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Using video observation in the family context: The association between camera-related behaviors and parental sensitivity

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Abstract

Research on parental sensitivity often relies on video observation of parent–infant dyads. However, to date, no study has assessed both infants' and parents' interactions with the camera, and how this relates to parental sensitivity levels. This exploratory study micro-coded camera-related behaviors (CRB) by 4-month olds and their mothers and fathers on a 1-s time base, and examined the associations between those behaviors and parental sensitivity in 75 Dutch families. While parents' CRB made up only 0.8% of total interaction time, infants' made up 12%. Multi-level time-series analyses showed that infants' CRB predicted mothers'. Infants' CRB predicted fathers' CRB, and vice versa. Maternal sensitivity was significantly lower when children looked at the camera for over one-third of total interaction time (Cohen's $d = 1.26$). These findings indicate further research is required to better understand how video observation might threaten ecological validity.

KEYWORDS

camera awareness, camera reactivity, camera-related behaviors, parental sensitivity, video observation

1 | INTRODUCTION

Direct observation is hailed as the "gold standard" for assessing the nature and quality of parent–child interactions (Hawes & Dadds, 2006). Whereas self-report measures are, especially in the parenting context, often subject to social desirability bias (Law & Roy, 2008; Van de Mortel, 2008), direct observation is deemed more objective. Therefore, research in developmental psychology relies heavily on the video observation of parent–child dyads. However, despite a wide literature showing that being observed and video recorded alters one's behavior and heightens public self-awareness (e.g., Alden et al., 1992; Bennetts et al., 2017; Chen et al., 2015; Govern & Marsch, 2001; Lindon-Morris & Laidlaw, 2014; Zegiob et al., 1975), surprisingly little research has investigated the effects of video observation on behavior in family contexts. If parents behave differently under the eye of a camera, that could undermine the ecological validity of research relying on video observation measures. The current study is the first to systematically assess how infants, fathers, and mothers interact with a video camera, and examine associations of such camera-related behaviors with observed parenting behavior.

Video observation is praised for its intercoder reliability and replicability, the possibilities to review the same material multiple times, do post hoc analyses, and to discuss the data with other researchers or participants (Barriage & Searles, 2019; Mesman, 2021b). For these reasons, video observation is often used in developmental research, such as in the hallmark NICHD Early Child Care Research Network (1997), and many other studies focused on early childhood parental sensitivity, defined as parents' prompt and appropriate responsiveness to the signals of their child (Ainsworth et al., 1974), as reviewed by Mesman and Emmen (2013). Indeed, sensitivity is not easily assessed with self-report measures, because it reflects awareness of child signals that if absent is logically impossible (Mesman, 2021a). Based on research using video observation, sensitive parenting has been shown to be related to lower behavioral problems, more social competence (Leerkes et al., 2009), more academic success (Jaekel et al., 2015), and more optimal infant attachment quality (De Wolff & Van IJzendoorn, 1997).

Given the central role of video observations in this field, examining parents' and infants' interaction with the camera in such research settings, and whether that relates to the parenting behavior of interest, is crucial to understanding the ecological validity of such studies. Camera-related behaviors (CRB) are measurable behaviors that signal awareness of the camera, such as looking at or talking about the camera (Penner et al., 2007). Although some research in medical fields has found these to occur infrequently (Antal et al., 2014; Penner et al., 2007; Zhou et al., 2010), these studies cannot be used to extrapolate to the family context, because the strong distracting stimulus of a healthcare provider discussing the patient's medical condition is absent in the family context, while this distraction is used as the core explanation of the low frequency of CRB in medical contexts (Penner et al., 2007).

Within family contexts, a handful of studies have investigated the nature and predictors of CRB in parents and children. Studies in several non-Western countries video coded the CRB of mothers using a 3-point global coding scheme and found the percentage of mothers who display CRB to vary strongly between countries (Alsarhi et al., 2021; Asanjarani et al., 2021; Fourment et al., 2021; Lima Ribeiro et al., 2021; Mesman et al., 2021; Rahma et al., 2021). Children's CRB have been found to occur frequently (Barriage & Searles, 2019). Whereas mothers' CRB declined over the course of an observation (Asanjarani et al., 2021), children's CRB did not (Barriage & Searles, 2019). There is some evidence that younger parents show more CRB (Dawson et al., 2018; Mesman et al., 2021), and some fathers have reported to be more affected by observers than mothers (Russell et al., 1992).

Theoretically, it is to be expected that parenting self-efficacy (PSE), which refers to the expectations caregivers hold regarding their abilities to parent successfully (Jones & Prinz, 2005), affects CRB. In theory, this relationship could run in either direction. Low PSE could increase CRB, because a parent with low PSE might be made to feel more insecure by the presence of a video camera, thus become more aware of the camera and display CRB. On the other hand, high PSE could increase CRB, because a more confident parent might be more likely to acknowledge the presence of the camera when their child looks at it, not fearing that the child's interest in the camera, not them, means they have failed as a parent. In either scenario, it is relevant to measure PSE, because if PSE influences CRB, and if CRB influences parental sensitivity, then observed differences in sensitivity might merely reflect differences in PSE. In non-family contexts, self-efficacy seems to increase observational reactivity (Alden et al., 1992; Shrauger, 1972). However, research in medical contexts has not found evidence that PSE and CRB are related (Antal et al., 2014).

