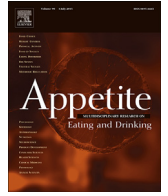


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The role of food experiences during early childhood in food pleasure learning

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ABSTRACT

Infants are born equipped to ingest nutrients, but have to learn what to eat. This must occur early, because the mode of feeding evolves dramatically, from “tube” feeding in utero to eating family foods. Eating habits established during early years contribute to the development of subsequent eating habits. Therefore, it is fundamental to understand the most important early periods (between birth and 2 years, i.e. onset of food neophobia) for the development of eating habits and the drivers of this development. The role of pleasure in eating is central, especially during childhood when cognitive drivers of food choices may be less prominent than later in life. It is not easy to define and measure pleasure of eating in early childhood. However, it is possible to identify the characteristics of the eating experience which contribute to drive infant's eating and to shape preferences (food sensory properties; food rewarding properties; social context of eating). The learning processes involve repeated exposure (including to a variety of flavours), association with post-absorptive consequences and with contextual signals (including family members). The important early periods for learning food pleasure start being well identified. Beyond the first flavour discoveries during the prenatal and lactation periods (through the infant's exposure to flavours from foods of the mother's diet), the most important phase may be the beginning of complementary feeding. Infants discover the sensory (texture, taste and flavour) and nutritional properties (energy density) of the foods that will ultimately compose their adult diet; parents are still in charge of providing appropriate foods, timing, context for eating. Inter-individual differences in food pleasure learning, related to temperamental dimensions, or to sensory sensitivity also have to be taken into account.

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1. Introduction

Eating is essential for survival, and human infants are born well equipped to ensure proper food ingestion. However, learning to eat has to occur quickly, in particular because the mode of feeding evolves dramatically during the first years of life, from “tube” feeding through the cord in utero to eating family foods by the end of the first year, through milk and complementary feeding. Moreover, very few food likes are inborn, except the enjoyment of the sweet taste: food preferences are learned, essentially during the first years of life (Schwartz, Scholtens, Lalanne, Weenen, &

Nicklaus, 2011).

This paper evaluates the role of food experiences, especially during the early childhood, from birth until the age of two years, which corresponds to the onset of food neophobia, in the development of food pleasure in human infants or children. It firstly considers the interest of studying pleasure of eating in early childhood. Secondly, it defines pleasure of eating in young children, and exposes how to measure it. Thirdly, it describes the characteristics of the food experience that may influence the learning of food pleasure, highlighting in particular the role of food properties, and of the social context. A fourth part describes the crucial periods in food pleasure learning. A fifth section describes some of the factors that have been identified to explain inter-individual difference between children in food pleasure learning.

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2. Why studying pleasure of eating during early childhood?

Early childhood is a sensitive period for development, and in particular of healthy eating habits (Schwartz, Scholtens, et al., 2011). Infants are born immature, from a physiological and psychological point of view; and several organs and functions related to eating will dramatically develop during the first years. Brain size triples in the first 2 years (Dekaban, 1978). The gastrointestinal tract is not functional and needs to achieve maturation to tolerate the introduction of nutrients (Neu, 2007). Oral abilities (tongue mobility, chewing, etc.) evolve to a major extent during this period (Nicklaus, Demonteil, & Tournier, in press). Cognitive functions develop, like object representation and language. During this period of intense development, the organism is especially sensitive to the effect of its environment, in particular its nutritional environment, which has led to the concept of metabolic programming (Bateson et al., 2004). It has been suggested, based on experimental and epidemiological data, that the first thousand days of life, from conception to the second birthday, constitute a sensitive period in life, when interventions are likely to have a strong impact on health outcomes later during childhood and adulthood.

This is also the period when enormous changes in the mode of feeding happen. These changes start by the transition from “tube” feeding during gestation, through the cord, toward oral feeding a unique liquid food, milk (whether it is from the mother’s breast or from a bottle), approximately during the first half of the first year, then transitioning to complementary feeding, which is accompanied by the discovery of a variety of foods, which differ in smell, taste, flavour, texture, energy density and microbial communities, to ultimately results in eating at the family table, which is likely to occur at the end of the first year, and certainly by the end of the second year. At this stage in children’s development, food neophobia and food pickiness will start to develop (Dovey, Staples, Gibson, & Halford, 2008; Nicklaus, 2009), which may be accompanied by a clear reduction in the variety of children’s food choices, even for foods that were easily accepted previously (Nicklaus, Chabanet, Boggio, & Issanchou, 2005). This involves that during a relatively short period of time, children must learn how to eat, mechanically speaking (Nicklaus et al., in press), as well as what to eat, and how much to eat (Schwartz, Scholtens, et al., 2011).

