

## ARTICLE

# The impact of parents' smartphone use on language development in young children

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## Abstract

Smartphone use is ubiquitous in the lives of parents, and an emerging area of research is investigating how parental smartphone use during parent–child interactions affects children's language outcomes. Findings point toward negative outcomes in language development, but it is less clear what processes affect language outcomes. Gaze following, parental responsiveness, and joint attention are also reduced when parents use their smartphone, and all are critical to language development. In this article, we propose that these factors may mediate the effects of technofence due to parents' smartphone use on language development in children from birth to 5 years. Because of methodological differences in the limited research conducted on this topic, it is difficult to draw firm conclusions about this proposal. We discuss these considerations and suggest directions for the field.

## KEY WORDS

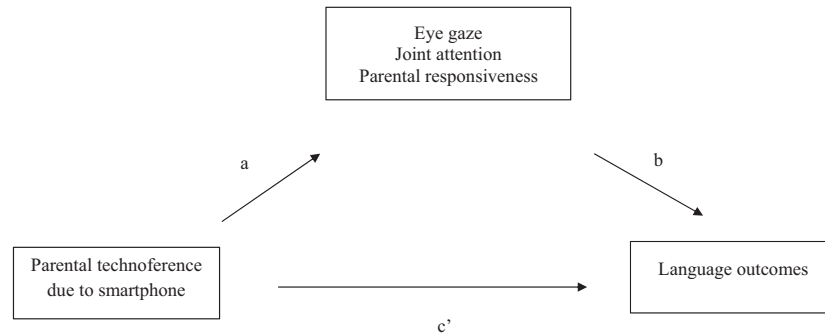
language, parent–child interactions, technofence

Since their development in 2007, smartphones have become ubiquitous in our daily lives, including during parent–child interactions. Observations show that parents' smartphone use is relatively low when a parent is with their child (Hiniker et al., 2015), but when parents do use their smartphone around their child, it tends to be used exclusively and not alongside other activities (Abels et al., 2018). This creates the risk of parents becoming absorbed in their smartphone, which causes *technofence* (Vanden Abeele et al., 2020): the interference of parent–child interactions due to parents' use of technology (McDaniel & Coyne, 2016). Given the importance of parent–child interactions in the early years, technofence can be problematic for child development (e.g., Bordeleau et al., 2012). Because children are likely to spend a significant amount of time at home with their parents before starting school, the influence of technofence in the first 5 years is critical to explore (e.g., Smith et al., 2000).

In this article, we review evidence of the effects of smartphone technofence during parent–child interactions on language outcomes. We propose that technofence affects language development by disrupting processes critical to language acquisition—namely, gaze following, joint attention, and parents' responsiveness (see Figure 1). Newborns and young infants demonstrate a preference for faces accompanied with direct gaze (Farroni et al., 2002), this preference facilitates the development of gaze following (Farroni et al., 2004), and gaze following can initiate joint attention exchanges (Stephenson et al., 2021). Both gaze following and joint attention skills during infancy are related to later language outcomes (Brooks & Meltzoff, 2005). Parents' responsiveness also facilitates language development (see Deans, 2020, for a review) because parents who respond to their child's communicative efforts are also likely to share a common object of attention (Tamis-LeMonda et al., 2001), thus facilitating joint attention.

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**FIGURE 1** Proposed mediation model of how parental technoference may influence language outcomes. Joint attention is defined as when the infant and caregiver attend to the same object, with both being aware that the other is focused on that object (Tomasello et al., 2005). Parental responsiveness is defined as the ability of the parent to respond to their child's needs and bids for attention

Contingency, which is a key feature of responsiveness, also predicts language development in infants (Tamis-LeMonda et al., 2014). Here, we argue that technoference may reduce gaze following, joint attention, and parental responsiveness, subsequently affecting later language outcomes.

