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Tuning into the real effect of smartphone use on parenting: a multiverse analysis

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Background: Concerns have been raised regarding the potential negative impacts of parents' smartphone use on the parent–child relationship. A scoping literature review indicated inconsistent effects, arguably attributable to different conceptualizations of parent phone use and conflation of phone use with technological interference. **Methods:** Based on a sample of n = 3, 659 parents collected in partnership with a national public broadcaster, we conducted a multiverse analysis. We explored 84 different analytic choices to address whether associations were weak versus robust, and provide clearer direction for measurement, theory, and practice. Effects were assessed in relation to p values, effect sizes, and AIC; we further conducted a meta-analytic sensitivity check. **Results:** Direct associations between smartphone use and parenting were relatively weak and mixed. Instead, the relation between use and parenting depended on level of technological interference. This pattern was particularly robust for family displacement. At low levels of displacing time with family using technology, more smartphone use was associated with *better* (not worse) parenting. **Conclusions:** Our results indicate fragility in findings of risks for parental smartphone use on parenting; there were few concerns in this regard. Rather, at low levels of technological interference, more phone use was associated with higher parenting quality. Scholars should avoid generalized narratives of family risk and seek to uncover real effects of smartphone use on family outcomes across diverse households and contexts. **Keywords:** Smartphone; parenting; parent–child relationship; technoference; multiverse.

Introduction

A host of challenges confront scientists seeking to uncover the 'real' effect of smartphones on parenting. Parents dealing with the very same media often hold vastly different rules, norms, and communication ethics regarding their use (Clark, 2013). Likewise, parents make heterogeneous choices based on past experiences, perceived harms, and future concerns (Nelson & Nelson, 2010). Unfortunately, these conceptually and practically important differences across family, ethnic, and class boundaries currently sit in the background of psychological discussion of parental smartphone use. In place of more meaningful dialogue regarding what exactly constitutes 'good' parenting in relation to technology use, and for whom, is a clouded assertion that risks to good (warm, attached) parenting are in mother's and father's own hands—in the form of smartphones. The contention being that parents' ubiquitous computing necessarily comes at a relational cost; we immerse in our smartphones at the expense of disengaging from our children.

There is a well-worn history of public controversy over the potential harmful effects of new technologies on children and families (Modecki, Minchin, Harbaugh, Guerra, & Runions, 2014; Wartella & Jennings, 2000), and experts at the intersection of technology, media, and family are increasingly calling into question this dichotomy between smartphone connectivity versus relational togetherness (Harmon & Mazmanian, 2013; Livingstone & Helsper, 2010). Yet a basic challenge stands in the path of our asking more nuanced questions about parental smartphone use and child outcomes. In its present form, most psychological data and associated findings have been gleaned from a labyrinth of measures, myriad operationalizations, inconsistent controls, and small samples. With so much variability, any actual link between smartphone use and parenting remains largely obscured. Scholars are left to weigh whether findings of negative impacts of smartphones on parenting are largely the artifact of a specific operationalization of smartphone use, the result of a sample too small to meaningfully represent its population, apply only to a specific parenting outcome, or other study-specific choices. In this investigation, we address this question regarding robustness (and direction) of effects of parents' smartphone use on the parent–child relationship

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via an increasingly popular approach for conducting comprehensive and transparent analyses, a multiverse analysis (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016).

Multiverse analysis

Multiverse analysis acknowledges that a final published dataset and associated analyses are the result of a series of decisions made in the form of multiple processing choices (Steegen et al., 2016). If subsequent findings are dependent on a very specific combination of choices made, this points to fragility of conclusions (e.g. Modecki, 2016). Particularly relevant to scientific arenas in which measures are noisy (i.e., error-prone), effects can be relatively small, or data preparation requires choices from numerous plausible options, multiverse analysis exposes the impact of various choices, with the aim to discern those elements which are sound versus sensitive to choice. These choices range from well-justified to arbitrary; for instance, choosing which variable best represents a construct of interest, to micro-decisions such as transformation of scales (Steegen et al., 2016). Within the arena of parental technology use and family well-being, in particular, the nature of association is increasingly subject to debate (Harmon & Mazmanian, 2013). As a result, a multiverse analysis can helpfully expose those key choices upon which conclusions have hinged and better establish direction and robustness of effects (Steegen et al., 2016).

Parents' media use and family well-being: where are the effects?

One of the central suspects worth investigating in terms of fragility of effects is how 'time on device' is operationalized in relation to parenting outcomes. Our scoping review found largely inconsistent and several null findings relating parental device use with parent–child relationship outcomes (Table S1). This inconsistency could be attributable to parents' varying use of devices (e.g., Radesky et al., 2016) and varying immersion in their technology depending on type of use (e.g., phone calls versus social network site use). Most commonly, however, parents are asked to report overall time on devices in a typical day. Yet findings linking this index to outcomes are mixed (e.g., overall time predicts children's screen time, Lauricella et al., 2015, but not parenting roles, Blackman, 2015), and effect sizes tend to be small.

Rather, it may prove more fruitful to conceptualize parents' use of devices in terms of degree of immersion (e.g., Radesky et al., 2016). Illustratively, parents' responses to children's behavior can be delayed if most of the interaction is spent scrolling on devices (i.e., divided engagement; Lemish et al., 2019), and phone checking and absorption in social networking sites (SNS) can consume parents' attention without limits. This near-constant checking of cell phones has been characterized as 'dependence' within certain scholarly spheres.

In contrast, less immersive uses such as phone calls and texting tend to be time-limited and allow for maintenance of eye contact with children. These uses can simultaneously provide some freedom yet allow parents to quickly switch away from the phone when needed (Hiniker, Sobel, Suh, Sung, Lee, & Kientz, 2015; Oduor et al., 2016). Given simultaneous benefits of relational upkeep and stress relief (Radesky et al., 2016), such time-limited use might have positive implications for parenting. Indeed, when studies have examined parental calling and texting for communication purposes, a positive relation with parenting emerges (Warren & Aloia, 2018).