Unfortunately, most of these studies in families focused exclusively on mothers, while some evidence indicates that the strength of observer effects differs by gender (Russell et al., 1992). Moreover, only one study measured the CRB of children, who were 3–6 years old (Barriage & Searles, 2019). Given evidence in the medical field that young children display more CRB than older children (Antal et al., 2014), it is important to examine the CRB of infants.

Moving beyond descriptions and predictors of CRB, two types of studies have investigated camera reactivity, which is defined as the process by which video observation of a phenomenon changes that phenomenon. Research using semi-structured in-depth interviews with parents and questionnaires has found strong evidence for observer and camera reactivity, with parents reporting their and their children's behavior to change (Bennetts et al., 2017; Russell et al., 1992; Thornberry, 2013). Some of the studies that video-coded mothers' CRB in non-Western contexts associated these with parental sensitivity, and found no associations (Alsarhi et al., 2021; Lima Ribeiro et al., 2021; Rahma et al., 2021). The discrepancy between the outcomes of these self-report and observational methods could be because the latter used a very rough measure of CRB, namely a 3-point scale for the whole video, thereby making it unlikely to find more nuanced effects.

If an association between CRB and parental sensitivity exists, it is important to understand the direction of these effects. If variations in parental sensitivity cause variations in CRB, this association need not be seen as undermining the ecological validity of studies interested in parental sensitivity. However, if variations in CRB cause variations in parental sensitivity, then the usage of video observation might obscure the measurement of parental sensitivity. Therefore, the current study presented two models, one for each direction. Although it is impossible to give conclusive evidence on causal claims using observational data, these causal models were presented to facilitate falsification, leading to clearly testable hypotheses.

In describing these models, it is important to differentiate between CRB and camera awareness. Camera awareness is used to refer to the effects of being aware of the presence of a camera on cognitive and emotional manifestations. Thus, whereas camera awareness refers to non-observable internal states of mind, CRB are measurable behaviors that signal camera awareness. In the first model (see Figure 1), the infant's interest in the camera, as signaled by their CRB, heightens the parent's camera awareness. This, in turn, increases the parent's own CRB. Moreover, the parents' heightened camera awareness decreases their sensitivity in this model, which would be expected for a variety of reasons. Firstly, it would be in line with findings that video cameras are known to increase self-focus (Alden et al., 1992; Govern & Marsch, 2001; Lindon-Morris & Laidlaw, 2014), which is negatively associated with parental

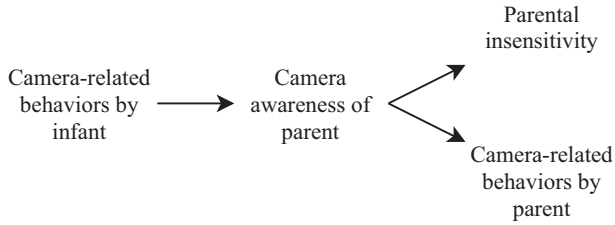

FIGURE 1 The first model to explain the association between CRB and parental sensitivity

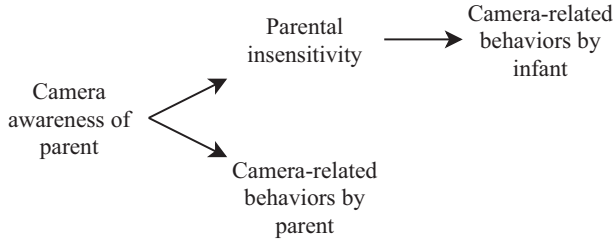

FIGURE 2 The second model to explain the association between CRB and parental sensitivity

sensitivity (Dix et al., 2004; Leerkes et al., 2015), as self-focus may lead to withdrawal or intrusiveness in parents (Cassidy, 1994; Lorber & O'Leary, 2005; Martin et al., 2002). Moreover, being distracted by the camera reflects divided attention, which is known to also reduce sensitive responsiveness (Golen & Ventura, 2015). Lastly, parents are often told to pretend the researcher and camera do not exist. This may cause parents to feel they are not supposed to focus on the camera, even when their child does so. This might artificially obstruct joint attention, which involves exchanges in which parents and infants are aware of their mutual attention for a third object or event (Bigelow et al., 2004), which is a key aspect of sensitivity (Bigelow et al., 2004, 2010).

In the alternative model, parents' camera awareness increases their CRB and causes them to be less sensitive for the same reasons as described above. Their decreased sensitivity would then cause infants' to display CRB. This could be because infants display less attentional engagement when their parents are insensitive (Conradt & Ablow, 2010), thereby turning toward the camera instead of their parent. This model is summarized in Figure 2.

Both of these models lead to the following three hypotheses: (1) Infants' CRB and parents' CRB are positively interrelated; (2) infants' CRB and parental sensitivity are negatively interrelated; (3) parents' CRB and parental sensitivity are negatively interrelated. The sequencing of parents' and infants' CRB differentiates these two models. If infants' CRB precedes parents', the first model is preferred over the second, and vice versa. Based on research findings that in the vast majority of cases young children's orientation toward the camera was preceded by a sibling or parent doing so (Barriage & Searles, 2019), parents' CRB were expected to precede infants', thus favoring the second model.

The aims of the current study were to (1) obtain a descriptive understanding of the way infants, mothers, and fathers display CRB, in terms of the frequency of different types of CRB, their development over the course of an observation, and related parent characteristics (age, gender, or PSE); (2) investigate the association between CRB and parental sensitivity and the moderators in this association; (3) examine whether infants' CRB preceded and predicted parents' CRB or vice versa.

