

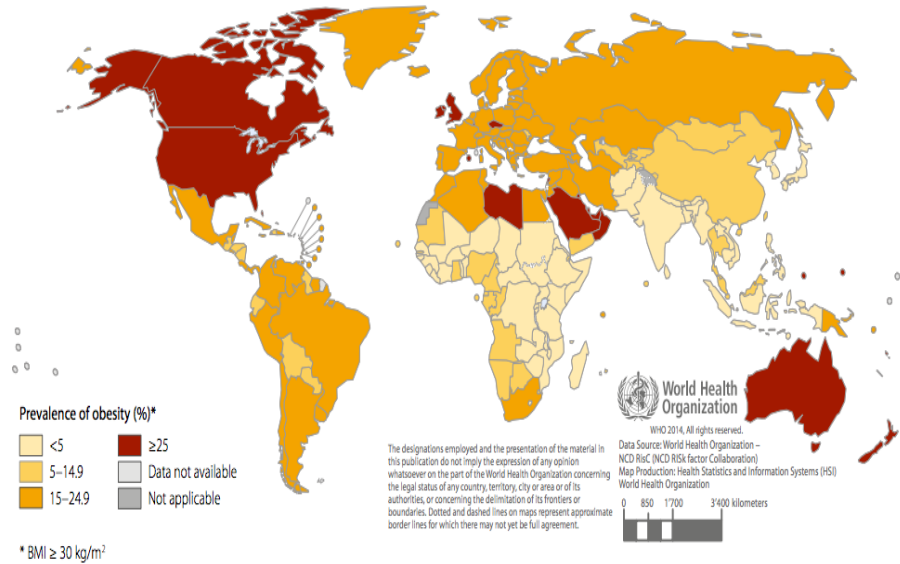
Impact of chronic exposure to palatable foods on hedonic and cognitive brain processes of normal-weight adults

A fMRI pilot study



Nowdays, 1 billion people
In 2030 : 3.3 billion

Fig. 7.1 Age-standardized prevalence of obesity in men aged 18 years and over (BMI ≥ 30 kg/m²), 2014



Difficult management

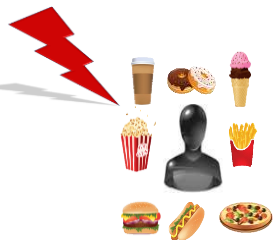
- Drugs
- Restrictive diets
- Rebalancing food
- Bariatric surgery
- Cognitive-behavioral therapy
- Deep brain stimulation...

Actual goals :

- **Curative:** more adapted + low invasive care pathways
- **Preventive:** pre-symptomatic marker identification => better management

=> Personalized care pathway

Eating habits and brain



Eating behavior disorders:

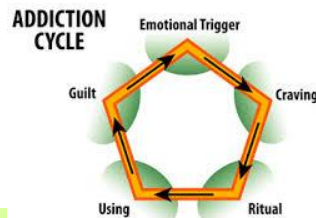
=> *Binging*

=> *Overeating*

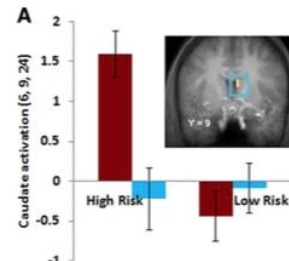
Levine et al., 2003

Volkow et al., 2012

Lenoir et al., 2007

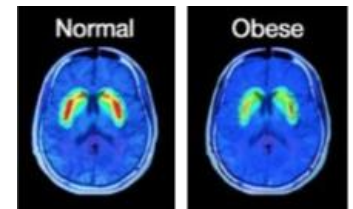


Reward anticipation: adolescents with high risk of obesity expect more from reward



Obesity and brain

Wang et al., 2004



Inclusion criteria : 18 - 40 years old, BMI [18-25], men & women, **N=17**

Exclusion criteria : left-handed, athletic, addiction (food, tobacco, drug, alcohol), pregnant, BMI < 18 or > 25, weight history