Technology's interference with parenting

A second source of fragility within the technology use-parenting literature is the conflation of parents' time on device with technology's interference in the parent–child relationship. That is, for many families, the presence of smartphones may be unexceptional and time on device does not necessarily connote interference. Rather, the frequency with which parents allow devices to interrupt interactions with their children (i.e., *technoference*; McDaniel, & Coyne, 2016) has been tied to poorer parent–child attachment (Xie, Chen, Zhu, & He, 2019), and so may be a modifier of a smartphone use-parenting association. Indeed, children's sense of parental disengagement is implicated in negative outcomes, with parents 'displacing' attention to their phone rather than to offspring. Likewise, family members sometimes report feeling ignored because of others' device use, leading to frustration and interpersonal conflict (Oduor et al., 2016). Thus, technoference might involve two distinct elements, displacement of family relationships and family conflict over use (Kildare & Middlemiss, 2017).

Regarding displacement, observational work suggests parents are less attentive to offspring when also engaged with their mobile devices (Hiniker et al., 2015; Lemish et al., 2019; Radesky et al., 2016). Nevertheless, Hiniker et al. (2015) showed that relative time displaced by parental phone use is quite small. Further, too, 'displaced' time is typically followed by an intensive burst of highly attentive parenting.

Regarding conflict, this conceptualization is especially problematic, as it conflates technological interference with conflict over parent's phone use. The idea here is that parental smartphone use can potentially negatively alter how members communicate with one another, express intimacy, and maintain relationships (Hertlein, 2012). As a result, conflict can arise among families complaining about parental phone use.

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Parenting outcomes

A third source of fragility within the literature relates to parenting outcomes, namely two axes of parenting: attachment and warmth. Theoretically, parents' physical and emotional availability could be affected by smartphone use, which in turn might be interwoven with feelings of secure parent–child attachment. That said, most previous work on devices and attachment has focused on children's, rather than parents', technology use. More broadly, other research has considered the role of parenting styles in relation to family media use. In this case, parental warmth has been linked to positive attitudes toward the internet and predicts children's internet use (Valcke, Bonte, De Wever, & Rots, 2010). Surprisingly, however, parental warmth is rarely assessed when asserting risks of parental smartphone use, even though this is a key facet of positive parenting.

The current study

All told, a clearer picture is needed regarding the effects of parents' smartphone use on the parent–child relationship. To the extent that different methodological choices point to similar direction and strength of effects, a multiverse analysis can speak to robustness of findings and provide good evidence for informing policies and programs. On the other hand, when different choices highlight inconsistent or largely nonsignificant results, multiverse analysis can serve as a call for clearer operationalizations, better measurement, and more nuanced theory.

Accordingly, we addressed three main arenas in our exploratory multiverse. Firstly, we assessed size and direction of association between parental device use and parent–child relationship outcomes across varying operationalizations of smartphone use (time on phone, calling, texting, checking, and SNS). We hypothesized that effects would vary based on how devices are being used, with nonimmersive use perhaps tied to better parenting outcomes. Even for immersive forms of use, small negative (and inconsistent) relations appear to be the norm, so that concerns may be overstated. More likely, negative impacts from smartphone use occur only at high levels of technological interference, when use supplants healthy family time or is associated with family conflict. Thus, secondly, we assessed the modifying role of technoference (family displacement and family conflict), on the association between phone use and parenting. Third, we employed a meta-analytic procedure as a descriptive tool to assess sensitivity of effects. This summarized how standardized effects varied across model settings. Across all questions, we tested two distinct conceptualizations of parenting: parental warmth and parent–child attachment.

Methods

Data were collected via an online survey conducted by the national public broadcaster, the Australian Broadcasting Corporation (the ABC, akin to the UK's BBC and USA's NPR) for an August 2017 National Science Week initiative. Approval to analyze the dataset was granted by the university ethics committee (#2017/182). Survey constructs tapped smartphone use, technology interreference at home and work, family well-being, and key controls (e.g., child age, marital status, education level). Recruitment was assisted by the ABC's public relations teams. The survey was planned to reach a diverse audience, including Indigenous Australians and different socioeconomic groups.

Surveys were completed within approximately 10 min. Of 14, 623 participants completing the full survey, 3, 659 were eligible parents (children living at home and youngest child 18 or under) and genders were balanced (52% female). Appendix S1 provides further details on data collection, and Appendix S2 provides more substantive details on study measures.

Table S2 includes specifics regarding participant demographics, and Table S3 reports validity checks for study measures.

Measures

Time on smartphone. The multiple dimensions of time spent on smartphone were measured by five items. We validated each item with participants' reports of relationship satisfaction and relationship closeness (for participants who were partnered), level of recent life stress, and perceived ability to handle stress (Table S3 describes these measures and associated validity checks).

Time. Overall time on smartphone was assessed with an open-ended question, 'How much time have you spent using your smartphone in the last 24 hrs? Please consider all uses except listening to music.' Given that this construct was positively skewed, we further transformed time via square root (*Time Sqrt*).

Calls. Participants responded to an open-ended question regarding how many phone calls they made on their smartphone in the last 24 hrs. This open-ended construct was highly positively skewed, and we further transformed calls via square root (*Calls Sqrt*) and natural logarithm (*Calls Log*) in order to normalize the distribution.

Texting. Participants estimated how often they used their smartphones to send texts or instant messages on an average day. Response options ranged by frequency from never (1) to always (8).

SNS. Participants reported the approximate proportion of time on their smartphones they spend using social media (0 = None, 1 = Quarter, 2 = Half, 3 = Three quarters, 4 = All).

Checking. This question was similar to the texting question, with the same answer options, but replaced 'text' with 'check or use phone.'

