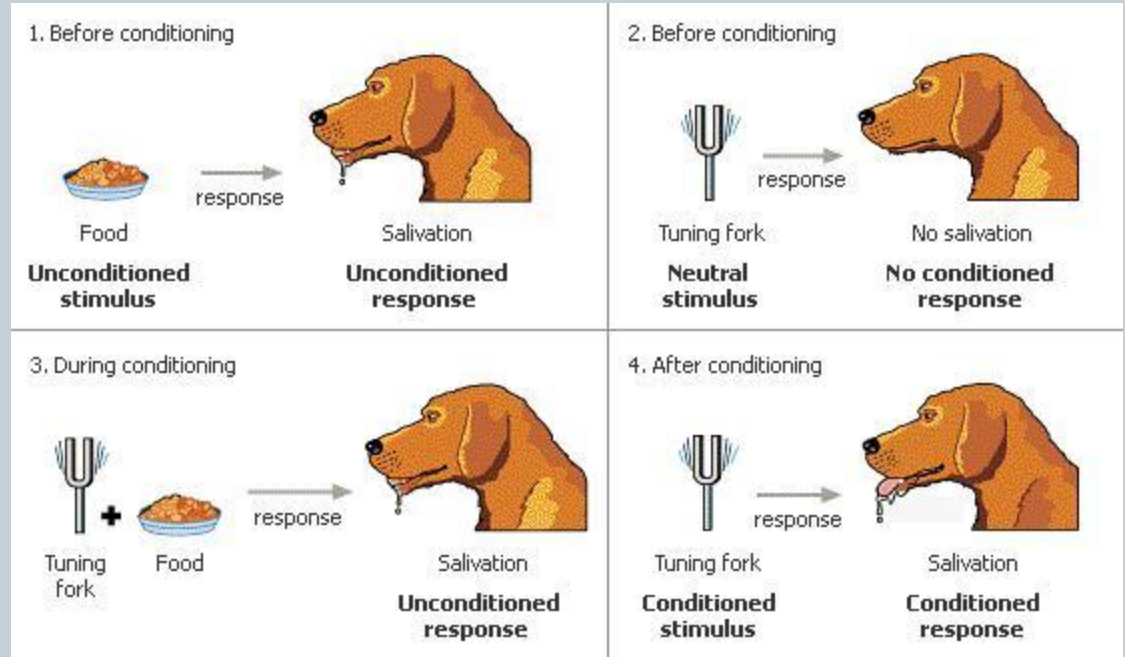


Imaging the placebo response



**M CATHERINE BUSHNELL
MCGILL UNIVERSITY**

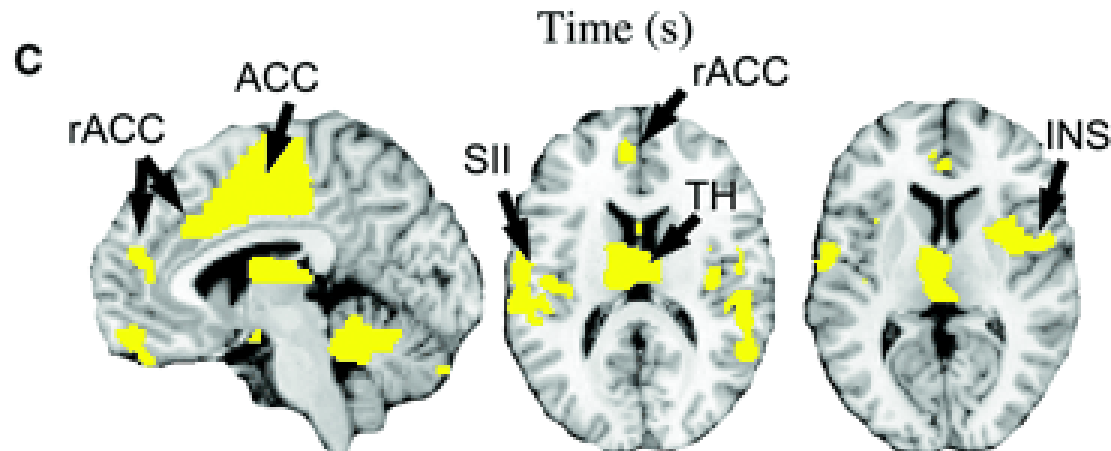
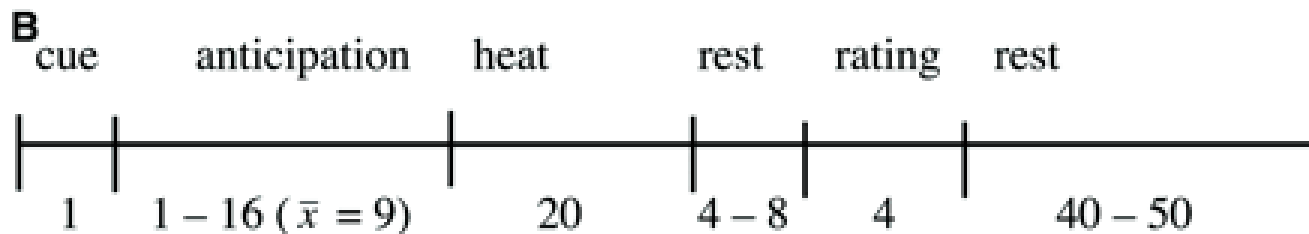
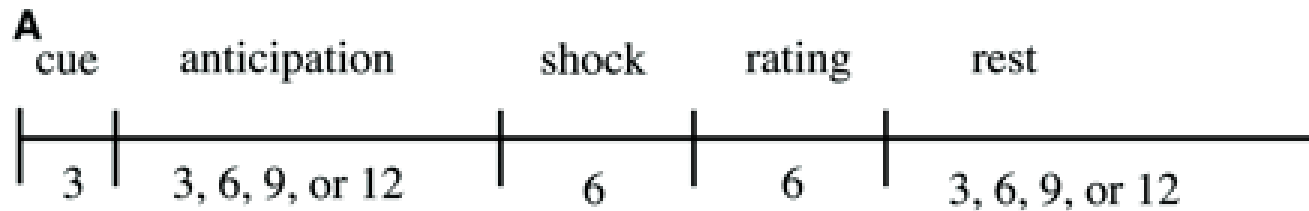
How is placebo effect created?



