Beyond hunger:

Reward mechanisms implicated in food intake and in obesity

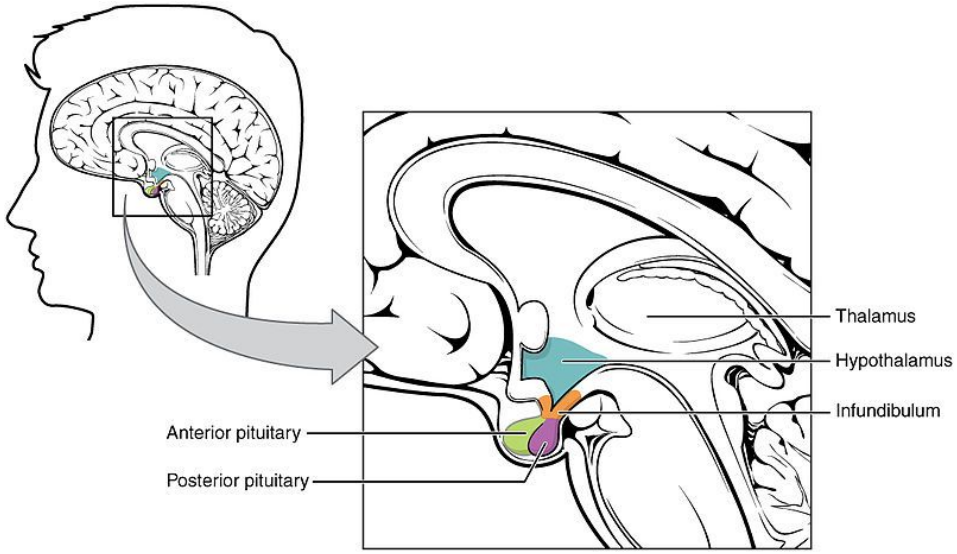
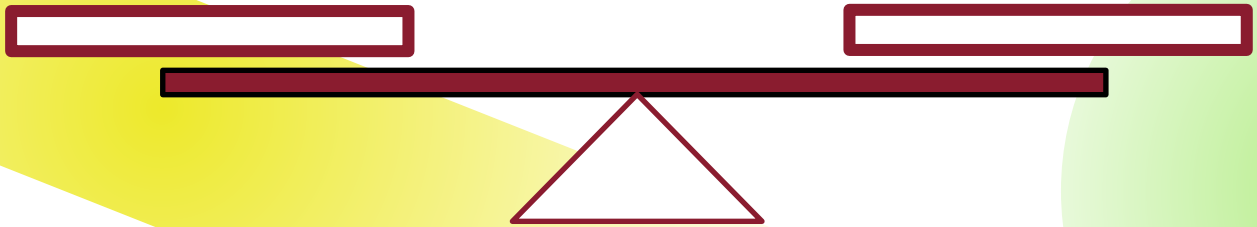