Intensity. Finally, following quality of life research, we calculated intensity constructs by making an adjustment for total smartphone time, so that intensity provided a weight to various types of phone time. Thus, six intensity measures were derived as independent variables: *SNS Intensity; SNS Intensity Sqrt; Check Intensity; Check Intensity Sqrt; Text Intensity; Text Intensity Sqrt.*

Family displacement due to technology use. Parents rated the extent to which their smartphone use displaced

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family time via two averaged items (1 = Strongly Disagree; 5 = Strongly Agree; α = .78).

Family conflict over technology use. Two items were used to tap conflict: 1 = Strongly Disagree; 5 = Strongly Agree; α = .75).

Parenting. One item (1 = Strongly Disagree; 5 = Strongly Agree) which loaded highly on the Trust/Avoidance subscale of the Revised Inventory of Parent Attachment (Johnson, Ketring, & Abshire, 2003) measured *parent–child attachment*. Similarly, one item (1 = Strongly Disagree; 5 = Strongly Agree) which loaded highly on the Authoritative Parenting subscale of the Parenting Practices Questionnaire (Robinson, Mandleco, Olsen & Hart, 1995) measured *Parental Warmth*.

Covariates. All analyses adjusted for participant age, relationship status, education, employment status, and age of youngest child (see Appendix S3 Model Covariates).

Planned analyses

First we explored operationalizations of smartphone use and parenting, via cumulative logistic regression on an ordinal response. These were characterized in terms of *p*-values, scaled effect sizes, and AIC. Next, we assessed moderation effects for family displacement and family conflict separately for each parenting indicator. Third, a meta-analysis was used descriptively, to summarize the ways in which effects varied across model choices. Although this approach violates a primary assumption of meta-analysis that each 'study' is independent, we employed this guided by principles of sensitivity analyses, as a summary of effects. Calculations were done in R using the polr package (as described in Venables & Ripley, 2002).

Results

Does smartphone use predict parenting?

For both parental warmth and attachment, the 14 different independent variables (IV's) tapping smartphone use were run via a series of models using R's polr package. For comparison, we plotted key diagnostics for each model, including *p* values, effect sizes, and AIC. Diagnostics helped assess the utility of each IV for predicting the effect (*p* value), the influence of each IV on each DV (effect size), and how well the whole model performed (AIC).

Figure 1 plots *p* values with each panel corresponding to each smartphone use variable. For ease of interpretation, the *y*-axis is plotted along log-transformed p-values, with significant studies falling below the black horizontal line ($\log(p) < -3$; $p < .05$). Within each panel, models with parental warmth are indicated via triangles and parent–child attachment via circles.

Parental warmth. For main effects of smartphone use, our focus is on the left side of each panel (N on the *x*-axis, Figure 1) representing no modifier in the model. First for parental warmth (triangles), three predictors had significant *p* values (below the horizontal line). Specifically, SNS, SNS Intensity, and SNS Intensity Sqrt each predicted parental warmth. That is, all smartphone dimensions tapping SNS use were statistically significant on warmth and these were the only dimensions to exert a significant effect.

To assess direction of effects, Figure 2 compares effect sizes (*y*-axis, log-odds scaled for ease of interpretation) for each parenting variable and smartphone operationalization (panel).

Thus, SNS showed a relatively small significant positive effect (.25), while SNS Intensity and SNS Intensity Sqrt had very small nonzero positive effects (Figure 2: bottom row, blue main effects with N on x-axis). Other main effects on parental warmth were negligible and nonsignificant.

Parent–child attachment. For quality of parent–child attachment (circles Figure 1), a wider range of smartphone use variables emerged as significant predictors. Daily Checking, Check Intensity, Check Intensity Sqrt, Daily Texting, Text Intensity, Text Intensity Sqrt, SNS Intensity, SNS Intensity Sqrt, Time, and Time Sqrt each predicted attachment quality (e.g., corresponding p-values falling below horizontal line). Thus, a wider range of phone use variables were related to attachment quality and the only independent variables not to show a significant effect were generally related to calls.

In relation to effect sizes (Figure 2, top two rows), a pattern of relatively small negative effects was found for each significant effect as follows: Daily Checking, Check Intensity, Check Intensity Sqrt, Daily Texting, Text Intensity, Text Intensity Sqrt, SNS Intensity, SNS Intensity Sqrt, Time, and Time Sqrt. Standardized effects ranged from approximately −1 to −2.

Main effects models. Although *p* values and effect sizes give a sense of strength and influence of individual smartphone use predictors, AIC values measure the ability to explain parenting by the different smartphone constructs. Consistently, these confirmed that 'technoference' interactions, and particularly family displacement, always improved models of parenting (Figure S1). Additionally, models with SNS Intensity Sqrt were the best-fitting for four of six choices of parenting and technoference, and in the top third for the other two choices (Table S4).

Does 'interference' condition the relation between smartphone use and parenting?

Parental warmth. Family conflict: Exploring *p* values associated with family conflict (Figure 1, C, midpoint on *x*-axis within each panel), there were very few significant phone X family conflict effects for parental warmth. While there were some small positive effects associated with family conflict interaction terms, there was also uncertainty (Figure 2, CI's cross zero), and only Daily Texting X Family