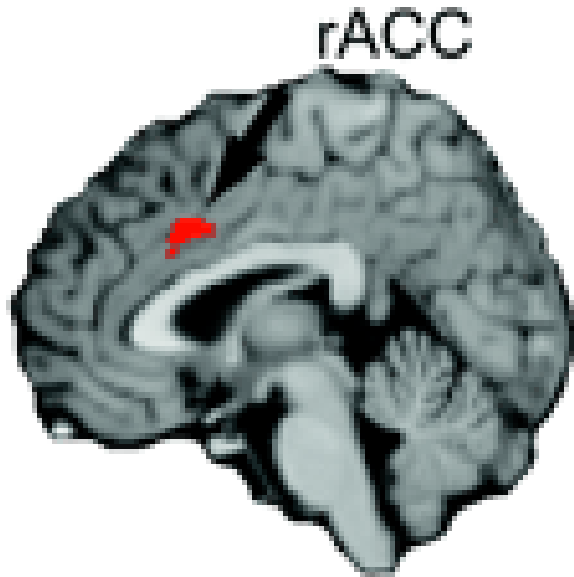
Expectation

Conditioning

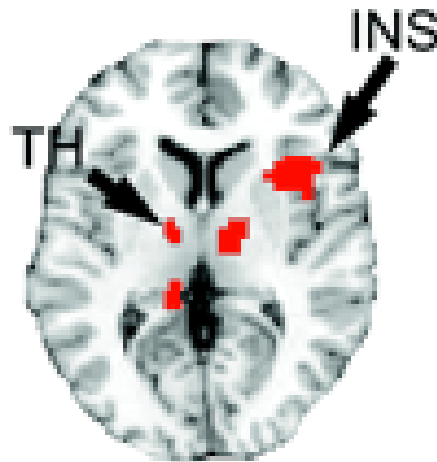
Imaging placebo analgesia



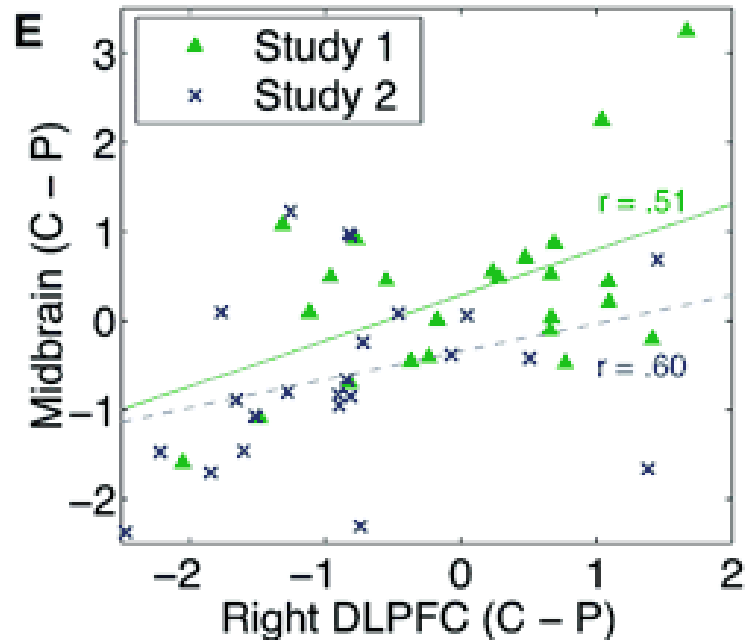
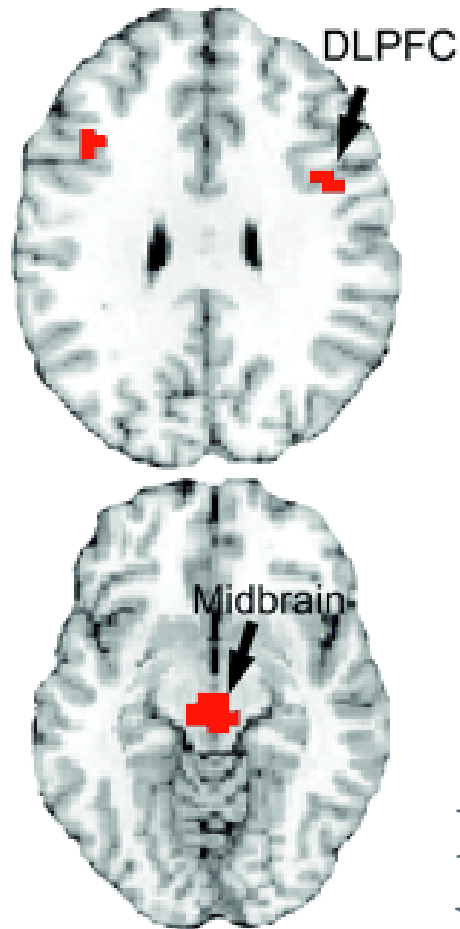
Imaging placebo analgesia