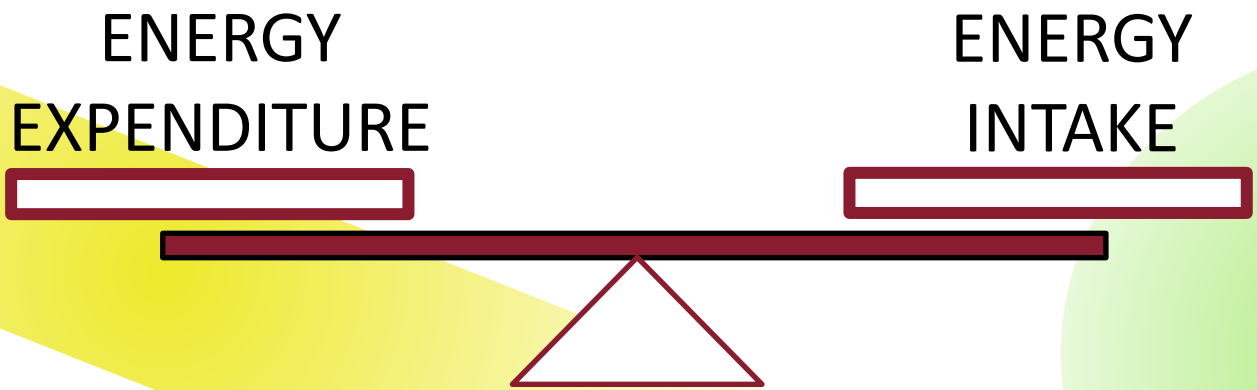
Image: Wikimedia Commons

HYPOTHALAMUS:
Central in appetite regulation

ENERGY EXPENDITURE

ENERGY INTAKE

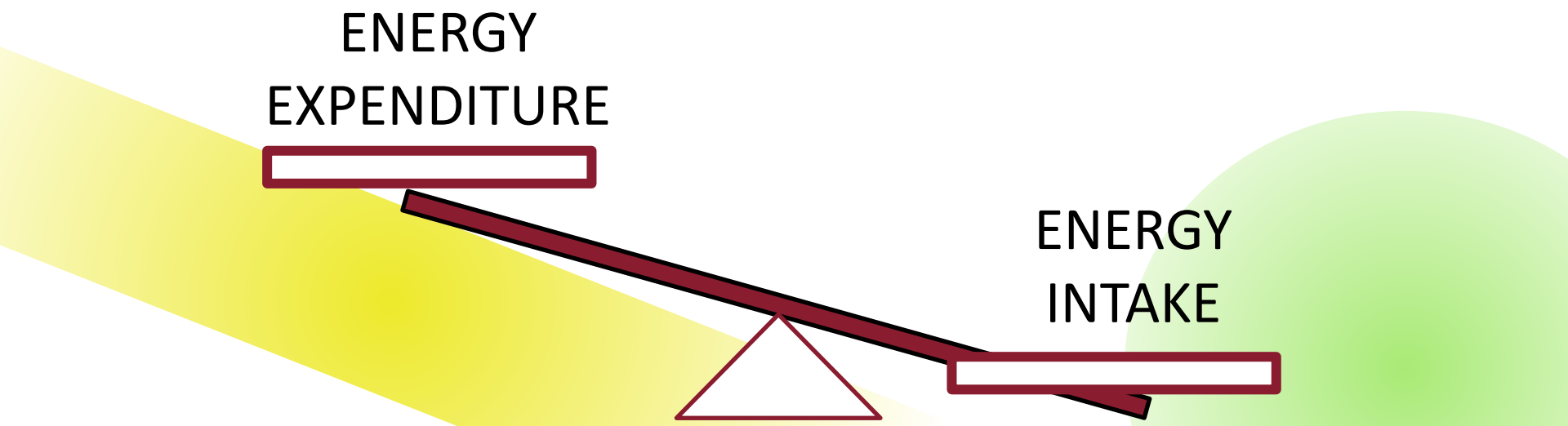



ENERGY
EXPENDITURE
ENERGY
INTAKE

ghrelin
insulin

 Y neuropeptide and agouti-related peptide

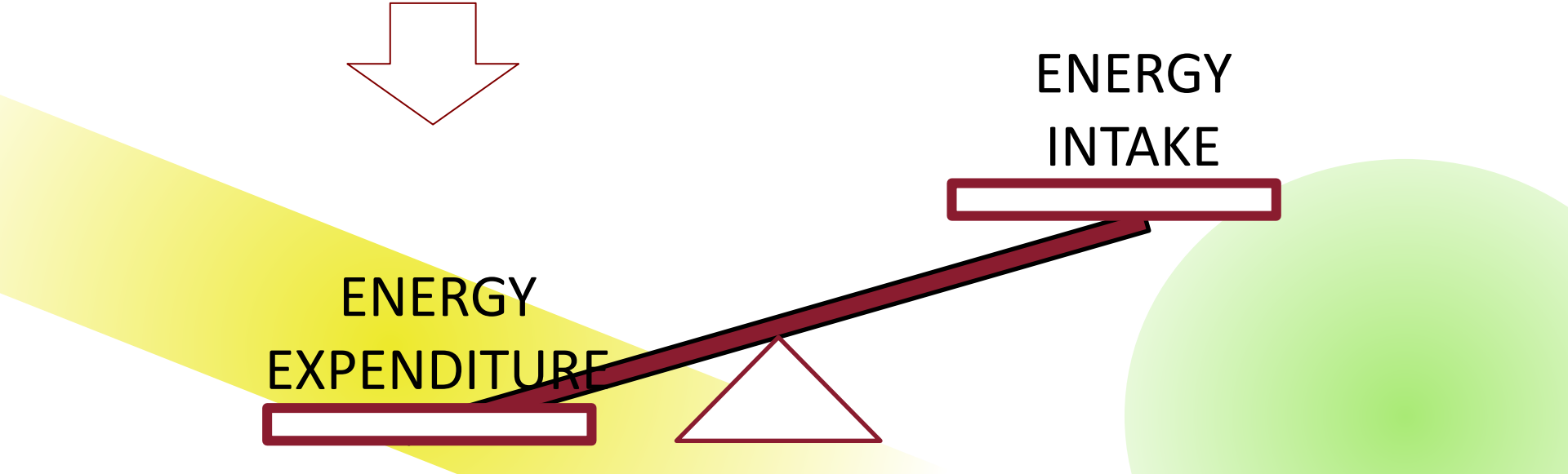
Lateral hypothalamus stimulation
Ventromedial hypothalamus inhibition