Screening



Food Frequency Questionnaire

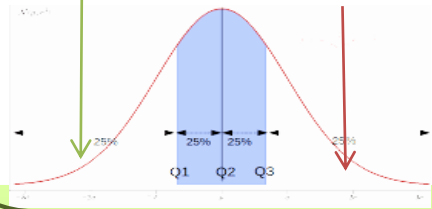
« In the last twelve months, how often did you consume ... »



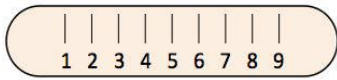
Low Frequency group



High Frequency group



Evaluate Liking and ED



kcal kcal kcal

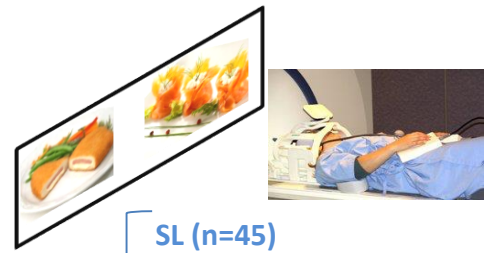


Matching photos (90 pairs)

- Hedonic valence (SL, DL)
- Energy difference (HE, LE)

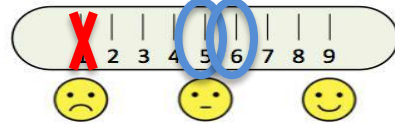


fMRI Choice (wanting) N = 90

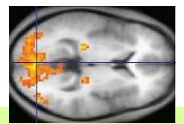
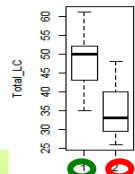
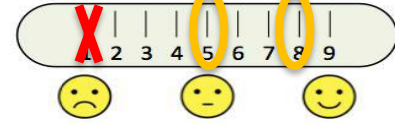


HE vs. LE

SL (n=45)