Placebo reduces pain-evoked activity in ACC, insula and thalamus



Imaging placebo analgesia

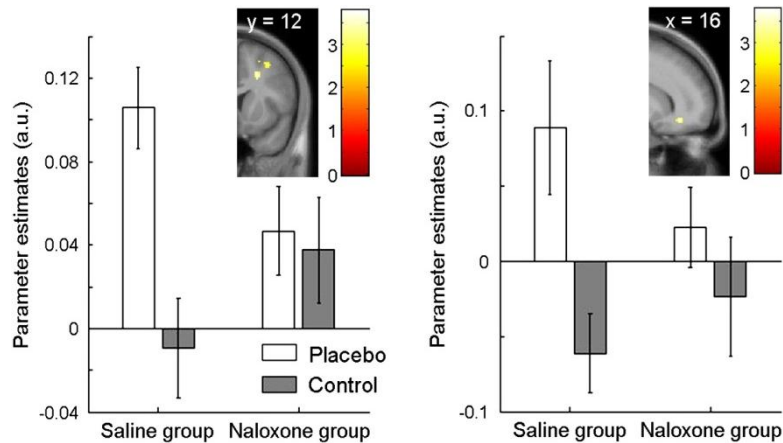


Placebo increased prefrontal and midbrain activity in anticipation of pain

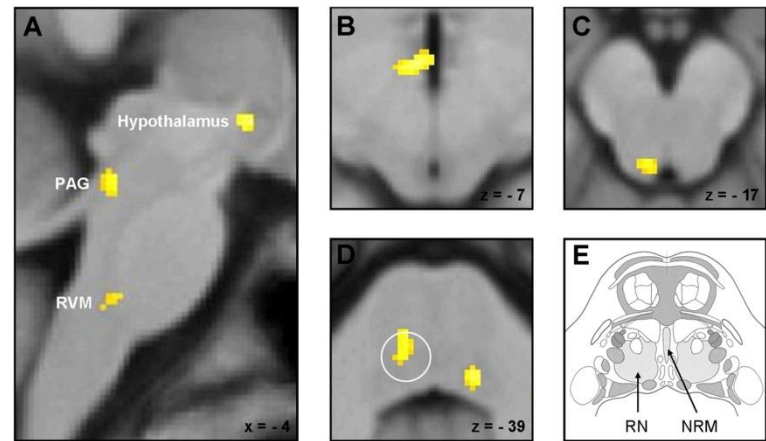
Naloxone disrupts rACC-PAG functional connectivity



