

Development of Food Preferences and Appetite in the First Years

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Evolution of the mode of feeding

-9 mo Birth ~6 mo ~2 years ~8 years 20 years

Major transitions



Cord ('Tube feeding')

Milk feeding (Breast / Bottle)

Complementary feeding

Family foods

Food neophobia

Eating away
from parents

Learning to eat:

How?

What?

How much?

When?

In which context?

Evolution of the mode of feeding

-9 mo Birth ~6 mo ~2 years ~8 years 20 years

Major transitions

Tracking



Cord ('Tube feeding')

Milk feeding (Breast / Bottle)

Complementary feeding

Family foods

Eating behaviour at 2-3 years predicts eating behaviour up to early adulthood

Nicklaus, Boggio, et al., *Food Qual Pref*, 2004

Nicklaus, Boggio, et al., *Appetite*, 2005

Nicklaus & Remy, *Current Obesity Reports*, 2013

→ Focus on the determining factors of the early development of eating behaviour

Early development of *hedonic* aspect of eating behaviour

Food likes



Early learning: the milk feeding period

Effect of exposure to flavours



-9 mo



Birth



~6 mo



The flavours of the foods consumed by the mother are transmitted into:

- the amniotic fluid
- the maternal milk



Early learning: the milk feeding period

Effect of exposure to flavours



-9 mo



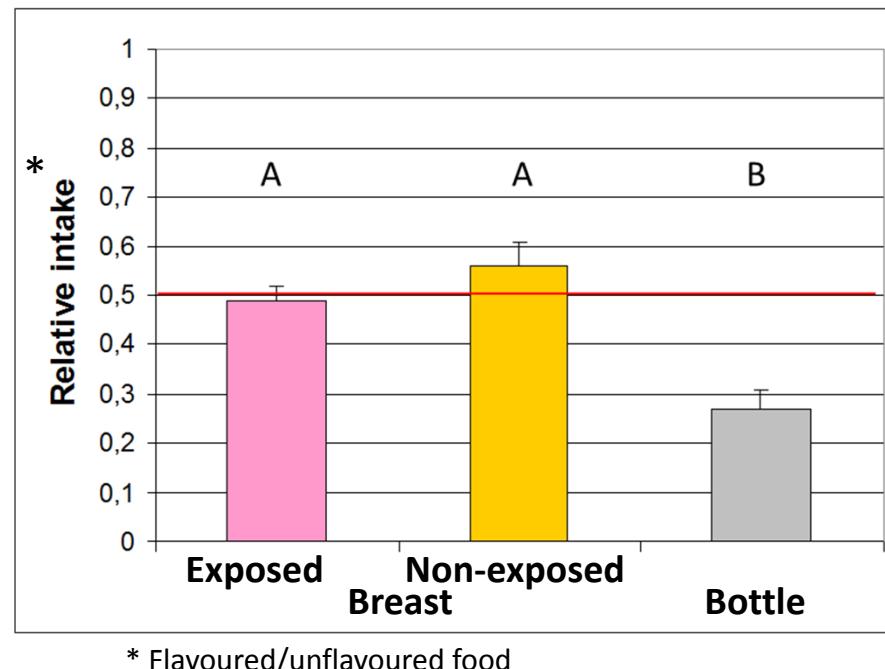
Birth



~6 mo



Having been breastfed is associated with a higher acceptance of a food with an unknown flavour at the start of complementary feeding, whether or not breast fed infants were exposed to the specific flavour in breast milk.



Variety of flavour exposure in breast milk may be key, not only specific exposure to a given flavour

[6]

Early learning: the milk feeding period

Effect of exposure to tastes



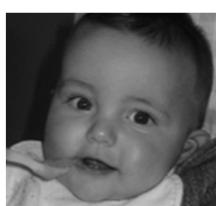
-9 mo

Breast milk contains 14x more glutamate than formula

Agostoni et al., *J Am Coll Nutr*, 2000



Birth

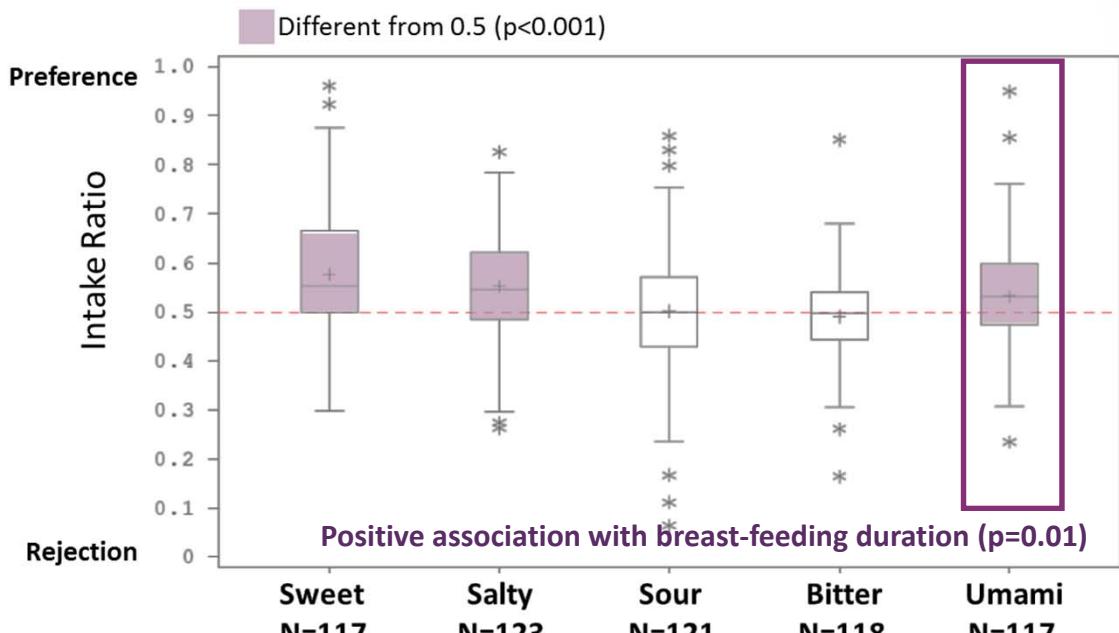


~6 mo



~2 y

Breastfeeding duration is associated to a higher preference at 6 months for the « umami » taste (Na glutamate)



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Early learning: the complementary feeding period