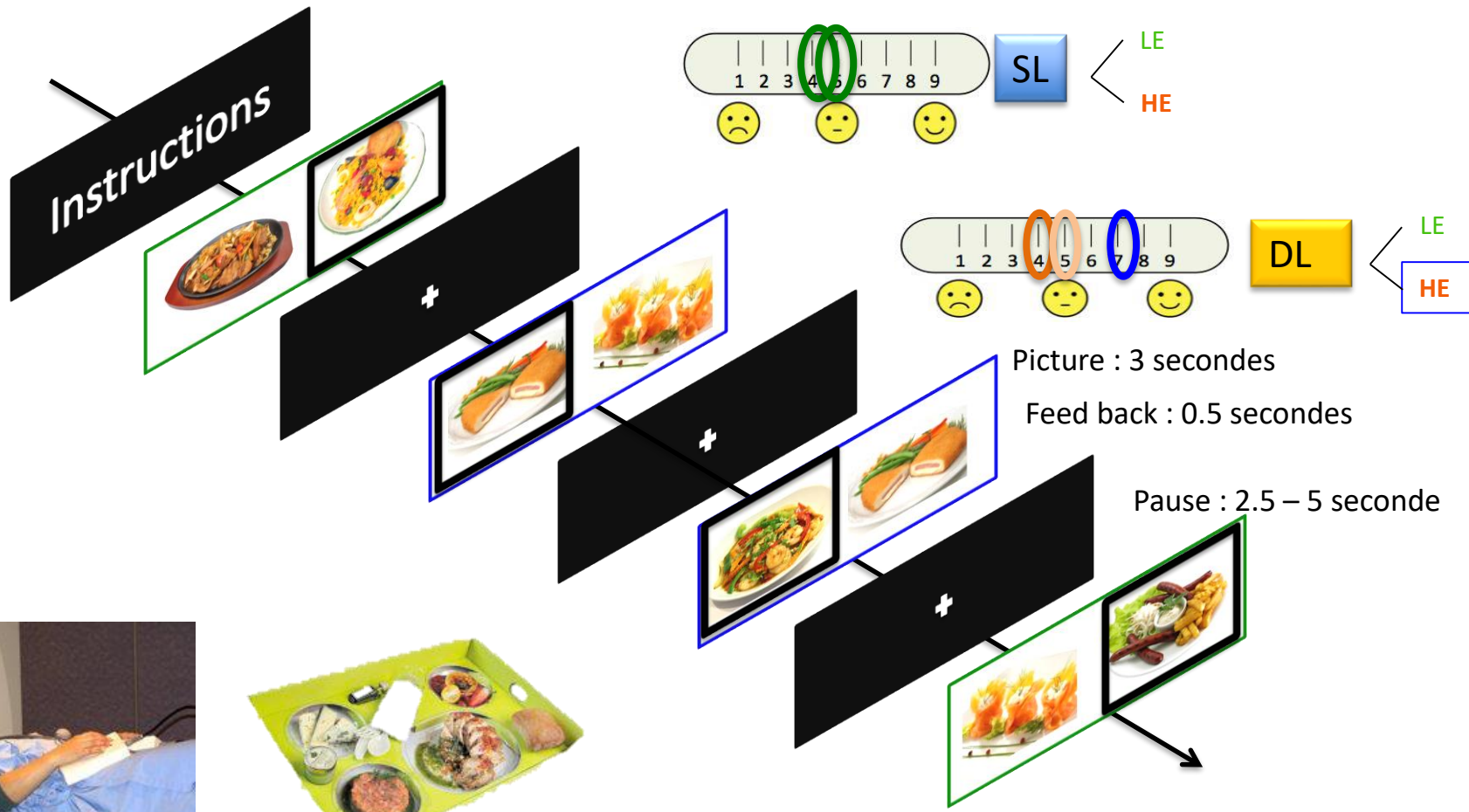


DL (n=45)



Choice test in fMRI : « Wanting » task

«Choose what you would like to eat now »



