Heliyon 6 (2020) e03276

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Development and validation of the Maternal Distraction Questionnaire

Alison K. Ventura *, Megan Hupp, Shawnee Alvarez Gutierrez, Rebeca Almeida

California Polytechnic State University, Department of Kinesiology and Public Health, Center for Health Research, One Grand Ave, San Luis Obispo, CA, 93407, USA

ARTICLE INFO

Keywords:
Psychology
Mother-infant interactions
Digital technology use
Maternal distraction

ABSTRACT

This paper describes the development of a self-report measure of mothers' engagement in technological activities during mother-infant interactions. In Study 1, mothers (n = 332; infants: 3.8 1.4 months) completed the Maternal Distraction Questionnaire (MDQ) and related questionnaires. Factor analysis revealed two distinct subscales representing engagement with technological distractors and perceived distraction. Subscales correlated with relevant measures of feeding styles, attachment, and infant eating behaviors and temperament. In Study 2, mothers (n = 24; infants: 3.8 1.8 months) completed the MDQ and kept feeding activity diaries. Significant correlations between MDQ subscales and diary data were noted. In sum, the MDQ is a valid measure of maternal engagement with technological activities during mother-infant interactions.

1. Introduction

1.1. Development and Validation of the Maternal Distraction Questionnaire

Young infants have inborn capacities for making social connections with caregivers and engaging in social learning (Yogman et al., 2018). Indeed, in some form or another, the majority of learning during early childhood happens within the context of relationships (Vygotsky, 1978). Thus, a key foundation for early cognitive and socioemotional development is responsive and reciprocal caregiver-child interactions.

Of particular importance are "serve and return" interactions with caregivers, wherein the infant engages the caregiver (e.g., coos) and the caregiver promptly responds in a way that is contingent and consistent (e.g., makes eye contact and smiles) (Harvard Center on the Developing Child, 2015). An important foundation for successful serve and return interactions is caregiver sensitivity to infant cues and attempts at engagement, which is defined by four essential components: 1) awareness of infant cues, 2) accurate interpretation of these cues, and responses to these cues that are 3) developmentally appropriate and 4) prompt and contingent (Lohaus et al., 2001). It is important to emphasize that caregiver attentiveness to infant cues and attempts at engagement comprise a critical foundation for developmentally appropriate and contingent responsiveness to those cues, especially within the framework of serve and return interactions. Consistent caregiver attunement and contingent responsiveness during caregiver-child interactions communicates to the child that he or she is an important agent who can make meaningful contributions within social interactions (Berk and Meyers, 2015). Additionally, these interactions help promote the development of effective self-regulatory skills for infants and create the groundwork for secure attachments (Ainsworth and Bell, 1970; Bowlby, 1977a, 1977b; Feldman, 2006; Feldman et al., 2011; Tronick, 2005, 2007; Tronick et al., 1977). Over time, repeated experiences with successful serve and return interactions provide the infant with a multitude of opportunities for cognitive and socioemotional growth, as these experiences allow infants to learn about and understand the world around them through the scaffolded guidance of a trusted caregiver (Berk and Meyers, 2015; Harvard Center on the Developing Child, 2015; Tronick, 2007).

1.2. The potential for caregiver distraction by technology

There is increasing concern in both lay and professional communities that the omnipresence of portable technology (e.g., smartphones, tablets, smartwatches) may be negatively impacting caregiver attentiveness during caregiver-child interactions and changing the nature of family interactions. A 2019 Pew Research Center survey illustrated 96% of Americans own a cellphone, 81% own a smartphone, and 50% own a tablet (Pew Research Center, 2019b). Additionally, studies of smartphone use illustrate adult users check their phones multiple times per hour to consume notifications, email messages, alerts, and social media comments, and use the internet on their phones multiple times per day (Rosen et al., 2013). Although caregiver distraction is not a new problem, *per se*, given the potential for distraction by other children, adults, or household activities, the nature of today's distractions may differ from

* Corresponding author.
E-mail address: akventur@calpoly.edu (A.K. Ventura).

https://doi.org/10.1016/j.heliyon.2020.e03276
Received 19 September 2019; Received in revised form 3 January 2020; Accepted 17 January 2020

previous generations given that portable technology is potentially always available (e.g., always in a parent's pocket) and is specifically designed to be attention-grabbing and habit-forming (Oulasvirta et al., 2012; Ward et al., 2017; Wilmer et al., 2017). The omnipresence and habitual use of portable technology has created a digital "culture of connectedness" where many feel dependent on their phones and uncomfortable when forced to go without them (Cheever et al., 2014). Thus, today's parents and caregivers may be faced with a uniquely difficult challenge of having to overcome potentially ingrained and habitual technology use to intentionally attend to and interact with their children.

Parents of and caregivers to young infants may be particularly vulnerable to habitual technology use during caregiver-infant interactions because the first few months postpartum are primarily dedicated to infant care – and, in particular, infant feeding – potentially leaving new parents and caregivers with frequent and long bouts of time where their activities are constricted and dedicated to their infants, with relatively less time for self-care or other interests. Although limited data regarding caregivers' use of technology in the presence of infants and during caregiver-infant interactions are available, two studies of mother-infant dyads illustrated that the majority of mothers indicated that they used some sort of technology (e.g., TV, smartphone, tablet) while feeding their infants (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017).

Technology use, especially in the form of social media, can be an effective way for new mothers to connect with other mothers and family members, especially when they feel bound to a space (e.g., during infant feeding) or their home (McDaniel et al., 2012). This media outlet can facilitate new mothers' psychological adjustment to their sometimes all-consuming new role. Additionally, parents report mobile devices help ameliorate psychological discomforts that may accompany parenting by lessening feelings of social disconnectedness, reducing boredom, and providing relief from stress (Radesky et al., 2016). However, there is potential for frequent device use to cause "technoference," defined as interruptions in interpersonal interactions caused by technology use (McDaniel and Radesky, 2018b).

1.3. Does caregiver technology use impact caregiver-child interactions?

There is increasing interest in understanding potential short- and long-term impacts of caregiver technology use during caregiver-child interactions, yet the limited number of studies available predominantly focus on parents of preschool and school-age children [see (Kildare and Middlemiss, 2017; McDaniel, 2019) for reviews]. Observational studies have shown that parents using mobile devices engaged in fewer conversations with their children, were less responsive to attention bids from their children, and responded to many of these attention bids in a more negative manner (e.g., raising their voice) than those who were not using a mobile device (Radesky et al., 2014, 2015). In an experimental study of effects of parent distraction by TVs, computers, and phones on parent supervisory behaviors within a simulated home environment, parents were less engaged with and exhibited lower visual attention to their preschoolers when distracted compared to when not distracted (Boles and Roberts, 2008). Although parents of children 10 years and younger report that they prioritize child supervision over phone use when supervising their children in environments such as public parks and playgrounds (Hiniker et al., 2015), several studies have documented parent distraction within settings where parent supervision and vigilance is essential for preventing accidental injury and death (Palsson, 2014), including driving with children in the car (Macy et al., 2014; Roney et al., 2013) or supervising children who are swimming (Simon et al., 2003) or bathing (Moran, 2010).

Studies of parents with younger children (birth to 2 years) have predominantly focused on the potential impact of parent technology use during early learning interactions for children 1–2 years of age. Several studies have focused on the potential effect of background television – defined as an adult-directed television show that is playing in the background while children play alone or with a parent – and illustrate that children engage in shorter play episodes and exhibit less focused attention when the television is turned on versus off (Schmidt et al., 2008). Background television also reduces the quality of parent-child interaction: parents talk to their children less, use lower quality speech, spend less time actively involved with their children's play, and are less responsive to their children's bids for attention when background television is present versus absent (Kirkorian et al., 2009; Pempek et al., 2014; Tanimura et al., 2007). In addition, an experimental study illustrated that when mothers were tasked with teaching their children a new word, their teaching was less effective when they were interrupted by a call on a cellphone compared to when they were allowed to teach their child in a distraction-free environment (Reed et al., 2017).

To date, few studies have explored potential correlates and impacts of caregiver technology use during caregiver-infant interactions during early infancy, despite the well-established importance of caregiver attunement and contingent responsiveness for promoting high-quality caregiver-infant interactions. However, the few studies available do suggest that maternal technology use during mother-infant interactions may impact some aspects of dyadic interactions in ways that are consistent with research on parents of older children. For example, in an experimental study of mothers and their 7–24 month old infants, infants exhibited increased levels of negative affect, decreased levels of positive affect and engagement with their mothers, and increased frequency of social bids to obtain their mothers' attention when mothers were instructed to engage with a mobile device in the presence of their infant compared to when they were instructed to play and interact with their infant (Myruski et al., 2018). During a lab-based bottle-feeding observation, mothers who were distracted were significantly less sensitive to their babies' cues than mothers who were not distracted (Golen and Ventura, 2015b). For those mothers with infants who had lower capacities to self-regulate, mothers who were distracted had infants who consumed greater volumes of formula compared to infants of mothers who were not distracted (Golen and Ventura, 2015b). Additionally, in within-subject experimental study wherein breastfeeding mother-infant dyads were observed while feeding under two counterbalanced conditions (*digital media use:* mothers were instructed to watch a show on a mobile device during a breastfeeding interaction versus *control:* mothers listened to ambient-level classical music in a distraction-free environment during a breastfeeding interaction), mothers engaged their infants in significantly less cognitive growth fostering during the digital media use versus control condition (Ventura et al, 2019). Taken together, these studies suggest caregiver-child interactions are negatively affected by parent technology use, but given the diversity of age groups examined, types of parent technology use examined, and study designs employed, further research is warranted.