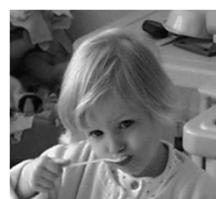
-9 mo



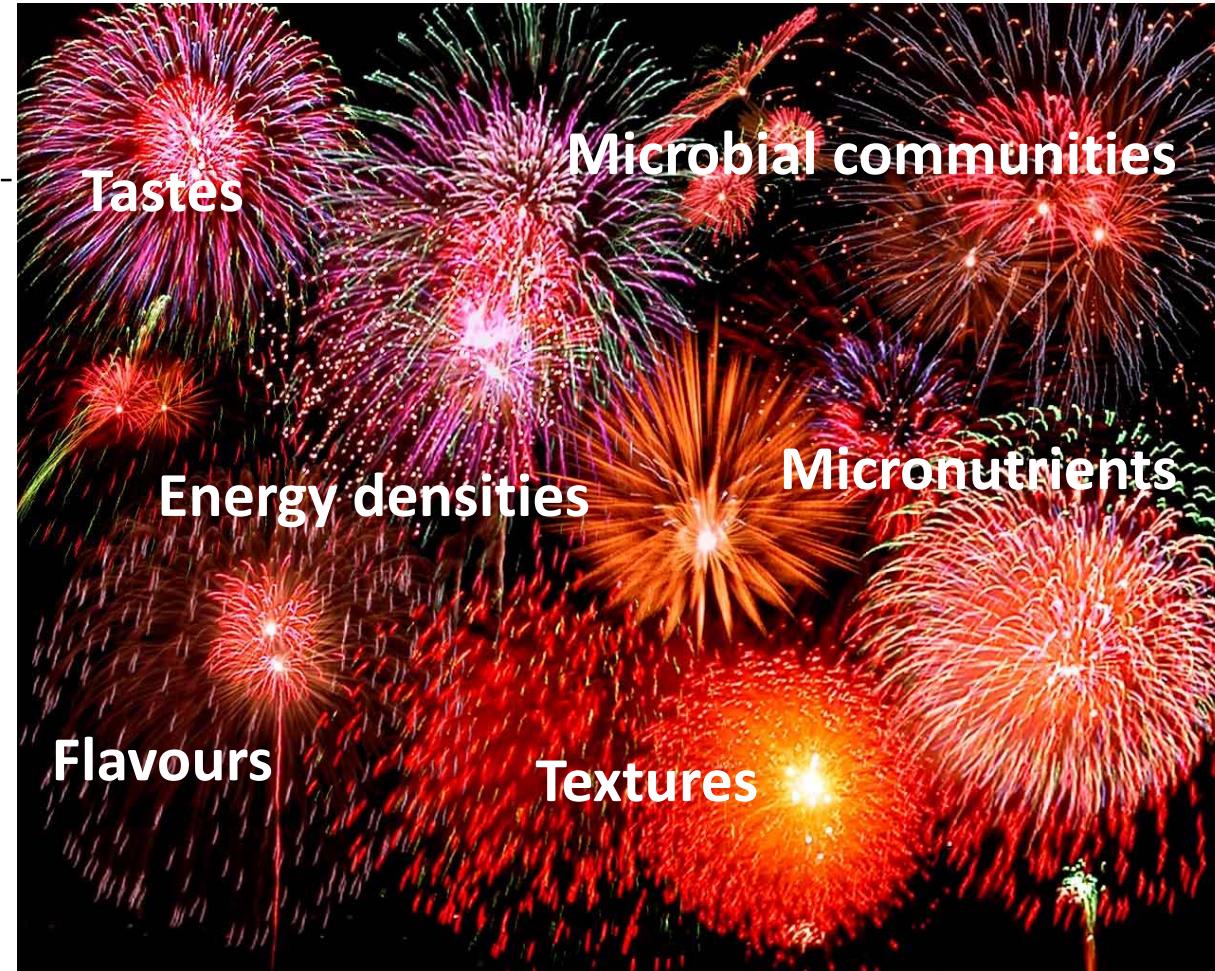
Birth



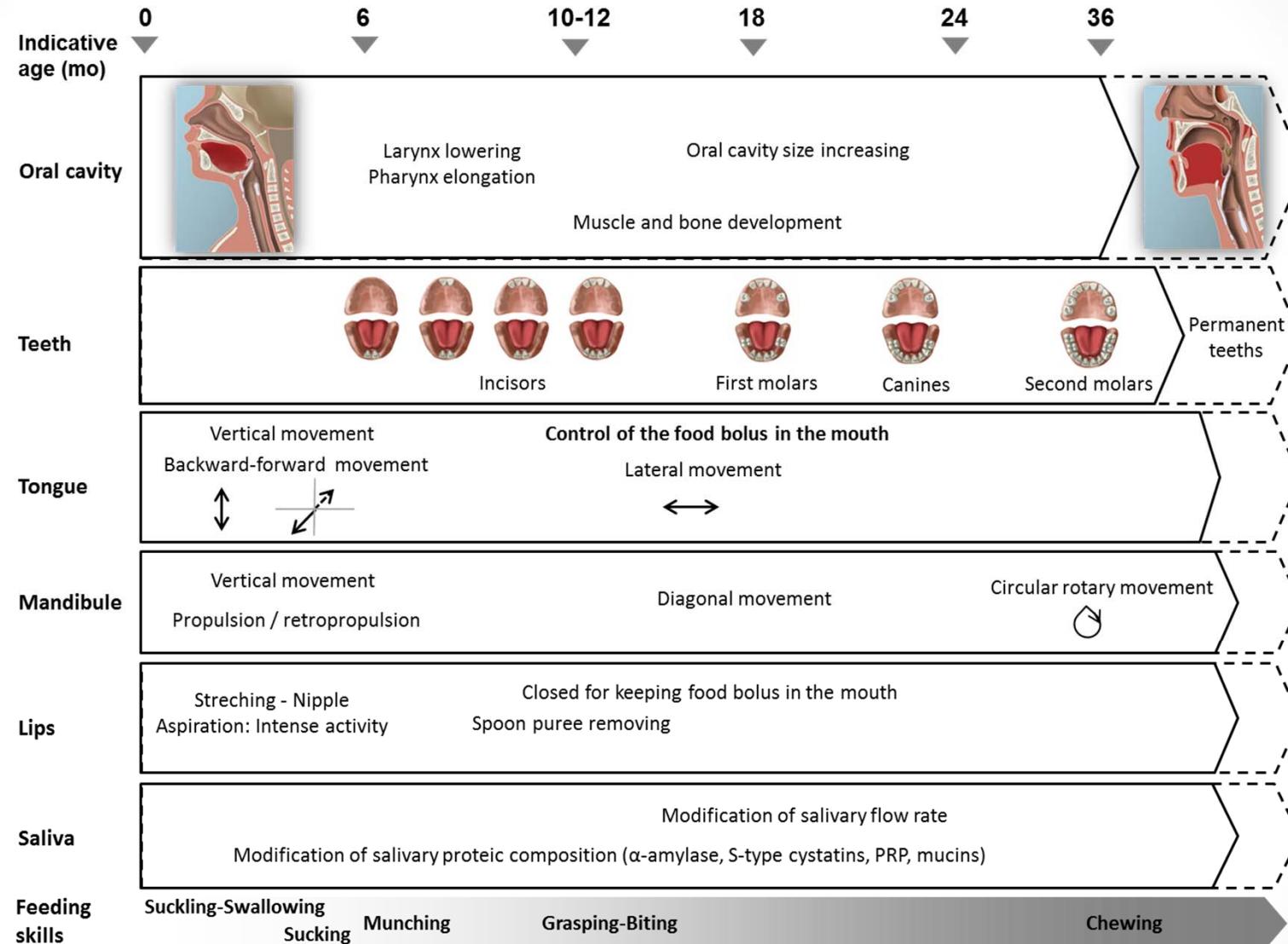
~6 mo



~2 y



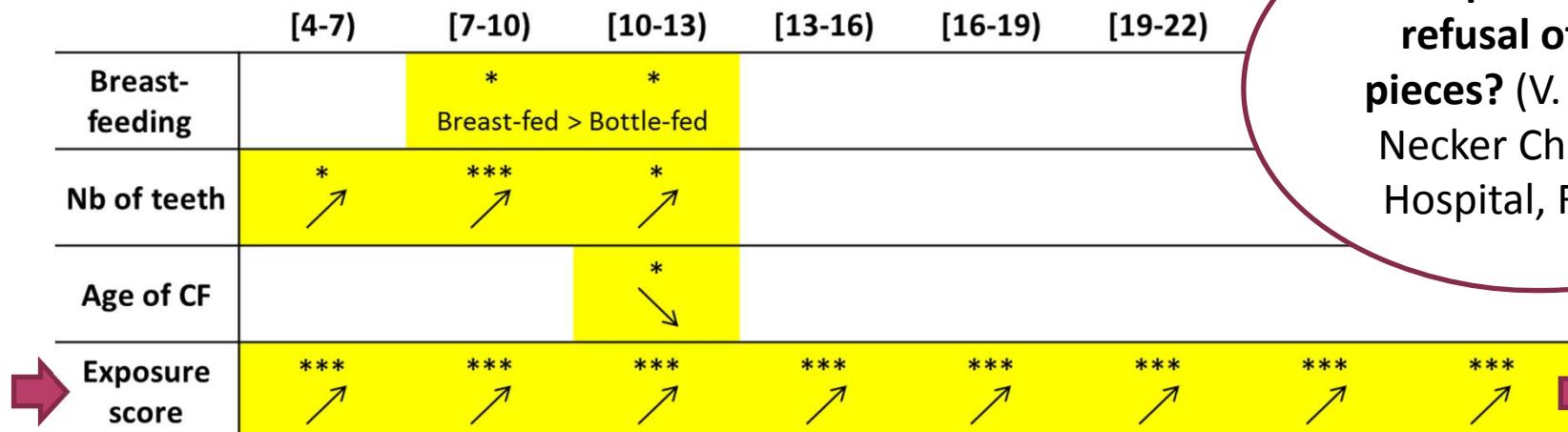
Development of feeding skills



Exposures to food texture: effect on acceptance