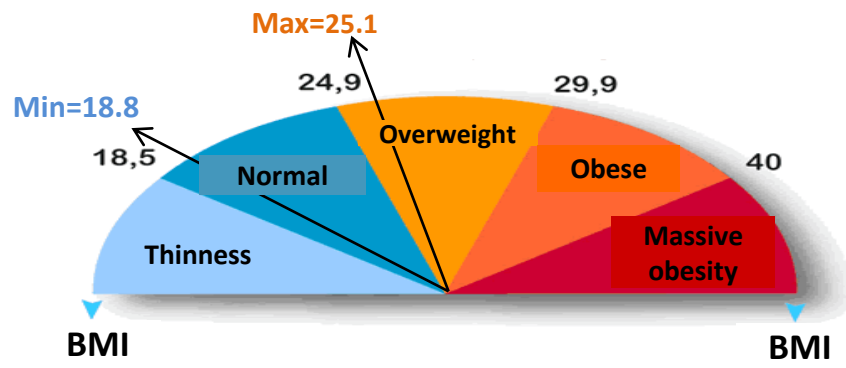
Van der Laan et al., 2014

Results

Population

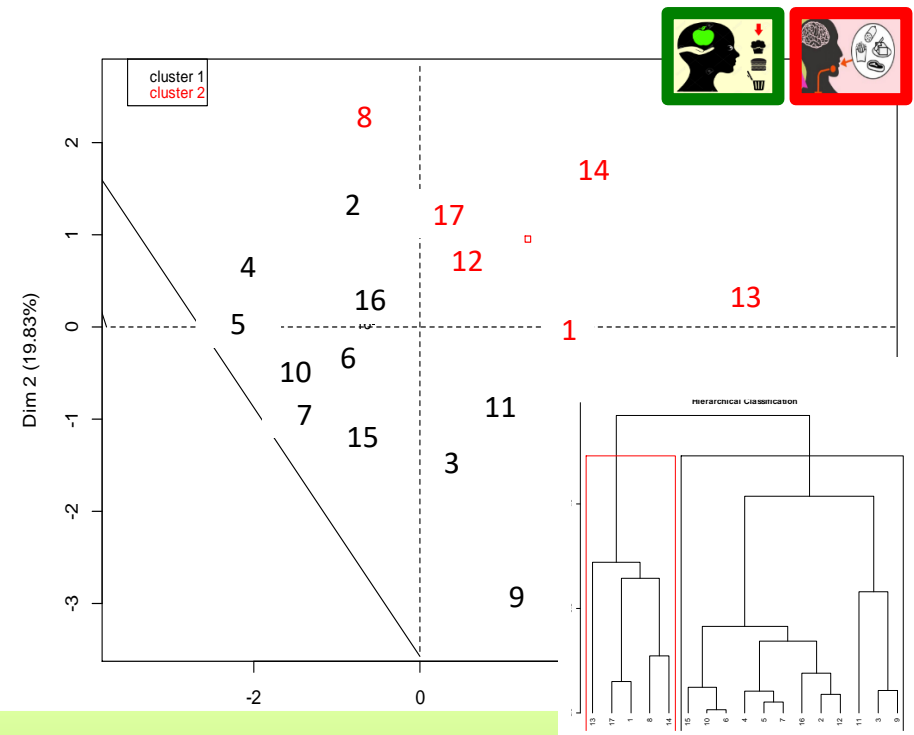
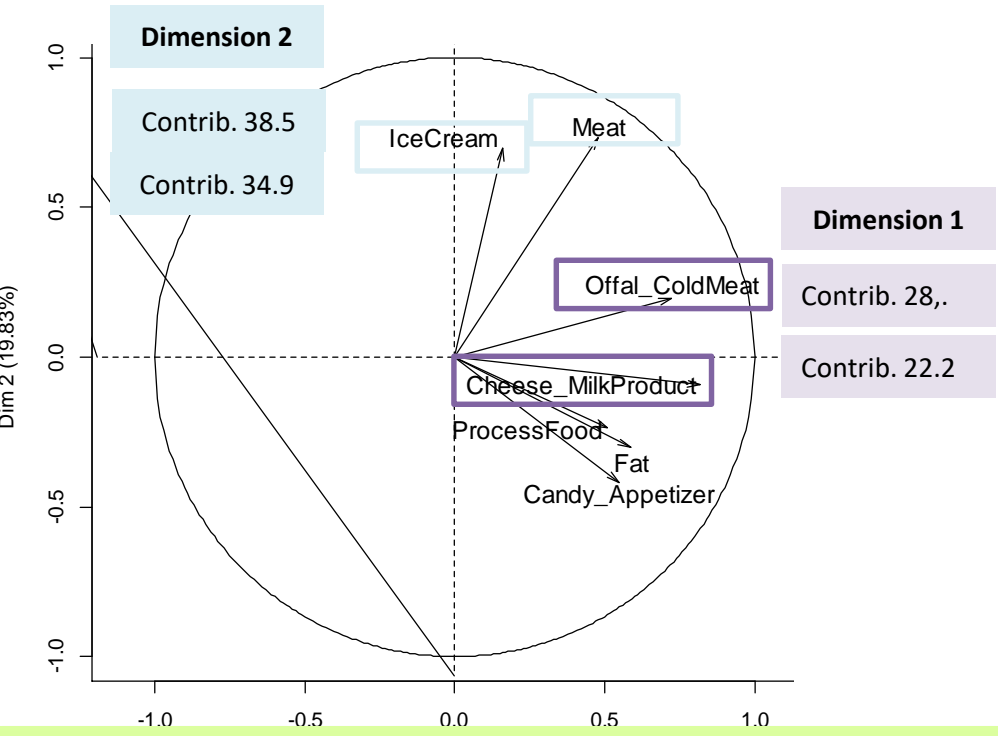
Volunteers **N=17**
 Sex ratio: 8F and 9M
 Age: 29.2 ± 6.2 years