1.4. The need for reliable and validated measures of caregiver technology use

With continued increases in technology ownership and interest in understanding potential positive and negative impacts of caregiver technology use, it is important for researchers to have a diverse array of tools to measure caregiver technology use during caregiver-child feeding and care interactions. Previous studies have used observational methods, such as observations in public venues (Hiniker et al., 2015; Mangan et al., 2018; Moran, 2010; Radesky et al., 2014) and structured observations in a lab setting (Golen and Ventura, 2015b; Radesky et al., 2015). Other studies have used diary methods that require caregivers to document details of feeding interactions with their infants, as well as any activities engaged in during the feeding interaction (Golen and Ventura, 2015a; Ventura and Teitelbaum, 2017). However, collection and analysis of these measures of technology use and caregiver-child interactions are labor-intensive for participants and researchers, and may affect the participants' behaviors of interest. Although other studies have used survey methods that directly assess parents' perceptions of how often technological devices interrupt family interactions (McDaniel and Coyne,

2016a, 2016b; McDaniel and Radesky, 2018a, 2018b), there is need for additional, validated survey measures that assess caregiver technology use more broadly (not just technology use that caregivers perceive as disruptive) and during the earliest interactions – between caregivers and infants – given the documented prevalence of technology use during these interactions (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017) and high potential for technology use interfere with caregivers' sensitivity to infant cues (Golen and Ventura, 2015b; Kirkorian et al., 2009; Myruski et al., 2018; Pempek et al., 2014; Tanimura et al., 2007; Ventura et al., 2019).

In addition, previous research suggests measures of maternal distraction should distinguish between feeding interactions versus during all other, non-feeding interactions. First, during early infancy, feeding interactions occur frequently, with young infants feeding at least 8–12 times per day (Fomon, 1993). Therefore, dyads spend a substantial portion of each day engaged in feeding. These feeding interactions are a time when caregivers' activities are relatively constricted and limited, thus may be a time when caregivers are particularly vulnerable to "tuning out" by engaging in other activities, such as watching television or using a mobile device (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017). Second, feeding interactions have both nutritional and social significance (Black and Aboud, 2011); caregivers should be attentive and responsive to infants' hunger and fullness cues during these interactions, but can also engage in opportunities to promote infant socioemotional and cognitive growth (e.g., making eye contact with the infant, talking to the infant about aspects of the feeding or broader environment) (Oxford and Findlay, 2015). Previous research illustrates use of technology during these interactions may decrease mothers' likelihood of engaging with their infant in these ways during the feeding (Ventura et al., 2019), thus may lessen the non-nutritive benefits of feeding interactions. Third, there is a long-standing precedent for using feeding interactions as a proxy for the quality of caregiver-child interactions in both feeding and non-feeding contexts [see (Worobey, 2016) for a review]; thus, a specific focus on feeding interactions would be consistent with other methodological approaches in the field and may provide insights into mothers' use of technology during a particularly frequent and important form of early dyadic interaction.

To this end, the purpose of these two studies was to develop and validate a self-report measure of mothers' engagement with distractors during mother-infant interactions within both feeding and non-feeding contexts. Although both maternal and non-maternal caregivers are important contributors to infant care and outcomes, the present research focuses on mothers given that, during early infancy, mothers are typically predominately responsible for infant feeding and care (DeMaris et al., 2013). In Study 1, the factor structure and construct validity of this self-report measure were determined within a cross-sectional, internet-based survey of mothers of young infants. In Study 2, the concurrent criterion validity of this self-report measure was determined within a cross-sectional, observational feeding diary study.

2. Study 1

2.1. Methods

2.1.1. Participants

Mothers ($n = 332$) of infants 6 months of age were recruited from Amazon Mechanical Turk (MTurk), a crowdsourcing platform that allows individuals to sign up as "workers" to complete tasks, such as online surveys (Follmer et al., 2017). Previous research has demonstrated MTurk can be a cost-effective way to obtain reliable data from demographically diverse samples (Buhrmester et al., 2011; Chandler and Shapiro, 2016; Dworkin et al., 2016), especially when recruiting populations who may find it difficult to travel to participate in research, such as parents with young infants (Tran et al., 2017). Through MTurk, interested workers (i.e., potential research participants) were invited to participate in the online survey. Inclusion criteria were adult mothers (18 years or older) with healthy infants 6 months of age or younger who resided in the U.S. Mothers of infants who were preterm, had developmental delays, or had medical conditions that interfered with feeding were excluded. Eligible participants who completed the survey received a unique verification code that could be entered into MTurk to receive compensation. Participants were compensated $0.50, which is comparable to other studies using MTurk (Buhrmester et al., 2011). Participants who completed the screening questions and did not meet eligibility requirements were directed to the end of the survey and were thanked for their interest, but did not receive compensation. All study procedures were reviewed and approved by the California Polytechnic State University Institutional Review Board.

Approximately 54% ($n = 178$) of mothers had female infants. Average infant age was 3.8 1.4 months. Average age of mothers was 31.2 4.7 years. Thirty-one percent ($n = 103$) of mothers were primiparous. The majority reported being married (67.2%; $n = 223$). Thirty-nine percent ($n = 130$) of mothers reported their highest level of education was an undergraduate or graduate degree. Fourteen percent ($n = 47$) reported a family income <$25,000 per year, 62.2% ($n = 204$) reported a family income between $25,000-$75,000, and 23.5% ($n = 77$) reported a family income >$75,000; 4 mothers did not report their family income. Sixty percent ($n = 198$) reported that they participated in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The majority (75.8%; $n = 248$) identified as non-Hispanic White, 9.7% ($n = 32$) non-Hispanic Black, 8.8% ($n = 29$) Hispanic, 3.7% ($n = 12$) Asian, and 2.4% ($n = 8$) mixed race; 3 mothers did not report their race/ethnicity.

On average, mothers reported being responsible for 81.8 20.9% of their infants' feedings. With respect to milk type, 48.5% ($n = 161$) of mothers reported their infant was fed breast milk, 26.2% ($n = 87$) reported their infant was fed formula, and 25.3% ($n = 84$) reported their infant was fed a combination of breast milk and formula. With respect to feeding mode, 29.5% ($n = 98$) of mothers reported their infant was exclusively fed from the breast, 32.5% ($n = 108$) reported their infant was exclusively fed from bottles, and 38.0% ($n = 126$) reported their infant was both breast- and bottle-fed. Thirty-four percent of infants ($n = 114$) had been introduced to complementary foods and beverages.

2.1.2. Procedures and measures

All online data collection occurred through Qualtrics (www.qualtrics.com). Upon entry into the Qualtrics survey site, mothers were provided with a brief description of the research and were asked a series of screening questions to assess their eligibility to participate. Eligible mothers were then presented with the informed consent form. Those who were eligible, provided informed consent, and indicated that they wanted to participate in the study were allowed access to the remainder of the study. Mothers then completed the following measures:

2.1.2.1. Quality control/attention questions. Mothers were presented with two quality control/attention questions to ensure they were completing the survey intentionally and accurately. These questions also facilitated screening of unreliable responses. For the first question, mothers were instructed to "Please select yes" and for the other question mothers were asked to provide a qualitative response to the prompt: "Tell us about being a parent."