Although the definition of technoference is clear, measuring technoference and language in a valid way remains challenging. First, technoference is operationalized differently across studies, which may account for some of the conflicting findings. Second, much research gathers quantitative data, leaving a gap in our understanding of the nuances that occur when a parent chooses to use their smartphone when engaged with their child. Finally, few studies have explored the direct effects of technoference on eye gaze and joint attention, both generally and in the context of language development.

Although technoference can happen in any interpersonal relationship and with any technology, in this article, we focus on technoference that occurs as a result of smartphone use (after 2007) and interrupts parent–child interactions in children from birth to 5 years. First, we review research on the effects of technoference on language development. Since much of the early work on technoference is exploratory rather than theoretical, we draw connections between findings and the mediating role that eye gaze, joint attention, and parental responsiveness may have on technoference and language outcomes. We then address methodological considerations, proposing directions for research on the effects of smartphone technoference on language acquisition in young children.

## TECHNOFERENCE AND LANGUAGE OUTCOMES

Technoference—specifically, the amount of audible notifications parents report receiving per hour—was negatively associated with infants' vocabulary in controlled observations of 18- to 25-month-olds from New Zealand (Corkin et al., 2021). In experimental work with

U.S. mothers and their 2-year-olds, when dyads' interaction was interrupted by a 30-s phone call, children were less likely to learn a novel action word than when there was no interruption (Reed et al., 2017). In a U.S. study of 3- to 5-year-olds, parents asked their child fewer information-seeking questions when using a smartphone than when completing a pen and paper task or remaining undistracted (Gaudreau et al., 2021). Similarly, children were also less likely to ask questions while their parent was using a smartphone than when their parent was undistracted.

Taken together, these findings point toward the conclusion that technoference negatively affects language. However, generalizability is limited because of the largely homogenous, White, middle class samples in these studies. Although observational research with U.S. families of diverse backgrounds has reported similar effects, children's verbal responses to parents varied as a result of parents' smartphone use during interactions, with children responding less when parents used their smartphone than when parents did not use their smartphone (Kelly & Ocular, 2021). While the causal factors responsible for the association between technoference and language development remain unknown, next, we propose a mediating role of gaze following, joint attention, and parental responsiveness.

## MEDIATORS BETWEEN TECHNOFERENCE AND LANGUAGE OUTCOMES

### Eye gaze

Technoference can lead to a parent gazing at their smartphone rather than their infant during interactions (Bury et al., 2020), causing disrupted gaze following and reduced opportunities for joint attention. Indeed, converging evidence suggests that smartphone use interferes with opportunities for eye gaze in parent–child interactions. In observational research with participants from the United States and Israel who were diverse in terms of socioeconomic status, race, and ethnicity, parents who

used their phones in playgrounds and eateries tended to turn their bodies away from their child and engaged in minimal to no eye contact with them (Elias et al., 2020). In another study, U.S. parents from the Boston area who varied in neighborhood, income, and urbanicity tended to maintain eye contact with their child during phone calls, but not during swiping tasks, when they were in fast food restaurants (Radesky et al., 2014). Although these quantitative findings suggest that technofence can disrupt eye gaze, the results may depend on the task, since swiping tasks demand that parents look at their phones and are more absorbing than calls (Radesky et al., 2014).

The type of dyadic interaction can also influence the association between technofence and parents' eye gaze toward the child. In an experiment with highly educated mothers and their 3- to 6-month-olds in Israel, during face-to-face interactions, mothers directed their gaze more often toward their infant than toward their smartphone (Nomkin & Gordon, 2021). However, mothers' gaze toward their infant declined when they used a smartphone during breastfeeding. Breastfeeding might involve fewer interactive exchanges than face-to-face interactions, which may explain why gaze was reduced in this context. This suggests that the type of interaction may moderate the effects of technofence on parents' eye gaze and possibly on subsequent language development.