 insulin, leptin and YY neuropeptide

 proopiomelacortin and cocaine-amphetamine regulated transcriptor

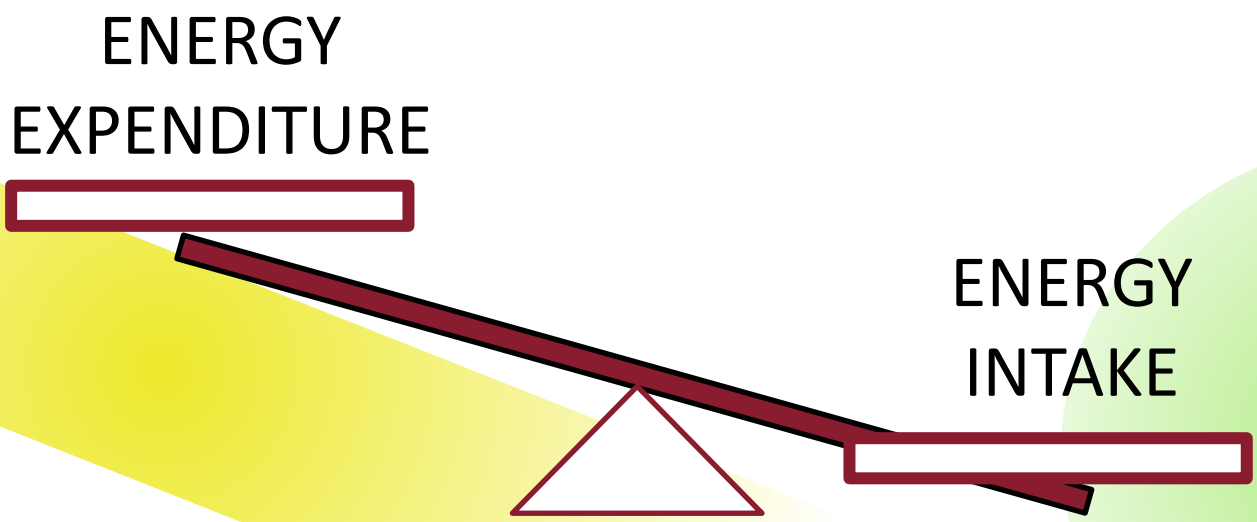
Ventromedial hypothalamus stimulation
Lateral hypothalamus inhibition



Excessive accumulation of lipids in several tissues and organs

Adverse cellular responses

Increased risk for metabolic and cardiovascular diseases
Brain tissue vulnerability



