

Development of food choice during infancy

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Human infants are unique amongst mammals in having an extended period when, by virtue of their physical immaturity, food selection is a problem as much for the parent as for the infant. Indeed, the first choice which many mothers make concerning their infant's diet is often before birth, namely the decision to feed from the breast or from the bottle. This choice has major consequences for the subsequent development of feeding and sleeping patterns in the infant, which in turn place constraints on when other foods are introduced into the diet. This review will first examine the inter-relationship between feeding method and sleep/meal patterns in early infancy and discuss the implications this interaction has for decisions mothers make as to when they should introduce solids into the diet of their infants. It will then examine the techniques that mothers commonly use to manipulate food intake and the food preferences of the preschool child.

IMPLICATIONS OF INFANT FEEDING METHODS FOR SOLIDS INTRODUCTION

Whereas a policy to encourage breast-feeding has existed in the UK for a number of years, the national figures published by the Office of Population Censuses and Surveys continue to record that by 6 weeks of age, well under 50% of babies will be breast-fed. Although in 1985 the majority of mothers started breast-feeding, some 36% gave infant-formula feeds from birth. Of those who started breast-feeding, 39% had stopped by 6 weeks and some of those who continued were giving formula feeds as well as breast-feeds. Thus, by the time they were 6 weeks old 62% of babies in the UK were being fed infant formulas (Martin & White, 1988).

Since the publication of the Department of Health and Social Security (1974) report *Present Day Practice in Infant Feeding*, there has been widespread adoption of modified formulas resembling as closely as possible human milk. It is recommended that the criteria for the use of such milks should be 'as for the breast-fed baby' (Scowen & Wells, 1984). Unfortunately what such manuals do not emphasize is that choice of breast-feeding or bottle-feeding leads to a very different pattern of feeding, with implications for the advice offered by health professionals. For example, if mothers over a 4 d period keep a complete record of all feeds and test-weigh their infants before and after each feed, then whereas the average size of breast-feeds across 24 h is not significantly different at about 4 weeks of age, by 6–8 weeks a pronounced diurnal rhythm of meal size has developed with the largest meals falling early in the morning (Pao *et al.* 1980; Wright *et al.* 1980). Mothers cite the late afternoon as a period when their infant is most hungry, and many mothers who cease breast-feeding at about 6 weeks do so because they are convinced they do not have enough milk to satisfy their infants' requirements (Wright, 1987). If this transition from the equal-sized feeds once lactation is successfully established, to the changes in meal pattern seen in older infants, were more widely recognized by health professionals, then mothers would be better prepared to anticipate changes in their infants' hunger demands as they grow, and I believe many more mothers

would overcome this '6-week hurdle' and continue successful breast-feeding (Wright, 1990).

There are certain developmental milestones such as an unbroken night's sleep, which are welcomed by all mothers, and which seem to be related to method of feeding. Bottle-fed infants will begin sleeping through the night at a significantly earlier age than fully breast-fed infants. This has been shown both prospectively by asking mothers from birth to keep careful records of sleeping and feeding patterns (Wright, 1987); and retrospectively by questioning mothers of preschool-age children about their early feeding experiences (Wright *et al.* 1983). When bottle-feeding mothers are asked for reasons why they have introduced solids at a particular age, many will cite the return of night waking. As sleeping through unsocial hours of the night occurs in most bottle-fed infants before the recommended age for introducing solids at between 3 and 4 months (Department of Health and Social Security, 1974), this means that the bottle-feeding mother is faced with a dilemma (waking at night) which does not occur for the average breast-feeding mother until well after the recommended age for solids introduction. For the breast-feeding mother there is, therefore, no problem in conforming to this advice, but for the bottle-feeding mother, the different behaviour of her infant provides a powerful reason for trying a solution (introducing solids) which she believes, rightly or wrongly, will aid sleeping through the night.

INNATE DIETARY WISDOM?

