



# Through babies' eyes: Practical and theoretical considerations of using wearable technology to measure parent–infant behaviour from the mothers' and infants' view points



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## ABSTRACT

**Aims:** To explore the utility of first-person viewpoint cameras at home, for recording mother and infant behaviour, and for reducing problems associated with participant reactivity, which represent a fundamental bias in observational research.

**Methods:** We compared footage recording the same play interactions from a traditional third-person point of view (3rd PC) and using cameras worn on headbands (first-person cameras [1st PCs]) to record first-person points of view of mother and infant simultaneously. In addition, we left the dyads alone with the 1st PCs for a number of days to record natural mother–child behaviour at home. Fifteen mothers with infants (3–12 months of age) provided a total of 14 h of footage at home alone with the 1st PCs.

**Results:** Codings of maternal behaviour from footage of the same scenario captured from 1st PCs and 3rd PCs showed high concordance ( $\kappa = 0.8$ ). Footage captured by the 1st PCs also showed strong inter-rater reliability ( $\kappa = 0.9$ ). Data from 1st PCs during sessions recorded alone at home captured more 'negative' maternal behaviours per min than observations using 1st PCs whilst a researcher was present (mean difference = 0.90 (95% CI 0.5–1.2,  $p < 0.001$  representing 1.5 SDs).

**Conclusion:** 1st PCs offer a number of practical advantages and can reliably record maternal and infant behaviour. This approach can also record a higher frequency of less socially desirable maternal behaviours. It is unclear whether this difference is due to lack of need of the presence of researcher or the increased duration of recordings. This finding is potentially important for research questions aiming to capture more ecologically valid behaviours and reduce demand characteristics.

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## 1. Introduction

Variations in mother–infant interactions have a substantial impact on offspring health and functioning in later life. Non-human animal studies have demonstrated stable and enduring changes in the brain as the outcome of variations in maternal

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behaviour, even in cross-fostering studies which eliminate the influence of genetic transmission (Francis, Diorio, Liu, & Meaney, 1999). A recent human study also demonstrates associations between variation in parenting within the normative ranges and infant brain development (Bernier, Calkins, & Bell, 2016). Experimental manipulations in human mothers further demonstrate the causal role of maternal behaviour on infant and child development. The still-face procedure (Cohn & Tronick, 1983), where the mother is instructed to behave temporarily in a disengaged manner (blank face and non-response) results in immediate infant distress. In addition, manipulation of contingency of maternal verbalisations (either responding to infant vocalisations within an appropriate time frame or not) leads to changes in infant vocalisations (Goldstein, Schwade, & Bornstein, 2009). Longitudinal studies, which have measured maternal behaviour, also highlight associations between variations in maternal behaviour and longer-term emotional, behavioural, and cognitive outcomes in children (Bornstein, Arterberry, & Lamb, 2014). However, many questions regarding the long-term impact of variations in maternal response remain unanswered. The first step is ecologically valid measurement of parental behaviour, and this is the focus of the current paper.

Measurement of maternal behaviour, in large longitudinal studies or randomised control trials investigating parenting interventions, is essential to understanding parental behaviour and its effects. The accepted gold standard for measuring mother–child interactions is generally to have a researcher observe or film an interaction between mother and child in a clinical, research, or home setting and film from this third person point of view (3rd PC). There are several limitations to this approach, however:

#### 1. Demand characteristics or reactivity

Observation from a third, often unknown party (the researcher) is undeniably intrusive (Heisenberg, 1927). In observational study, the presence of a videographer may represent a kind of novelty that evokes atypical responses from those observed; this phenomenon is termed “reactivity” or ‘demand characteristics’. Observation may promote socially desirable or appropriate behaviours and suppress socially undesirable or inappropriate behaviours (e.g., adults may display higher rates of positive interactions with children; Baum, Forehand, & Zegiob, 1979; Zegiob, Arnold, & Forehand, 1975). This result may be differential according to different maternal characteristics; that is, some mothers may behave more positively, whilst others may become self-conscious and thus behave less positively (Weber & Cook, 1972).

#### 2. False representation of the infant's experiences

Generally, if maternal behaviour is coded from the viewpoint of an observer (3rd PC), what is coded is what the observer sees and not necessarily what the infant or mother experiences. From the point of view of developmental research, however, the ideal is to capture the infant's or mother's experience. For example, a mother smiling at her baby while the baby is looking at the floor differs from when the infant actually sees the smile. Whilst in both cases the intent may be the same and the smile is an act of warmth by the mother, from the infant's point of view the maternal behaviour is unlikely to influence the child if the child misses it.

#### 3. Participant and researcher burden

Due to demands on participant and researcher time, observations are usually of short duration and therefore only provide a snapshot of the mother–child relationship.

##### 1.1. Current study: first-person viewpoint

First person cameras (1st PC) are small portable cameras worn by the participant facing outward to capture the view point of the individual. A few recent studies have used 1st PCs, worn on head bands in an effort to capture the viewpoint of mothers and infants. Bornstein and Arterberry (2010), for example, used infant and mother worn 1st PC to record and compare the world from infant versus adult perspectives. Yurovsky, Smith, and Yu (2013) also used this technique to assess how infant's co-ordinate attention with a visual partner and highlight the different viewpoints of babies as compared to adults. For example, a child's view largely consists of a single dominating object compared to a mother's wider perspective. Sugden, Mohamed-Ali, and Moulson (2014) also used 1st PCs worn by infants for a number of hours at home, in order to measure the infant's exposure to adult faces

Using 1st PCs offers many practical and research advantages that address the three shortcomings listed above. They: (1) eliminate the need for a researcher to be present, reducing potential influences of the researcher on mother and infant behaviour; (2) record the viewpoints of each interactant, so different perspectives are captured; and (3) diminish participant burden by removing the need to attend or host a research visit. So far, however, these studies have only measured the viewpoint of one-half of the dyad and therefore miss the combined footage. In the present paper, we explore and evaluate the gains and limits of using 1st PCs simultaneously worn both mother and infant. We evaluate how well 1st PCs capture relevant information via video and audio data-collection functions, we describe the reliability of existing coding systems that could be used on data captured by 1st PCs, and we explore 1st PCs ability to attain the 3 advantages described above.

We first investigated whether two independent raters show reliability when coding behaviours from video footage from 1st PCs alone. This would mean that the recorded footage from 1st PCs alone is of adequate quality that it can be reliably coded as the same event by two different coders.

We next explored whether the 1st PC reduced the role of participant reactivity (advantage number 1). We hypothesise that removing the researcher and allowing a longer duration will reduce reactivity and demand characteristics thereby reducing

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