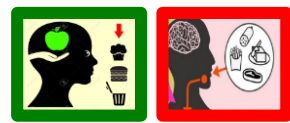
Statistics: mean \pm SD



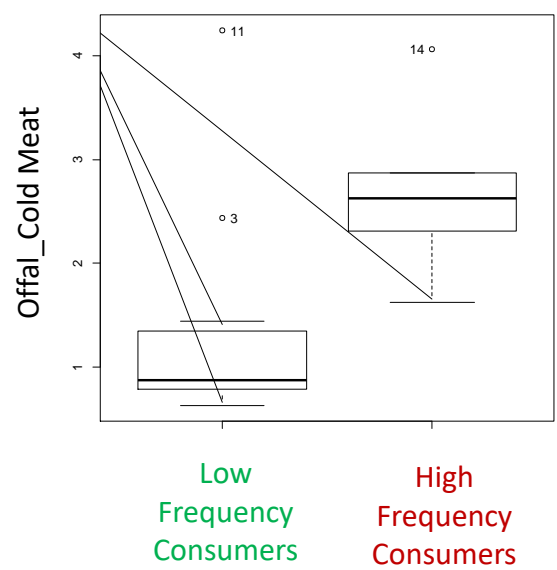
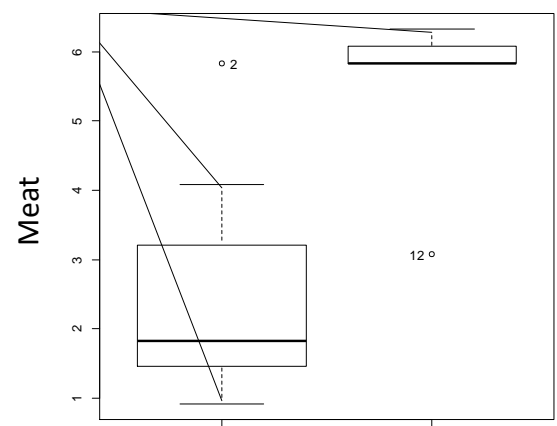
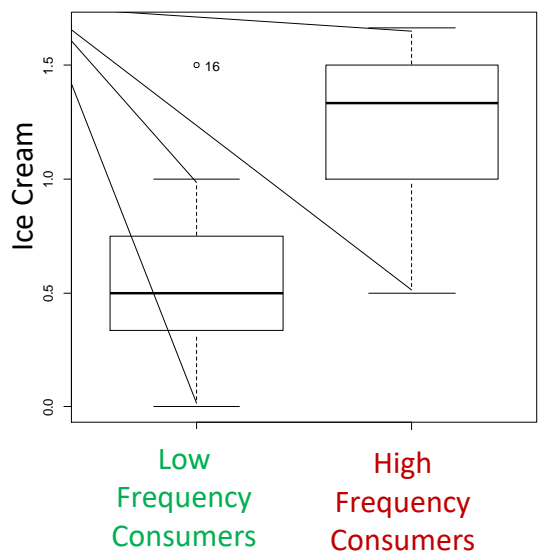
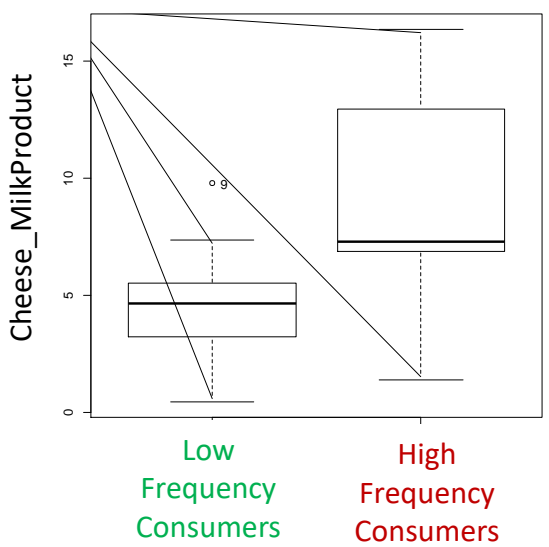
BMI: 21.3 ± 2.3