2.1.2.2. The Maternal Distraction Questionnaire (MDQ). The MDQ is a self-report measure of the various activities that mothers may do while interacting with their infants within both feeding and non-feeding (e.g., soothing, play) contexts. Development of MDQ items was based, in part, on the research team's previous qualitative work wherein mothers were asked to keep feeding diaries (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017). Within this previous research, mothers were asked to keep feeding diaries over a 3-day period, wherein for each feeding they recorded: 1) the feeding start and end time; 2) what was fed (e.g., formula, breast milk from the breast, breast milk from a bottle); 3) the

amount fed (if known); and 4) what else, if anything, they were doing while feeding their infants. Thematic analysis of this final component of these feeding diaries revealed that mothers most commonly reported doing the following activities while feeding their infants: 1) watching television; 2) using a smartphone or tablet; 3) using a computer; 4) talking on the phone or to another adult; 5) sleeping; and 6) reading a book, magazine, or newspaper (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017). While developing the MDQ, the research team also reviewed published measures assessing distraction in other settings [e.g., multitasking (Zwarun and Hall, 2014)] to determine questionnaire structure and any other activities that should be included. The combined result was the MDQ, an 18-item questionnaire wherein the mother is asked a series of questions related to how often she engages in common activities (e.g. watching television, talking or texting on the phone, using the computer, or reading a magazine) during infant feeding interactions and other infant care interactions. For each item, the mother uses a 5-point Likert scale ranging from 1 (Never), 2 (Rarely), 3 (Sometimes), 4 (Often), 5 (Always). The MDQ also contains 4 items that directly ask the mother how much attention she gives to her infant and how distracted she is during infant feeding interactions and other infant care interactions, respectively, using similar 5-point Likert scales; two questions ask the mother how distracted she feels during feeding and care interactions (scale range = 1 [Not at all distracted], 2 [A little distracted], 3 [Somewhat distracted], 4 [Very distracted], 5 [Completely distracted]) and two questions ask the mother how much attention she pays to her infant during feeding and care interactions (scale range = 1 [Not much attention], 2 [A little attention], 3 [Some attention], 4 [Close attention], 5 [Extremely close attention]). Table 1 presents all questionnaire items and descriptive statistics for each item.

2.1.2.3. Family demographics. This information was assessed using a questionnaire developed by the research team. This questionnaire assesses age, parity, education level, marital status, and employment status. It also assesses family income and use of federal assistance programs. Additionally, mothers reported the extent to which they were responsible for their infants' care versus the extent to which their infants were cared for by other adults (e.g., partner, extended family, babysitters, daycare staff).

2.1.2.4. Baby basic needs questionnaire (BBNQ). The BBNQ is a mother-report measure of the infant's feeding history (e.g., duration and extent of breast- versus formula- or bottle-feeding), as well as the extent to which the mother uses food to soothe her infant (Stifter et al., 2011; Stifter and Moding, 2015). To assess use of food to soothe, mothers rate, on a scale of "Never" to "Always," their tendencies to use food to soothe their infants in a variety of places (e.g., church, car, doctor's waiting room) and during various activities (e.g., getting ready to leave, when on the phone, when you are stressed) on a scale of "Never" to "Always." The food to soothe scale was validated by Stifter and Moding (2015), who also reported that this scale demonstrated good reliability (Crohnbach's coefficient alphas $\alpha = .73$ to .79). In the present study, Crohnbach's coefficient alpha for this scale was $\alpha = .91$.

2.1.2.5. Infant Feeding Styles Questionnaire (IFSQ). The IFSQ is a validated measure of maternal behaviors (e.g., control) and beliefs (e.g., concern about feeding) related to infant feeding (Thompson et al., 2009). Questionnaire items are used to calculate 4 feeding style scores: Laissez-faire (example item: "I think it is okay to prop an infant's bottle"), Restrictive (example item: "It's important for the parent to decide how much an infant should eat"), Pressuring (example item: "I try to get my child to eat even if s/he seems not hungry"), and Responsive (example item: "My child knows when s/he is hungry and needs to eat"). Thompson et al. (2009) reported all subscales showed good predictive validity and internal reliability (H coefficients >.75). In the present study, Crohnbach's coefficient alpha for the feeding styles subscales were: Laissez-faire $\alpha = .61$, Restrictive $\alpha = .71$, Pressuring $\alpha = .85$, and Responsive $\alpha = .69$.

2.1.2.6. Maternal postnatal attachment questionnaire (MPAQ). The MPAQ is a validated, 19-item self-report measure that assesses the mother's feelings of attachment to her infant (Condon and Corkindale, 1998). Subscales include: Quality of Attachment (example item: "I now think of

Table 1. Descriptive statistics for the Maternal Distraction Questionnaire items.

	Mean	SD	% (*n*) Reporting Often or Always
Please indicate the extent to which you do the following while breastfeeding or bottle-feeding your baby:[a]			
Watch television (e.g., videos, shows, or movies)	3.1	1.1	39.5 (131)
Use a computer (e.g., check email, surf the internet, work)	2.5	1.1	20.5 (68)
Talk on the phone	2.6	1.0	15.7 (52)
Text or use apps on a mobile device or tablet	3.1	1.1	37.2 (123)
Read a book, magazine, or newspaper (not on a mobile device or tablet)	2.5	1.2	22.3 (74)
Other	1.8	1.2	11.9 (32)
In general, how distracted do you feel when you are breastfeeding or bottle-feeding your baby?[b]	1.9	0.9	3.0 (10)[c]
In general, how much attention do you pay to your baby when you are breastfeeding or bottle-feeding him/her?[d]	3.9	0.9	75.3 (250)[e]
Please indicate the extent to which you do the following while caring for or spending time with your baby (excluding feeding time):[a]			
Watch television (e.g., videos, shows, or movies)	2.8	1.0	19.6 (65)
Use a computer (e.g., check email, surf the internet, work)	2.6	0.9	11.8 (39)
Talk on the phone	2.5	0.9	10.8 (36)
Text or use apps on a mobile device or tablet	2.8	1.0	21.5 (71)
Read a book, magazine, or newspaper (not on a mobile device or tablet)	2.4	1.1	15.4 (51)
Other	1.9	1.3	15.7 (37)
In general, how distracted do you feel while caring for or spending time with your baby (excluding feeding time)?[b]	1.9	0.8	3.6 (12)[c]
In general, how much attention do you pay to your baby when caring for or spending time with him/her?[d]	4.2	0.8	86.7 (287)[e]

[a] Score range = 1 (Never), 2 (Rarely), 3 (Sometimes), 4 (Often), 5 (Always).
[b] Score range = 1 (Not at all distracted), 2 (A little distracted), 3 (Somewhat distracted), 4 (Very distracted), 5 (Completely distracted).
[c] %(n) reporting Very distracted or Completely distracted.
[d] Score range = 1 (Not much attention), 2 (A little attention), 3 (Some attention), 4 (Close attention), 5 (Extremely close attention).
[e] %(n) reporting Close attention or Extremely close attention.

my baby as:" with response options ranging from "very much my own baby" to "not yet really my own baby"), Absence of Hostility (example item: "Regarding the things that we have had to give up because of the baby:" with response options ranging from "I find I resent it quite a lot" to "I find I don't resent it at all"), Pleasure of Interaction (example item: "I try to involve myself as much as I possibly can playing with the baby:" with response options ranging from "this is true" to "this is untrue"). Higher scores represent greater feelings of attachment. Condon and Corkindale (1998) demonstrated these subscales had high internal reliability (Crohnbach's coefficient alpha = .78-.79). In the present study, Crohnbach's coefficient alphas for the subscales were: Quality of Attachment α = .52, Absence of Hostility α = .67, and Pleasure of Interaction α = .86. We excluded the Quality of Attachment subscale from further analysis due to its poor reliability (α < .60).

2.1.2.7. Baby Eating Behavior Questionnaire (BEBQ). The BEBQ is a validated, 18-item measure of caregiver perceptions of infants' eating behaviors (Llewellyn et al., 2011). Questionnaire items are used to calculate scores for 5 subscales, which represent several domains of infant eating behavior: 1) Enjoyment of Food (example item: "My baby enjoys feeding time."); 2) Food Responsiveness (example item: "Even when my baby has just eaten well, s/he is happy to be feed again if offered."); 3) Slowness in Eating (example item: "My baby takes more than 30 min to finish feeding."); 4) Satiety Responsiveness (example item: "My baby gets filled up easily."; and 5) General Appetite (single item: "My baby has a big appetite."). Llewellyn et al. (2011) reported good internal reliability (assessed via Crohnbach's coefficient alpha) for all subscales: enjoyment of food, α = .81; food responsiveness, α = .79; slowness in eating, α = .76; and satiety responsiveness α = .73. In the present study, Crohnbach's coefficient alphas for subscales were: enjoyment of food, α = .79; food responsiveness, α = .89; slowness in eating, α = .66; and satiety responsiveness α = .75.

2.1.2.8. The Rothbart Infant Behavior Questionnaire-Revised Very Short Form (IBQ-RVS). The IBQ-RVS is a widely-used parent-report measure of infant temperament that has been validated in diverse samples (Gartstein and Rothbart, 2003; Putnam et al., 2014). Questionnaire items are used to calculate scores for 14 scales and 3 overarching factors: Positive Emotionality/Surgency (Approach, Vocal Reactivity, High Intensity Pleasure, Smiling and Laughter, Activity Level, and Perceptual Sensitivity), Negative Affectivity (Sadness, Distress to Limitations, Fear, and loading negatively, Falling Reactivity), and Orienting/Regulatory Capacity (Low Intensity Pleasure, Cuddliness/Affiliation, Duration of Orienting, and Soothability). Putnam et al. (2014) reported the IBQ-RVS subscales demonstrated good internal reliability (assessed via Crohnbach's coefficient alpha): Positive Emotionality/Surgency, α = .77; Negative Affectivity, α = .78; Orienting/Regulatory Capacity, α = .75. In the present study, Crohnbach's coefficient alphas for subscales were: Positive Emotionality/Surgency, α = .86; Negative Affectivity, α = .84; and Orienting/Regulatory Capacity, α = .76.