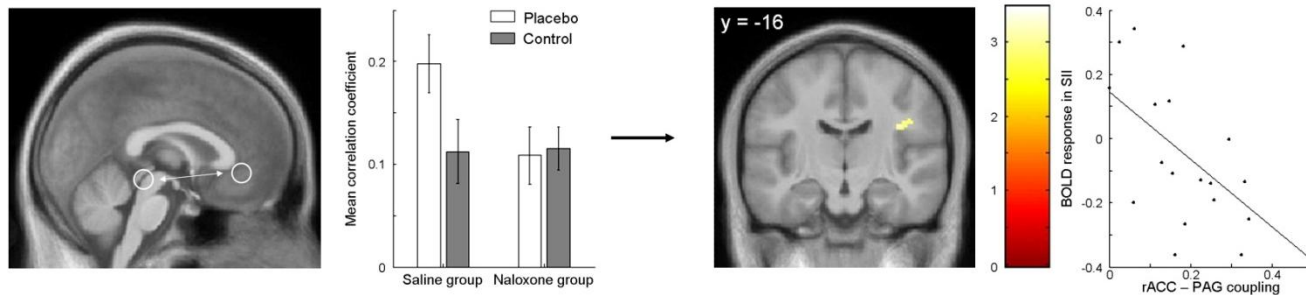
DLPFC and rACC active during placebo



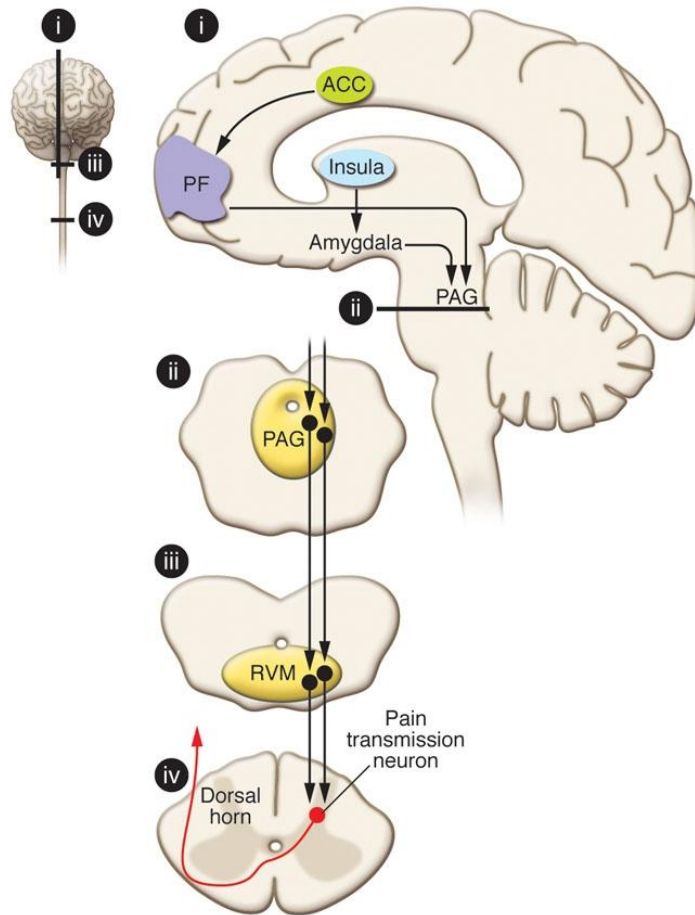
Mid-brain and brainstem activations



rACC-PAG functional connectivity disrupted by naloxone



rACC, PFC & PAG involved in descending pain modulation





Dopamine



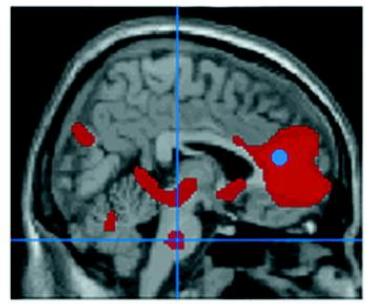
Opiates

**Imaging neurotransmitters
involved in placebo analgesia**

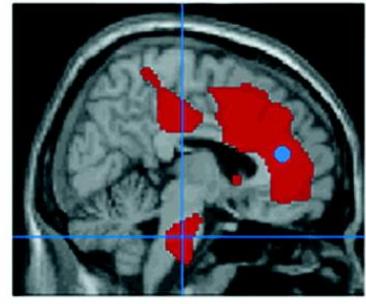
Both opiates and expectation-induced placebo activate rACC-brainstem circuit