Food Frequency Questionnaire (FFQ) _ PCA + AHC analysis to discriminate groups





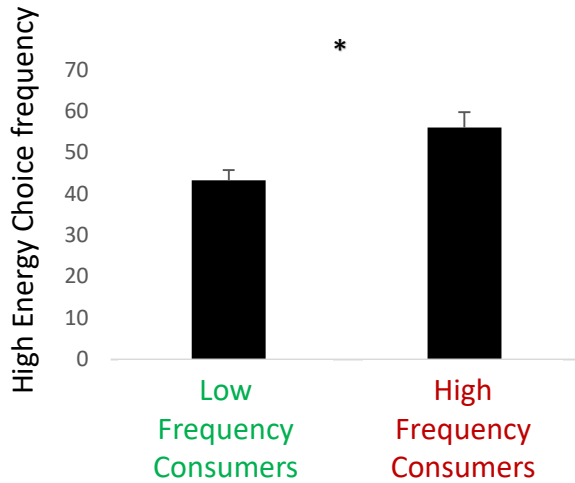
FFQ: Groups effect



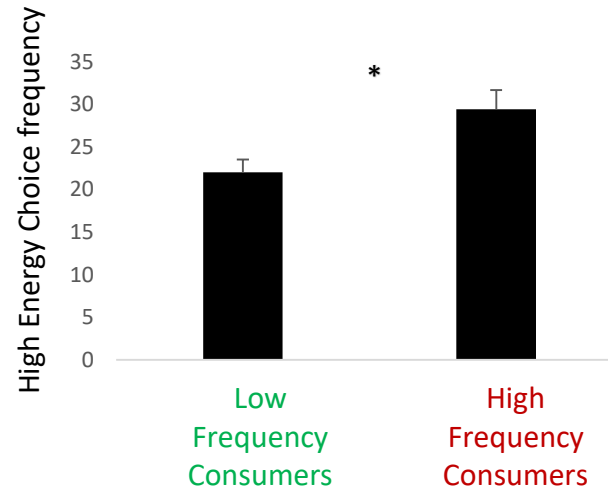
	p-value	Significance
Cheese_MilkProduct	0.053	t
Ice Cream	0.016	*
Meat	0.0019	**
Offal_Cold Meat	0.032	*

- « Wanting » task: High energy (HE) food choice

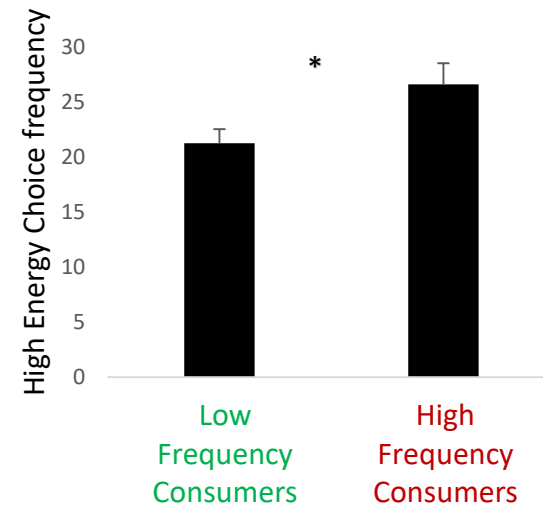
Total HE choices



Different liking (DL) situation



Similar liking (SL) situation



Remember

Appraisal: LowEnergyFood < HighEnergyFood

Brain activation, response delay

Situation effect (SL vs. DL)