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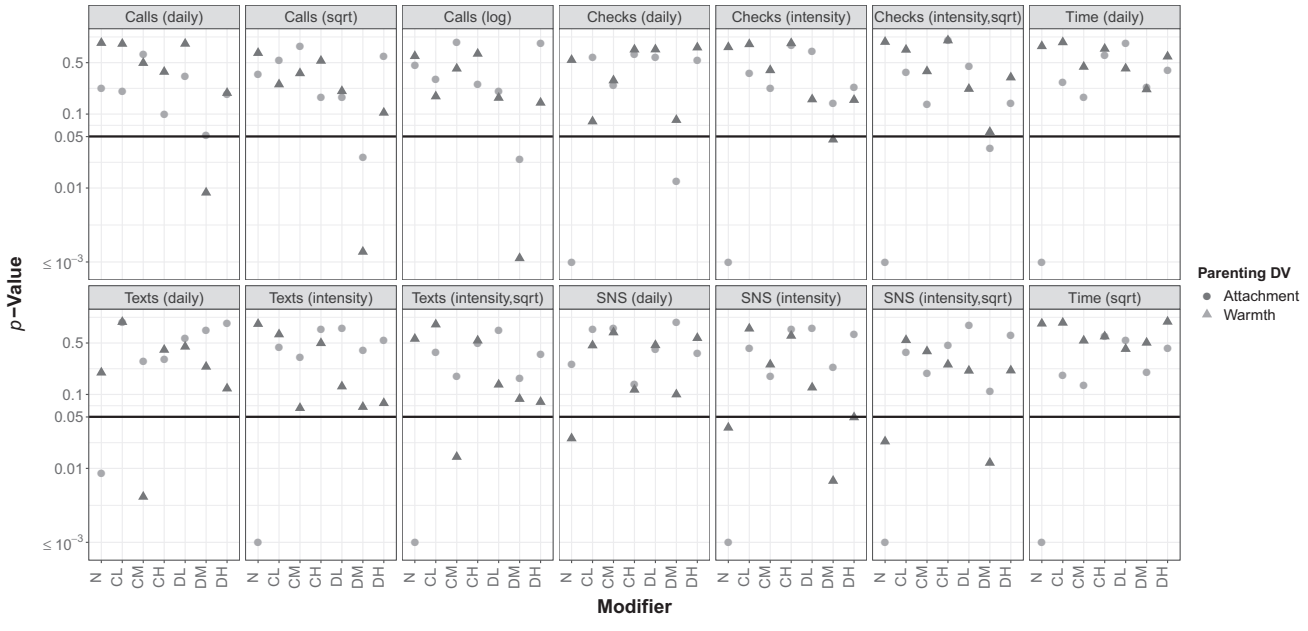

Figure 1 *p* Values for smartphone use variables predicting parenting. Note. Each panel corresponds to a technology use IV. *Y*-axis plots log transformed *p* values; points below horizontal line are $p < .05$. *X*-axis shows values with no modifier in the model (N), values for smartphone use X family conflict interaction (C), and values for smartphone use X family displacement interaction (D) at low (L), medium (M), and high (H) levels. Within each panel, ▲ = *p* values for parent warmth; ● = *p* values for parent attachment

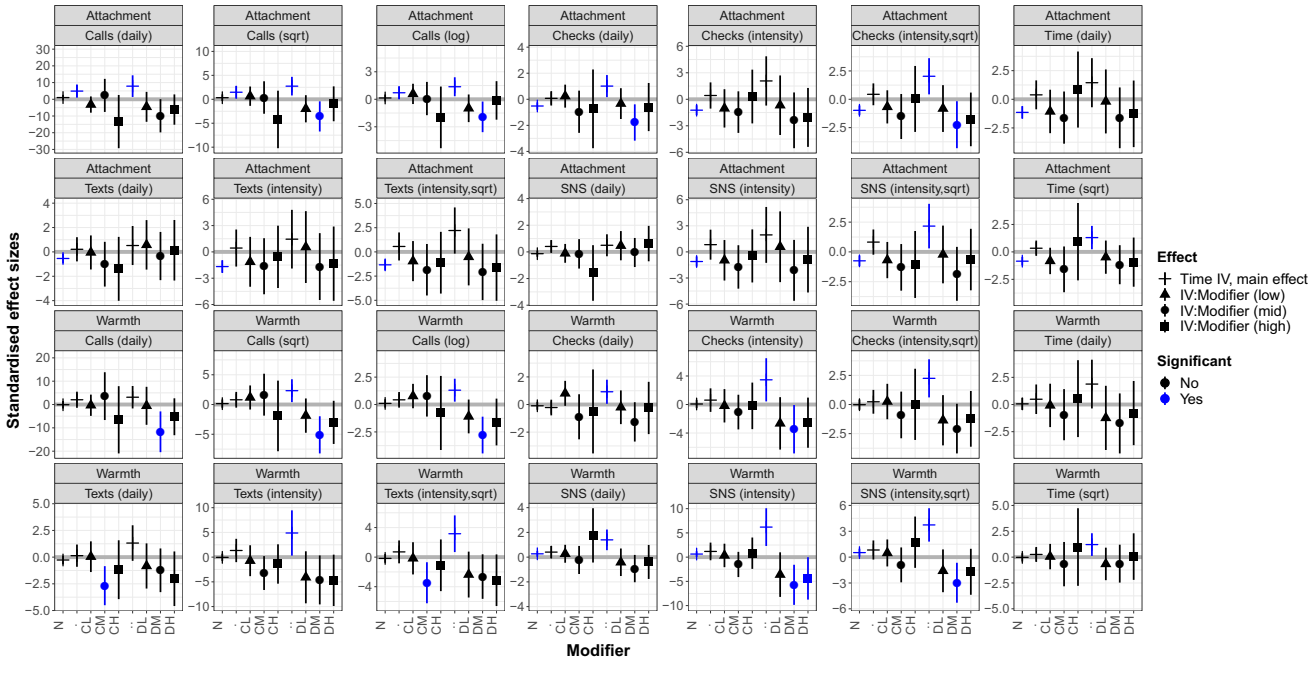

Figure 2 Effect size values for each smartphone use variable predicting parenting. Note. Separate panels for each independent variable. *Y*-axis represents effect size estimates (log-odds scaled for ease of interpretation), with horizontal line denoting zero and blue indicators denoting significant effect. *X*-axis shows values with no modifier in the model (N), values for smartphone use X family conflict interaction (C), and values for smartphone use X family displacement interaction (D) at low (L), medium (M), and high (H) levels. Effect sizes for parental attachment are shown in top rows, and effect sizes for warmth are in bottom rows [Colour figure can be viewed at wileyonlinelibrary.com]

Conflict (moderate levels) showed a noteworthy effect (−3).