2.1.3. Data analysis

Prior to data analysis, data were thoroughly cleaned and assessed for normality. A three-pass data cleaning approach was employed: First, respondents were excluded from the sample if their survey was incomplete (defined as less than 90% of survey completed). During the second pass, respondents were excluded from the sample if they incorrectly answered the first quality control question ("Please select yes") or provided an incoherent response for the second quality control question ("Tell us about being a parent"). Finally, respondents with invalid responses for write-in questions such as infant birth date or infant weight and length, were excluded. Of the 820 mothers who responded to our advertisement, 341 did not complete the survey. Of the 479 mothers who completed the survey, 147 incorrectly or incoherently responded to the quality control questions or provided invalid responses for write-in questions (e.g., infant birth weight and length). Because we excluded mothers who completed 90% of the survey or less, missing data was minimal and limited to demographics characteristics (e.g., family income); these missing values were coded as "Not Reported." The final analytical sample was 332 mothers. Mothers who were excluded were not statistically different from mothers who were included for key demographic characteristics, including infant sex ($p = .4602$) and age ($p = .3650$); maternal age ($p = .0600$), parity ($p = .8169$), and education level ($p = .6030$); and family income ($p = .2383$).

All quantitative analyses were conducted using SAS v.9.4 (July 2013; SAS Institute Inc., North Carolina, USA). Descriptive statistics were calculated to summarize sample demographics and MDQ items. To identify the factor structure of the MDQ, principal components analysis (PCA) and scree plots were initially used to determine the number of factors that best fit the data. Then, factor analysis with an orthogonal (varimax) rotation was used to determine factor loadings for each of the MDQ items. Once the factor structure was determined, subscales were created by taking the average of all items that loaded highly (defined as .50) on each factor. Internal consistency of each subscale was determined using Crohnbach's coefficient alpha. Then, to assess construct validity for each subscale, correlation analysis was used to explore associations between the MDQ subscales and related psychosocial characteristics of mothers (i.e., feeding practices and styles and perceived mother-infant attachment) and infants (i.e., eating behaviors and temperament). $p < .05$ was used as the criterion for statistical significance.

2.2. Results

2.2.1. Descriptive statistics for MDQ items

Table 1 illustrates the proportion of mothers who selected the top two responses (Often and Always for the individual items; Very Distracted and Completely Distracted for the perceived level of distraction items; Close Attention and Extremely Close Attention for the perceived level of attention items). Approximately 40% ($n = 131$) of mothers reported they watched television while feeding their infants, 37.2% ($n = 123$) reported they texted or used apps on a mobile device or tablet, and 22.3% ($n = 74$) reported they read books, magazines, or newspapers. Only 3% ($n = 10$) reported high levels of distraction during infant feeding and 75.3% ($n = 250$) reported high levels of attention. During infant care interactions, 11.8% ($n = 39$) of mothers indicated they use a computer, 21.5% ($n = 71$) indicated they text or use apps, and 19.6% ($n = 65$) indicated they watched television. Only 3.6% ($n = 12$) reported high levels of distraction during infant care interactions and 86.7% ($n = 287$) reported high levels of attention. For mothers who reported "other" activities during infant feeding interactions and care interactions, common responses included caring for other children, doing housework, eating, listening to music, and sleeping.

2.2.2. Factor structure of the MDQ

Initial PCA and scree plots indicated that a 3-factor structure best fit the data, with factors exhibiting initial eigenvalues of 5.03, 1.69, and 1.27. The final factor structure, determined by orthogonal (varimax) rotation, illustrated three factors (Table 2). Factor 1 represented engagement in technological activities, such as watching television, app use on a mobile device, during infant feeding and care interactions. Factor 2 represented responses for the questions assessing perceived levels of distraction and attention during infant feeding and care interactions. Factor 3 represented engagement in non-technological activities, such as reading books, magazines, or newspapers, during infant feeding and care interactions. Items representing feeding versus non-feeding interactions showed similar loadings for each of these factors. In general, factor loadings were high and well-distinguished from other factors.

Table 2. Factor loadings from the varimax matrix for Maternal Distraction Questionnaire items.

	Factor 1	Factor 2	Factor 3
During Feeding Interactions			
Watch television	**.69**[a]	.21	
Use a computer	**.67**	.18	
Talk on the phone	**.71**		
Text or use apps on a mobile device or tablet	**.71**	.19	
Read a book, magazine, or newspaper	.47		**.50**
Other			**.75**
General distraction	.24	**.61**	
General attention (R)[b]	.18	**.65**	
During Non-Feeding Interactions:			
Watch television	**.65**	.14	.16
Use a computer	**.66**	.25	.17
Talk on the phone	**.60**		.25
Text or use apps on a mobile device or tablet	**.62**	.28	.15
Read a book, magazine, or newspaper	.44		**.53**
Other		.16	**.77**
General distraction		**.70**	
General attention (R)[b]	.11	**.69**	.12
Variance Explained by Each Factor	4.07	2.07	1.86

[a] Factor loadings >.10 are presented. Factors loadings .50 are bolded.
[b] (R) indicates reverse scored item.

2.2.3. Internal consistency of the MDQ

Items with high loadings (.50) for each of the three factors identified were averaged to create subscales. Subscales included: *Tech Engagement*, defined as mothers' frequency of engagement with technology during infant feeding and care interactions (Factor 1); *Perceived Distraction,* defined as mothers' perceived level of distraction and lack of attention during infant feeding and care interactions (Factor 2), and *Non-Tech Engagement,* defined as mothers' frequency of engagement in non-technological activities during infant feeding and care interactions (Factor 3). However, "Read a book, magazine, or newspaper" during feeding and non-feeding interactions loaded on Factors 1 and 3 at very similar levels (.44–.53). Given these loadings and the finding that only "Read a book, magazine, or newspaper" and "Other" during feeding and non-feeding interactions comprised the *Non-Tech Engagement* subscale, these items and this subscale were dropped from the final measure and further analysis.

Cronbach coefficient alpha was $\alpha = .86$ for the *Tech Engagement* subscale and $\alpha = .79$ for the *Perceived Distraction* subscale. Higher subscale scores represent more frequent engagement in technological activities or greater perceived levels of distraction, respectively, during infant feeding and care.

Table 3. Pairwise correlation matrix for associations between Maternal Distraction Questionnaire subscales and Maternal and Infant Psychosocial Characteristics.

Psychosocial Characteristics	Technological Engagement	Perceived Distraction
Maternal Feeding Practices and Styles[a]		
Food to Soothe Score	**.19**	.09
Laissez faire feeding style	**.43**	**.21**
Pressuring feeding style	**.21**	-.07
Restrictive feeding style	-.08	**-.23**
Responsive feeding style	**-.11**	-.10
Mother-Infant Attachment[b]		
Absence of Hostility	**.33**	**.24**
Pleasure in Interactions	-.02	.03
Infant Eating Behaviors[c]		
Enjoyment of Food	**-.11**	-.03
Food Responsiveness	**.32**	.08
Slowness in Eating	.02	-.03
Satiety Responsiveness	**.17**	.04
General Appetite	**.23**	.01
Infant Temperament[d]		
Positive Emotionality/Surgency	.01	**-.11**
Negative Affectivity	**.29**	**.11**
Orienting/Regulatory Capacity	-.09	**-.22**

Bolded correlation coefficient values are significant at $p < .05$.
[a] Assessed via the Food to Soothe Scale (Stifter et al., 2011; Stifter and Moding, 2015) and Infant Feeding Styles Questionnaire (Thompson et al., 2009).
[b] Assessed via the Mother-Infant Attachment Questionnaire (Condon and Corkindale, 1998); the Attachment Quality subscale was not included in these analyses due to poor reliability.
[c] Assessed via the Baby Eating Behavior Questionnaire (Llewellyn et al., 2011).
[d] Assessed via the Infant Behavior Questionnaire – Very Short Form (Putnam et al., 2014).

2.2.4. Construct validity of the MDQ

Tech Engagement was significantly and positively correlated with *Perceived Distraction* during infant feeding and care interactions ($r = .33, p < .001$). Table 3 presents pairwise correlations between MDQ subscales and related maternal psychosocial characteristics, including infant feeding practices and styles and mother-infant attachment. *Tech Engagement* scores were positively associated with use of food to soothe ($r = .19, p < .001$), and adherence to laissez faire ($r = .43, p < .001$) and pressuring ($r = .21, p < .001$) feeding styles, and negatively correlated with adherence to a responsive feeding style ($r = -.11, p = .043$). *Tech Engagement* scores were also positively associated with perceived absence of hostility ($r = .33, p < .001$). *Perceived Distraction* scores were positively associated with adherence to a laissez faire feeding style ($r = .21, p < .001$) and negatively associated with adherence to a restrictive feeding style ($r = -.23, p < .001$). *Perceived Distraction* scores were also positively associated with perceived absence of hostility ($r = .24, p < .001$).

