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Review

Understanding infant eating behaviour – Lessons learned from observation

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HIGHLIGHTS

- Infants signal appetite through their interest or disinterest in food
- Infants use rapid and transient facial expressions to signal liking
- They use subtle or potent gestures, bodily movements and vocalisations to express wanting
- Coding infant communication and caregiver response using video capture reveal the nature of mealtime interactions
- Responsiveness to infant communication can promote self-regulation

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ABSTRACT

Observations of human infants during feeding presents a rich source of data to identify the ways in which hunger, appetite and satiety are communicated in early life. Infants signal appetite through their interest or disinterest in food using a series of communication cues from rapid and transient facial expressions to subtle or potent gestures and bodily movements through to vocalisations and eventually speech. Even in the first days of life facial expressions in response to basic tastes are clearly demonstrated and shared between human infants, other primates and the rat. These sensory typical reactions are said to have biological significance since the positive affective response to sweet taste secures a safe and useful source of energy whilst an aversive response to bitter may protect against toxicity. However, beyond these shared responses to basic tastes, the human infant has a sophisticated communication system to demonstrate readiness to eat, avid or waning appetite and satiety. Video capture and behavioural coding of infant communication and caregiver responses during meals reveal the dynamic nature of mealtime interactions. Responsiveness to infant cues is influenced by maternal characteristics and mode of feeding. Breastfeeding facilitates communication by enhancing maternal responsiveness and increasing the frequency of engagement and disengagement cues of the infant. This demonstrates the bi-directionality and interdependence of infant communication during a feed, namely that more responsive feeding for example, through breastfeeding, is associated with more proficient communication by the infant. Overall, observational methods have revealed the complex ways in which infants signal energy needs to their caregivers, and in turn these same methods have captured on film the ways in which carers recognise and react to these signals as part of responsive feeding. Potential applications of these methods includes developing interventions to facilitate infant self-regulation through responsive feeding.

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1. Introduction

In order to investigate basic aspects of a biologically driven behaviour such as eating, psychologists have turned to the origins of their discipline and applied a phenomenological approach. The first and most obvious method to investigate a behaviour is to characterise its basic elements through observation. For those trained in biopsychology the assumption is that observed behaviour reflects underlying physiological processes. Thus for Curt P Richter, behaviour represented a biological phenomenon seeking to maintain physiological balance and so-called "wisdom of the body" [4]. The classic studies by Clara Davis (1928, 1939) investigating nutritional wisdom demonstrated that infants aged 8 m could choose appropriately from an array of raw and cooked foods to ensure adequate nutrition, growth and wellbeing. The infants selected a variety of foods not simply the most liked nor the most sweet. Whilst the experiment was flawed in many ways including questionable ethics as well as no provision of processed, highly palatable foods, this study revealed the importance of careful observation of very young children revealing their astonishing capacity to select wisely to meet energy and nutrient requirements (see [44] for further discussion).

During the milk feeding phase, babies signal to their mothers their need to eat through a systematic process of agitation, orientation towards the breast, mouthing, hand movements to the mouth, progressing to more distress until the hunger cry is heard. It is assumed that mothers will respond to these signals and feed as needed. Beyond the milk feeding period infants signal hunger, satiation, liking and wanting in ever more sophisticated ways and it is the carer's responsibility to identify then respond to these cues. Responsive feeding will make the difference between healthy feeding, providing too much or too little. This can then impact on body weight. For example, it is assumed that rapid infant weight gain, a known predictor of childhood obesity, may be driven by maternal overfeeding. However, what is not clear is whether mothers are simply responding appropriately to a hungry baby or misreading signals from their infants and providing too much food [27]. Child eating traits such as fussiness and satiety responsiveness are highly heritable [26]. Therefore, food-relevant signals produced by infants may reflect underlying traits and temperament and how mothers respond to this may in turn determine whether the infant is fed responsively or not.