2 | METHOD

2.1 | Participants

Data for this study were collected from the research program "Origins of early individual differences in self-regulation: A multi-method study involving mothers, fathers and infants in the United Kingdom, the Netherlands and the US." This study included 75 4-month-old infants and both their fathers and mothers. These families were selected from a larger sample of 132 families recruited in the Netherlands from September 2014 to March 2015 through pregnancy fairs, prenatal exercise classes, and posters and flyers distributed at midwife clinics and pregnancy stores. Parents were eligible if they were over 20 years of age, first-time parents, living together in the Netherlands and both spoke Dutch, planning on raising their child together, had no history of severe mental illness or substance misuse, and were not undergoing an extensive medical or therapeutic treatment. Between the prenatal and 4-month assessment, 13 parents withdrew from the study due to the lack of time ($n = 8$), infant health problems ($n = 4$), and parent mental health problems ($n = 1$). Parents that withdrew and parents that did not withdraw from the study did not differ on level of education, parental age, number of hours worked per week, personal income, and household income (ps: 0.07−0.77). Due to the time-intensive nature of micro-coding videos, the sample to be analyzed was limited to 75 families, i.e., 150 videos. Thus, 75 of these 119 families were chosen randomly and did not differ from non-included families on any of the before mentioned demographics (ps: 0.11−1.00).

At the 4-month assessment, fathers in this sample were between 24 and 48 years old ($M = 32.8$, $SD = 4.4$), mothers were between 21 and 42 years old ($M = 30.4$, $SD = 3.9$), and infants between 3 and 5 months ($M = 4.1$, $SD = 0.4$). Moreover, 87% of mothers and 99% of fathers had a paid job. Of those parents that had a job, mothers worked on average 27.47 h per week and fathers 38.80. Fathers and mothers were asked independently to report an estimate of their household income, and their estimates were averaged in case they differed. Based on these data, household income ranged between 1,500 and 9,966 euros per month ($M = 5{,}167$, $SD = 1{,}699$). With regard to level of education, 69% of mothers had a high level of education (had at least a bachelor's degree), 14% had a medium level of education (obtained a postsecondary or short-cycle tertiary education), and 17% had a low level of education (completed no more than upper secondary education). Regarding the fathers, 62% had a high level of education, 9.0% had a medium level of education, and 29% had a low level of education.

The present study was conducted according to guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent or guardian for each child before any assessment or data collection. All procedures involving human subjects in this study were approved by the Ethics Review Board at the Institute of Education and Child Studies of Leiden University, the Netherlands.

2.2 | Procedure

This research relied on 5-min video observations of parent–child dyads in a free-play context. At the 4-month assessment, parents were visited separately, with a period of around seven days separating the visits. The order in which mothers and fathers were visited was counterbalanced. As not to disturb the assessment with the target parent, if the other parent was at home during the visit, they were in a different room. In all other cases, no one besides the child and the target

parent was present during the visit. During the home visit, parent–child dyads were videotaped, while the infant was on the floor or on the parent's lap, during which parents were instructed to play with their child in the way they would do normally for 5 min, but without a pacifier or toys. Researchers stayed present during the recording, stationed behind the camera.

Trained undergraduate and graduate students conducted the visits, and both parents gave informed consent. After every home visit, parents received a small present for their infant and a gift voucher.

2.3 | Measures

2.3.1 | Parental sensitivity

Parental sensitivity was coded using the Ainsworth Sensitivity Scale (Ainsworth et al., 1974). This is a 9-point global Likert scale that ranges from 1 (highly insensitive) to 9 (highly sensitive). Ten coders were trained to reliability by the second author. The reliability set contained 30 cases; intraclass correlation coefficients (single rater, absolute agreement) ranged from 0.73 to 0.92 ($M = 0.83$). Parents from the same family were assessed by different coders.

2.3.2 | *Camera-related behaviors*

CRB were micro-coded. The onset and offset times of each behavior were recorded in milliseconds. The following behaviors were coded, based on the coding schemes and findings of previous research (Antal et al., 2014; Barriage & Searles, 2019; Mesman, 2021a; Penner et al., 2007; Zhou et al., 2010). (1) Looking at the camera: This included deliberate looks at the camera and quick glances. (2) Talking about the camera: This was coded whenever the parent talked about the presence of the camera. This included commenting either to themselves, the camera person, or their child about the fact that they were being filmed, the duration of the filming, or worries about what people who see the video would think. Talking about the camera was only coded when words were used that referenced explicitly to the camera or the act of being filmed. Sentences that might talk about the camera, but do not specifically mention it (e.g., "It is odd to be watched, isn't it?"), were excluded. (3) Gesturing toward the camera: This could take forms as waving or pointing. (4) Not classifiable behaviors: This included behavior that could only be classified as "other" or that were not initially part of the coding scheme, such as parents taking their infant's arms to wave at the camera.

For the CRB of infants, only measures 1, 3, and 4 applied. For the full coding handbook, including more exhaustive descriptions of how the different behaviors were coded, see Appendix S1. Videos were coded using Datavyu version 1.3.7 (Datavyu Team, 2014) by the first author and a second coder they trained. Both coders were blind to sensitivity and PSE scores. For each family, the interactions between infant and mother and between infant and father were coded by a different coder. Both coders coded an equal number of fathers and mothers. Reliability estimates were computed per behavior for 12 dyads.