- Online cross-sectional survey in France, infants without feeding disorders (n=3089)
- Predictors of infant's acceptance of food texture, at each age



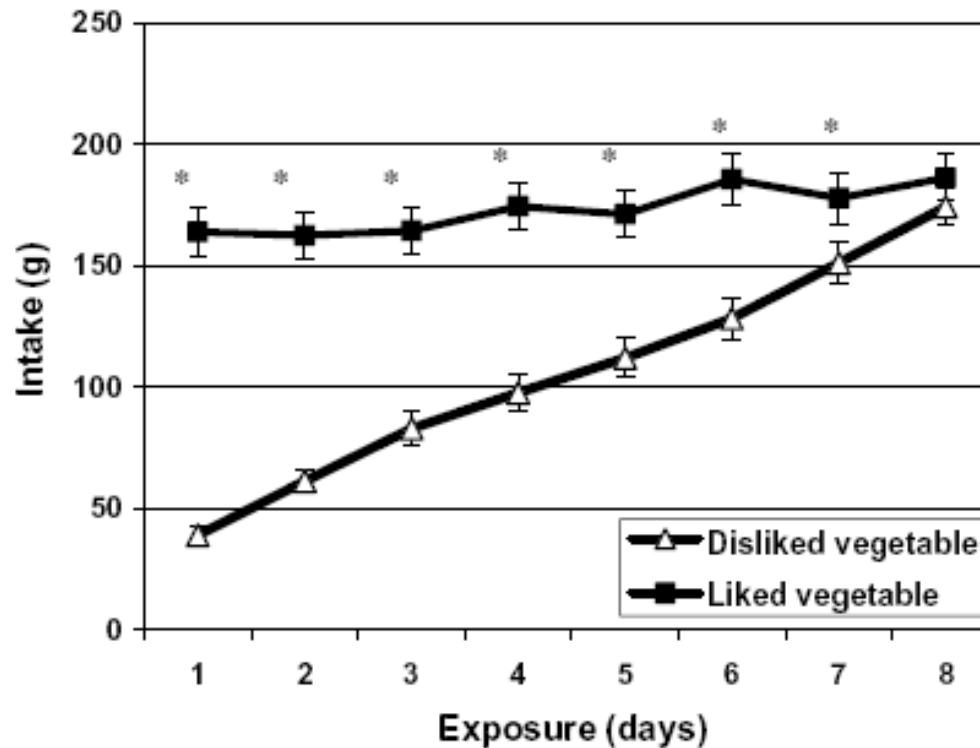
A new pathology: the refusal of food pieces? (V. Abadie, Necker Children's Hospital, France)