Family displacement: In contrast, *p* values were associated with family displacement (Figure 1, D, far right x-axis within each panel), point to a number of significant phone use interactions predicting parental warmth (triangles). Plotted interactions are highlighted from only four levels out of nine for each moderator: very low (VL, subsumed in main effect of IV), low (L), moderate (M), and high (H) levels. Here, Daily Calls, Calls Sqrt, Calls Log, SNS Intensity, and SNS Intensity Sqrt all had significant interactions. The largest effects were for Daily Calls X Moderate

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Displacement (−12) though this effect was also associated with a great deal of uncertainty (wide CI's; Figure 2 effect sizes). The pattern of these interaction effects are characterized in Figure 3 and described below.

First, consider the effects of SNS (Intensity, Sqrt) on parental warmth, modified by family displacement. Separate vertical columns are plotted for SNS scaled at low (0), medium (.5), and high (1) levels. Here, the *x*-axis reflects each level of parental warmth, from very low (VL), low (L), moderate (M), high (H), to very high (VH). The *y*-axis reflects probability (with confidence intervals) of belonging to each parental warmth level. Finally, separate rows are plotted for different levels of the moderator (family displacement) at low (L), medium (M), and high (H) levels.

Assessing relations between SNS and parental warmth at low levels of family displacement (top row), moving rightward from low levels of SNS to medium and high, we see a clear shift in probability of being categorized in terms of high (H) parental warmth to increased probability of categorization to very high (VH) parental warmth. Further, at moderate levels of family displacement (middle row), we see a somewhat similar pattern in that moving rightward from low levels of SNS to medium and high, there is a shift in probability of being categorized in terms of low (L) or moderate (M) warmth to increased probability of being categorized in terms of high (H) parental warmth. At high levels of family displacement (bottom row), this same pattern is present-increased probability of enhanced parenting associated with more SNS.

The take-home message here is, supposing a causal relation exists, for individuals who would not self-classify as warm parents, they may be better off displacing family time with their phone as opposed to not, at least for some uses such as time on SNS. The other (noncausal) interpretation is that parents who displace more time with their phones, and also spend a great deal of time on their phones

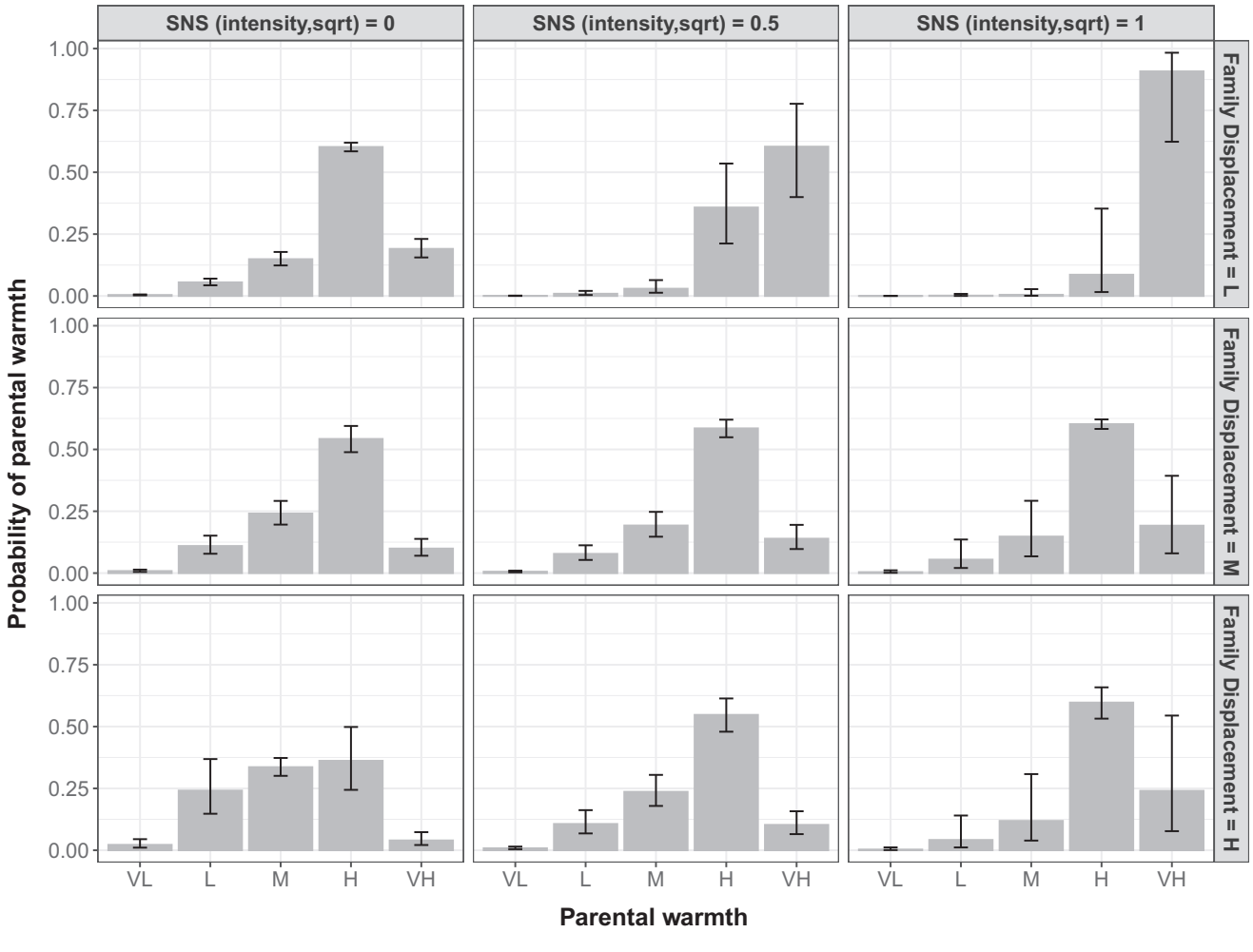

Figure 3 Plots of moderator effects; relation between **SNS intensity (sqrt)** predicting **parental warmth** at different levels of **family displacement**. Note. Separate columns for low (0), medium (.5), and high (1) levels of SNS intensity (square root transformed). *X*-axis reflects each level of parental warmth, from very low (VL), low (L), moderate (M), high (H), to very high (VH). *Y*-axis reflects probability (with confidence intervals) of belonging to each parental warmth level. Separate rows for different levels of family displacement at low (L), medium (M), and high (H) levels