Beyond homeostasis: hunger feelings

Habits	Boredom	Stress
Hormone changes	Social pressure	Hedonic hunger

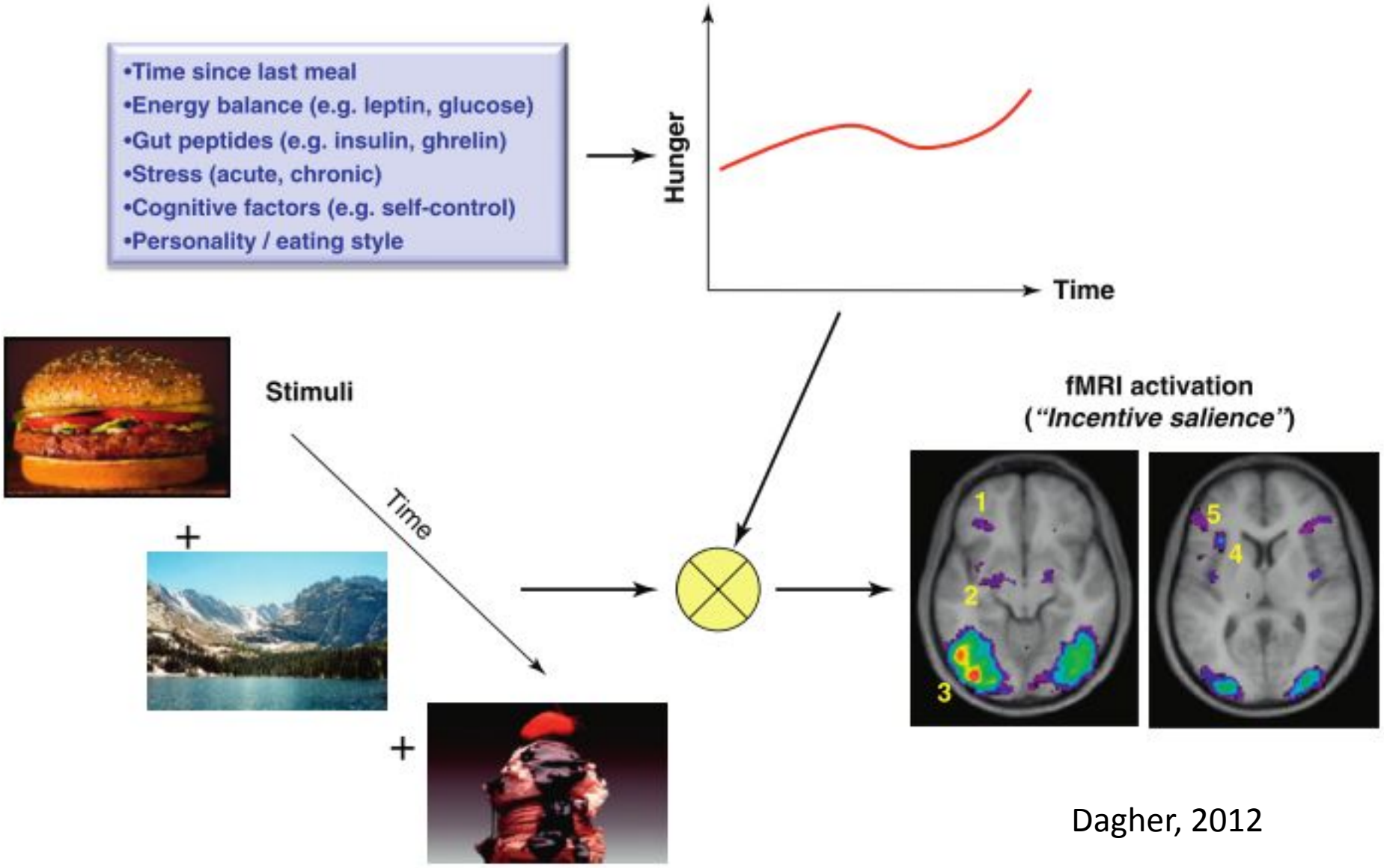
Beyond homeostasis: hunger feelings

Habits	Boredom	Stress
Hormone changes	Social pressure	**Hedonic hunger**

Hunger as a reinforcing behavior

- **Eating behavior**: reverse of „unpleasant“ hunger signals
- Linked with **hedonic** and **reward** mechanisms