## Joint attention

As mothers use more words during periods of joint attention with their child (Tomasello & Farrar, 1986), smartphone use may prevent language opportunities if joint attention is disrupted. Indeed, when parents use their smartphone during interactions with their child, they initiate fewer verbal and nonverbal interactions (Radesky et al., 2015). Technofence can also interfere with language development by disrupting opportunities for joint attention during dyadic interactions (Davidovitch et al., 2018). In a U.S. study of caregivers and children from birth to age 4 in high- and low- to middle-income areas, engagement in joint attention was lower when caregivers used a mobile device than when they did not use a mobile device (Ochoa et al., 2021). The decline was more pronounced when caregivers were absorbed in the use of their device than when they used the device intermittently. Caregivers also spoke less with their child while using a smartphone than when not using a smartphone, suggesting that lowered joint attention may reduce opportunities for talking. Yet another study (mentioned previously) found no relation between joint attention and language, or between joint attention and technofence (Corkin et al., 2021). In this study, joint attention was measured during a 3-min phone-free interaction and not when technofence occurred. Joint attention may mediate the effects of technofence on language if the variables are operationalized differently.

Nonetheless, parents' smartphone use may not necessarily cause technofence; the device may act as the object of joint attention and facilitate vocabulary. In fact, in the study mentioned earlier (Corkin et al., 2021), frequent (vs. less frequent) co-use of a smartphone had a beneficial effect on infants' vocabulary. Co-using the device could increase verbal interactions because the dyad might talk about what they are doing on the phone. The quantitative data in the studies described do not allow an understanding of the nuances of technofence beyond cross-sectional data, and many questions remain unanswered. Whether a parent using their smartphone during an interaction with their child affects language likely differs depending on how the phone is used and possibly why the phone is used over time, because this may affect how absorbed a parent is with their phone.

## Parental responsiveness

A growing body of literature shows that technofence is associated with reduced levels of parents' responsiveness (see Braune-Krickau et al., 2021, for a review). In an experiment with Japanese mothers and their 3- to 6-month-olds, mothers who did not use their smartphone during breastfeeding adjusted their posture to look at their baby's face and recognized promptly when the baby had finished feeding. However, when the same mothers breastfed while using a smartphone, maternal responsiveness was delayed (Nakagawa et al., 2019). Therefore, from the very first stages of a child's life, technofence may interfere with parents' ability to recognize their infants' cues and respond accordingly. Similar findings have been reported in naturalistic observations in playgrounds and health centers and in controlled observations, where parents' responsiveness declined when using a smartphone compared to when parents did not use a smartphone (Abels et al., 2018; Elias et al., 2020) and with an increase in the number of audible notifications (Corkin et al., 2021).

Critical to language development is the finding that parents who used a smartphone were less likely to interact with their child than parents who did not use one (Abels et al., 2018). Despite a link between responsiveness and technofence, responsiveness did not mediate the relation between audible notifications and infants' vocabulary (Corkin et al., 2021). Furthermore, neither parents' nor children's responsiveness to questions differed when the parent was smartphone free, completing a pen and paper task, or using their smartphone (Gaudreau et al., 2021). The way responsiveness is measured may have affected the results. In one study, although parents' responsiveness to their child's conversation was consistent in smartphone-using and smartphone-free parents, on closer analysis of the conversations, parents were more likely to respond contingently when they were smartphone-free (Kelly & Ocular, 2021).

Contingency may be a key feature of responsiveness in the relation between technoference and language, so contingency disruption could explain why interruptions to an interaction affect language (Reed et al., 2017). If contingent and responsive parenting is important for language learning, technoference may not be unique in its ability to disrupt contingent responses from parents and any interruption could have the same effect. In line with this argument, in another study (Konrad et al., 2021), interruption from a smartphone or a paper and pencil task reduced parental responsiveness equally, lending support to the suggestion that technoference may not affect language directly, but instead may disrupt processes conducive to language development. Comparing parents' responsiveness and children's word learning during technoference to these measures during a nontechnological interruption may help solve this puzzle.