Strong and consistent role of exposure to food texture on acceptance

Repeated exposures: effect on CF acceptance



- At the beginning of CF, **repeated exposures to a new food help increasing its consumption** (Sullivan & Birch, *Pediatrics*, 1994)
- Repeated exposures to a disliked vegetable increase its acceptance. After 8 exposures it is as accepted as a liked vegetable

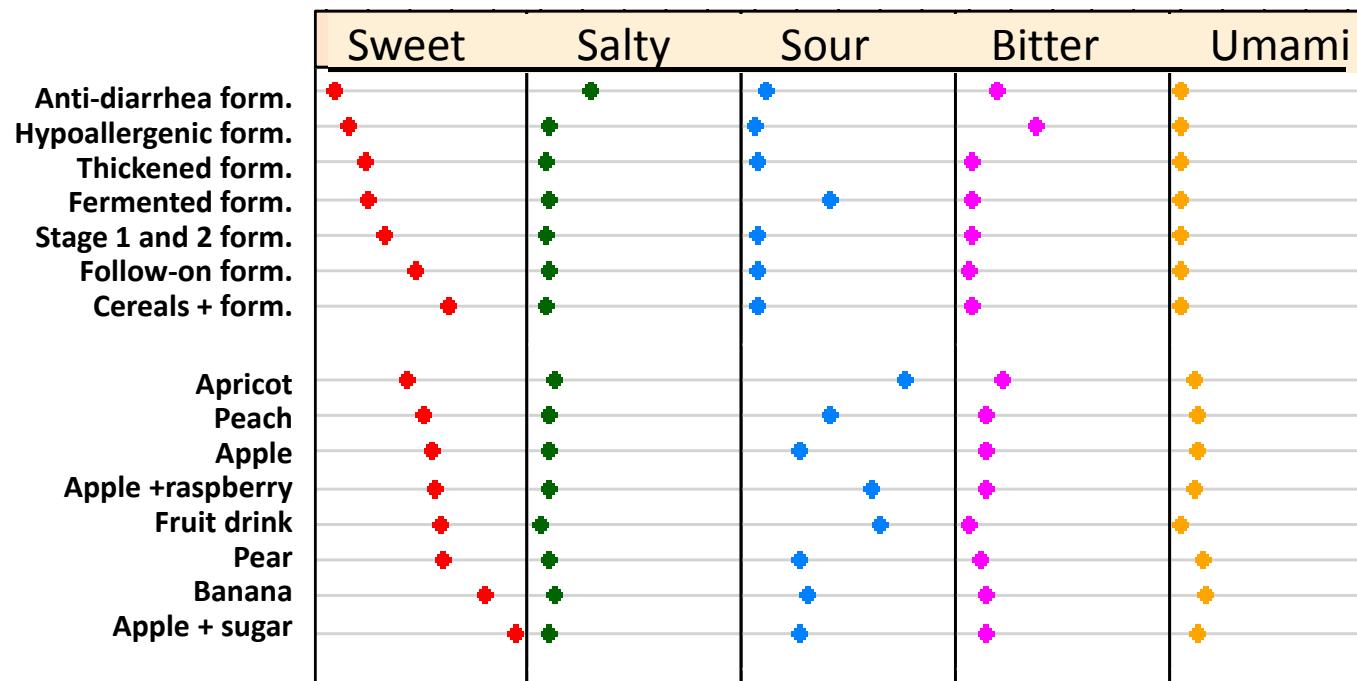


Early learning: the complementary feeding period

Exposure to tastes



Sensory profiling of formula and complementary foods



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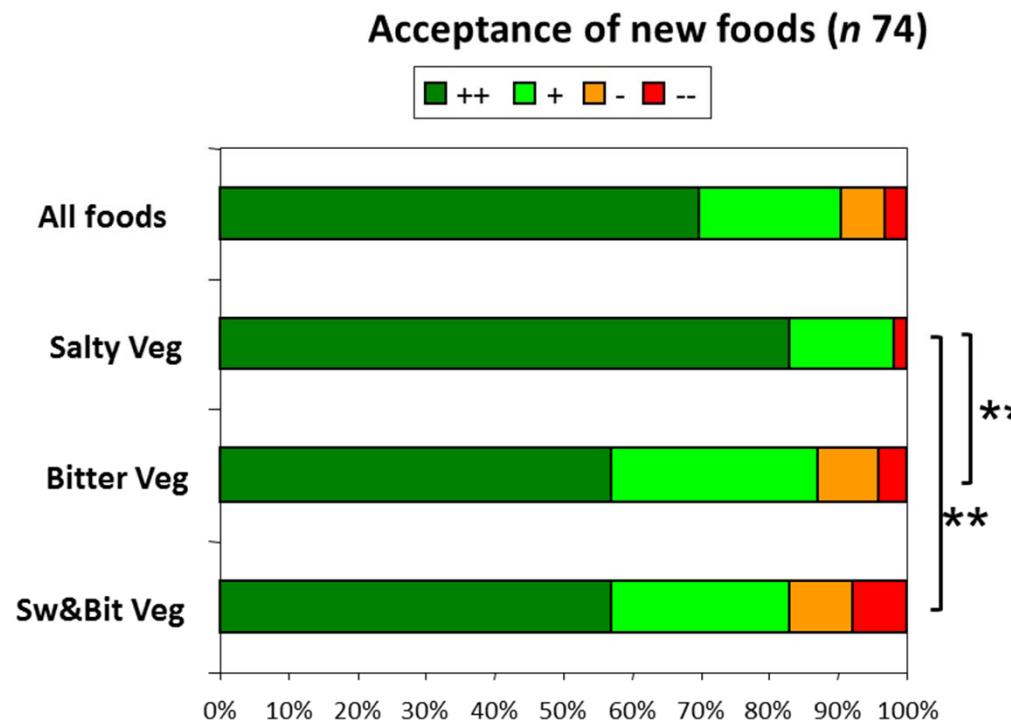
Early learning: the complementary feeding period

Effect of taste on acceptance



At the start of complementary feeding (5-7 months):

- Infants easily accept the foods they are fed
- The acceptance of new foods vary according to their tastes