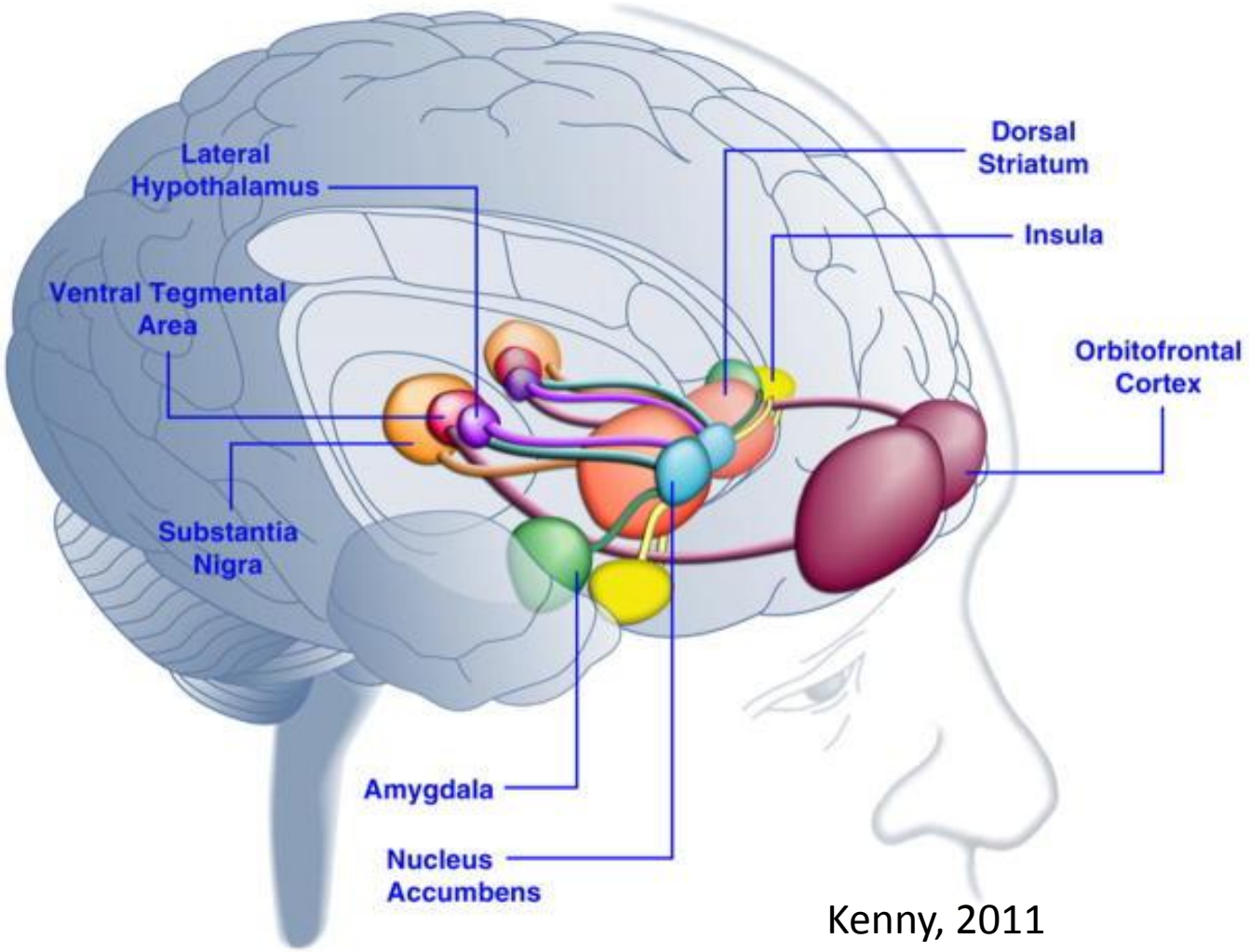
Neuroimaging studies of appetite



Dagher, 2012

The “appetitive” network in the brain

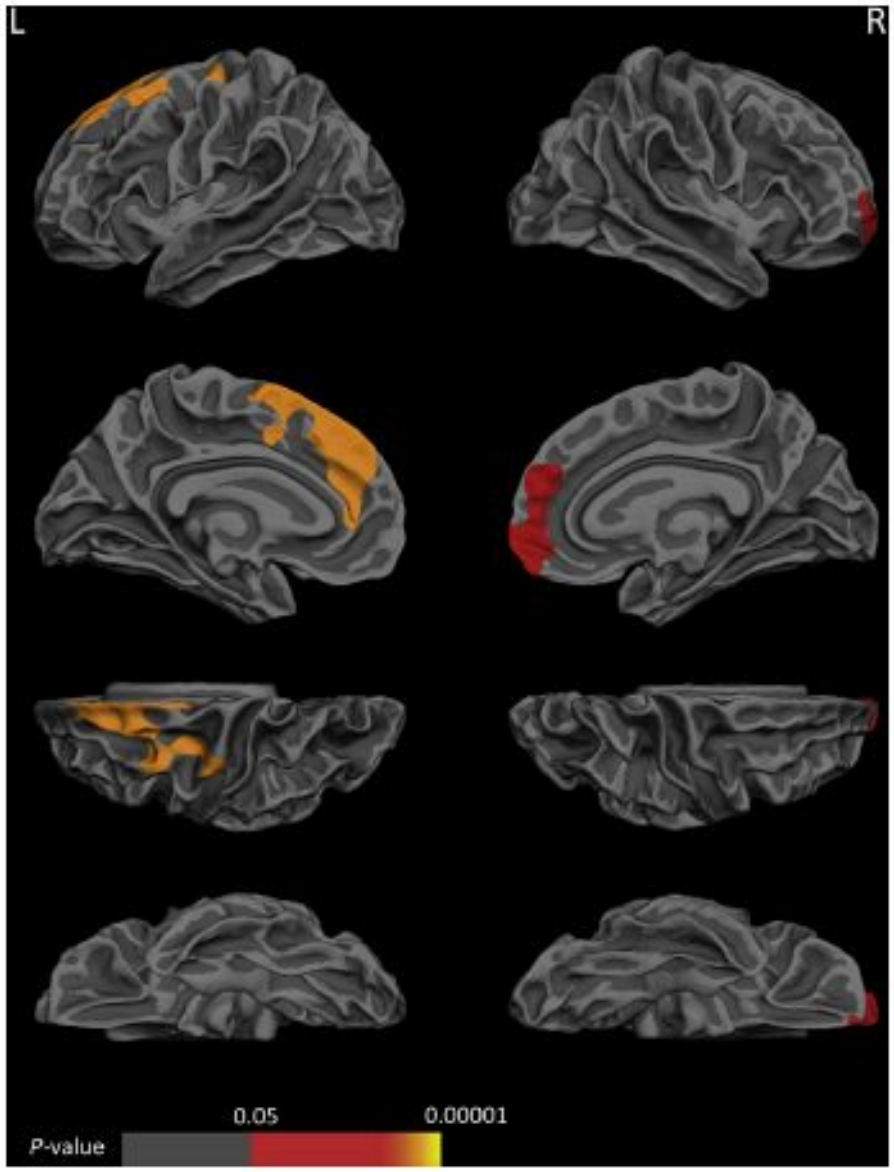
Reward system: mesocorticolimbic dopaminergic regions



