What are the prerequisites for the establishment of a pig model to investigate the mechanisms of conditioned food aversion in humans ?

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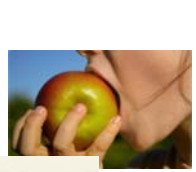
Feeding behaviour in human and animals

research and consumption of food and drink

- maintain vital functions : survival, reproduction

but appears to be also driven

- by pleasure : hedonic value
- by sociocultural influence



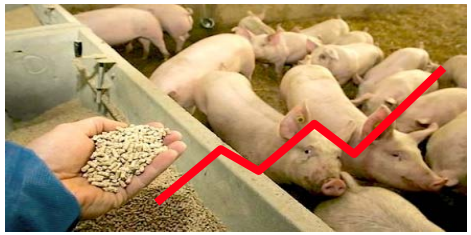


Regulation of food ingestion :

- research of high-energy foods, avoidance of toxic foods,
- sensorial characteristic of food (taste, odour, texture, visual cues),
- post-ingestive consequences associated to the sensorial characteristic of food or contextual events of intake.

➔importance of aversion mechanisms in food selection

Socio-economic and medical context related to food aversions in humans and pigs



neophoby

feeding transition

new diets

anorexia

in chemotherapy-treated patients
in hospitalised elderly patients

AVERSION

Optimisation of production

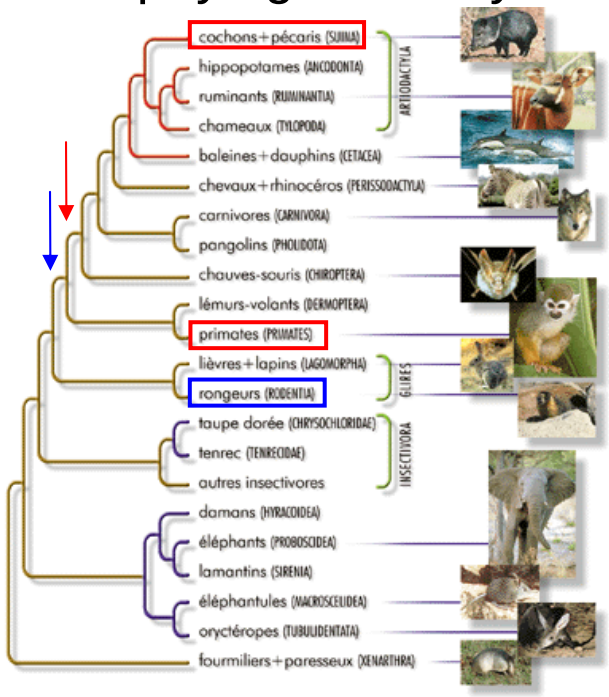
Welfare improvement

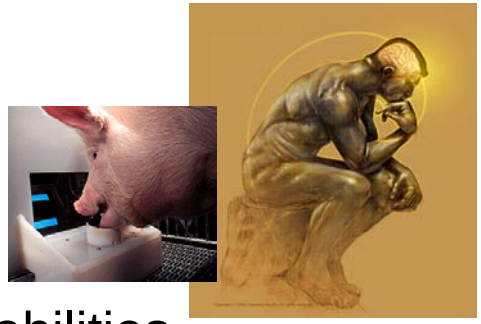
Therapeutic applications

Food diversification

Pig as a model for research in human

close phylogenetically





Cognitive abilities

Analogies : morphology / physiology

omnivorous feeding regimen

Brain

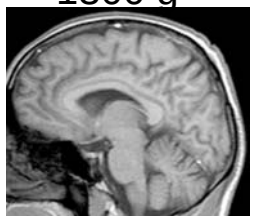
Human 1300 g

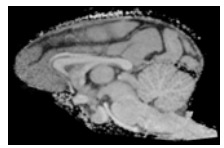
Primate 300 g

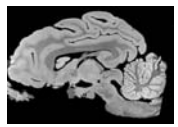
Pig 180 g

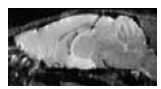
Rat 10 g

Cerebral Image (IRM)