Table 3 also presents pairwise correlations between MDQ subscales and related infant characteristics, including infant eating behaviors and temperament.

Mothers' *Tech Engagement* scores were significantly and negatively associated with infant enjoyment of food ($r = -.11, p = .038$) and significantly and positively associated with infant food responsiveness ($r = .32, p < .001$), satiety responsiveness ($r = .17$, $p = .002$), and general appetite ($r = .23, p < .001$). Mothers' *Tech Engagement* scores were also positively associated with negative affectivity for infants ($r = .29, p < .001$). Mothers' *Perceived Distraction* scores were not associated with infant eating behaviors, but were negatively associated with positive emotionality/surgency ($r = -.11, p = .039$) and orienting/regulatory capacity ($r = -.22, p < .0001$), and positively associated with negative affectivity ($r = .11, p = .048$).

3. Study 2

3.1. Methods

3.1.1. Participants

Mothers ($n = 24$) who participated in previously published infant feeding studies were asked to keep a diary of their infants' feeding patterns for 3 days (Ventura and Hernandez, 2019; Ventura et al., 2019). Inclusion criteria for infants were: 1) healthy, 2) born full-term, 3) 6 months of age or younger, and 4) not yet introduced to solid foods. Inclusion criteria for mothers were: 1) between 18 and 40 years of age and 2) absence of gestational diabetes or any complications during pregnancy or birth that lead to infant feeding problems. Participants were recruited through fliers posted in WIC offices, breastfeeding support groups, libraries, coffee shops, and local pediatric offices, as well as through targeted Facebook advertisements. Both oral and written informed consent

were obtained from each mother prior to participation. Mothers were provided a $25 cash compensation for study participation. All study procedures were reviewed and approved by the California Polytechnic State University Institutional Review Board.

Approximately 61% ($n = 14$) of mothers had female infants. Average infant age was 16.7 7.8 weeks. Average age of mothers was 32.2 3.7 years. Fifty-five percent ($n = 12$) of mothers were primiparous. The majority reported being married 90.9% ($n = 20$). Seventy-four percent ($n = 17$) of mothers reported their highest level of education was an undergraduate or graduate degree. Seventy-one percent ($n = 15$) of mothers reported a family income >$75,000 and only 2 mothers reported that they participated in WIC. The majority (91.3%; $n = 21$) identified as non-Hispanic White and 2 identified as Hispanic. Eighty-seven percent ($n = 20$) of mothers were exclusively breastfeeding their infants, 2 were exclusively formula-feeding, and 2 were feeding a mix of breast milk and formula.

3.1.2. Procedures and measures

Mothers received feeding records via postal mail or email. Through both verbal instruction by a research assistant and written instructions on the form, mothers were asked to record, for each feeding: 1) the start and end time; 2) what was fed (e.g., formula, breast milk from the breast, breast milk from a bottle); 3) the amount fed (if known); and 4) what else, if anything, they were doing while feeding their infants.

Printed records were collected from all mothers during a laboratory visit several days later, at which time mothers also completed a demographic questionnaire and the MDQ, as well as their study-specific protocol [see (Ventura and Hernandez, 2019; Ventura et al., 2019) for more details].

3.1.3. Data analysis

Mothers' responses to the question: "What else, if anything, were you doing while feeding your infant?" were sorted into thematic categories using constant comparison within the framework of grounded theory (Charmaz, 2000). Prior to coding, the first author developed a coding manual that included a list of relevant themes; this list of themes represented activities that mothers reported engaging in during infant feeding within previous research on mother-infant feeding interactions Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017. Three trained coders then independently coded all records based on the coding manual. Results were reviewed and compared for validity by the coding team and any discrepancies in theme identification or coding, albeit rare, were discussed and rectified via research team consensus (Harry et al., 2005). Inter-coder reliability was established by comparing the common coding of a total of 10 records by all coders. The mean Pearson's rho for the correspondence among coders was $\rho(7df) > 0.80$, indicating good reliability among coders.

After coding was complete, themes were used to classify feedings into 2 categories: 1) mother engaged in other activities while feeding her infant (e.g., mother reported she watched TV or used a mobile device) and 2) mother did not engage in other activities while feeding her infant (e.g., nothing was specified, mother reported interacting with her infant). Reported activities were also further classified into technological (e.g., watching TV, using a computer, smart phone, or tablet) versus non-technological (e.g., reading, doing housework). To obtain a measure of each mothers' intensity of engagement in other activities during infant feeding, the percentage of feedings during which the mother reported any (technological and non-technological) activities was calculated for each mother (= [number of feedings wherein any activity was reported/total number of feedings reported]*100). Similarly, the percentage of feedings during which the mother reported technological activities was calculated for each mother (= [number of feedings wherein a technological activity was reported/total number of feedings reported]*100), as was the percentage of feedings during which the mother reported non-technological activities (= [number of feedings wherein a non-technological activity was reported/total number of feedings reported]*100). Intercoder reliability for technological activities was $\rho = .95$ and for non-technological activities was $\rho = .84$.

All quantitative analyses were conducted using SAS v.9.4 (July 2013; SAS Institute Inc., North Carolina, USA). Descriptive statistics were calculated to summarize sample demographics and mothers' frequency of different activities during reported feedings. To assess criterion validity, correlation analyses were used to examine associations between the MDQ subscales identified in Study 1 and the percentage of feedings during which mothers reported engaging in any activities, technological activities, and non-technological activities, derived from qualitative analysis of feeding diaries. $p < .05$ was used as the criterion for statistical significance.

3.2. Results

3.2.1. Criterion validity of the MDQ

Mothers' scores on the *Tech Engagement* subscale were significantly and positively correlated with the percentage of feedings during which technological activities were reported ($r = .43$, $p = .038$) within the feeding diaries. Mothers' *Perceived Distraction* was significantly and positively associated with the percentage of feedings during which any activities were reported ($r = .63$, $p = .001$), as well as with the percentage of feedings during which non-technological activities were reported ($r = .45$, $p = .029$). There was a trend toward an association between mothers' *Perceived Distraction* and percentage of feedings during which technological activities were reported ($r = .40$, $p = .056$).

4. Discussion

This paper reports findings from two psychometric studies of the Maternal Distraction Questionnaire, a 14-item questionnaire designed to assess mothers' engagement in technological activities during infant feeding and care interactions. Findings from factor analysis of MDQ items illustrated the presence of two distinct, underlying factors that were similar across feeding versus general care interactions; these factors represented the extent to which mothers engaged with technological activities and the extent to which mothers perceived themselves to be distracted during infant feeding and care interactions. Overall, examination of factor loadings illustrated items were well distinguished between these two subscales, and, within each subscale, items exhibited good internal consistency. Additionally, investigations of MDQ construct (Study 1) and criterion (Study 2) validity demonstrated MDQ subscales were significantly correlated with several relevant maternal and infant psychosocial characteristics and with mothers' reports (collected via feeding diaries) of engagement in technological and non-technological activities during infant feeding interactions. These findings suggest the MDQ is a reliable and valid self-report measure of mothers' levels of engagement in technological activities during infant feeding and care, as well as mothers' perceived level of distraction during early infancy.

When designing the MDQ, we placed an emphasis on understanding maternal distraction within feeding interactions versus during all other, non-feeding interactions; thus, we hypothesized that it would be important to separate feeding interactions from non-feeding interactions within the questionnaire structure. This decision was based on previous research on infant feeding interactions and other methodological approaches in the field (Black and Aboud, 2011; Fomon, 1993; Golen and Ventura, 2015b; Oxford and Findlay, 2015; Ventura et al., 2019; Ventura and Teitelbaum, 2017; Worobey, 2016). Inconsistent with this hypothesis, factor analysis revealed that items assessing maternal distraction during feeding versus non-feeding interactions loaded on the same factors and thus could be combined into the same subscales. However, we did note that greater proportions of mothers indicated they "Often" or "Always" engaged with technology during feeding versus non-feeding interactions, which was consistent with our hypothesis. Taken together, these findings may suggest that mothers who more frequently

engage with technology during feeding interactions also more frequently engage with technology during non-feeding interactions with their infant, but, for most mothers, technology use is more common during feeding compared to non-feeding interactions.