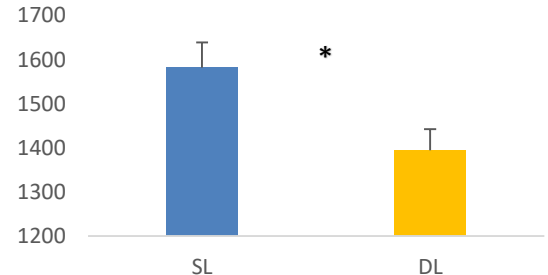
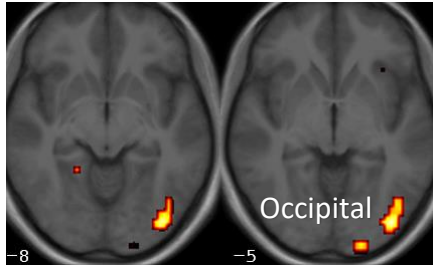


Figure 1: Response delay, SL vs. DL

Comparison	Coordinates			Cluster size (voxels)	Zone	Cluster p-value			
	x	y	z			FWE-corr	FDR-corr	Uncorrected	
SL vs. DL	-36	-82	-11	75	Occipital inf	0.002	0.002	0.0005	visual cortex
	-18	-100	1	29	Occipital Mid	0.114	0.07	0.008	visual cortex

Caloric content effect (LE vs. HE)

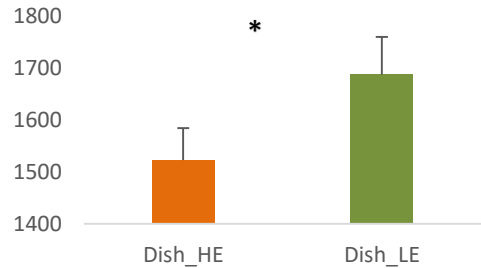
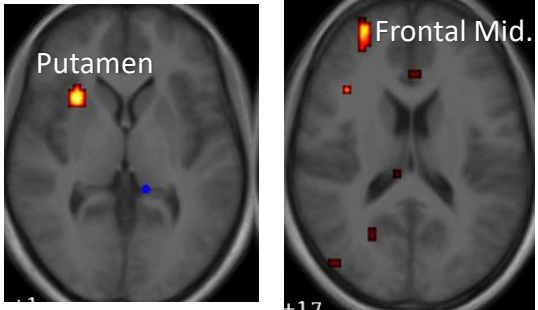


Figure 2: Response delay, HE vs. LE

Comparison	Coordinates			Cluster size (voxels)	Zone	Cluster p-value			
	x	y	z			FWE-corr	FDR-corr	Uncorrected	
HE vs. LE	30	17	1	22	Putamen	0,232	0,228	0.017	movement sequence, motor skills learning, reinforcement, "reward-circuit"
	30	53	16	21	Frontal Mid	0,258	0,228	0.019	executive mechanisms (go-no go task)
	15	29	28	13	Cingulate Ant	0,587	0,45	0.056	reward anticipation, decision making, conflict monitoring, cognitive dissonance, prediction/detection error

Take home message

▪ About paradigme



Pictures data base validation

Two relevant groups distinction based on FFQ

FFQ results consistant with « wanting » fMRI task

▪ About results



Internal conflict in SL => increase gaze alternance
=> activation Occipital cortex

HE vs. LE involves:

- Reward-circuit (Putamen => unlike-circuit)
 - Decision making system (Frontal cortex)
- => Low energy foods choice involve more cognitive processes

▪ About bigger on-going study (in course)

N=40, 18-24 ans, women only

+ Biological sampling (blood, feces, urine)

+ Beverage choice task

Thank you for your attention

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