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(for some purposes), will be warmer than they otherwise would be. This pattern of effects held for measures of immersive tasks: SNS Intensity constructs, Check Intensity constructs; Text Intensity constructs, SNS, and Daily Checking. In this case, constructs tapping immersion with phone appear to work to connect or entertain parents and/or diffuse stress, concurrently nudging them upwards in warmth.

Parent–child attachment. Family conflict: Exploring *p* values associated with tech-conflict (Figure 1, C, *x*-axis in panels), there were no significant phone X family conflict effects for parental attachment (circles below horizontal line).

Family displacement: Exploring *p* values, several smartphone use variables had significant interactions predicting parent–child attachment quality, including Calls Sqrt, Calls Log, Daily Checking, and Check Intensity Sqrt (Figure 1). Notably, examining effect sizes (Figure 2), Calls had a large positive effect size at moderate levels of family displacement (10), an order of magnitude larger than the other significant interaction effects (ranging from 2–4). However, the pattern of interactions for this construct was too noisy to meaningfully interpret. Among the remaining significant interactions, the pattern of effects fell into one of two groups.

The first pattern of interactions occurred for Daily Checking (Figure 4) as well as Calls Sqrt and Calls Log. Working through the figure, separate columns are again plotted for low (0), medium (.5), and high (1) levels of daily checking. The *x*-axis reflects each level of parental attachment, from very low (VL), low (L), moderate (M), high (H), to very high (VH). Further, the *y*-axis again reflects probability of belonging to each parental attachment level. Finally, the separate rows are shown for family displacement at low (L), medium (M), and high (H) levels.

At low levels of family displacement (top row), there is a pattern of moving away from being characterized in terms of low (L) or moderate (M) parent–child attachment and towardincreasing probability of being characterized in terms of high (H) or very high (VH) as Daily Checking increases from low to high (across the columns). Whereas at high levels of family displacement (bottom row), and low Daily Checking (bottom left panel), parents showed a fairly even probability of being characterized as having low (L), moderate (M), or high (H) parent–child attachment. Yet scanning across the columns toward medium (M) and high (H) daily checking, probabilities shift away from low (L) toward increased probability of being characterized as having high (H) parent–child attachment. A slightly different patterned emerged at moderate levels of family displacement (middle row). There was a subtle pattern of increased smartphone checking being associated with increased probability of lower parent–child attachment. That is, with increased checking, the probability of being characterized in terms of high (H) and very high (VH) attachment shifted toward increased probability of being characterized in terms of low (L) and moderate (M) attachment.

Here, the take-home message is that for checking smartphones, at low levels of displacement parents can use smartphones without concerns about poorer parenting outcomes. However, at average levels of family displacement, for parents who do not classify themselves as especially attached, displacing family time with checking smartphones may nudge them into a slightly lower quality of attachment.

The second pattern of interaction is described in Figure S2 and was evident only for SNS Intensity Sqrt. At the highest level of family displacement, as SNS Intensity increases, the probability of parental attachment being very high (VH) or high (H) drops to near zero, and probability of attachment being very low (VL) or low (L) increases. This is an immersive form of use, and at high levels of displacement, we see a negative impact. Whereas, at the lowest level of family displacement we observe the familiar pattern seen across all significant interaction models. At low levels of displacement, more smartphone use is associated with higher probability of higher quality parenting.

Interaction models. Across both types of parenting, the best fit was consistently associated with family displacement as an interaction term (AIC, Figure S1). This echoes the pattern of significant interaction terms for family displacement and the more robust (repeats across many constructs) pattern of findings in association with parental warmth (see Table S5 for ranked effect sizes).

Meta-analysis. Finally, we ran a series of meta-analyses separately by moderator and dependent variable (Figure 5). These confirmed findings from modeled predictions in that the level of the modifier was the biggest source of difference among model settings. Further, the contributions of whether smartphone use was immersive and the level of the modifier together explain significant heterogeneity (Table S6). Across model choices, there were stronger positive effects of phone use on parenting at low (vs. moderate) levels of interference.

Discussion

Media entities, policy makers, and various scholars have voiced concerns that smartphones represent a risk for warm and attached parent–child relationships. But blaming smartphones for problematic parenting is, arguably, missing the point (Odgers, 2018). In the current study, we sought to better characterize the real effect of parental smartphone use on the parent–child relationship via a