To date, few studies have explored the possible advantages and disadvantages of caregiver engagement with mobile devices and other forms of distracting technology during infant feeding and care interactions (Kildare and Middlemiss, 2017; McDaniel, 2019). Given the omnipresence of television, mobile devices, and handheld technologies in the lives of today's families (Pew Research Center, 2019b), there is a need to better understand the role these technologies play in caregivers' daily routines and in their children's development. The benefits of caregivers' sensitivity and contingent responsiveness to infant cues within both feeding and non-feeding contexts are well-documented (Gunning et al., 2013; Harrist and Waugh, 2002; Reyna and Pickler, 2009), hence, there is potential for distractions to detract from caregivers' attentiveness to their infants' bids for attention and cues, thus, decreasing the quality of early dyadic interactions. However, there are also documented benefits to caregivers' access to and use of technology as a way to connect with others during potentially socially-isolating periods of parenting or as a way to disconnect from the stresses of parenting (McDaniel et al., 2012; Radesky et al., 2016). The present study provides a measure for better understanding the technological distraction of mothers during infancy; further research employing this measure within longitudinal studies that aim to understand long-term associations between caregiver technology use and caregiver and child outcomes is warranted.

A challenge for research examining caregivers' technology use during caregiver-child interactions is understanding whether caregiver technology use equates to distraction and inattention, or whether caregivers are effective at disengaging from technology and other activities frequently or when their child cues or bids for attention. Some, but not all, previous studies suggest that parents are not effective at disengaging when using mobile devices or other forms of technology during mealtime (Kushlev and Dunn, 2018; Moser et al., 2016; Radesky et al., 2014, 2015), play (Kirkorian et al., 2009; Myruski et al., 2018; Pempek et al., 2014; Schmidt et al., 2008; Tanimura et al., 2007), and supervisory (Boles and Roberts, 2008; Mangan et al., 2018; Moran, 2010) interactions with their children. For example, parents engage with their children less when a technological distractor is present (Golen and Ventura, 2015a; Kirkorian et al., 2009; Pempek et al., 2014; Radesky et al., 2014, 2015; Schmidt et al., 2008; Tanimura et al., 2007; Ventura et al., 2019) and children become upset and increase their bids for attention when their parents are absorbed with technology (Myruski et al., 2018; Radesky et al., 2014). In the present study, there was a significant association between mothers' frequency of using technological devices during infant feeding and care and mothers' perceived level of distraction during these interactions, which may support the notion that mothers are indeed distracted when they use technological devices during dyadic interactions (Ward et al., 2017; Wilmer et al., 2017).

Associations between MDQ subscales and relevant maternal psychosocial variables were consistent with the few related studies that precede this work. In particular, *Tech Engagement* was associated with mothers' adherence to a laissez fare and pressuring feeding styles and frequency of use of food to soothe. Findings for an association between technology use during infant feeding and adherence to a laissez faire feeding style are corroborated by previous research within a diverse sample of mothers of young infants (Ventura and Teitelbaum, 2017). Laissez faire feeding style is defined by a general lack of structure and involvement in the feeding (Thompson et al., 2019); thus, it makes intuitive sense that mothers who are less involved during feeding interactions are also more willing to engage in other activities during infant feeding and care. Additionally, mothers who adhere to a pressuring feeding style, a construct that encompasses use of food to soothe, have low sensitivity to their infants' cues and are more likely to start and end the feeding based on contextual cues, such as the time of day or amount of milk in the bottle (Thompson et al., 2019). Previous research illustrated distracted mothers were less sensitive to their infants' cues during feeding compared to mothers who were not distracted (Golen and Ventura, 2015a), thus, mothers who tend to be less reliant on their infants' cues to guide the course of the feeding interaction may be more able and willing to engage in other activities during feeding.

As possible support for the dual nature of maternal distraction, *Tech Engagement* and *Perceived Distraction* subscales were positively correlated with an absence of hostility, meaning that mothers who felt less hostile toward the aspects of their life that had changed due to the birth of their infants also more frequently engaged in technological and non-technological activities during infant feeding and care and more often felt distracted during these interactions. Therefore, distracted mothers felt less hostile about their transition to parenthood. Due to the correlational nature of this study, it is unclear whether mothers' engagement in distractions lead to fewer feelings of hostility because these distractions helped mothers remain socially connected (e.g., via social media) and engaged in activities they enjoyed prior to parenthood (Bennett et al., 2017; McDaniel et al., 2012), or whether mothers who were already feeling less hostile about parenthood were more willing to disengage from infant feeding and care interactions with other activities.

Associations between MDQ subscales and relevant infant characteristics are also consistent with previous research (Golen and Ventura, 2015b; Ventura and Teitelbaum, 2017). In particular, mothers' engagement in technological activities during infant feeding and care were associated with several dimensions of mothers' perceptions of infant eating behaviors, including lower enjoyment of food, but greater food responsiveness, satiety responsiveness, slowness in eating, and general appetite. Because mother-infant interactions are bidirectional, it is possible that mothers' habitual engagement with technological distractors during feeding shapes the development of infant eating behaviors, but it is also possible that infant eating behaviors shape mothers' perceptions of their infants [e.g., (Forestell and Mennella, 2012)] or the likelihood of engaging with distractors during feeding. In particular, mothers who feel their infants are slow eaters and have large appetites may be more likely to engage in other activities to cope with the large volumes of time they feel they devote to feeding. Similarly, all measured dimensions of infant temperament (positive emotionality/surgency, negative affectivity, orienting/regulatory capacity) were associated with mothers' perceived level of distraction, but only negative affectivity was positively associated with mothers' engagement with technological distractors during infant feeding and care, a finding consistent with research with parents of 1- to 5-year-old children, which found that parents who reported higher levels of technological distraction also reported their children exhibited more internalizing (e.g., whining) and externalizing (e.g., temper tantrums) behaviors (McDaniel and Radesky, 2018b). Thus, caregiver distraction may foster more negative affectivity and problematic behaviors among children, but it is also possible that parents who perceive their children to be more difficult are more likely to use technology and other distractors to cope with difficult parent-child interactions (McDaniel and Radesky, 2018a, 2018b; Myruski et al., 2018; Radesky et al., 2014).

As highlighted by the discussion above, a limitation of this research is the correlational nature of the data presented, which makes it difficult to fully understand the nature and direction of associations between MDQ subscales and maternal and infant characteristics. A strength of the MDQ is that it is relatively easy to administer and likely has minimal impact on mothers' behaviors of interest. However, the self-report nature of the MDQ is also a limitation given it may be susceptible to reporting bias. In particular, adults often under-report mobile device use because bouts of use tend to be short and interspersed throughout the day (Berolo et al., 2015) and recent research specific to parents demonstrates parents tend to underestimate their smartphone use (Yuan et al., 2019). While some aspects of technology use might be easy for caregivers to provide generalized estimates of (e.g., television viewing, where viewing duration is likely driven by the length of the show watched), other aspects, like mobile device use, might be difficult to accurately estimate or may be

under-reported due to social desirability biases. In addition, although comparison of mothers' MDQ responses to feeding diary data in Study 2 provided additional support for the validity of the MDQ, this measure of validity may be exaggerated due to common method bias – that is, maternal reports were used for both measures. Some of our measures were further limited by low internal consistencies (i.e., Cronbach coefficient alphas ranging between .60-.69). Thus, future observational work is needed to confirm the validity of the MDQ with a broader array of reliable and valid measures.

Another potential limitation of these studies is their sole focus on mothers. Mothers of young infants are typically predominately responsible for infant feeding and care (DeMaris et al., 2013), but increasingly these roles are becoming more balanced with fathers or other caregivers (Pew Research Center, 2019a) and the importance and impact of fathers and other caregivers have been widely recognized (Allport et al., 2018). Expansion of this psychometric work to a wider range of caregivers (e.g., fathers, daycare providers) would allow for a broader understanding of the extent to which infants may be cared for by caregivers who are engaging with technological distractors. In addition, it is possible that findings from Study 1 were biased by the fact that mothers were recruited from MTurk, an internet-based recruitment platform, and completed all study questionnaires online. This recruitment method allowed for recruitment of a diverse sample of mothers across the U.S. and also facilitated participation by a population (mothers with young infants) who might otherwise have difficulty participating in a study. However, given both the recruitment and data collection components of Study 1 were technology-based, it is possible that the mothers surveyed in Study 1 were more technologically-inclined than mothers recruited using non-technological methods. Additionally, the sample for Study 2 was small and predominately white, middle to upper socioeconomic status, and breastfeeding. Although the sample for Study 1 was more socioeconomically diverse, Black and Hispanic participants were still underrepresented. Further psychometric work within more diverse samples recruited from a wider range of venues is warranted.

It is also important to note we originally included both technological and non-technological activities within the MDQ, but the main non-technological item (Read a book, magazine, or newspaper) loaded similarly on two factors. This may indicate that mothers who are more likely to engage with technological distractors are also more likely to engage with other distractors. This likely also illustrated that it would have been beneficial to include a broader array of non-technological items within the MDQ to achieve a more effective representation of the non-technological distractions mothers may engage in during infant feeding and care. Given these considerations, we decided to drop the 4 items representing non-technological activities from the final measure. Measurement of maternal distraction via technological devices is warranted and important because these devices are more addicting and absorptive than non-technological activities (Ward et al., 2017; Wilmer et al., 2017), thus we assert that the MDQ measures a phenomenon that is particularly relevant to today's parents and caregivers. However, future work could expand the MDQ to further expand the "Other" category so that the MDQ contains a broader array of non-technological activities (e.g., caring for other children, doing housework, eating) and allows for a more valid measure of mothers' engagement with non-technological activities during infant feeding and care.