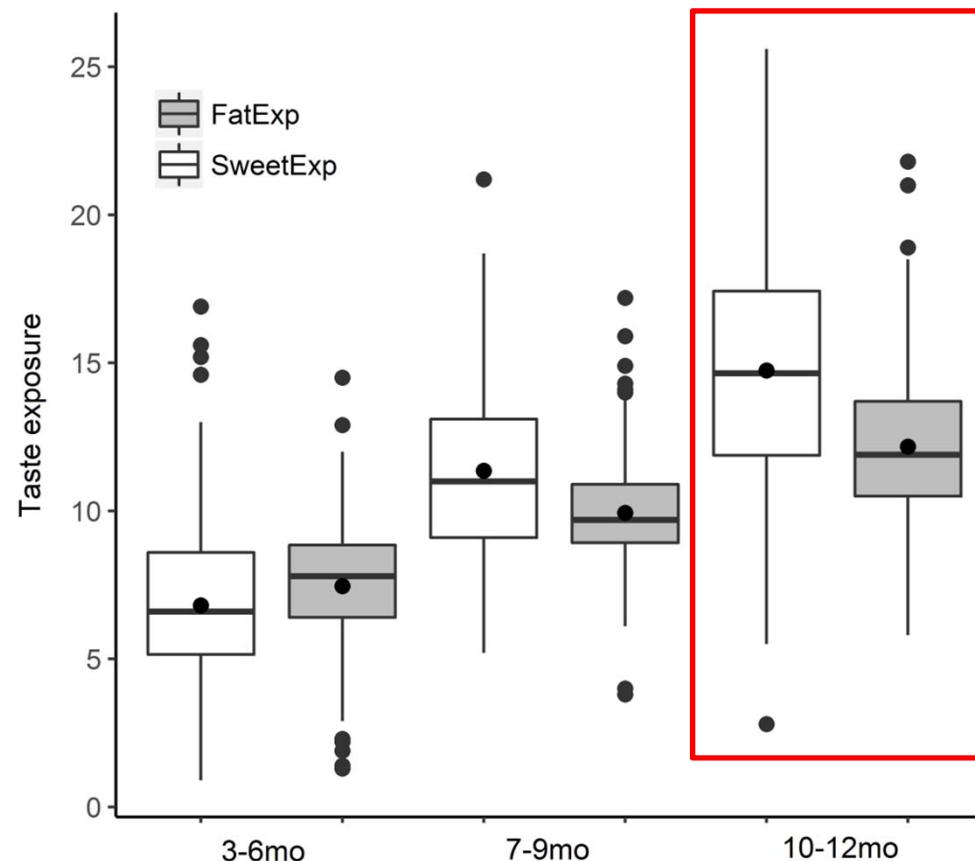
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Early learning: the complementary feeding period

Exposure to tastes



French infants' exposure to Sweetness and Fattiness (n=264)



Higher exposure in boys than girls

Sweetness:

- Higher if CF introduction <6mo
- Adult foods>Baby foods>Home made foods

Fattiness:

- Adult foods>Home made foods>Baby foods

Early learning: the complementary feeding period

Effect of « sensitivity » to tastes and flavours



At 6 months, individual « sensitivity » to tastes modulates the acceptance of foods bearing these tastes

- Significant associations between acceptance of sour, sweet and umami tastes in water solution and acceptance of sour, sweet and umami foods, respectively
- No association for salty and bitter foods



At 12 months, individual « sensitivity » to flavours of foods modulates the acceptance of foods with these flavours

- Significant associations observed for unpleasant odours:
 - Liking of the odour of trimethylamine and acceptance of fish
 - Liking of the odour of dimethyl disulphide and acceptance of sulphurous cheeses
- No association for pleasant odours

Schwartz, Chabanet, Lange, Issanchou, Nicklaus,
Physiology & Behaviour, 2011

Wagner, Issanchou, Chabanet, Lange, Schaal,
Monnery-Patris, *Appetite, 2014*

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Early learning: the complementary feeding period

Effect of « sensitivity » to tastes and flavours



Taste reactivity at 20 mo



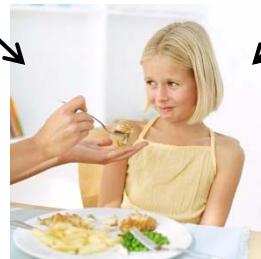
Olfactory reactivity at 22 mo

P=0.29

X

?

P=0.04



Food neophobia at 24 mo

Monnery-Patris, Wagner, Rigal, Schwartz, Chabanet, Issanchou, Nicklaus,
Appetite, 2015

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Early learning: the complementary feeding period

Effect of variety of exposure to foods



The introduction of a variety of vegetables and fruits at the beginning of complementary feeding promotes the acceptance of a new food

Gerrish & Mennella, *American Journal of Clinical Nutrition*, 2001

Mennella, Nicklaus, Jagolino, Yourshaw, *Physiology & Behavior*, 2008

Maier, Chabanet, Schaal, Leathwood, & Issanchou, *Clinical Nutrition*, 2007

Remy, Issanchou, Chabanet, Nicklaus, *Journal of Nutrition*, 2013

Lange, Visalli, Jacob, Chabanet, Schlich, Nicklaus, *Food Quality and Preference*, 2013

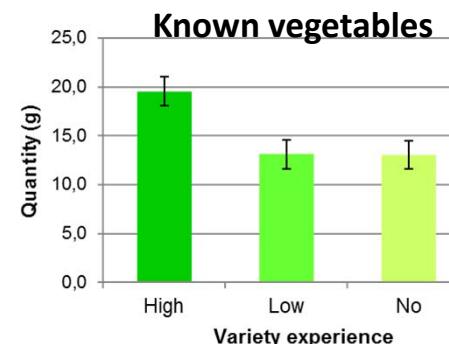
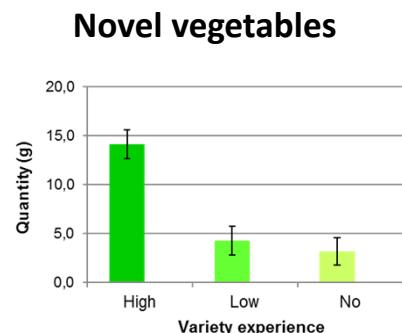
Fildes, Lopes, Moreira, (...), Manios, Beeken, Wardle, & Cooke, *British Journal of Nutrition*, 2015