Nevertheless, caution is needed when drawing conclusions since much of this research has been conducted via observations away from the home environment and has gathered quantitative data. In a qualitative study that used information from diaries and interviews of an ethnically and socioeconomically diverse sample of U.S. parents of children under 3 years old, parents' smartphone use in the home differed from their phone use when out with their children. Parents reported that when at home, smartphone use was complex and adapted to the ever-changing demands of family-life (Garg, 2021). Parents may interact with their children less when they are away from home because external environments can provide entertainment for the child (e.g., at a playground). Indeed, in one study, children entertained themselves at a park and turned to their parent for an interaction only after seeking all other avenues for self-entertainment (Elias et al., 2020). Thus, despite evidence demonstrating a link between technoference and responsiveness, we do not know whether this reflects technoference at home. Researchers should explore this relation and its possible impact on language outcomes.

## LIMITATIONS AND NEXT STEPS

Technoference is an emerging field, and research on its effects on language development remains incomplete. While considering all areas of exploration is beyond the scope of this article, here we explore the difficulties of measuring technoference accurately and of obtaining a true picture of why parents use their smartphone. We also address the need for longitudinal research on technoference. (For a broader review of the literature, see Kildare & Middlemiss, 2017, and McDaniel, 2019.)

### What is technoference?

A major limitation of the emerging research into technoference and language development is the lack of

consistency in how technoference is operationalized. Because parent-child interactions are key to language development (e.g., Tamis-LeMonda et al., 2001), studies must measure technoference and not general smartphone use by parents. Smartphone use and technoference differ conceptually and, as such, should be treated as separate constructs. Smartphone use becomes technoference only when it disrupts a parent-child interaction, so surveys that ask how often a parent uses their smartphone when with their child (Corkin et al., 2021; Kelly & Ocular, 2021) might not measure technoference accurately if the smartphone is not disrupting an interaction between the dyad. The lack of distinction between smartphone use and technoference can also occur in naturalistic observations, where technoference is measured through general parental smartphone use across the observation (e.g. Kelly & Ocular, 2021).

Because technoference interrupts the dyad, a more effective way to measure such interruptions in these ecological settings is, for example, to record instances of delayed responses to children's cues or failures to respond altogether (e.g., Elias et al., 2020). However, this approach overlooks technoference occurring during an already-initiated parent-child interaction (e.g. Reed et al., 2017). Technoference that disrupts a parent-child interaction may have different effects on language development than technoference that prevents an interaction from taking place. In one study, well-educated, high-income German mothers periodically looked up to monitor their child when their smartphone use disrupted an already-established interaction (Konrad et al., 2021), suggesting that they may have been able to continue to respond by sharing attention between the child and the phone (Vanden Abeele et al., 2020). Researchers should compare the effects on language, looking at both technoference that prevents an interaction from occurring and technoference that disrupts an already-established interaction.

Another aspect that requires consideration when defining and examining technoference is the fact that each task on a smartphone may make different demands of the user (Kildare & Middlemiss, 2017). To assess the effects on language development, studies have measured technoference in terms of self-reported time spent on the phone per hour and the average number of audible notifications the parent receives (Corkin et al., 2021); in other studies, researchers experimentally manipulated phone calls (Reed et al., 2017), experimentally manipulated the medium causing the interruption (Gaudreau et al., 2021), and measured the self-reported number of photos taken during an aquarium visit (Kelly & Ocular, 2021). Inconsistency across studies makes it difficult to compare findings because how the smartphone is used may moderate the effect of technoference on language outcomes.

A well-documented issue with surveys is accuracy in parents' estimations of their own phone use, with most

parents under-reporting smartphone use when with their child (Kelly & Ocular, 2021). While manipulating phone use experimentally allows control over technofence to a certain extent, it is unlikely to capture the complexity of parents' smartphone use. To address these difficulties, researchers should combine multiple measures of parents' smartphone use, such as observations, self-report questionnaires, and more objective techniques (e.g., passive sensing applications; Yuan et al., 2020). This approach is fundamental to developing experiments that can manipulate technofence in a valid way to gain a true understanding of its impact on language outcomes.