For infant looking, parent looking, and parent talking, the total time the behaviors occurred per 5 min observation was calculated. Here, the mean intraclass correlation coefficient (absolute agreement) was 0.83 for infant looking, 0.81 for parent looking, and 0.72 for parent talking. For parent looking and parent talking, a binary was also created for whether or not the behavior

occurred at all during a given interaction. Here, observed proportionate agreement scores were 0.92 for parent talking, 0.83 for parent looking, and 0.92 for a composite measure of whether either form of CRB occurred. Cohen's kappa was 0.83 for parent talking, 0.57 for parent looking, and 0.63 for the composite measure. Infant looking, parent looking, and parent talking were re-coded into a 1-s time unit. Thus, for every second in the observation, a binary was created as to whether the behavior occurred. Mean observed agreement scores were 0.92 for infant looking, 0.995 for parent looking, and 0.99 for parent talking. Mean Cohen's kappa was 0.74 for infant looking, 0.66 for parent looking, and 0.59 for parent talking, indicating substantial agreement (Viera & Garrett, 2005).

2.3.3 | *Parenting self-efficacy*

PSE was measured at the 4-month assessment using a Dutch translation of the Self-Efficacy in the Nurturing Role Questionnaire, which is an adaptation by Pedersen et al. (1989) of the Parental Sense of Competence Scale developed by Gibaud-Wallston and Wandersmann (1978). This scale contains 16 items rated on 7-point Likert scales about parents' perceptions of their competence in caring for an infant (e.g., "I feel confident in my role as a parent," "I can soothe my baby easily when he or she is crying or fussing," "Touching, holding, and being affectionate with my baby is comfortable and pleasurable for me"). For the total score, the reverse scored items (3, 4, 6, 10, 11, 13, and 16) were reversed, and all items were summed. Thus, the potential scores ranged from 16 to 112. In the past, robust test-retest reliability and moderate to high internal consistency have been shown (Pedersen et al., 1989), and recent studies found Cronbach's alphas between 0.78 and 0.91 at different stages, both pre- and post-partum, both with the English original and Dutch translations, for both fathers and mothers (Cassé et al., 2018; Hsu & Sung, 2008; Porter & Hsu, 2003; Solmeyer & Feinberg, 2011; Verhage et al., 2013; Wernand et al., 2014). In this sample, Cronbach's alphas were 0.89 for fathers and 0.83 for mothers.

2.4 | Data analysis

Data analyses were conducted using *R* 3.6.1. For all variables of interest (CRB by infant, CRB by parent, parental sensitivity, and PSE) and all demographic variables (level of education, household income, personal income, and hours worked per week), outliers, defined as scores more than 3.29 *SD* away from the mean, were winsorized, as proposed by Tabachnick and Fidell (2013), by setting their scores equal to the highest (lowest) score that fell within 3.29 (−3.29) *SD* of the mean. No more than three outliers per variable were found. Data were missing for level of education (nine fathers and three mothers), hours worked (five mothers and three fathers), personal income (14 mothers and five fathers), and PSE (four mothers and three fathers). These parents were excluded from the data analyses that relied on these measures. Given that most parents did not display any CRB at all, parents' CRB was dichotomized (CRB absent vs present).

Preliminary analyses were conducted to examine the association between the demographic variables (level of education, household income, personal income, and hours worked per week), and the variables of interest (sensitivity, PSE, infant looking at camera, parent looking at camera, and parent talking about camera), using correlation coefficients, one-way analysis of variance (ANOVA) tests, group means *t*-tests, and Chi-squared tests (wherever applicable). Demographic

variables that correlated significantly with variables of interest were included as covariates in analyses using those variables of interest.

Given that for any analysis of data for mothers and fathers of the same child independence of the data cannot be assumed, fathers and mothers were either separated before analysis, or mixed effects models were run.

To investigate the association between the total time infants looked at the camera and parental sensitivity, three different models with parental sensitivity as the dependent variable and infant looking as the independent variable were run: (1) bivariate OLS regression models, where fathers and mothers were separated; (2) a mixed effects model including an interaction effect between infants' CRB and parental gender, because the first model only gave a significant association for mothers; (3) bivariate OLS regression models, with infant looking recoded into a binary, where a 0 was assigned if the infant looked for less than 100 s at the camera, and a 1 was assigned if the infant looked for 100 s or more, because all significant findings in models 1 and 2 were explained by a group of parents whose infants looked for over 100 s at the camera. Given the exploratory nature of this research, models 2 and 3 were chosen inductively.

To analyze whether infants' CRB preceded and predicted their parents' or vice versa, two sets of models were run. The first set was analyzed on a macro-level, namely the total CRB over a single observation, whereas the second set was analyzed on a micro-level, namely the CRB per second. On the macro-level, group means t-tests were run to compare infants' mean CRB when parents did and did not display CRB. On the micro-level, multilevel time-series models were run, which tested whether the CRB of infant and parent in one second were predicted by each other's CRB in the preceding seconds. For each second, a binary was created whether a particular type of CRB occurred or not. Thus, our multilevel time series models were generalized linear mixed logistic models. Lags of both the explanatory variables and the dependent variables up to 3 s were included. For a more elaborate explanation and the benefits of multilevel time-series models in this context, see Beebe et al. (2010). With a dichotomous variable, in case the number of events is smaller than the number of non-events, the limiting sample size is the number of events (Babyak, 2004). Given that CRB occurred very infrequently for parents (e.g., in only 27 s of all observations did a father talk about the camera), and given that at least ten events per variable are desirable in logistic regressions (Peduzzi et al., 1996), a composite measure of CRB was created. This was a binary variable that was positive in case the parent either talked about the camera, looked at it, or did both simultaneously, in a given second. This composite measure ensured the model was not overfitted. To test for robustness, these analyses were also conducted with conditional fixed effects logistic models, as suggested by Allison (2009).

