trait, between)	-0.11	-0.18	0.10	0.08	0.12	-0.13	0.02	-0.17	0.06	1		
11	Being Restless (state, between/within)	-0.26/ -0.12***	-0.12	-0.07/ -0.04	-0.17	0.04/ -0.02	0.14	0.26/ -0.02	0.05	-0.02/ - 0.10***	-0.03	1	
12	Being Restless (trait, between)	0.16	0.09	0.27*	0.13	0.26	-0.12	0.12	-0.07	0.09	0.02	-0.24	1

*Note. * p < .05, ** p < .01; *** p < .001. Correlation at the between-person level can only be examined with another variable at the same level of analysis. In other words, no correlation can be found between a state variable on the within-person level and a trait variable at the between-person level.*

Table 3.

Confirmatory Analysis, Direct and Indirect Within- and Between-Person Effects: Model 1 and 2.

	Bootstrapped Model Of Quality Time			**Bootstrapped Model Of Restless**		
	Beta	95% CI	Hypothesis	Beta	95% CI	Hypothesis
1. Effect on Technoference (M)						
a. Frequency → Technoference (a path)	**0.05**	**[0.022, 0.070]**		**0.046**	**[0.022, 0.070]**	
b. Frequency ⊬→ Technoference (a path)	**0.085**	**[0.034, 0.136]**		**0.085**	**[0.034, 0.136]**	
2. Effect on Y						
a. Frequency → Y (c' path)	-0.015	[-0.057, 0.03]	H1a rejected	-0.028	[-0.062, 0.01]	H2a rejected
b. Frequency ⊬→ Y (c' path)	0.11	[-0.012, 0.23]		0.049	[-0.083, 0.19]	
c. Technoference → Y (b path)	**-0.059**	**[-0.105, -0.012]**		-0.014	[-0.05, 0.023]	
d. Technoference ⊬→ Y (b path)	-0.125	[-0.263, 0.013]		-0.087	[-0.24, 0.06]	
3. Total Effect						
a. c path	-0.018	[-0.06, 0.02]		-0.028	[-0.062, 0.01]	
b. c path ⊬	0.097	[-0.015, 0.21]		0.041	[-0.087, 0.17]	
4. Indirect effects						
a. Mediator	-0.0026	[-0.0055, 0.00]	H1b rejected	-0.001	[-0.0024, 0.00]	H2b rejected
b. Mediator ⊬	*-0.009*	*[-0.025, 0.00]*		-0.008	[-0.020, 0.00]	

Note. Model with frequency as predictor, technoference as mediator, and quality time and being restless as dependent variables. Intercepts are random, slopes are fixed. Significance is indicated by bold text. Variables measured at the between-person level are indicated via ⊬.

Table 4.

Confirmatory Analysis, Direct and Indirect Within- and Between-Person Effects: Model 3 and 4.

	Bootstrapped Model Of Quality Time			**Bootstrapped Model Of Restless**		
	Beta	95% CI	Hypothesis	Beta	95% CI	Hypothesis
1. Effect on Displacement (M)						
a. Duration → Displacement (a path)	**0.12**	**[0.094, 0.143]**		**0.118**	**[0.094, 0.143]**	
b. Duration ⊬→ Displacement (a path)	**0.089**	**[0.031, 0.147]**		**0.089**	**[0.031, 0.147]**	
2. Effect on Y						
a. Duration → Y (c' path)	0.025	[-0.033, 0.07]	H3a rejected	**-0.083**	**[-0.12, -0.04]**	**H4a rejected**[13]
b. Duration ⊬→ Y (c' path)	-0.096	[-0.24, 0.05]		0.091	[-0.064, 0.23]	
c. Displacement → Y (b path)	**-0.090**	**[-0.14, -0.04]**		0.009	[-0.023, 0.047]	
d. Displacement ⊬→ Y (b path)	-0.029	[-0.17, 0.11]		-0.106	[-0.25, 0.04]	
3. Total Effect						
a. c path	0.0135	[-0.041, 0.06]		**-0.082**	**[-0.12, -0.04]**	
b. c path ⊬	-0.101	[-0.22, 0.02]		0.082	[-0.066, 0.22]	
4. Indirect effects						
a. Mediator	**-0.011**	**[-0.017, -0.01]**	**H3b accepted**	0.001	[-0.003, 0.01]	H4b rejected
b. Mediator ⊬	-0.0034	[-0.0196, 0.01]		-0.009	[-0.027, 0.00]	