So that infant eating behaviour can be investigated, and the role of communication between mothers and their babies understood, a clear set of recognisable behavioural cues are needed. In this paper, the use of observational data including facial expressions, overt behaviours and how mothers respond to these will be discussed. Following in the footsteps of Curt Richter, who was the consummate comparative psychobiologist, the commonalities between human and non-human primate responses to tastes will be considered before then moving on to consider the specific facial expressions, bodily movements, gestures and vocalisation communicated by human infants to their caregivers. If the infant is nutritionally wise expressing "wisdom of the body" then these communication signals should be easily discernible, reliable and responsive to a variety of nutritional challenges. Therefore, liking and wanting signals should differ as a function of the foods offered to infants and this will be explored in relation to acceptance of a novel vegetable. Finally, for the communication to be successful it is not sufficient for infants to signal hunger, satiation, liking and wanting, it is also necessary for the caregiver to understand and respond accordingly to these signals. Therefore, the final section of this paper will explore responsive feeding and how this may vary according to maternal characteristics and mode of feeding.

2. First tastes – the role of chemical continuity

When does the first experience of food-related sensory stimuli such as taste and smell occur? It is known that this occurs in utero. The foetus is exposed to flavours derived from the maternal diet. In his studies of foetal learning, Hepper [12] exposed pregnant rats to garlic or no garlic, then presented garlic or onion in Petri dishes to 12 day old pups. The time spent over each stimulus was recorded and the total amount of time spent on each side of the cage was recorded. Offspring of the dams fed garlic preferred garlic over onion and offspring of the control group showed no preference for either stimulus. This finding was replicated in cross-fostered pups. Therefore, odour learning occurs in utero and it is claimed that this is biologically adaptive, providing chemical continuity between the maternal diet, the food preferences of her offspring, serving to enhance kin recognition [13,14].

In the human equivalent of these studies, Marlier and Schaal [30] have shown that newborn babies use both head and mouth movements to indicate preference for odours. These elegant studies have been developed from a long history of assessing olfactory sensitivity in infants, revealing that neonates can detect, discriminate and assign incentive value to various odours. For example, in response to ammonia delivered via a cotton swab to 1–5 day old infants, most will turn their head away from the offensive smell [38]. Soussignan, Schaal and Marlier [43] investigated the response of 3 day old babies to artificial (vanillin, butyric acid, formula milks) and biological (breast milk, amniotic fluid) odours using recordings of behavioural (facial and oral movements) and autonomic (respiration, differential skin temperature) events. In these studies, nose wrinkling and the "grimace" facial expression were interpreted as disgust for an aversive relative to a positive odour (butyric acid vs vanillin; [43]). Thus in early life infants communicate like and dislike, acceptance and rejection.

Building on this, in order to assess preference of one odour over another the technique developed by Marlier and Schaal [30] employed an olfactory paired-choice test. The newborn is supported in a fabric apparatus and gauze pads presented on either side impregnated with either distilled water or milk (human or formula). In this test, the infant's response is video-recorded during 1 min exposures which are counterbalanced to minimise lateral bias of head turning. Overall, oral activation (mouthing) and head orientation were higher in response to human milk over formula milk for both breastfed and formula fed babies. This may be explained by the attractiveness of human milk which contains aromatic compounds familiar to infants via transmission in utero and is not dependent on experience since formula fed babies show this same response. During the early postnatal period infants communicate their preference via facial expressions, mouthing or head orientation towards familiar or liked odours.

To determine responses to taste in infants, methods based on the taste reactivity measurements in rodents developed by Grill & Norgren [10] analyse frame by frame reactions using video recording. The use of dynamic images captured on video has permitted fine-detail analysis of infant facial reactions to taste which is not possible in real time observations.

Newborn responses to different basic tastes have been well characterised. Classically this was demonstrated in the early work of Jacob Steiner (1977). In these studies, pure tastants were given via pipette to newborns to characterise the specific response to sweet, sour, bitter and salty and to investigate affective qualities. Steiner demonstrated distinctive facial expressions of the newborn to the sweet taste (tongue protrusions and "smile"), lip pursing in response to sour tastes and gape to bitter tastes. These facial responses are observed in non-human primates and in collaboration with Kent Berridge, the work of