3 | RESULTS

3.1 | Preliminary analyses

For the summary statistics of sensitivity, PSE, and CRB, see Table 1. Paired *t*-tests showed that the mean PSE scores of mothers were significantly higher than those of fathers ($p < 0.001$), but no such difference was found between their sensitivity scores ($p = 0.20$). The mean scores of fathers' and mothers' sensitivity levels lie between "inconsistently sensitive" (score 5) and "adequately sensitive" (score 6). Mean PSE was moderate to strong.

The sensitivity levels of fathers and mothers of the same child were moderately correlated, $r(73) = 0.33$, $p = 0.0005$. The PSE scores of fathers and mothers of the same child were not

TABLE 1 Summary statistics of sensitivity, PSE, and the total time of different types of CRB per video (in seconds)

	Fathers				Mothers			
Variable	**Min**	**Max**	***M***	***SD***	**Min**	**Max**	***M***	***SD***
Sensitivity	1	8	5.6	2.0	1	9	5.2	1.8
PSE	55	108	89.1	12.7	65	112	94.7	9.5
Infant looking	0	101.5 (34%)	30.8 (10%)	27.4	0	177.6 (59%)	42.6 (14%)	43.6
Parent looking	0	3.5 (1.2%)	0.6 (0.2%)	0.9	0	6.1 (2.0%)	0.7 (0.2%)	1.5
Parent talking	0	16.3 (5.4%)	1.5 (0.5%)	3.9	0	15.2 (5.1%)	1.7 (0.6%)	3.5

Note: Percentages are given as part of the total duration of the video, which was always 300 s.

significantly correlated ($p = 0.34$). There was no significant correlation between infants' CRB when they played with their fathers and when they played with their mothers ($p = 0.33$), nor between parents' CRB and their partners' CRB, for either looking or talking ($p = 0.41$ and $p = 0.26$, respectively).

Level of education was associated with sensitivity for fathers ($p = 0.05$). Personal income was related to parent looking at camera only for fathers, not for mothers ($M = 3{,}416$ for those fathers who looked, $M = 2{,}852$ for those who did not, $p = 0.02$). None of the other relations were significant (*p*s: 0.06–0.99). Based on these preliminary analyses, parental level of education was used as a control variable in subsequent analyses including fathers' sensitivity, and personal income was used as a control variable in subsequent analyses including father looking at camera.

PSE correlated weakly with father's sensitivity, $r(70) = 0.28$, $p = 0.02$, although this disappeared after education was included as a covariate, while PSE did not correlate with mother's sensitivity ($p = 0.66$). There was no association between PSE and parents' or infants' CRB or parental age (*p*s: 0.23–0.98). Moreover, there was no correlation between parental age and parental sensitivity or parents' or infants' CRB (*p*s: 0.18–0.99).

3.2 | Aim 1—Describing CRB

3.2.1 | Frequency of different types of CRB

The behaviors infant other, parent other, and parent gesturing never occurred. Only one infant gestured at the camera, which was not taken into the analyses after winsorizing. For the summary statistics of the total time, the remaining variables occurred per video, see Table 1. Infants looked longer at the camera when playing with their mother than with their father ($p = 0.04$), but fathers' and mothers' CRB were not different in duration (*p*s: 0.69–0.76). Notably, four infants looked at the camera for more than half of total interaction time. Out of 75 infants, only 11 (15%) never looked at the camera, 38 (51%) fathers and 44 (59%) mothers never looked at the camera, and 59 fathers (79%) and 52 mothers (69%) never talked about the camera.

Although there were fewer parents who talked about the camera than parents who looked at it, when parents talked, it took up more time than when they looked ($p = 0.04$ for fathers, $p = 0.02$ for mothers). There were only seven interactions (9.3%) in which neither the parent nor the infant displayed any CRB. In sum, in the vast majority of observations infants showed CRB,

while that cannot be said for parents, and infants' CRB lasted, on average, between 20 to 60 times as long as parents'.

3.2.2 | CRB development over the course of an observation

Infant looking at camera showed a moderate to strong negative correlation with time for interactions with fathers, $r(73) = -0.67$, $p < 0.001$, and a moderate negative correlation with time for interactions with mothers, $r(73) = -0.48$, $p < 0.001$. Parent talking about camera correlated moderately with time for fathers, $r(73) = -0.46$, $p < 0.001$, and weakly for mothers, $r(73) = -0.30$, $p < 0.001$. Parent looking at camera did not correlate significantly with time for fathers ($p = 0.59$), while there was a weak correlation for mothers, $r(73) = -0.13$, $p = 0.02$. See Figures S1 and S2 for histograms of the development of CRB over time.

In sum, the decrease in infants' CRB over time was stronger during interactions with fathers than with mothers, but in both cases it had not stabilized and was not eliminated after 5 min. Moreover, except for father looking at camera, parents' CRB also declined over time, but also did not disappear after 5 min.

3.2.3 | Parent predictors of parents' CRB

Parent talking about the camera was not predicted by age or by PSE, for either fathers or for mothers. This was true in both bivariate logistic regression models and for multivariate logistic regression models in which fathers and mothers were separated where both age and PSE were included as independent variables (*p*s: 0.35–0.95). To test the robustness of these results and gender effects, a mixed effects model was run in which all parents and all parent characteristics were included, which again yielded no significant results (*p*s: 0.18–0.89). For parent looking at the camera, the same models were run. Once again, there were no significant associations (*p*s: 0.07–1.00). In sum, none of the parent characteristics predicted parents' CRB.