Note. Model with duration as predictor, displacement as mediator, and quality time and being restless as dependent variables. Intercepts are random, slopes are fixed. Significance is indicated by bold text. Variables measured at the between-person level are indicated via ⊬.

[13] A direct within-person effect of duration was found on perceptions of the child being restless (95% CI [-0.12, -0.04]): when parents used their smartphone longer compared to their own baseline level, they reported that their child was less restless. The significance of this association is contrary to the hypothesized direction in H4a. Hence, this direct within-person effect is seen as significant, but the hypothesis of a positive association is rejected.

Table 5.

Exploratory Analysis, Comparison of Random and Fixed Slopes of Significant Within-Person Associations of the Four Models; and Overview of Between-Person Differences in Strength and Direction of Significant Within-Person Associations.

	Bootstrapped Models		**Heterogeneity of within-person associations**		
	Fixed slope	Random slope		Negative (n, %)	Positive (n, %)
1. Frequency → Technoference					
a. Deviance	2042.5	2007.1	a. Non-existent to small	18 (36%)	
b. AIC / BIC	2052.5 / 2079.0	2021.1 / 2058.2	b. Weak	2 (4%)	4 (8%)
c. Chi² (dif)	**35.346 (2) *** **		c. Moderate	2 (4%)	3 (6%)
			d. Strong	2 (4%)	19 (38%)
2. Technoference → Quality Time					
a. Deviance	4017.6	4001.7	a. Non-existent to small	13 (28.26%)	
b. AIC / BIC	4031.6 / 4068.7	4019.7 / 4067.4	b. Weak	**9 (19.57%)**	6 (13.04%)
c. Chi² (dif)	**15.894 (2) *** **		c. Moderate	**6 (13.04%)**	2 (4.35%)
			d. Strong	**4 (8.70%)**	6 (13.04%)
3. Duration → Displacement					
a. Deviance	2147.2	2044.2	a. Non-existent to small	21 (38.89%)	
b. AIC / BIC	2157.2 / 2183.7	2058.2 / 2095.4	b. Weak	2 (3.70%)	**2 (3.70%)**
c. Chi² (dif)	**102.93 (2) *** **		c. Moderate	2 (3.70%)	**6 (11.11%)**
			d. Strong	1 (1.85%)	**20 (37.04%)**
4. Displacement → Quality Time					
a. Deviance	4011.7	4007			
b. AIC / BIC	4025.7 / 4062.9	4025.0 / 4027.7			
c. Chi² (dif)	4.702 (2)				
5. Duration → Restless					
a. Deviance	3389.2	3382.9	a. Non-existent to small	19 (35.85%)	
b. AIC / BIC	3403.2 / 3440.4	3400.9 / 3448.6	b. Weak	**13 (24.53%)**	2 (3.77%)
c. Chi² (dif)	**6.366 (2) ***		c. Moderate	**6 (11.32%)**	3 (5.66%)
			d. Strong	**8 (15.09%)**	2 (3.77%)

Note. In the left part of the table, significant better fits of the models with random slopes are indicated by the Chi² (dif) values in bold. In the right part of the table, the amount and percentage of participants linked to the strength (non-existent to small [-0.10 < r < 0.10] , weak [-0.20 < r < -0.10; 0.10 < r < 0.20], moderate [-0.30 < r < -0.20; 0.20 < r < 0.30], or strong [-0.30 > r; r > 0.30]) and the direction (negative or positive) of the four significant within-person associations are outlined. In bold, the values consistent with the direction of the found significant within-person associations, indicated in table 2 and 3 (in general, without taking between-person differences in mind).