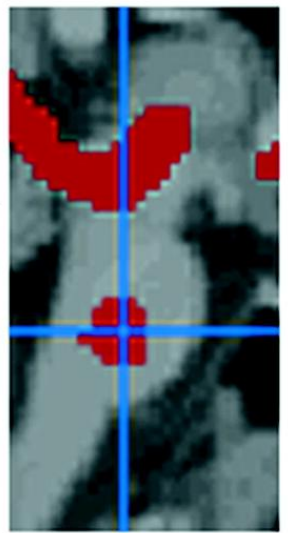
Pain + opiate



Pain + placebo

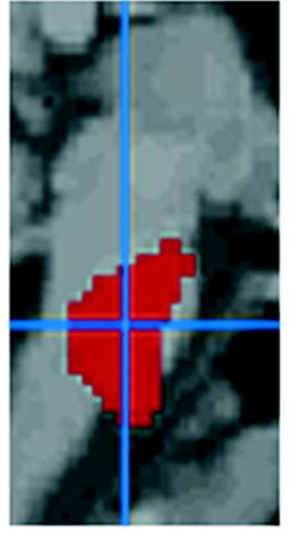


PAG

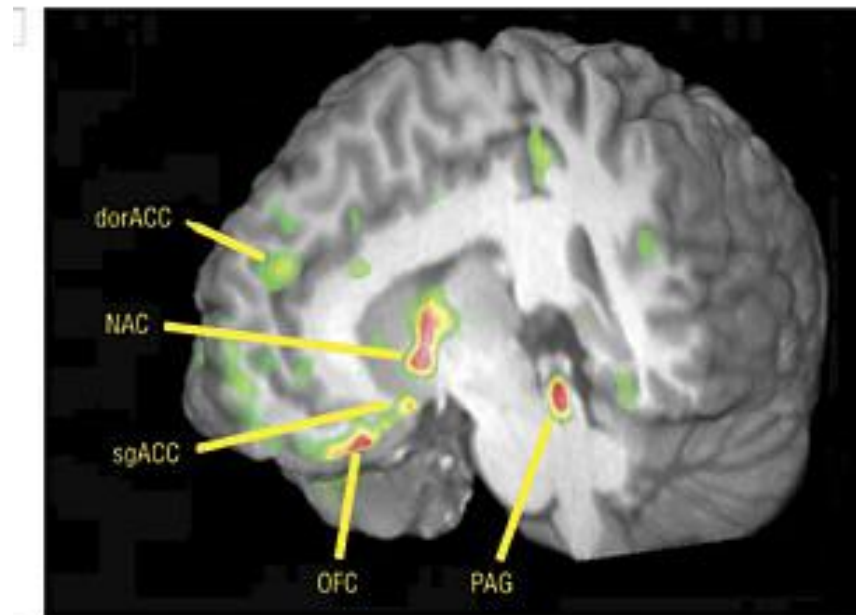


Pons

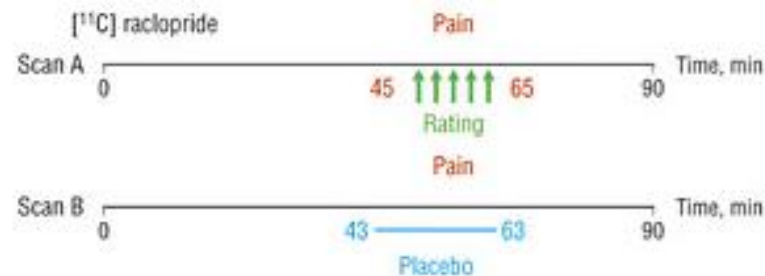
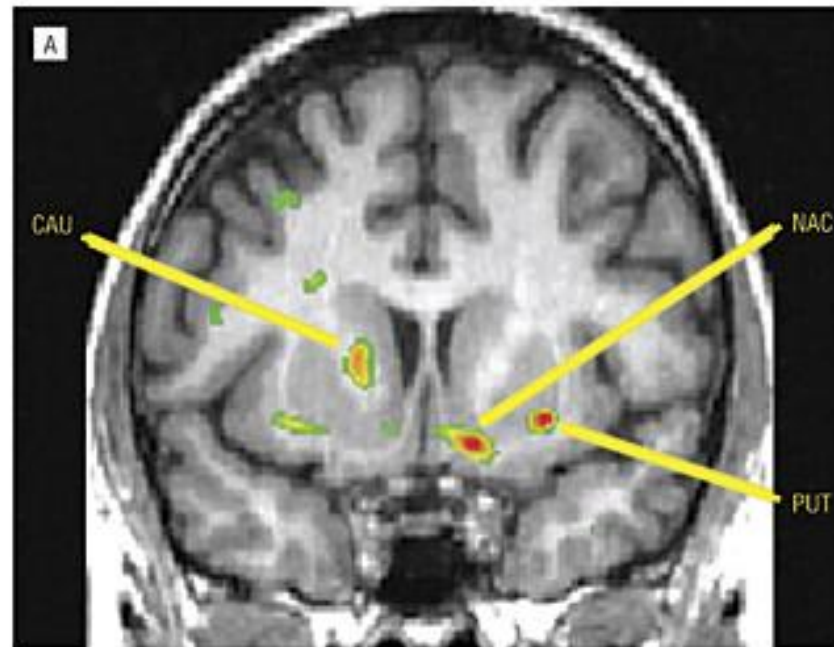
Pons



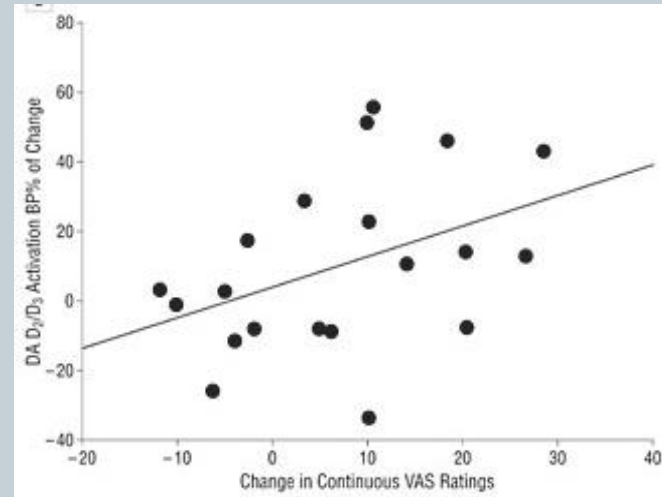
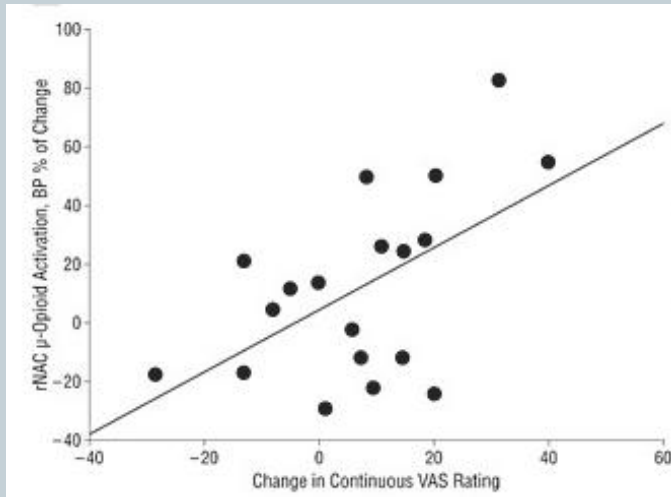
Placebo activates mu-opioid receptors