3.3 | Aim 2—Associations between CRB and sensitivity

3.3.1 | Infants' and parents' CRB in relation to parental sensitivity

Firstly, the association between the total time infants looked at the camera and parental sensitivity was investigated. The results of the three models used to analyze this association are summarized in Table 2.

In the bivariate OLS regression models (model 1 in Table 2), infant looking at camera did not predict fathers' sensitivity ($p = 0.53$), while it did predict mothers' sensitivity ($p = 0.02$). If the infant looked at the camera for one additional second, mothers' predicted sensitivity decreased with 0.011 points. The mixed effects model (model 2 in Table 2) did not reveal a significant interaction effect between parental gender and infant looking. The inductively chosen third model, with the dichotomous infant looking variable, confirmed a threshold model. The predicted sensitivity of fathers whose infants looked at the camera for over 100 s was 3.48 points lower than that of those fathers whose children looked for less than 100 s, and 2.26 points for mothers. Thus, Cohen's *d* was 1.26 for mothers and 1.74 for fathers. However, there were only two fathers

TABLE 2 Summary of the results of regression models 1, 2, and 3, with parental sensitivity as the dependent variable

	(1)				(2)		(3)			
	Father		Mother				Father		Mother	
	b (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*
Infant looking	−0.006 (0.009)	.53	−0.011 (0.004)	0.02*	−0.007 (0.008)	0.03*	−3.48 (1.30)	0.009**	−2.26 (0.71)	0.002**
Parent gender					−0.20 (0.41)	0.48				
Infant looking × gender					−0.002 (0.009)	0.47				
Adj. R^2	.05		.06				.16		.11	

Note: Gender is coded such that fathers are 0, mothers are 1. Significance codes: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

whose children looked at the camera for over 100 s, and one of those two was a bivariate outlier, measured by Mahalanobis distance with a cut-off significance level of 0.001, as proposed by Tabachnick and Fidell (2013). Thus, for fathers this finding is not robust and only applies to extreme cases. Although here were also only six mothers whose children looked at the camera for over 100 s, none of these were classified as bivariate outliers.

Next, the association between parents' CRB and their sensitivity was investigated. For neither fathers nor mothers was sensitivity predicted by parent talking about the camera ($p = 0.09$ and $p = 0.24$, respectively), nor was it by parent looking at the camera ($p = 0.37$ and $p = 0.26$) in bivariate regression models.

In sum, whereas infants' CRB clearly predicted mothers' sensitivity, that was not as robust for fathers' sensitivity. Parents' own CRB did not predict their sensitivity.

3.3.2 | Parent characteristics as moderators in the association between CRB and parental sensitivity

Interactions between PSE and infant looking and between parental age and infant looking were not significant predictors of parental sensitivity, not when infant looking was coded continuously or as a binary variable dependent on whether or not the infant looked for over 100 s (*p*s: 0.23–0.97). To test for robustness, these models were rerun as mixed effects models in which the interaction effects were also not significant (*p*s: 0.07–0.89). Lastly, it was already found under the previous research question that there was no significant interaction effect between parent gender and infant looking in the prediction of parental sensitivity. In sum, none of the parent characteristics moderated the association between infant CRB and parental sensitivity.

3.4 | Aim 3—Sequencing of CRB

3.4.1 | Does infant CRB predict parents' CRB or vice versa?

On the macro-level, infants' CRB was higher when mothers talked about the camera ($M = 59.9$ if mother did talk, $M = 35.0$ if she did not, $p = 0.03$), as was the case when mothers displayed at least one form of CRB ($M = 55.4$ if mother did display any form of CRB, $M = 29.5$ if mother did not, $p = 0.008$). No significant differences were found in mean infant CRB for mother talking ($p = 0.07$), father looking ($p = 0.92$), father talking ($p = 0.12$), or father either looking or talking ($p = 0.38$). In sum, on the macro-level, mothers' CRB was associated with their infants', while fathers' was not.

On the micro-level, the following models were run: (1) infants' CRB predicting parents' CRB; (2) parents' CRB predicting infants' CRB. The models were separated by parental gender (see Table 3).

Infants' CRB significantly predicted mothers' CRB. Mothers were 5.06, 95% CI [2.81, 9.10], times more likely to display CRB one second after their child looked at the camera and 2.60, 95% CI [1.26, 5.38] times after two seconds, than when the infant did not look at the camera. Mothers' CRB did not predict infants'. Infants' CRB and fathers' CRB predicted each other, such that fathers were 3.08, 95% CI [1.52, 6.26], times more likely to display CRB one second after their child looked at the camera and 2.79, 95% CI [1.32, 5.87], times after two seconds, while infants were 3.53, 95% CI [1.84, 6.79], times more likely to look at the camera one second after their

TABLE 3 Summary of the mixed effects models of parents' and infants' CRB predicting each other, including lagged independent variables