Early learning: the complementary feeding period

Effect of variety of exposure to foods

	Lab	Home										Lab
Day	1	2	3	4	5	6	7	8	9	10	11	12
Variety												
No	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	ZT
Low	Ca	Ar	Ar	Ar	GB	GB	GB	Pu	Pu	Pu	Ca	ZT
High	Ca	Ar	GB	Pu	Ar	GB	Pu	Ar	GB	Pu	Ca	ZT

Long-term effect: the difference in early variety of vegetables has an effect on the intake of (un/familiar) vegetables at 6 years



Maier, Chabanet, Schaal, Leathwood, & Issanchou, *Clinical Nutrition*, 2007

Maier-Nöth, Schaal, Leathwood, & Issanchou, *Plos One*, 2016

Early development of *motivational aspect of eating behaviour*

Food intake



Early learning: the neonatal period

Effect of prematurity/ low birth weight



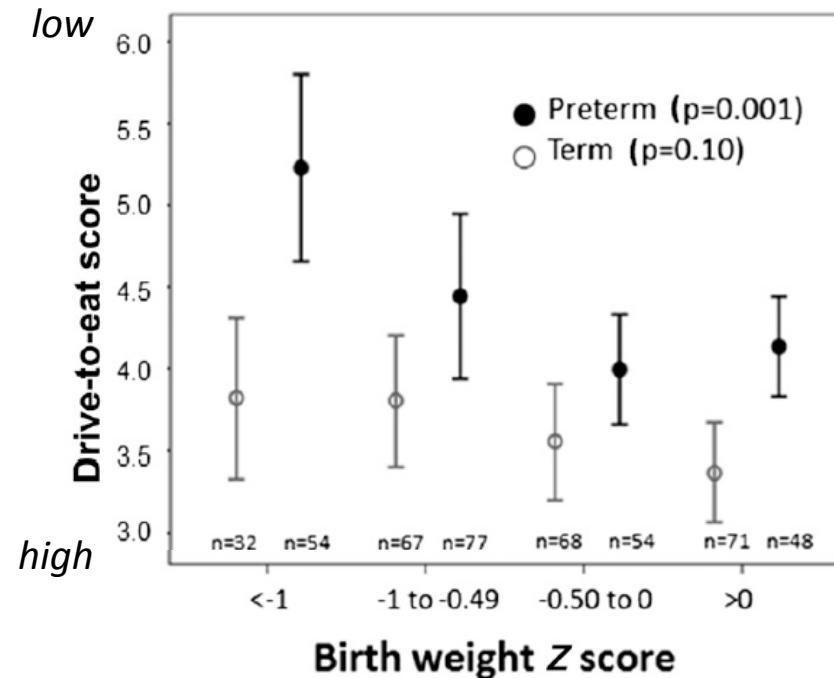
-9 mo

Birth

~6 mo

~2 y

Premature birth and a small-for-gestational birth weight are associated with a lower drive-to-eat score at 2 y*



* Low Appetite, Low Enjoyment in food, Neophobia, Pickiness, measured by parental report (Rigal et al., Appetite, 2012) in 2 French birth cohorts

Early learning: the complementary feeding period

Role of repeated exposure, flavour, energy density



- Conditioning study, evaluation of acceptance of a new vegetable (artichoke purée)
- Beginning of complementary feeding, ~6 mo
 - Complementary feeding had started > 2 weeks and < 2 months
- 3 experimental groups exposed to one type of the new vegetable

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Basic	■	■	■	■	■	■	■	■	■	■
Sweet	■	■	■	■	■	■	■	■	■	■
Fat	■	■	■	■	■	■	■	■	■	■

RE
FFL
FNL

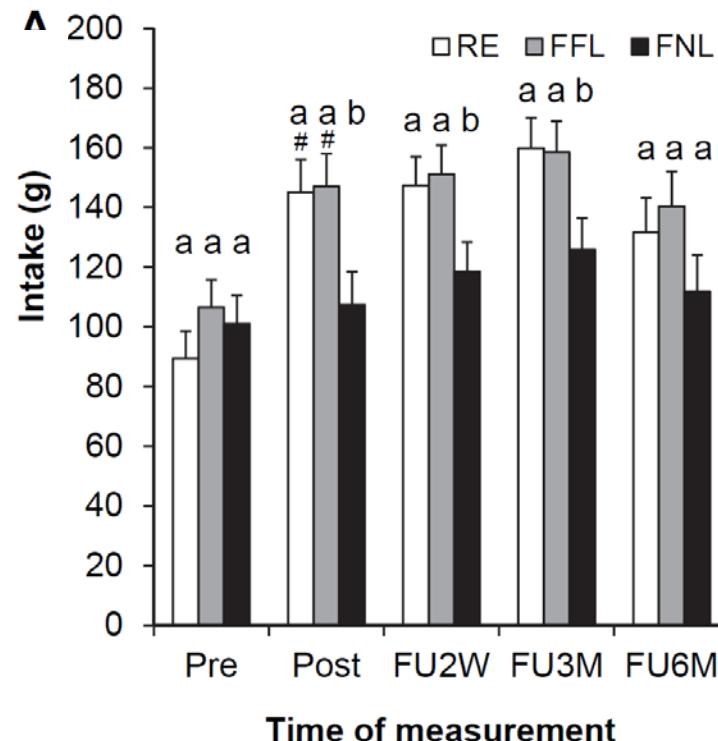
- Intake (before / after): Basic Artichoke, Carrot
 - Follow-ups: 2 wk, 3 mo, 6 mo post-exposure

Early learning: the complementary feeding period

Role of repeated exposure, flavour, energy density



- Merely repeating the presentation of a new vegetable promotes its acceptance
- No impact of the association with sugar on acceptance
- Higher energy density leads to learned satiation



Early learning: the complementary feeding period

Role of repeated exposure, flavour, energy density



Extension of the previous design with older children, range 4-38 months (n=332):