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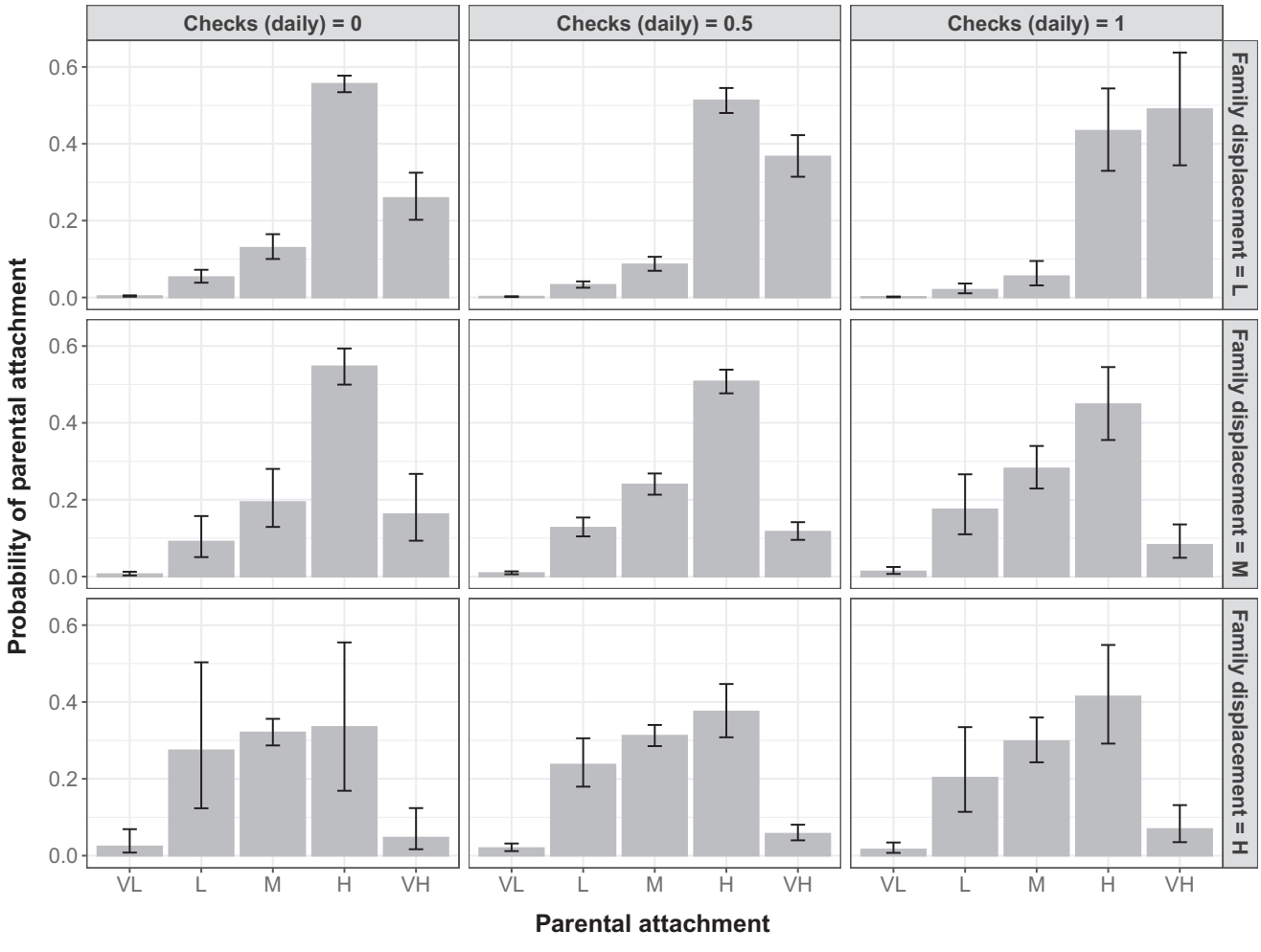

Figure 4 Plots of moderator effects; Relation between **daily checking** predicting **parent–child attachment** at different levels of **family displacement**. Note. Separate columns for low (0), medium (.5), and high (1) levels of daily checking. *X*-axis reflects each level of parental attachment, from very low (VL), low (L), moderate (M), high (H), to very high (VH). *Y*-axis reflects probability (with confidence intervals) of belonging to each parental attachment level. Separate rows for different levels of family displacement at low (L), medium (M), and high (H) levels

comprehensive and transparent analysis of data from more than 3,500 parents. Exploring the effects of 14 different characterizations of parental smartphone use on parent–child attachment and parental warmth via a multiverse analysis, we described results across 84 different analytic choices. All told, we found little evidence of a direct effect of phone use on parenting. Rather, the most common pattern of significant effect included 'technoference' as a modifier. That is, the link between phone use and parenting was conditioned by displacing time with family and experiencing family conflict due to parents' smartphone use. Importantly, this pattern of interaction favored positive impacts of smartphone use on parenting at nearly all levels of technoference. As a result, we assert that scholars should move beyond blanket assumptions of risk and interrogate their assumptions regarding how parents should be making use of smartphones (Clark, 2013).

We sought to move scholarly debate beyond general assertions of risk and uncover the 'true' effect of smartphone use on parenting within an exploratory multiverse analysis. Building on a growing literature taking such approaches (e.g., Orben, & Przybylski, 2019), we explored a diversity of possible analytic choices to better characterize the robustness (vs. fragility) of effects. Overall, parents' smartphone use was not the main story when exploring parenting outcomes; effects were relatively small and mixed (e.g., frail). We found relatively small *positive* effects for use in relation to parental warmth and several relatively small *negative* effects in relation to parental attachment.

However, these main effect models were not the best fit to the data and models including technoference provided a better fit across all smartphone use constructs for both measures of parenting. This robust pattern highlighted that the impact of parental phone use *depends on* the degree to which use interferes with family time. Moreover, the pattern of interactions robustly pointed to a positive relation between smartphone use and parenting, especially at low levels of family displacement and conflict.