The widely quoted cafeteria studies of Clara Davis (1928, 1939) have been interpreted by health professionals to mean that given a wide variety of choices, children will instinctively select and consume a well-balanced diet. In a reappraisal of her work, Story & Brown (1987) argue that this essential misinterpretation may lead to an overly relaxed attitude towards poor food habits and contribute towards the development of nutritional problems in children. As Davis (1928, 1939) only offered infants a selection of nutritious and unsweetened foods, from which the children adequately self-selected. It is unknown whether a balanced diet would have been selected had less wholesome foods such as ice-cream, jelly, and cakes etc. been also available. Indeed, studies with that other well-known omnivore, the laboratory rat, in similar cafeteria-style experiments, indicate that whereas body-weight is satisfactorily regulated with *ad lib.* access to a conventional laboratory chow diet, the addition of highly palatable supermarket foods, leads to massive obesity (Sclafani & Springer, 1976). Story & Brown (1987) somewhat optimistically advise limiting the diet of young children to a 'variety of fresh and frozen vegetables and legumes, dairy products, fresh and unsweetened fruits and fruit juices, breads, pastas, rice, cereals and other grain products and lean meats.'

Certainly the commonly expressed anxiety of many mothers of preschool children in Scotland agrees with earlier studies in the USA with slightly over 40% of mothers of preschool infants expressing concern either that their child ate only a limited variety of foods, or ate slowly; and 30% concerned that too little fruit and vegetables were consumed (Eppright *et al.* 1969). What will be concentrated on here is what has been characterized by Lepper *et al.* (1982) as the 'dinner table debate', the battleground for many conflicts between parent and child. There sits the stubborn child in front of a plate of cooling food while his mother cajoles and bribes in an attempt to get him to 'clean up his plate'. Is the child's aversion to certain foods some kind of innate rejection, or a

learned response, and is there any way that this pattern of stubborn refusal can be reversed?

GENETIC PREDISPOSITIONS

Studies with newborns reveal what appear to be at least two innate taste predispositions. First the infant prefers sugar solutions over plain water (Crook, 1979; Cowart, 1981) and individual differences in this preference seem to be present at birth and have been related both to sex and weight (Nisbett & Gurwitz, 1970). Various indices of sucking can be systematically altered in response to tasting different solutions. Heart-rate changes which accompany the switches in the taste of the solutions have been interpreted as evidence of pleasure on the part of the infant (Lipsitt, 1977). Second, the neonate has the stereotyped facial expression indicating an innate disgust reaction to sour, bitter and very salty tastes (Steiner, 1979). These reactions may have adaptive value, for example the liking of sugar solutions could be because the taste signals a safe carbohydrate which is a rich source of energy (Rozin & Vollmecke, 1986).

However, such innate mechanisms are all very general and unlikely to explain the overall taste preferences of humans as they develop. Rozin has argued that all omnivores, and man in particular, by virtue of differing habitats, must adapt food preferences accordingly. Indeed he argues that a biological consequence of being an omnivore is that there must be few genetic determinants of food choice. Man is, therefore, less in need of innate knowledge, but should be more open to learning about various food groups and the consequences of eating them. The simple reflexes present in a newborn are not a sufficient explanation for all the eating habits of the growing child and we must examine some of the learning or cultural mechanisms that the growing infant has or develops.

SIMPLE AVERSION LEARNING OR NEOPHOBIA

Food aversions, which may be what our reluctant eater is showing, are learnt and adaptive mechanisms. All species show a certain amount of neophobia, that is a 'fear of new food', which accounts for phenomena such as 'bait-shyness' in rats (Rozin & Kalat, 1971). It means that when an animal encounters a new food for the first time, then only very small amounts will be eaten. However, once the long-term digestive consequences have become clearer and the food is proven 'edible', the animal will gradually eat more of it and incorporate it into its diet. If illness, nausea, and especially vomiting occur some time after eating any new tasting food, then a powerful aversion to that taste or food will result after only a single experience (Garcia & Koelling, 1966), and in the case of humans, this aversion is peculiarly resistant to cognitive persuasion (de Silva & Rachman, 1987).