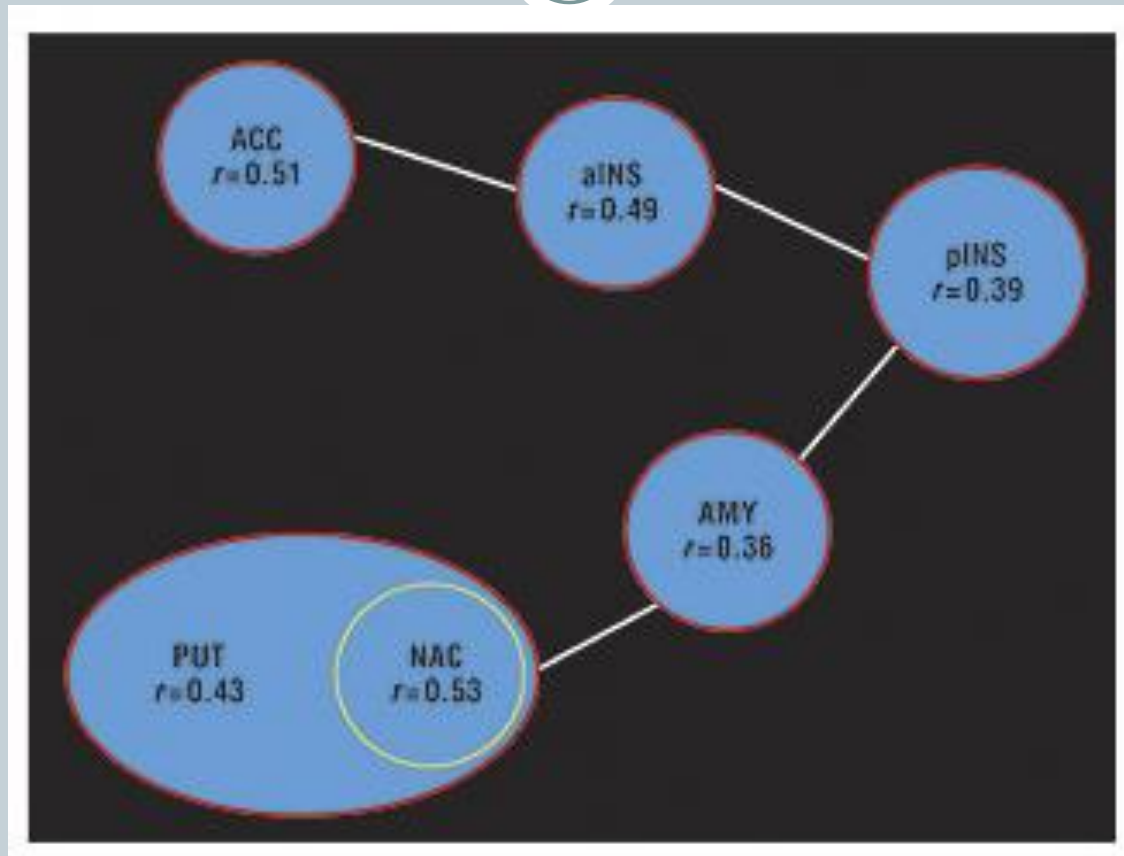
Placebo activates dopamine D2/D3 receptors