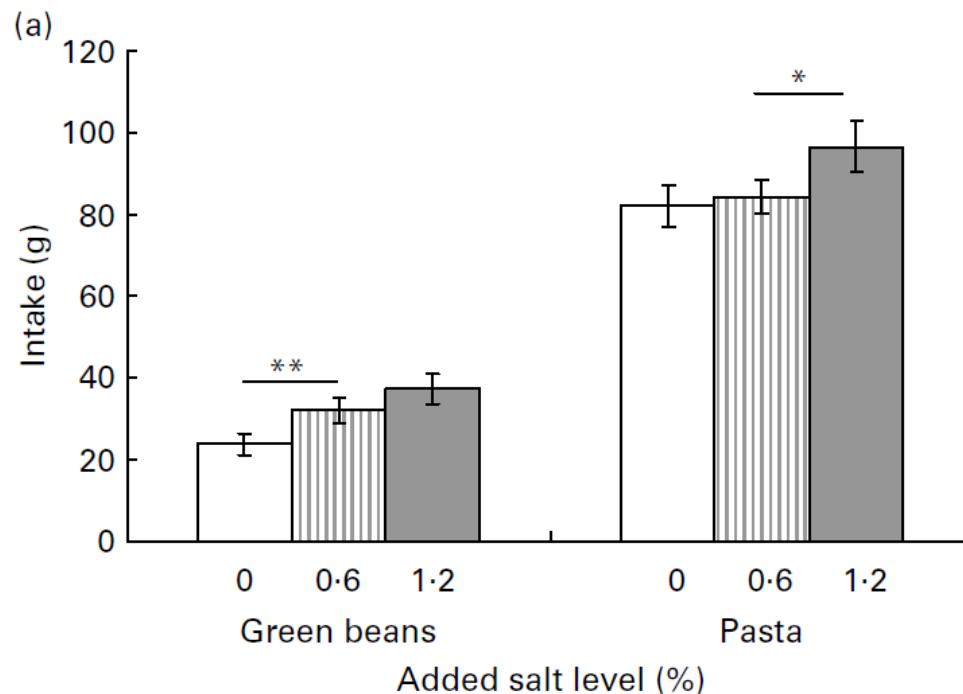
- Younger children consumed more of the new vegetable than older children
- 4 patterns of eating behaviour during exposure period:
 - learners (40%)
 - plate-clearers (21%)
 - younger children
 - high on « enjoyment of food »
 - low on « satiety responsiveness » (CEBQ)
 - non-eaters (16%)
 - older children
 - high on « food fussiness » (CEBQ)
 - others (23%)

Food-related factors affecting satiation

Role of taste



- In toddlers (& school-aged children), addition of salt is associated to a higher intake
- In toddlers , no effect
 - of addition of fat (+2.5%; +5%)
 - of addition of sugar (+5%; +10%)



Bouhlal, Issanchou, Nicklaus, *British Journal of Nutrition*, 2010
Bouhlal, Chabanet, Issanchou, Nicklaus, *PloS One*, 2013

Development of *hedonic and motivational aspects of eating behaviour*

Food likes &
food intake



Learning what and how much to eat

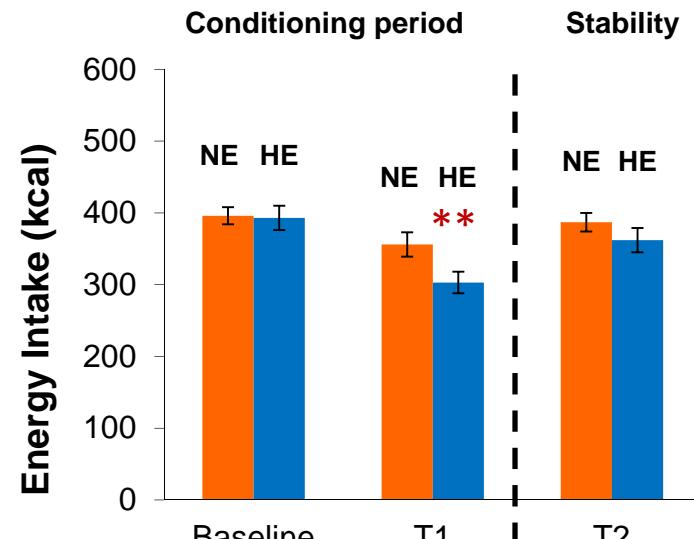
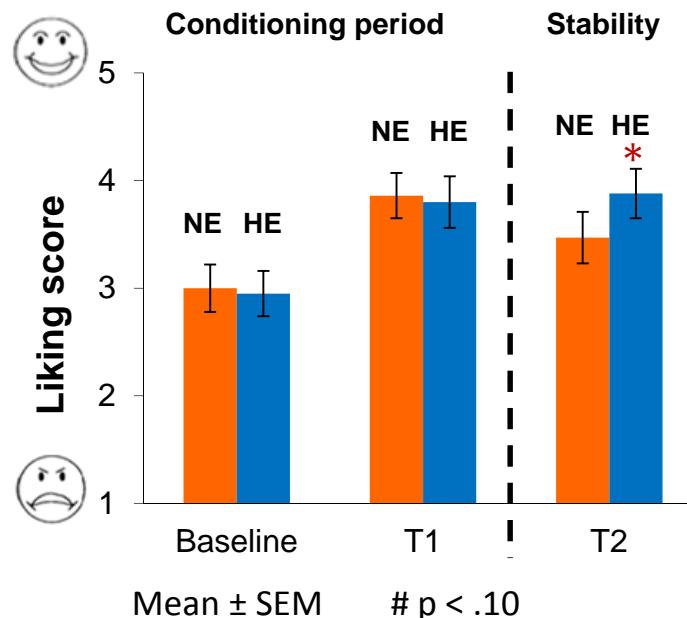
Role of energy density



- **Objective:**
 - To evaluate the consequences of exposure to **energy density** in a sweet beverage on learning for **liking** and **caloric compensation** in 8-to-11 year-old children
- **Outcome measurement:**
 - **Liking:** 5 point-scale, self-evaluated by the child
 - **Caloric compensation:** ad libitum food intake 45 minutes after the ingestion of the sweet beverage
- **Design**
 - Between pre- and post-exposure, children ($n = 44$) received several exposures to :
 - A flavored beverage **sweetened with sucrose (HE, 150 kcal)**
 - A flavored beverage **sweetened with sucralose (NE, 0 kcal)**
 - Follow-up measurements
 - After 3 weeks without exposure to the beverages
 - After an inversion of the flavour-calories association