Minimal neophobia is obviously adaptive in the early post-weaning period, when children are offered a variety of foods by the mother. Equally, when they are able to move away from the mother, and are capable of picking up and sampling whatever foods, berries, leaves etc. which they encounter, then it will be advantageous to show increasing neophobia. We presented preschool children in two age-groups of 2.5 and 3.5 years, and a group in their first term at primary school with an average age of 4.75 years with novel fruits to taste. The children were shown a whole lychee, kiwi fruit, or piece of

Table 1. *Numbers of preschool children who either accept or refuse to taste a novel fruit as a function of age*

Age (years)	Taste	Refuse
2.5	16	14
3.5	24	11
4.75	23	1
χ^2 13.29; $P < 0.01$		

coconut and asked if they could identify the fruits, and if they had ever eaten them. For all the children, at least one of the foods was entirely novel, and we simply recorded whether the child was prepared to put a small piece of the fruit into the mouth to taste. The results indicate that whereas the older children were prepared to taste the fruit, half of those in the youngest group refused to taste the novel food (see Table 1). Our testing situation was in the context of a nursery or primary school. Similar studies where children were tested at home, and were either offered a novel food or saw their mother eating the same food first, demonstrate the important influence of a trusted model in overriding their disinclination to accept the strange food (Lawrence & Harper, 1975).

SOCIAL AND LEARNED INFLUENCES ON FOOD PREFERENCES

In a formidable series of elegant experiments, Leanne Birch and colleagues working at the University of Illinois have demonstrated the importance of a range of learned, social, and cultural influences in the development of a child's eating habits. Birch & Marlin (1982) asked whether simply looking at new foods was as effective as tasting the foods in overcoming neophobia. They found that whereas visual experience with foods enhanced visual preference judgements, it was insufficient to produce enhanced taste preferences. This was considered consistent with a 'learned safety' interpretation of the exposure effects on taste judgements, and so novel tastes which do not result in negative gastrointestinal consequences will result in enhanced taste preferences. Such results would imply that use of foods directly, rather than photographs, food models or verbal descriptions must be used in studies examining human food acceptance patterns. However, it is possible that the design of this study, by presenting children with the bizarre situation of looking at some foods, whilst being allowed to taste others, may carry the covert instruction that the looked at foods were in some sense less palatable. If so, it may still be possible to influence food preferences, using representational foods, in a teaching programme for nursery-age children.

The preferences of children for foods characteristic of breakfast and of dinner change significantly as a function of the time of day when they are tested, indicating that cultural rules of food appropriateness have already been acquired by the preschool child (Birch *et al.* 1984a).

Children's preference for vegetables at lunchtime was manipulated in a nursery setting by seating a target child with a preference for one vegetable at a table with three peers who prefer another vegetable. After only two or three lunchtimes the target child had shifted its preference to that of the peers, and this enhanced preference was still apparent after several weeks (Birch, 1980).

FOODS AS REWARDS

Perhaps the most interesting work from Birch and her collaborators in terms of the 'dinner table debate' have been experiments showing how food preferences change as a function of the typical reward strategies that parents use. These techniques are often straightforward instrumental learning situations, i.e. the mothers encourage children to eat a particular food, X, by offering another food, Y, as a reward if they do so; presumably hoping that on future occasions this will result in increased likelihood of consuming X, now without the use of a reward, and indeed that children will have acquired a taste for food X. A number of theories from social psychology suggest that such 'if-then' instructions will have effects additional to that desired, i.e. increased positive attitude to the food in question. Cognitive dissonance would predict that the decision to eat the disliked food can be achieved either by making the reward even more attractive than it is already or by reducing the dislike of the target food (Festinger, 1957). Brehm's (1966) theory of psychological reactance would predict only one effect, an impairment of liking of the target food, because children would feel forced to eat this. A third theoretical viewpoint, from research on overjustification and intrinsic motivation also predicts effects only on the target food, arguing that salient tangible rewards for performing a particular activity will undermine an agent's intrinsic interest in that activity (Deci & Ryan, 1980).