Placebo-induced opiate and dopamine activations related to analgesia

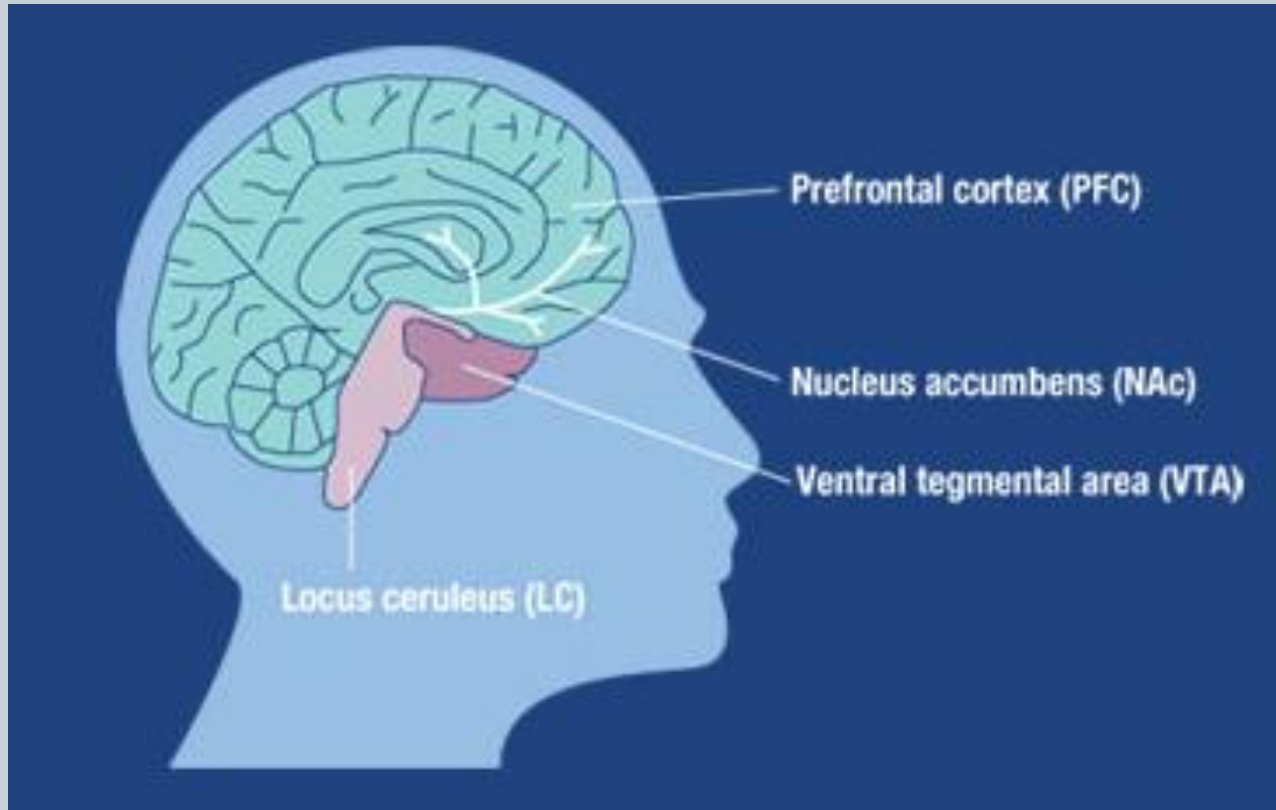


Imaging allows us to look at how opiate and dopamine systems may work together in producing placebo effect



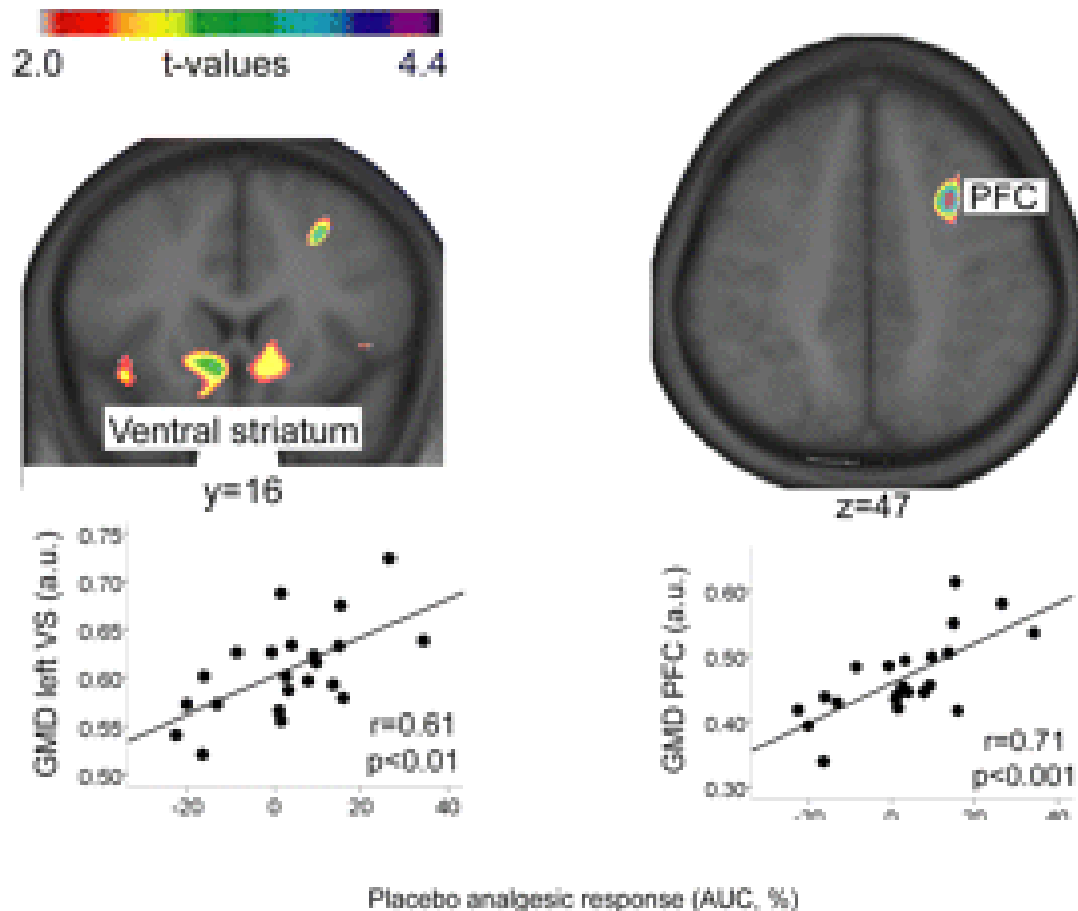
Correlation between placebo-related dopamine activation in nucleus acumbens and opiate activations