Kenny, 2011

Alterations in the appetitive network in obesity

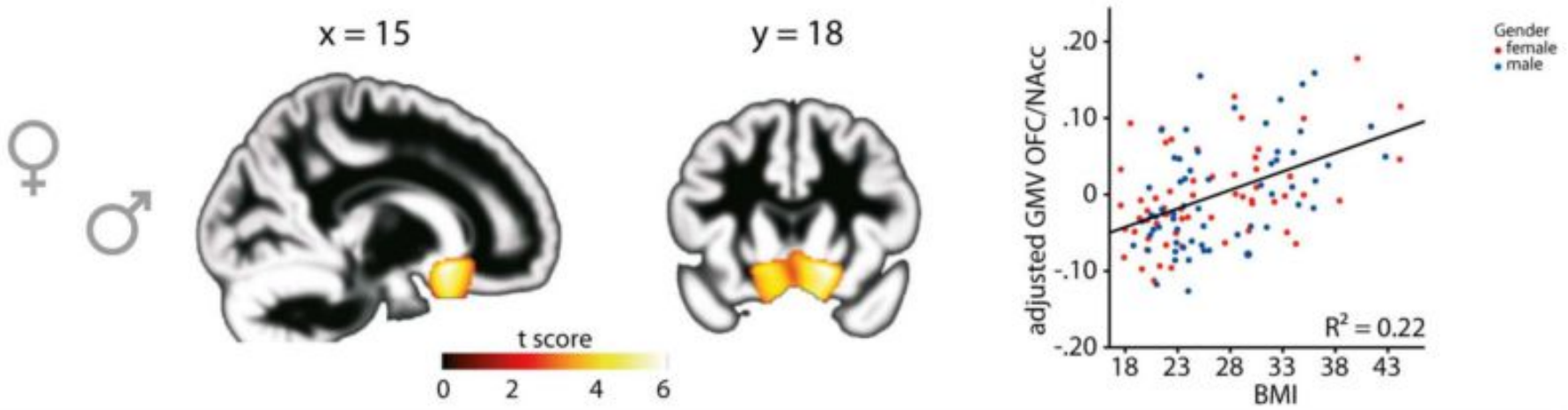
Reductions in gray matter volume and in cortical thickness in **prefrontal areas** in obesity