	Mother						Father					
	(1)			(2)			(1)			(2)		
	b (*SE*)	e^b	*p*	*b* (*SE*)	e^b	*p*	*b* (*SE*)	e^b	*p*	*b* (*SE*)	e^b	*p*
Infant CRB *t−1*	1.62 (0.30)	5.06	<0.001***	−0.27 (0.18)	0.77	0.14	1.13 (0.36)	3.08	0.002**	−1.22 (0.29)	0.29	<0.001***
Infant CRB *t−2*	0.96 (0.37)	2.60	0.009**	−0.006 (0.16)	0.99	0.97	1.03 (0.38)	2.79	0.007**	−0.03 (0.17)	0.98	0.88
Infant CRB *t−3*	0.50 (0.44)	1.65	0.25	0.40 (0.14)	1.49	0.004**	0.65 (0.43)	1.92	0.13	0.29 (0.16)	1.34	0.06
Parent CRB *t−1*	1.47 (0.63)	4.36	0.02*	−0.80 (0.71)	0.45	0.26	1.12 (0.74)	3.06	0.13	1.26 (0.33)	3.53	<0.001***
Parent CRB *t−2*[a]				0.10 (0.46)	1.11	0.82	1.04 (0.74)	2.84	0.16	0.75 (0.41)	2.11	0.07
Parent CRB *t−3*	1.38 (0.75)	3.96	0.07	0.11 (0.46)	1.12	0.81	1.04 (0.74)	2.84	0.16	−0.17 (0.59)	0.84	0.77

Note: Significance codes: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

[a]There were no observations in which mothers' CRB at t_0 and at t_2 occurred simultaneously, so this 2-s lag was taken out of the model. This did not change the coefficients or standard errors of the other variables in any significant ways.

father displayed any form of CRB. To test for robustness, these analyses were also conducted with conditional fixed effects logistic models. Although these gave somewhat smaller effect sizes and significance levels, this difference was negligible for interpretation.

Thus, where infants' CRB clearly predicted mothers', the conclusion is less straightforward for fathers, given the absence of significant correlations on the macro-level and the fact that infants' and fathers' CRB predicted each other on the micro-level.

4 | DISCUSSION

The goal of this research was to investigate the nature of CRB in parent–child interactions, and its relation to parental sensitivity. The study's first aim was to get a descriptive understanding of the occurrence of infants' and parents' CRB. Parents' CRB made up a negligible part of total interaction time, and the majority of parents did not display any CRB at all. In contrast, almost all infants displayed CRB, which did make up a significant portion of total time, in 5% of observations exceeding one-third of total interaction time. In contrast with previous research, infants' CRB showed a stronger negative correlation with time than parents', but none of these behaviors were eliminated after 5 min. Parent characteristics did not predict parents' CRB.

The second aim was to investigate the association between CRB and parental sensitivity. While parents' sensitivity levels were not related to how much they displayed CRB, it was related to how much their children displayed CRB. In this sample, this relation was best described as a threshold model. The sensitivity scores of parents whose children looked at the camera for more than one-third of the video were substantially lower than those of parents whose children did not. This effect size was very large (Cohen, 1988). This finding was more robust for mothers than for fathers, and parent characteristics did not moderate this association. Given that parental gender did not moderate this association, we choose not to create a theoretical story to explain this difference in robustness between fathers and mothers. A difference in significance is not the same as a significant difference.

The study's third aim was to test two competing models to explain this association. Both of these models generated three hypotheses, all of which were necessary conditions for the models to stand. Firstly, that infants' CRB and parents' CRB are positively interrelated. This relation was robust for mothers, being found both when analyzing their behaviors per second (the micro-level) and when looking at the total time the behaviors occurred per total observation (the macro-level). Although fathers' and infants' CRB predicted each other at the micro-level, this was not the case at the macro-level. These micro-level data are preferable to the macro-level data, as the latter rely on a rather raw measure of parents' CRB, namely whether or not the behavior had occurred at all during a video. The second necessary condition was that infants' CRB and parental sensitivity are negatively interrelated, which is discussed in the previous paragraph. The last condition was that parents' CRB and parental sensitivity are negatively interrelated. This was not the case. This either means the model is incorrect or the study suffered from measurement error. If the model is incorrect, it is plausible that the link between parents' camera awareness and their display of CRB is limited. This would be in line with the fact that qualitative studies that directly asked parents about their awareness of the camera found much stronger results than quantitative research trying to video-code CRB in adults. On the other hand, measurement error could easily have occurred because of the raw measure of parents' CRB.

To differentiate between the two models, the sequencing of parents' and infants' CRB was measured. Infants' CRB clearly preceded mothers' CRB, but infants' and fathers' CRB predicted

each other, thus not leading to a clear conclusion about the sequencing of their CRB. Note, however, that in case it is indeed true that the link between parents' camera awareness and parents' CRB is limited, the sequencing of CRB is no longer a good way to differentiate between the two causal models. Moreover, note that these two models are by no means the only two models that could explain the association between CRB and sensitivity. For example, it is also possible that CRB and parental sensitivity influence one another.

In conclusion, for a model where infants' CRB reduces parental sensitivity, three out of four necessary conditions were met for mothers, whereas the evidence was less strong for fathers. This model was preferable over one where sensitive parenting reduces infants' CRB, given that mothers' CRB clearly preceded infants'. Note that the aim of this study was not to prove causality, but rather to set up a causal model and to test it with observational data. More importantly, these causal models can guide future research on camera reactivity. For example, randomized controlled trials could try to experimentally manipulate parents' camera awareness and measure differences in parental sensitivity. Similarly, camera awareness can be measured directly using interviewing and survey methods. This would allow researchers to directly test the mediating role of camera awareness as proposed in our models. Alternatively, if infants' interest in the camera indeed reduces sensitivity because parents feel they are not supposed to interact with the camera because they were told "to pretend the researchers were not there", thereby limiting joint attention, future research could test this mechanism directly by varying whether parents are told not to interact with the camera.