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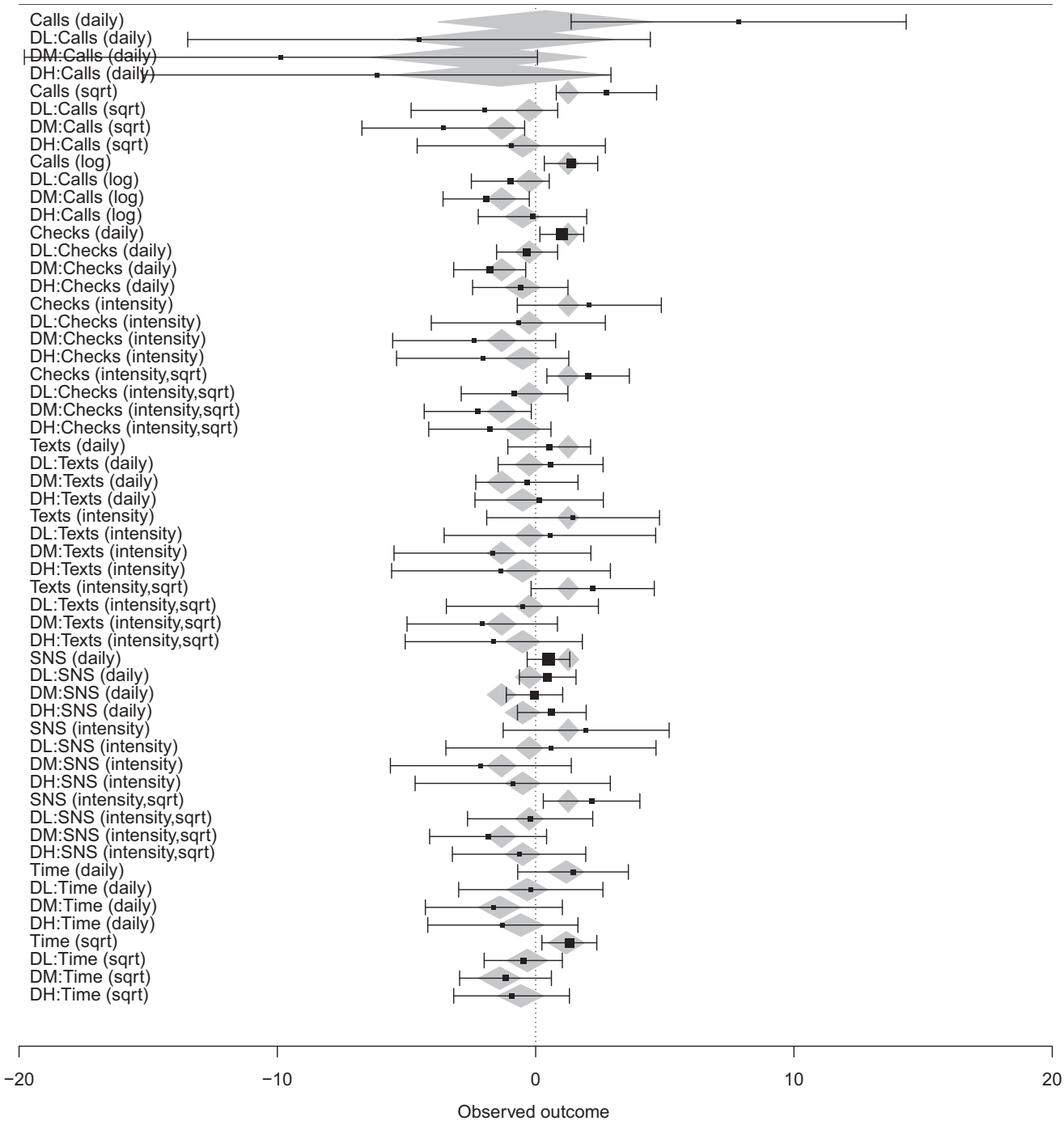

Figure 5 Meta-analysis of the effect of smartphone use predicting parent-child attachment, modified by family displacement. Pseudo meta-analysis used as a sensitivity check to compare the scaled effect sizes of IV's. Interactions were estimated for smartphone use X family displacement interaction at low (DL), medium (DM), and high (DH) levels of displacement.

Indeed, a meta-analytic sensitivity check likewise made clear that the greatest variation in effect size across models was attributable to the contrast between low versus moderate technoference. In particular, at low levels of interference, more phone use was associated with higher parenting quality. A second notable finding from the meta-analysis was that characterizing smartphone use based on level of 'immersion' explained more variation between models than models using individual operationalizations of phone use. Thus, future research should consider whether constructs tapping smartphone use are capturing less immersive use (i.e., calls, texts) versus more (i.e., SNS, checking, time).

There were several study limitations; most notable was our reliance on cross-sectional data. Longitudinal data are required to better infer direction of effects. Further, we relied on single-item constructs as the dependent variables. Although these items loaded highly on existing scales and showed good

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validity within our sample, future research should better measure parenting constructs.

Conclusion

To better characterize the relation between parental smartphone use and parent–child relationship quality, we deployed an intensive multiverse analysis (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016). Generally, findings pointed to fragility in previous assertions of smartphone risks. Direct associations between parental smartphone use and parenting were relatively small in size and tended to be both positive and negative. Instead, the relation between use and parenting largely depended on degree of technoference, particularly displacement from family time. At low levels of displacing time with family with smartphones, more phone use was associated with *better* (not worse) parenting. As a result, we assert that scholars should now move beyond simplistic narratives of family risk.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Data collection methods.
Appendix S2. Variable information.
Appendix S3. Model covariates.
Table S1. Literature scoping review with rankings of effect sizes.
Table S2. Participant demographics.
Table S3. Validity checks of study measures.
Table S4. Ranking of smartphone use IV's data-driven AIC.
Table S5. Ranking of smartphone use IV's driven by effect size.
Table S6. Summary of model fit for different sensitivity analyses across dependent variables and modifiers.
Figure S1. AIC decision tree values for parental warmth and parental attachment.
Figure S2. Plots of moderator effects; relation between SNS Intensity (sqrt) predicting parental attachment at different levels of family displacement.

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Key points

- Multiverse analysis revealed direct effects of parental smartphone use are relatively small and mixed; interactions between phone use and technological interference were more robust, across the board.
- The most robust pattern of effects was at low levels of technological interference; more phone use was associated with higher self-reported parenting quality.
- Effects of parental phone use were mainly positive, and practitioners' focus should remain on warm and attached parenting, rather than parents' technological interference.
- Future research should consider parental smartphone use in terms of high immersion (e.g., frequent checking, social networking use) versus low immersion (e.g., calling, texting).
- More broadly, future research should move beyond broad generalizations of risk to consider heterogeneity in family circumstances and use.

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