Marqués-Iturria, Pueyo, Garolera, Segura, Junqué, García-García, …, Jurado (2013)

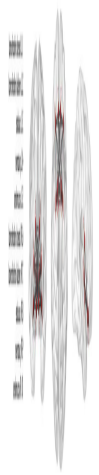
Directionality of volumetric differences is **less clear** in **subcortical regions**

(e.g., see Horstmann et al. 2011 and Jagust et al. 2005)



Horstmann, Busse, Mathar, Müller, Lepsien, …, Pleger (2011)

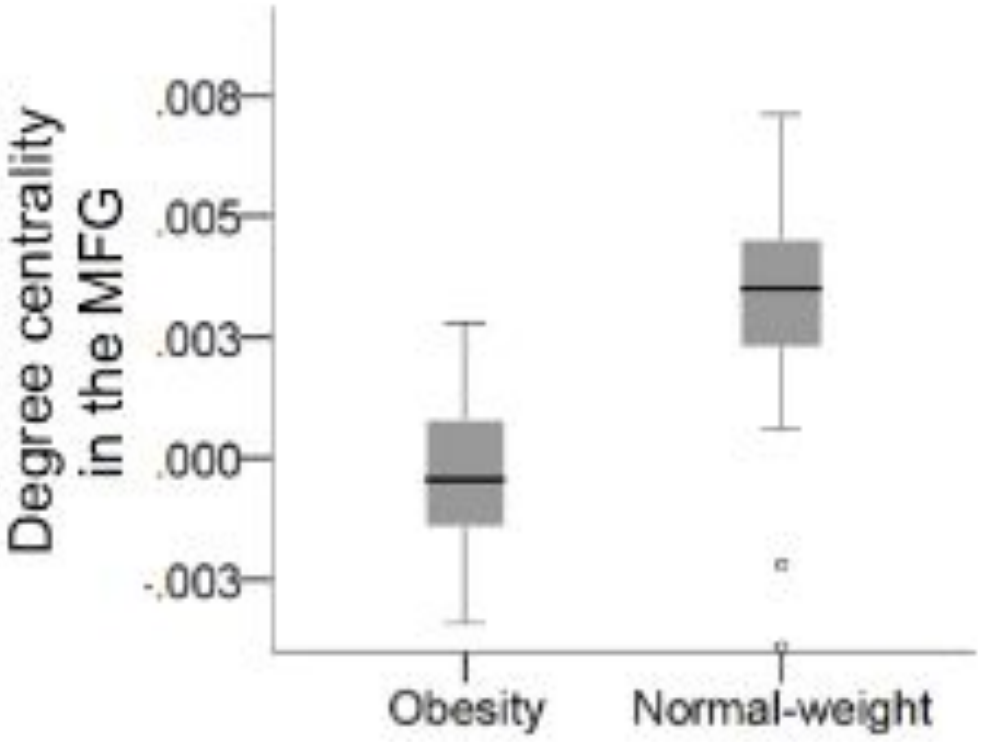
Decreased connectivity organization of the reward system structure in obesity

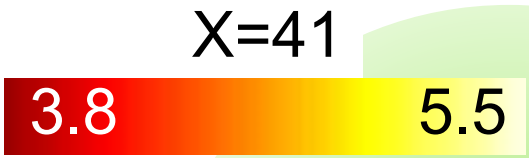


Control
Obese

Marqués-Iturria, Sholtens, Garolera, Pueyo, García-García, …, van den Heuvel. (2015) Neuroim