Anticipation of clinical benefit may be a type of reward anticipation



Placebo effect may involve dopamine mesolimbic reward system

Anatomical imaging shows that magnitude of placebo analgesia correlates with gray matter density in parts of reward system

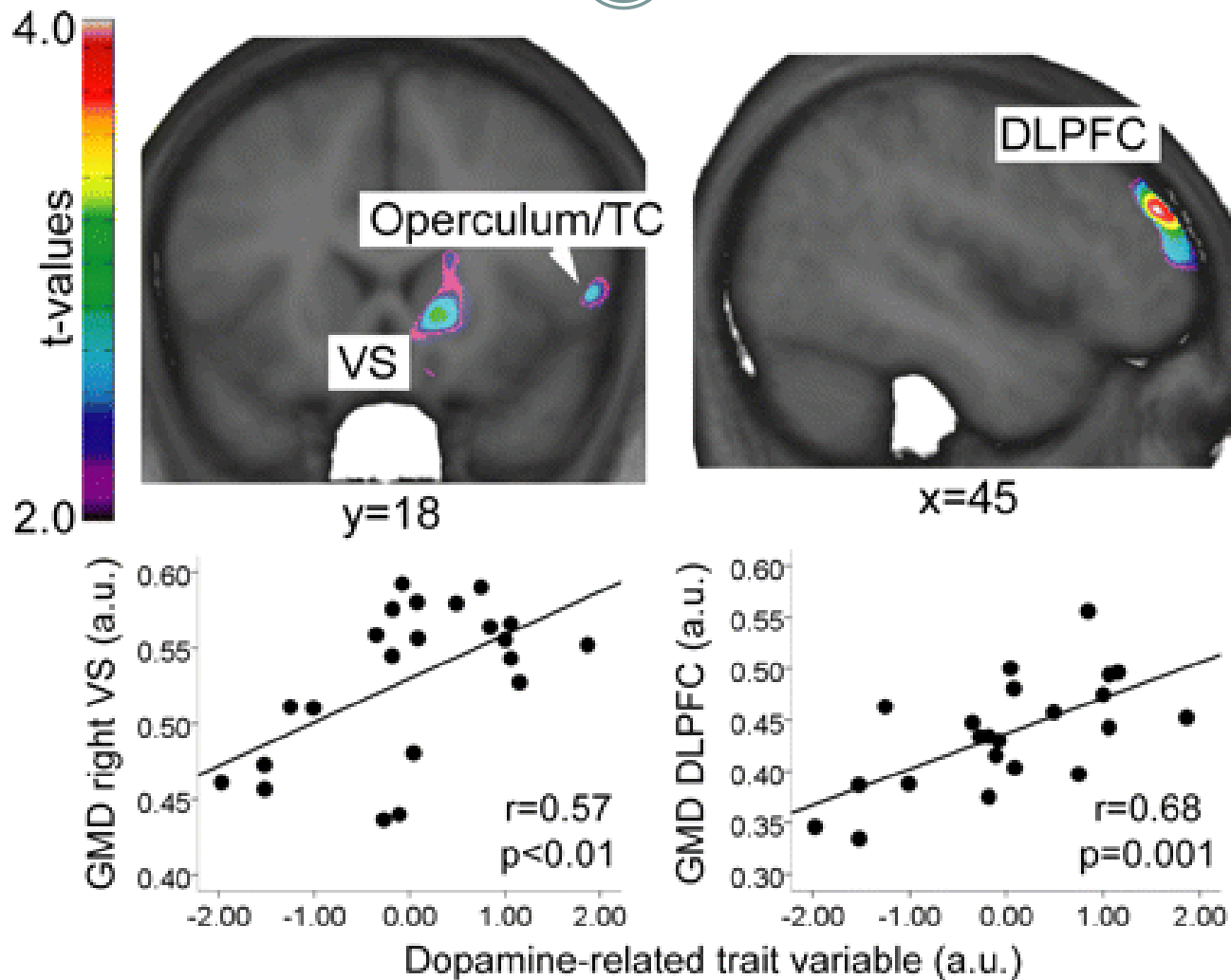


Dopamine-related traits explain ~30% of the variance of placebo-induced analgesia



- Traits related to dopamine neurotransmission:
 - Novelty seeking
 - Behavioral drive
 - Fun seeking
 - Reward responsiveness
 - Harm avoidance (negatively correlated)

Dopamine-related trait correlates with gray matter density in ventral striatum and prefrontal cortex



Summary



- Functional MRI reveals that expectation-related placebo analgesia activates descending modulatory systems.
- PET imaging shows how both opiate and dopamine systems are involved in placebo analgesia.
- Anatomical imaging reveals that individuals high in dopamine-related traits may be better placebo responders.