It has been previously shown that at the end of this early period, children’s eating behaviour is largely predictive of eating behaviour at later stages in life (Nicklaus, Boggio, Chabanet, & Issanchou, 2004; Nicklaus, Boggio, Chabanet, & Issanchou, 2005). The tracking of several aspects of eating behaviour (food preferences, food variety, portion size, dietary intake, eating traits) was summarized in a recent review (Nicklaus & Remy, 2013). This observation of the “tracking” of eating behaviour from early life on calls for studying the early factors which contribute to the early development of pleasure of eating, leading to adapted food choices; as well as the most favourable periods for the acquisition of lasting healthy eating habits.

3. Definition and measurement of food pleasure in early childhood

3.1. Defining food pleasure in young children

Defining pleasure of eating is not necessarily obvious. In infants, hunger is associated with unpleasant sensations often expressed by crying. Contrarily, eating is associated with a pleasant sensation of fullness and with a calming effect. In its most literal meaning, pleasure may be defined as “a sensation of fulfilment experienced after the satisfaction of a need, a desire” (Larousse, 2014). This definition does not involve that pleasure is a conscious feeling, contrarily to

other proposed definitions such as “the conscious experience of a reward” (Kringelbach & Berridge, 2010). The conscious or unconscious nature of pleasure is highly discussed in general. In infants, denying the unconscious aspect of pleasure would involve that they cannot experience pleasure; which does not correspond to every-day observations of infants showing signs of enjoyment while eating or once their meal is finished. At the negative end of the affective spectrum, there is no doubt that infants, even newborns, are likely to experience pain (Goubet, Clifton, & Shah, 2001), even if they are not consciously able to express their unpleasant affects. We postulate that young children can experience pleasure from eating, in a largely unconscious and unspoken way. From a neuro-scientific perspective, as developed elsewhere in this issue, two separate components are classically used to define pleasure: liking (hedonic drive), and wanting (motivation to eat) (Berridge, 1996; Berridge, Ho, Richard, & DiFeliceantonio, 2010). Many observations support the idea that there are hedonic “hotspots” in the brain, such as the nucleus accumbens, where opioids encode for the liking reactions; whereas in the reward system (composed partly by the ventral tegmental area, the nucleus accumbens, and part of the prefrontal cortex), dopamine release is related to the motivation to eat (Berridge, 1996; Berridge et al., 2010; Kenny, 2011).

3.2. Measuring food pleasure in young children

It is not possible to access explicit, conscious judgements in infants and young children because of limited cognitive skills, especially limited language development. Thus the evaluation of pleasure is mainly drawn from the observation of physiological parameters such as autonomic system response (heart rate, skin conductance ...), from the observation of micro- and macro-behaviours, such as facial expressions (which are likely to reflect the hedonic value of the tasted food, as observed in animals (Berridge, 2000)), spoon rejections, and, as very often reported, consumed amount of foods. Whereas in adults it may not be assumed that the consumed amount reflects the degree of pleasure the food elicits, because of cognitive processes likely to happen during eating situation such as restriction, it is more likely that in infants and young children (as in animals), the eaten amount will more directly reflect how much the food is liked (Berridge, 1996). Thus, reactions to food-related compounds was often evaluated through the analysis of intake patterns, analysing reactions to either brief stimulations (Crook, 1978; Schwartz, Issanchou, & Nicklaus, 2009; Stein, Cowart, & Beauchamp, 2006) or full eating episodes (Mennella, Jagnow, & Beauchamp, 2001; Sullivan & Birch, 1994).

The analysis of facial expressions was largely relied upon to evaluate pleasure from oral stimulations/foods in infants, after the seminal work from J. Steiner (Steiner, 1979). The gustofacial reflex was supposed to reflect affective reactions to stimulation, and methods were developed to codify the evaluation of the movements of facial muscles, such as the Facial Action Coding System (Ekman, Friesen, & Hager, 2002), which was adapted to infants and children (Oster, 2005). The analysis of gustofacial reflexes was largely used in infants to evaluate reactions to chemosensory stimuli, for instance taste stimuli (Ganchrow, Steiner, & Daher, 1983; Rosenstein & Oster, 1988), olfactory stimuli (Soussignan, Schaal, Marlier, & Jiang, 1997), or foods (Mennella et al., 2001).

When the examination of physiological parameters or the observation of detailed behaviours are not possible, or in complement to these approaches, other methods were applied: it is common to ask another person to judge the degree of liking expressed by the child while consuming a food (Mennella et al., 2001), may this be the mother, the father or any caregiver, or the experimenter (Schwartz et al., 2009).

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