Learning what and how much to eat

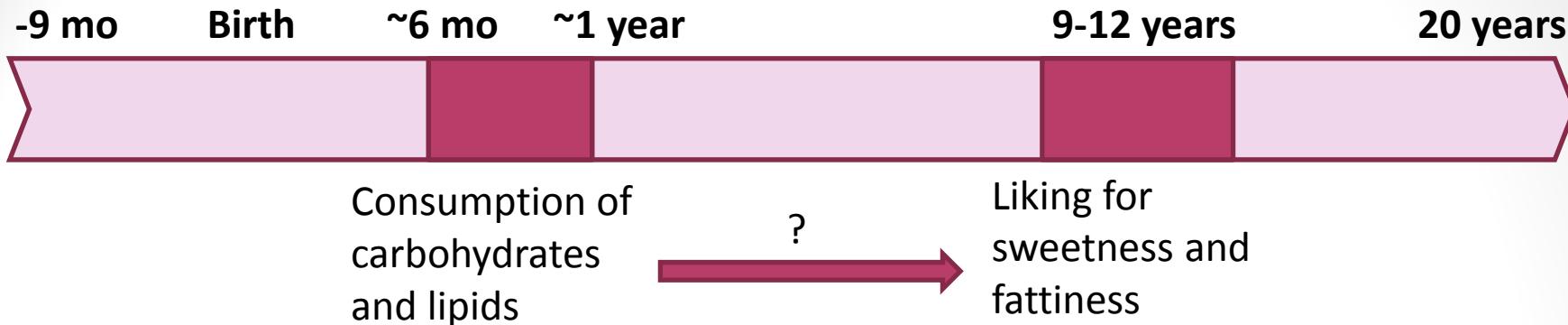
Role of energy density



Liking: exposure effect for both flavours, but liking remains higher for the energy-associated flavour

Caloric compensation: CC was learned after exposure to the beverages but not very stable

Effect of early taste exposure on taste preference?

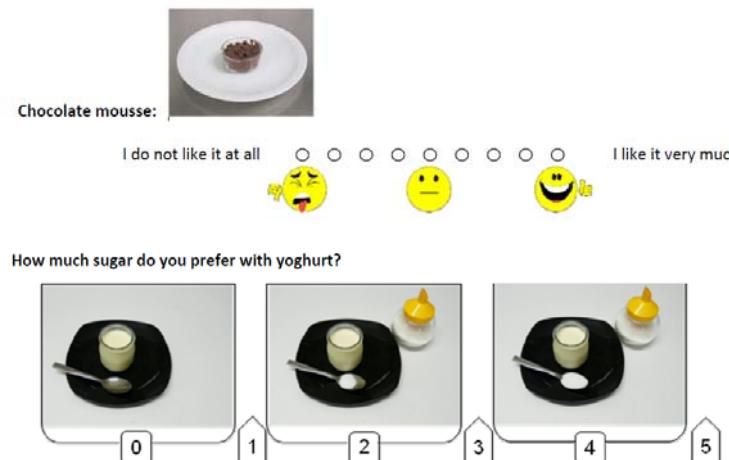


Birth cohort: EDEN (France)

Food frequency questionnaire at 8 and 12 months:

% Energy from carbohydrates
Consumption of sweet foods

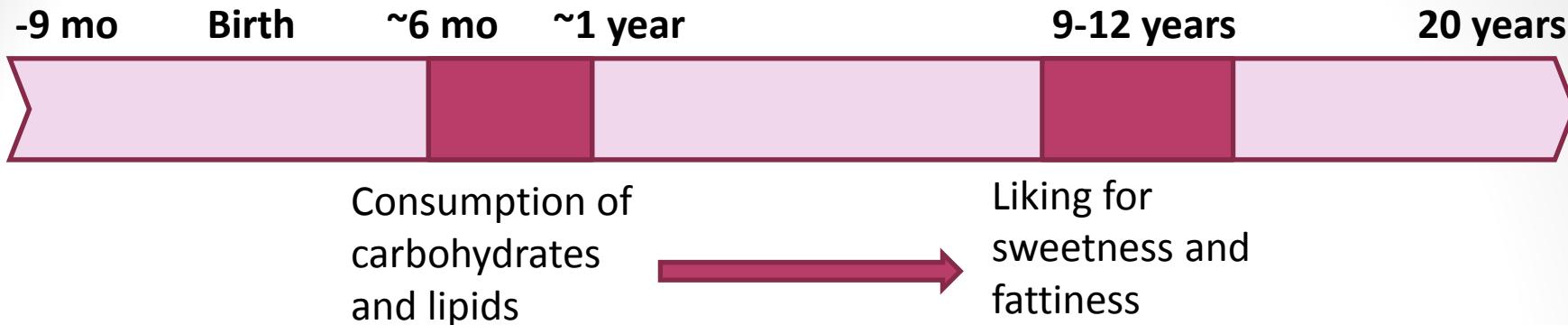
% Energy from lipids
Consumption of added fat



Yuan, Nicklaus, Lange, Forhan, Lioret, Heude, Charles, de Lauzon-Guillain on behalf of the EDEN mother-child cohort study group. *European Journal of Clinical Nutrition*. In press

Lange , Yuan, Schoumacker, Deglaire, de Lauzon-Guillain, Chabanet, Nicklaus, under review

Effect of early taste exposure on taste preference?



Birth cohort: EDEN (France)

Food frequency questionnaire
at 8 and 12 months:

% Energy from carbohydrates
Consumption of sweet foods

% Energy from lipids
Consumption of added fat

8mo 12mo
Liking for sweetness
 $P=0.44$ $P<0.001$

On going analysis -
Results coming soon

Yuan, Nicklaus, Lange, Forhan, Lioret, Heude, Charles, de Lauzon-Guillain on behalf of the EDEN mother-child cohort study group. In preparation

Conclusions

- Children are born with the ability to :
 - Taste, smell, discriminate foods (including milk)
 - Learn to like a new food (and its sensory properties)
 - Learn how much to consume of each food, given its energy density
- Learning abilities are likely high between the onset of complementary feeding and 2 years, i.e. before the onset of food neophobia (especially for vegetables): it is a window of opportunity to introduce foods from the family diet and let the child learn how to self-control energy intake
- Several *modifiable* factors impact acceptance of new foods
 - Early feeding experiences (e.g. during the milk feeding period)
 - Repeated exposure to a food and a variety of foods
 - Properties of foods: sensory aspects (taste, flavor) and energy density
- Long term effect of early feeding practices on eating behaviour need to be further characterised



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