Alterations in the appetitive network in obesity

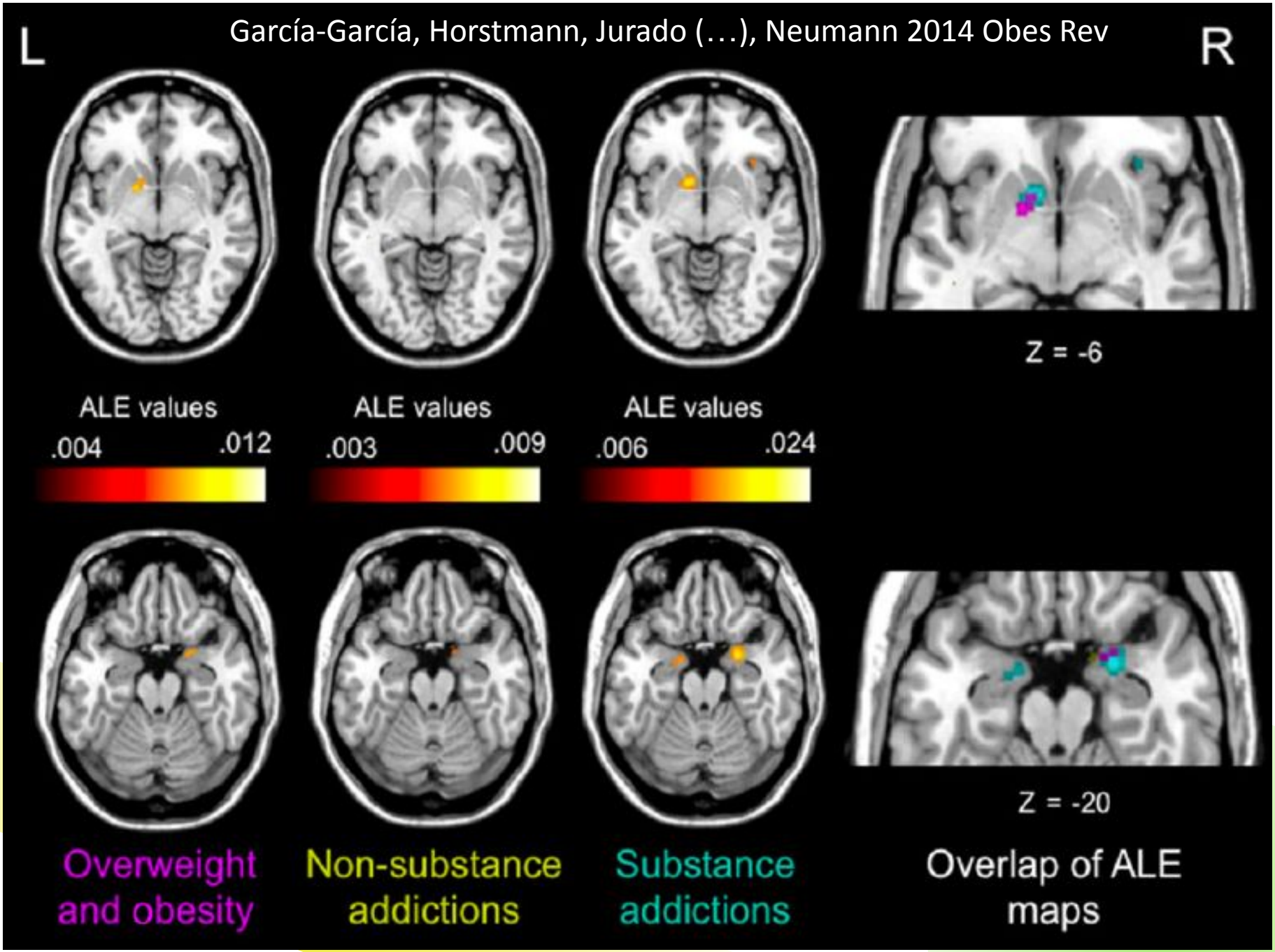




García-García, Jurado, Garolera, Marqués-Iturria, Horstmann, …, Neumann (2015). Psychiatry Research: Neuroimaging

The addictive or compulsive dimension of obesity

FOOD ADDICTION MODEL (Gearhardt et al. 2011; Kelley & Berridge, 2002)
Obesity resembles an addiction to drugs, both behaviorally and in terms of their underlying neural processes


García-García, Horstmann, Jurado (…), Neumann 2014 Obes Rev
L
R
ALE values
.004
.012
ALE values
.003
.009
ALE values
.006
.024
Z = -6
Z = -20
Overweight and obesity
Non-substance addictions
Substance addictions
Overlap of ALE maps

Conclusions

- **Obesity and substance addictions** shared a higher recruitment of the amygdala and striatum, key structures in salience, reward and habit formation.

- **Non-substance addictions** showed alterations in immediate (but not coincident) clusters in the amygdala