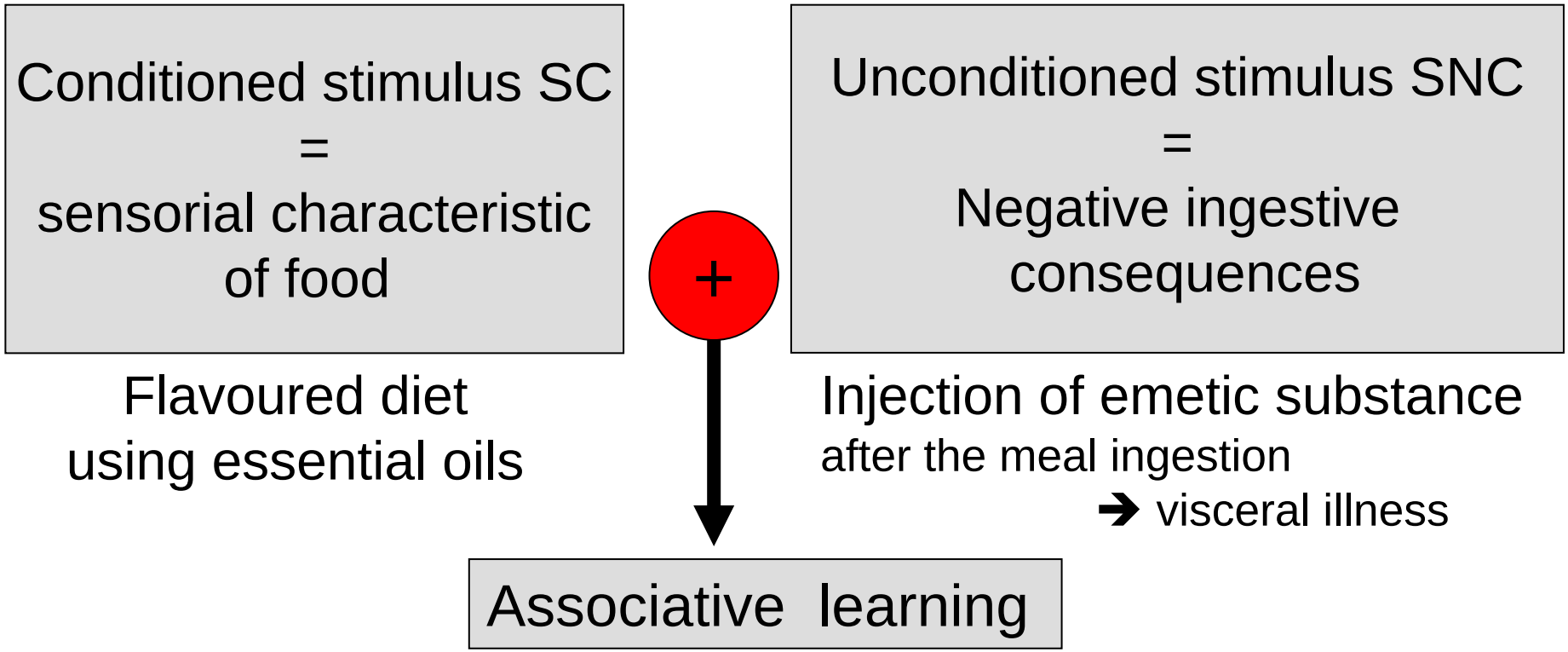




x 4

Experimental paradigm to study conditioned food aversion

Pavlovien associative learning (Pavlov, 1927)



Conditioned response evaluated by

behaviour : choice test ➔ learning

brain image in anaesthetized pigs ➔ central integration

Prerequisites for the establishment of a pig model to investigate conditioned food aversion

1/ Emetic substance ?