5. Conclusion

Responsive and reciprocal caregiver-child interactions are an important basis for cognitive and socioemotional development during infancy. The omnipresence of highly engaging and readily available technologies, such as mobile devices, may provide some benefits to caregivers, but may also detract from caregivers' abilities to be attentive to their children's cues and needs. Given the paucity of studies that have explored these issues, the MDQ can serve as a useful tool for much needed future research exploring potential correlates of and outcomes associated with maternal engagement with technological and other distractors during feeding and care interactions during early infancy. The present studies demonstrated the MDQ is a practical, self-report measure of maternal behaviors and perceived level of distraction during infant feeding and care interactions. Further research that examines the validity of this measure among fathers and other caregivers, as well as among caregivers to older infants, would provide an even broader foundation for future research within this field.

Declarations

Author contribution statement

A. Ventura: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

R. Almeida, S. Alvarez Gutierrez: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

M. Hupp: Analyzed and interpreted the data; Wrote the paper.

Funding statement

This work was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health (R03HD080730), the Simms/Mann Institute for Education and Community Development, and the Bill and Linda Frost Fund.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

We thank the mothers and infants who participated in this study.

References

Ainsworth, M.D., Bell, S.M., 1970. Attachment, exploration, and separation: illustrated by the behavior of one-year-olds in a strange situation. Child Dev. 41 (1), 49–67.

Allport, B.S., Johnson, S., Aqil, A., Labrique, A.B., Nelson, T., Kc, A., et al., 2018. Promoting father involvement for child and family Health. Acad. Pediatr. 18 (7), 746–753.

Bennett, C.T., Buchan, J.L., Letourneau, N., Shanker, S.G., Fenwick, A., Smith-Chant, B., Gilmer, C., 2017. A realist synthesis of social connectivity interventions during transition to parenthood: the value of relationships. Appl. Nurs. Res. 34, 12–23.

Berk, L., Meyers, A.B., 2015. Infants and Children: Prenatal through Middle Childhood, eighth ed. Plenum, New York, NY.

Berolo, S., Steenstra, I., Amick 3rd, B.C., Wells, R.P., 2015. A comparison of two methods to assess the usage of mobile hand-held communication devices. J. Occup. Environ. Hyg. 12 (4), 276–285.

Black, M.M., Aboud, F.E., 2011. Responsive feeding is embedded in a theoretical framework of responsive parenting. J. Nutr. 141 (3), 490–494.

Boles, R.E., Roberts, M.C., 2008. Supervising children during parental distractions. J. Pediatr. Psychol. 33 (8), 833–841.

Bowlby, J., 1977a. The making and breaking of affectional bonds. I. Aetiology and psychopathology in the light of attachment theory. An expanded version of the Fiftieth Maudsley Lecture, delivered before the Royal College of Psychiatrists, 19 November 1976. Br. J. Psychiatry 130 (3), 201–210.

Bowlby, J., 1977b. The making and breaking of affectional bonds. II. Some principles of psychotherapy. The fiftieth Maudsley Lecture. Br. J. Psychiatry 130, 421–431.

Buhrmester, M., Kwang, T., Gosling, S.D., 2011. Amazon's mechanical Turk: a new source of inexpensive, yet high-quality, data? Perspect. Psychol. Sci. 6 (1), 3–5.

Chandler, J., Shapiro, D., 2016. Conducting clinical research using crowdsourced convenience samples. Annu. Rev. Clin. Psychol. 12, 53–81.

Charmaz, K., 2000. Grounded theory: objectivist and constructivist methods. In: Denzin, K., Lincoln, Y.S. (Eds.), Handbook of Qualitative Research. Sage, Thousand Oaks, CA, pp. 509–536.

Cheever, N.A., Rosen, L.D., Carrier, L.M., Chavez, A., 2014. Out of sight is not out of mind: the impact of restricting wireless mobile device use on anxiety levels among low, moderate and high users. Comput. Hum. Behav. 37, 290–297.