Parents' smartphone use may have positive effects (Kildare & Middlemiss, 2017) that could affect language. For example, looking at screens and taking a photo are associated with increased levels of joint attention, compared to texting or swiping (Ochoa et al., 2021), suggesting that certain smartphone uses could enhance language acquisition. Yet evidence suggests that technofence reduces sensitivity in parents regardless of the type of smartphone use (Wolfers et al., 2020). Moreover, simply having the smartphone turned on, rather than turned off, is associated with less affectionate, responsive, and encouraging parental interactions (Rothstein, 2018). Thus, the mere presence of a smartphone that is turned on may create technofence and lead to cognitive distraction that affects parenting (McDaniel, 2021), subsequently affecting language development. Further experimental work should examine how parents' use of smartphones during interactions with their children affects the processes involved in language development.

### Why do parents use their smartphones?

In examining technofence and language, it is important to disentangle issues surrounding *why* parents use their smartphone around their children because this may moderate the effect of technofence on language acquisition. The reason a parent chooses to use their smartphone when engaged with their child may reflect other variables in the home, such as requests from family members (Garg, 2021). Technofence itself may be a moderator in language development, rather than a causal factor. In one study, parents who used their smartphone as a means of escape reported more parenting stress than parents who did not (Torres et al., 2021). Since parents' perception of their children (e.g., as having a difficult temperament) is one of the reasons for parental smartphone use during family mealtimes (Radesky et al., 2018), challenges in establishing a caregiving relationship may explain why some parents use their smartphone when with their child.

Smartphones may also play a role in reducing parental stress by providing emotional and instrumental support related to parenting via searching for information or seeking social support (Wolfers, 2021); in one study,

seeking social support reduced feelings of loneliness in mothers (Coyné et al., 2022). Parents who are less stressed may have interactions with their children that are more conducive to responsiveness and joint attention. We do not know whether the same conclusions would be drawn from direct measurements of technofence as opposed to general parent smartphone use. Researchers should investigate *why* parents use their smartphones when with their child, and explore the direction of the relation between parenting stress and technofence to ascertain whether technofence affects language outcomes causally.

### The need for longitudinal research

Research on technofence and language is predominantly cross-sectional, which prevents observing the effects of technofence on language development as they unfold over time. While parents may respond less to their child in a one-time observation (e.g., Elias et al., 2020), single time points may not be representative of regular technofence. Thus, longitudinal research is essential to investigate the impact of technofence on later language outcomes. The few longitudinal studies that have measured technofence in children from birth to age 5 have focused on a wider range of devices than just smartphones as sources of technofence and nonlanguage outcomes (e.g., child behavior; McDaniel & Radesky, 2018; attachment; Coyné et al., 2022). One study found different results at the cross-sectional level compared to the longitudinal data (Coyné et al., 2022), reinforcing the need for longitudinal work that captures more effectively the ongoing effects of technofence on language. As we have proposed, examining longitudinal trajectories of technofence during parent-child interactions can help us understand its effect on infants' gaze following, parental responsiveness, and joint attention, and how these affect subsequent language development.

### CONCLUSION

Parents tend to be distracted by their smartphones when with their young children. This distraction may reduce parents' responsiveness, and disrupt gaze following and joint attention, factors that mediate the effects of technofence on language development. However, without further research on how technofence affects language, we cannot begin to disentangle the contribution of the mediating processes to reach firm conclusions. While research has identified negative effects on language development, smartphones could enhance interactions if they are used as an object of shared attention or help reduce parents' stress. Researchers should explore the effects of technofence on language over time to shed light on the direction

of causality and facilitate clear recommendations for parents. Although professionals and parents can be advised about some aspects of using devices, such as being mindful of the potential for phone use to distract and reduce parents' gaze and asking questions, more work is needed to understand the nuanced ways phone use can both assist and hinder parenting and children's language development.

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