2/ Flavoured diet ?

3/ Flavour detected as isolated sensory modality ?

4/ Brain activation in anaesthetized pig during flavour exposure after a conditioned aversion

1/ what emetic substance ?

Methods

- Control diet supplied / meal duration : 30 min / 4 trials
- Substance : apomorphin, veratrin, erythrocyn, lithium chloride
- Injection of substance just after the end of the meal
- Behavioural recording during 1h after the injection: emetic response

Emetic response after the injection of substance

Apomorphin	Veratrin	Erythrocyn	Lithium Chloride
-	-	-	+

Li Cl injection

Emetic response to LiCl injection : low vomiting latency (min)

g/ ml saline NaCl	Duodenal	Gastric	Peritoneal
6 /150	5-10	-	
6 / 50	5-10		20-30
4 / 50	>30		
9 / 50		> 60	

Duodenal 6g in 50ml saline

2/ Which concentration of essential oils to avoid spontaneous aversion/preference towards the three flavoured diets ?

choice rank according to the level of the refusal weight in each trough
rank : 1, 2 or 3 ; averaged values on 4 pigs /test

Three-choice tests

Solubilised essential oil	Concentration % (total oil)	Averaged choice rank	Deviation
Cinnamon	1	1.5	0.5
Thyme	5	2	
Orange	5	2	
Cinnamon	1	1.25	0.5
Thyme	2	1.75	
Orange	2	1.7	
Cinnamon	2	1.75	0.25
Thyme	5	1.75	
Orange	5	2	

slightest deviation of differences

3/ Flavour detected as isolated sensory modality ?

Conditionned aversion by flavoured diet

?

Detection of flavour as isolated sensory modalities

flavour -> digestive troubles by injection of emetic substance.
flavour : taste and smell

Odour diffused in the ambiant air just above a standard diet

Two-choice test : standard diet in two troughs

- 8 pigs tested
- essential oil tested : Cinnamon, Thyme
- negative odour : air odorized with essential oil previously associated with digestive troubles

choice

Food discrimination according to hedonic value

4/ Brain imaging results

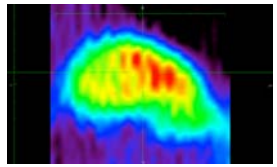
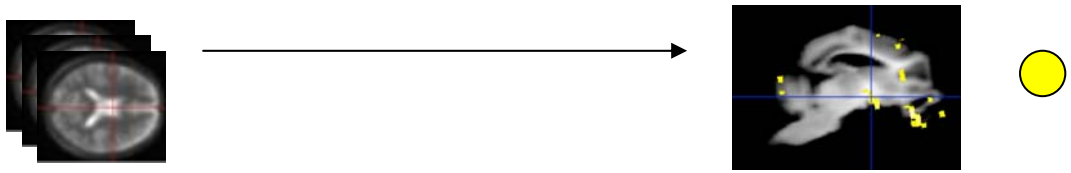


Image acquisition -> **single photon emission Tomography** (SPECT)

Spatial processing and statistical analysis -> statistical Parametric Mapping



activated brain area

Conditioned aversion stimulus vs Control stimulus

Higher activation of specific areas :

- Medulla - Olfactory bulb - Somatosensory association cortex
- Primary visual cortex
- Perirhinal cortex - Anterior prefrontal cortex

structures related to :

- olfactogustatory sensations : perception of essential oil
- sensory associative processes : unconscious visual image of food
- contextual memory

Conclusion

Behavioural approach : establishment of clear-cut aversion for flavoured diets associated to visceral illness

Brain imaging approach :
differential brain activation according to experience with flavour

➔ unconscious cognitive dimension evoked by flavour

➔ sensory image of food

Pig model of conditioned food aversion

Further studies using the pig as a model in biomedical research to explore the mechanisms of food aversion and their consequences on nutrition and health.

Thank you for your attention