Birch *et al.* (1984b) have demonstrated experimentally that children decrease their preferences for previously favoured fruit juices when asked to drink them instrumentally, and increase their preferences for foods which have been offered as rewards for performing some other activity (Birch *et al.* 1980). Lepper *et al.* (1982) have further shown that children reject imaginary foods instrumentally eaten by characters in stories, commenting that the rejected category foods probably contained 'more vitamins' or were 'full of meat'. The implication of these experimental studies is the paradoxical suggestion that in order to encourage consumption of a disliked food (e.g. green vegetables), it may be better to offer the child this food as a reward for eating something it really likes, such as chocolate ice-cream! There are obvious problems with such a strategy, and further experiments (Mikula, 1989) cast some doubt on the idea that repeated implementation of 'if-then' contingencies with the disliked food in the 'then' position can reliably increase the child's liking for that food. Mikula (1989) does successfully demonstrate that this may be a useful technique when introducing entirely novel foods to the child, and that a single experience of the 'if-then' instruction has a greater impact in shifting preferences than do repeated employments.

Finally I should like to return to the importance of the beliefs that mothers have about children's eating habits which are clearly so powerful an influence on actual behaviour. In recent experiments where we have been examining liking for common foods in children by showing them photographs of food, we also gave all the parents a short questionnaire at the end of the study, which called for information on the child's most liked and disliked foods. A variety of foods were named by the mothers, and because three of these foods coincidentally were used in our experiment, we could look at the agreement, if any, between the likes of the child and the beliefs of the mother. The children had been shown photographs of eight common dinner foods, and a food has been scored as liked if it falls within the top three ranks, after the children have indicated their preference for all the foods. Whereas the mothers appear to have attributed a different pattern of likes as a function of the sex of the child, the actual choices of the

Table 2. *Mother and child's most-liked foods according to sex of child*

(Mothers' choice based on questionnaire data, child's choice based on top three rankings of eight photographs of dinner foods)

Mother's choice		Food	Child's choice	
Male	Female		Male	Female
2	14	Fruit	10	15
4	5	Fish fingers	13	8
8	1	Cakes	18	15
χ^2 13.93; $P < 0.001$			χ^2 2.35; not significant	

children reveal no difference between the sexes (see Table 2). There is a need for more systematic research into how nutritional advice disseminated both to mothers and directly to children in primary schools, influences the foods offered to and accepted by the children.

So, in conclusion, to talk about dietary preferences in children as others in the present symposium have discussed such food choices in animals is a different problem, but we can talk about individual food preferences, and clearly we must consider this from the viewpoint of both mother and child. Experimental studies are beginning to show what a rich ground this is for examining learning effects on food choice, and that the combined social, cultural, and learned influences on the child, may not always move choice advantageously in the direction required by the mother.

REFERENCES

- Birch, L. L. (1980). Effects of peer models' food choices and eating behaviours on preschoolers' food preferences. *Child Development* **51**, 489–496.
- Birch, L. L., Billman, J. & Richards, S. (1984a). Time of day influences food acceptability. *Appetite* **5**, 109–112.
- Birch, L. L. & Marlin, D. W. (1982). I don't like it; I never tried it: Effects of exposure on two-year-old children's food preferences. *Appetite* **3**, 353–360.
- Birch, L. L., Marlin, D. W. & Rotter, J. (1984b). Eating as the 'means' activity in a contingency: effect on young children's food preference. *Child Development* **55**, 431–439.
- Birch, L. L., Zimmerman, S. & Hind, H. (1980). The influence of social affective context on preschool children's food preferences. *Child Development* **51**, 856–861.
- Brehm, J. W. (1966). *A Theory of Psychological Reactance*. New York: Academic Press.
- Cowart, B. J. (1981). Development of taste perceptions in humans: and preference throughout the life span. *Psychological Bulletin* **90**, 43–73.
- Crook, C. K. (1979). Taste perception in the newborn infant. *Infant Behaviour and Development* **1**, 49–66.
- Davis, C. (1928). Self selection of diets by newly weaned infants. *American Journal of Diseases of Children* **36**, 651–679.
- Davis, C. (1939). Results of the self selection diets of young children. *Canadian Medical Association Journal* **41**, 257–261.
- Deci, E. L. & Ryan, R. M. (1980). The empirical exploration of extrinsic motivational processes. In *Advances in Experimental Social Psychology*, vol. 13, pp. 39–80 [L. Berkowitz, editor]. New York: Academic Press.
- Department of Health and Social Security (1974). *Present Day Practice in Infant Feeding. Reports on Health and Social Subjects* no. 9. London: H.M. Stationery Office.
- de Silva, P. & Rachman, S. (1987). Human food aversions: nature and acquisition. *Behaviour Research and Therapy* **25**, 457–468.
- Eppright, E. S., Fox, H. M., Fryer, B. A., Lamkin, G. H. & Vivian, V. M. (1969). Eating behaviour of preschool children. *Journal of Nutrition Education* **6**, 16–19.

- Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stamford: Stamford University Press.
- Garcia, J. R. & Koelling, R. A. (1966). Relation of cue to consequence in avoidance learning. *Psychonomic Science* **4**, 123–124.
- Lawrence, L. V. & Harper, K. M. (1975). The effects of adults' eating on young children's acceptance of unfamiliar foods. *Journal of Experimental Child Psychology* **20**, 206–214.
- Lepper, M. R., Sagotsky, G., Dafoe, J. L. & Greene, D. (1982). Consequences of superfluous social constraints: Effects on young children's social inferences and subsequent intrinsic interest. *Journal of Personality and Social Psychology* **42**, 51–65.
- Lipsitt, L. P. (1977). A study of sensory and learning processes of the newborn. *Clinics in Perinatology* **4**, 163–186.
- Martin, J. & White, A. (1988). *Infant Feeding 1985*. London Office of Population Censuses and Surveys, Social Survey Division SS.
- Mikula, G. (1989). Influencing food-preferences of children by 'if-then' type instructions. *European Journal of Social Psychology* **19**, 225–241.
- Nisbett, R. E. & Gurwitz, S. (1970). Weight, sex and eating behaviour of human newborn. *Journal of Comparative Physiology and Psychology* **73**, 245–253.
- Pao, E. M., Hines, J. M. & Roche, A. F. (1980). Milk intakes and feeding patterns of breast-fed infants. *Journal of American Dietetic Association* **77**, 540–545.
- Rozin, P. & Kalat, J. W. (1971). Specific hungers and poison avoidance as adaptive specializations of learning. *Psychological Review – New York* **78**, 459–486.
- Rozin, P. & Vollmecke, T. A. (1986). Food likes and dislikes. *Annual Review of Nutrition* **6**, 433–456.
- Sclafani, A. & Springer, D. (1976). Dietary obesity in adult rats: similarities to hypothalamic and human obesity syndromes. *Physiology and Behaviour* **17**, 461–471.
- Scowen, P. & Wells, J. (1984). *Feeding children in the First Year. Edsall Summaries for Health Professionals* no. 1. London: B. Edsall & Co Ltd.
- Steiner, J. E. (1979). Human facial expressions in response to taste and smell stimulation. In *Advances in Child Development and Behaviour*, vol. 13, pp. 257–295 [H. W. Reese and L. P. Lipsitt, editors]. New York: Academic Press.
- Story, M. & Brown, J. E. (1987). Do young children instinctively know what to eat? *New England Journal of Medicine* **316**, 103–106.
- Wright, P. (1987). Mothers' assessment of hunger in relation to meal size in breastfed infants. *Journal of Reproductive and Infant Psychology* **5**, 173–181.
- Wright, P. (1990). Overcoming the six week hurdle: some psychological insights into early feeding behaviour. In *Midwifery: Excellence in nursing, the research route*, pp. 33–34 [A. Faulkner and T. Black, editors]. London: Scutari Press.
- Wright, P., Fawcett, J. N. & Crow, R. A. (1980). The development of differences in the feeding behaviour of bottle and breastfed human infants from birth to two months. *Behavioural Processes* **5**, 1–20.
- Wright, P., Macleod, H. A. & Cooper, M. (1983). Waking at night: the effect of early feeding experience. *Child Care Health and Development* **9**, 272–282.