The main limitation of this study was its non-experimental nature. An ideal experiment would measure variations in observer effects using four conditions: one in which only a researcher is present, one with a researcher and a camera, one with only a camera present, and one with a camera placed out of sight of the participants. Another limitation was the researcher's positioning behind the camera during the video recordings, thus making it difficult to differentiate what behaviors were aimed at the camera versus the researcher. However, researchers were positioned truly behind the camera, thereby hiding their face, and did not make eye contact with parents or child, minimizing the effect of their presence.

The current study also has several strengths. Firstly, it is, to our knowledge, the first to measure the CRB of infants (and only the second to measure it in children of any age), and the first to examine the CRB of children in relation to parental behavior. As suggested by previous findings that children display more CRB than their parents (Antal et al., 2014), and given that our findings show that infants' CRB is related to parental sensitivity whereas parents' CRB does not, this is a crucial step in understanding camera reactivity in family contexts. Secondly, this study included both fathers and mothers and found that the robustness and nature of the studied associations differ per gender, once again highlighting the importance to also include fathers in studies in family research. Lastly, by micro-coding the CRB of both parents and infants, it was possible to investigate the sequencing of these behaviors, which allowed us to test two competing models that can explain the positive association between infants' CRB and parental sensitivity.

Future research and interventions relying on video observation are recommended to follow the following practices to limit camera reactivity: firstly, allow participants to get used to the presence of the camera before starting the observation. This is in line with our findings of a decline of CRB over time and has reportedly been useful in previous research (Brown et al., 2007; Curran et al., 2017). Secondly, place the camera out of sight as much as possible (Bennetts et al., 2017; Curran et al., 2017). It is especially important to ensure that the infant cannot see the camera, as they display most CRB, and if there is indeed a causal relation between CRB and parental sensitivity, our study shows that it is most likely that infants' CRB influences parental sensitivity.

Thirdly, ensure the researcher is out of the room, as to decrease total observational reactivity (Westen et al., 2019); lastly, especially in the case of sensitivity research, do not tell subjects they are not supposed to look at the camera, but rather tell them it is okay if their child is interested in the camera, thereby obscuring joint attention less.

The effects of video observation on parents' and infants' behavior are an unexplored field, and this exploratory study represents an important first step in understanding how infants' and parents' interactions with a camera and parental sensitivity are interrelated. Without sufficient proof that parental sensitivity is not affected by the act of video recording parent–infant dyads, the validity of research and interventions using video could be threatened.

In sum, this study found clear evidence for significant CRB by infants, and preliminary evidence suggesting this CRB might influence parental sensitivity. One might argue that camera reactivity is not a problem for sensitivity research, because seeing how parents behave while feeling observed is an ecologically valid way of measuring their sensitivity, as parents are often being watched while parenting. However, studies in this area should then only draw conclusions about parental behaviors while they are being watched instead of suggesting a generalizable assessment of sensitivity. In addition, in case infants' CRB influences parental sensitivity, that would harm both research and intervention practices. For academic research, this would unnecessarily inflate between-subject variance. Moreover, in case certain parent characteristics do influence camera reactivity, then conclusions about group differences in sensitivity might only be caused by the assessment used, and not reflect an inherent group difference. For intervention practices, parents are less likely to take feedback seriously when they feel the camera observation is not reflective of their normal behavior. Thus, much more future research is warranted to investigate the validity of video research in family contexts.

Ideally, future studies relying on video observation would routinely measure CRB and camera awareness themselves to establish its potential effect on observational measures. When micro-coding or in-depth interviews are too time-intensive, at the very least the macro-coding of CRB should be feasible, and relations between those macro-coded results and variables of interest ought to be tested, as done by Alsarhi et al. (2021), Lima Ribeiro et al. (2021), and Rahma et al. (2021). Follow-up surveys regarding camera awareness and reactivity are also easily accessible and useful, as it has been frequently used in research in medical contexts (Themessl-Huber et al., 2008), and are able to measure camera awareness directly, rather than having to rely on its expression in the form of CRB. It is important that studies relying on video observation provide evidence that their method did not interfere with their observations.

The benefits of video observation are vast, including objectivity, reliability, and opportunities for detailed analysis. In addition, large-scale longitudinal studies have found that the observations of early childhood parental sensitivity predict children's developmental outcomes later in life (e.g., Ding et al., 2020; Kok et al., 2015; Raby et al., 2015), suggesting that these video observations are ecologically valid. However, the effect sizes in these types of studies tend to be small, and very little research has studied the ecological validity of video observations of parenting directly, by examining whether the act of video observation influences the behavior under study. The findings of the current study suggest that such influences exist, and therefore questions the ecological validity of video observations of parenting. Explicit attention to the influence of cameras on parental behavior in future studies may result in more ecologically valid assessments and improve predictive models in longitudinal research.

Although parental sensitivity may be particularly susceptible to camera effects due to the influence of self-awareness on sensitivity (Dix et al., 2004; Leerkes et al., 2015), it is likely that video observation of any parenting behavior is prone to such influences given the general tendencies of

social desirability (Russell et al., 1992), as well as widespread insecurities specific to the parental role (Jones & Prinz, 2005). Thus, addressing the ecological validity of video assessments is relevant to any study in the field of parenting and developmental psychology.

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