Condon, J.T., Corkindale, C.J., 1998. The assessment of parent-to-infant attachment: development of a self-report questionnaire instrument. J. Reprod. Infant Psychol. 16 (1), 57–76.
DeMaris, A., Mahoney, A., Pargament, K.I., 2013. Fathers' contributions to housework and childcare and parental aggravation among first-time parents. Fathering 11 (2), 179–198.
Dworkin, J., Hessel, H., Gliske, K., Rudi, J.H., 2016. A comparison of three online recruitment strategies for engaging parents. Fam. Relat. 65 (4), 550–561.
Feldman, R., 2006. From biological rhythms to social rhythms: physiological precursors of mother-infant synchrony. Dev. Psychol. 42 (1), 175–188.
Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., Louzoun, Y., 2011. Mother and infant coordinate heart rhythms through episodes of interaction synchrony. Infant Behav. Dev. 34 (4), 569–577.
Follmer, D.J., Sperling, R.A., Suen, H.K., 2017. The role of MTurk in education research: advantages, issues, and future directions. Educ. Res. 46 (6), 329–334.
Fomon, S.J., 1993. Nutrition of Normal Infants. Mosby-Year Book, Inc, St. Louis, MO.
Forestell, C.A., Mennella, J.A., 2012. More than just a pretty face. The relationship between infant's temperament, food acceptance, and mothers' perceptions of their enjoyment of food. Appetite 58 (3), 1136–1142.
Gartstein, M.A., Rothbart, M.K., 2003. Studying infant temperament via the revised infant behavior questionnaire. Infant Behav. Dev. 26 (1), 64–86.
Golen, R.B., Ventura, A.K., 2015a. Mindless feeding: is maternal distraction during bottle-feeding associated with overfeeding? Appetite 91, 385–392.
Golen, R.B., Ventura, A.K., 2015b. What are mothers doing while bottle-feeding their infants? Exploring the prevalence of maternal distraction during bottle-feeding interactions. Early Hum. Dev. 91 (12), 787–791.
Gunning, M., Halligan, S.L., Murray, L., 2013. Contributions of maternal and infant factors to infant responding to the still face paradigm: a longitudinal study. Infant Behav. Dev. 36 (3), 319–328.
Harrist, A.W., Waugh, R.M., 2002. Dyadic synchrony: its structure and function in children's development. Dev. Rev. 22 (4), 555–592.
Harry, E., Sturges, K.M., Klingner, J.K., 2005. Mapping the process: an exemplar of process and challenge in grounded theory analysis. Educ. Res. 34 (2), 3–13.
Harvard Center on the Developing Child, 2015. Serve and return. Retrieved from. https://developingchild.harvard.edu/science/key-concepts/serve-and-return/.
Harvard Center on the Developing Child, 2015. Serve and return interactions shapes brain circuitry. Retrieved from. https://developingchild.harvard.edu/resources/serve-return-interaction-shapes-brain-circuitry/.
Hiniker, A., Sobel, K., Suh, H., Sung, Y.C., Lee, C.P., Kientz, J.A., 2015. Texting while Parenting. Proceedings of the 2015 CHI Conference on Human Factors in Computing Systems, pp. 727–736.
Kildare, C.A., Middlemiss, W., 2017. Impact of parents mobile device use on parent-child interaction: a literature review. Comput. Hum. Behav. 75, 579–593.
Kirkorian, H.L., Pempek, T.A., Murphy, L.A., Schmidt, M.E., Anderson, D.R., 2009. The impact of background television on parent-child interaction. Child Dev. 80 (5), 1350–1359.
Kushlev, K., Dunn, E.W., 2018. Smartphones distract parents from cultivating feelings of connection when spending time with their children. J. Soc. Pers. Relatsh. 36 (6), 1619–1639.
Llewellyn, C.H., van Jaarsveld, C.H., Johnson, L., Carnell, S., Wardle, J., 2011. Development and factor structure of the baby eating behaviour questionnaire in the gemini birth cohort. Appetite 57 (2), 388–396.
Lohaus, A., Keller, H., Ball, J., Elben, C., Voelker, S., 2001. Maternal sensitivity: components and relations to warmth and contingency. Parenting 1 (4), 267–284.
Macy, M.L., Carter, P.M., Bingham, C.R., Cunningham, R.M., Freed, G.L., 2014. Potential distractions and unsafe driving behaviors among drivers of 1- to 12-year-old children. Acad. Pediatr. 14 (3), 279–286.
Mangan, E., Leavy, J.E., Jancey, J., 2018. Mobile device use when caring for children 0-5 years: a naturalistic playground study. Health Promot. J. Aust. 29 (3), 337–343.
McDaniel, B.T., 2019. Parent distraction with phones, reasons for use, and impacts of child outcmes: a review of emerging research. Human Behav. Emerg. Technol. 1 (2), 72–80.
McDaniel, B.T., Coyne, S.M., 2016a. "Technoference": the interference of technology in couple relationships and implications for women's personal and relational well-being. Psychol. Pop. Media Cult. 5, 85–89.
McDaniel, B.T., Coyne, S.M., 2016b. Technology interference in the parenting of young children: implications for mothers' perceptions of coparenting. Soc. Sci. J. 53 (4), 435–443.
McDaniel, B.T., Coyne, S.M., Holmes, E.K., 2012. New mothers and media use: associations between blogging, social networking, and maternal well-being. Matern. Child Health J. 16 (7), 1509–1517.
McDaniel, B.T., Radesky, J.S., 2018a. Technoference: longitudinal associations between parent technology use, parenting stress, and child behavior problems. Pediatr. Res. 84 (2), 210–218.
McDaniel, B.T., Radesky, J.S., 2018b. Technoference: parent distraction with technology and associations with child behavior problems. Child Dev. 89 (1), 100–109.
Moran, K., 2010. Watching parents, watching kids: water safety supervision of young children at the beach. Int. J. Aquat. Res. Educ. 4, 269–277.
Moser, C., Schoenebeck, S.Y., Reinecke, K., 2016. Technology at the Table: Attitudes about Mobile Phone Use at Mealtimes. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, pp. 1881–1892.
Myruski, S., Gulyayeva, O., Birk, S., Perez-Edgar, K., Buss, K.A., Dennis-Tiwary, T.A., 2018. Digital disruption? Maternal mobile device use is related to infant social-emotional functioning. Dev. Sci. 21 (4), e12610.
Oulasvirta, A., Rattenbury, T., Ma, L., Raita, E., 2012. Habits make smartphone use more pervasive. Personal Ubiquitous Comput. 16 (1), 105–114.
Oxford, M., Findlay, D. (Eds.), 2015. Caregiver/Parent-Child Interaction: Feeding Manual, second ed. NCAST Programs, Seattle, Washington.
Palsson, C., 2014. That Smarts!: Smart Phones and Child Injuries. Retrieved from. http://www.palssonresearch.org/wp-content/uploads/2014/10/smartphone_v17.pdf.
Pempek, T.A., Kirkorian, H.L., Anderson, D.R., 2014. The effects of background television on the quantity and quality of child-directed speech by parents. J. Child. Media 8 (3), 211–222.
Pew Research Center, 2019a. 8 Facts about American Dads. Retrieved from. https://www.pewresearch.org/fact-tank/2019/06/12/fathers-day-facts/.
Pew Research Center, 2019b. Mobile Technology Fact Sheet. Retrieved from. https://www.pewinternet.org/fact-sheet/mobile/.
Putnam, S.P., Helbig, A.L., Gartstein, M.A., Rothbart, M.K., Leerkes, E., 2014. Development and assessment of short and very short forms of the infant behavior questionnaire-revised. J. Personal. Assess. 96 (4), 445–458.
Radesky, J.S., Kistin, C., Eisenberg, S., Gross, J., Block, G., Zuckerman, B., Silverstein, M., 2016. Parent perspectives on their mobile technology use: the excitement and exhaustion of parenting while connected. J. Dev. Behav. Pediatr. 37 (9), 694–701.
Radesky, J.S., Kistin, C.J., Zuckerman, B., Nitzberg, K., Gross, J., Kaplan-Sanoff, M., et al., 2014. Patterns of mobile device use by caregivers and children during meals in fast food restaurants. Pediatrics 133 (4), e843–849.
Radesky, J.S., Miller, A.L., Rosenblum, K.L., Appugliese, D., Kaciroti, N., Lumeng, J.C., 2015. Maternal mobile device use during a structured parent-child interaction task. Acad. Pediatr. 15 (2), 238–244.
Reed, J., Hirsh-Pasek, K., Golinkoff, R.M., 2017. Learning on hold: cell phones sidetrack parent-child interactions. Dev. Psychol. 53 (8), 1428–1436.
Reyna, B.A., Pickler, R.H., 2009. Mother-infant synchrony. J. Obstet. Gynecol. Neonatal Nurs. 38 (4), 470–477.
Roney, L., Violano, P., Klaus, G., Lofthouse, R., Dziura, J., 2013. Distracted driving behaviors of adults while children are in the car. J. Trauma Acute Care Surg. 75 (4 Suppl 3), S290–295.
Rosen, L.D., Whaling, K., Carrier, L.M., Cheever, N.A., Rokkum, J., 2013. The media and technology usage and attitudes scale: an empirical investigation. Comput. Hum. Behav. 29 (6), 2501–2511.
Schmidt, M.E., Pempek, H.L.K., Lund, A.F., Anderson, D.R., 2008. The effects of background television on the toy play behavor of very young children. Child Dev. 79 (4), 1137–1151.
Simon, H.K., Tamura, T., Colton, K., 2003. Reported level of supervision of young children while in the bathtub. Ambul. Pediatr. 3 (2), 106–108.
Stifter, C.A., Anzman-Frasca, S., Birch, L.L., Voegtline, K., 2011. Parent use of food to soothe infant/toddler distress and child weight status. An exploratory study. Appetite 57 (3), 693–699.
Stifter, C.A., Moding, K.J., 2015. Understanding and measuring parent use of food to soothe infant and toddler distress: a longitudinal study from 6 to 18 months of age. Appetite 95, 188–196.
Tanimura, M., Okuma, K., Kyoshima, K., 2007. Television viewing, reduced parental utterance, and delayed speech development in infants and young children. Arch. Pediatr. Adolesc. Med. 161, 618–619.
Thompson, A.L., Mendez, M.A., Borja, J.B., Adair, L.S., Zimmer, C.R., Bentley, M.E., 2009. Development and validation of the infant feeding style questionnaire. Appetite 53 (2), 210–221.
Thompson, A.L., Wasser, H., Bentley, M.E., 2019. Validation of the Infant Feeding Beliefs Questionnaire (IFBQ) among pregnant African- American women and their study partners. Appetite 141, 104316.
Tran, M., Cabral, L., Patel, R., Cusack, R., 2017. Online recruitment and testing of infants with Mechanical Turk. J. Exp. Child Psychol. 156, 168–178.
Tronick, E.Z., 2005. Why is connection to others so critical? Dyadic meaning making, messiness, and complexity-governed selective processes which co-create ans expand individual's states of conciousness: the assembling of states of conciousness and experiential impelling certitude from the messiness of age-possible meanings of emotions, actions, and symbols. In: Nadel, J., Muir, D. (Eds.), Emotion Development. Oxford University Press, New York, pp. 293–315.
Tronick, E.Z., 2007. The Neurobehavioral and Social Emotional Development of Infants and Young Children. Norton, New York.
Tronick, E.Z., Als, H., Brazelton, T.B., 1977. Mutuality in mother-infant interaction. J. Commun. 27 (2), 74–79.
Ventura, A.K., Hernandez, A., 2019. Effects of opaque, weighted bottles on maternal sensitivity and infant intake. Matern. Child Nutr. 15 (2), e12737.
Ventura, A.K., Levy, J., Sheeper, S., 2019. Maternal digital media use during infant feeding and the quality of feeding interactions. Appetite 143, 104415.
Ventura, A.K., Teitelbaum, S., 2017. Maternal distraction during breast- and bottle feeding among WIC and non-WIC mothers. J. Nutr. Educ. Behav. 49 (7S2), S169–S176 e161.
Vygotsky, L.S., 1978. Mind in Society: the Development of Higher Psychological Processes. Harvard University Press, Cambridge, MA.
Ward, A.F., Duke, K., Gneezy, A., Bos, M.W., 2017. Brain drain: the mere presence of one's own smartphone reduces available cognitive capacity. J. Assoc. Consumer Res. 2 (2), 140–154.
Wilmer, H.H., Sherman, L.E., Chein, J.M., 2017. Smartphones and cognition: a review of research exploring the Links between mobile technology habits and cognitive functioning. Front. Psychol. 8, 605.

Worobey, J., 2016. Observational scales of mother-infant feeding: a catalogue and review. In: Worobey, J. (Ed.), Infant Feeding: Parental Perceptions, Behaviors, and Health Effects. Nova Science Pubishers, Inc, New York, pp. 197–213.

Yogman, M., Garner, A., Hutchinson, J., Hirsch-Pasek, K., Golinkoff, R.M., Committee on Psychosocial Aspects of Child and Family Health, & Council On Communications and Media, 2018. The power of play: a pediatric role in enhancing development in young children. Pediatrics 142, e20183058.

Yuan, N., Weeks, H.M., Ball, R., Newman, M.W., Chang, Y.J., Radesky, J.S., 2019. How much do parents actually use their smartphones? Pilot study comparing self-report to passive sensing. Pediatr. Res. 86 (4), 416–418.

Zwarun, L., Hall, A., 2014. What's going on? Age, distraction, and multitasking during online survey taking. Comput. Hum. Behav. 41, 236–244.