The role of the opioid system in decision making and cognitive control

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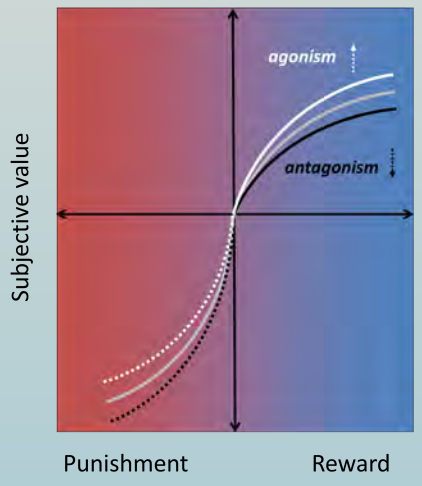
Why this review paper?

- Opioid peptides play an import modulatory role in neural signalling. Mu-opioid receptors are densely distributed in valuation and control regions. What is the current evidence that the opioid systems plays a role in decision making and cognitive control?
- Animal studies have suggested that stimulating mu-opioid receptors shifts liking, but also wanting and learning. Do opioids also shift value-based decision making in humans?
- Acute and chronic opioid use has often been associated with impaired concentration. Which cognitive control components are exactly modulated by opioids?
- This review summarizes what we currently know about acute effects of opioid drugs in healthy humans.

Marie & Siri @ University of Oslo

Summary Decision Making

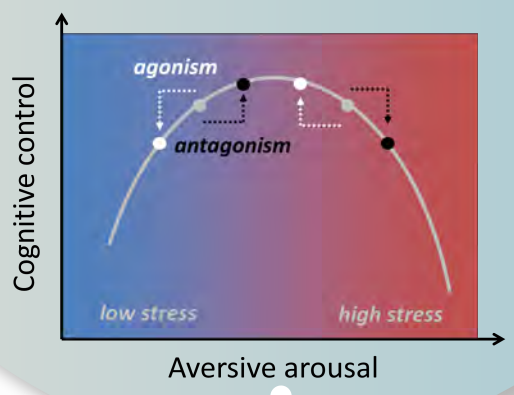
- Initial evidence that opioid antagonists reduce outcome pleasantness.
- Stimulating opioid receptors enhances and blocking opioid receptors reduces the motivational value and learning of high-value outcomes.
- Impulsivity (delay discounting) not modulated by opioids.



- Proposal: opioid drugs shift the subjective value of reward. Similar modulation may occur for punishment but more research is necessary.

Summary Cognitive Control

- Opioid agonists impair digit symbol substitution and logical reasoning, but high-dose effects could be due to sedation. No consistent effects of opioid drugs on working memory and attention.
- Some findings suggest that small dose of opioid agonists actually improves performance under stress.
- Working hypothesis: (endogenous) opioids dampen aversive arousal, which in turn can modulate cognitive control.



Opioids play a key role in pleasure and pain.

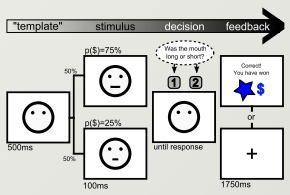
But how do they impact cognition?

This field is in its infancy!

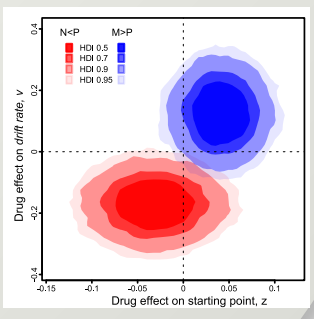
- Examples of future work:
  - What is the role of affective and motivational states?
  - How does the opioid system interact with other neurotransmitter systems?

Highlight from Oslo lab

- Mu-opioid agonists versus antagonists might have opposite effects on value-based choice.
- Participants did a two-alternative decision-making task known to induce a bias towards the most frequently rewarded response option.



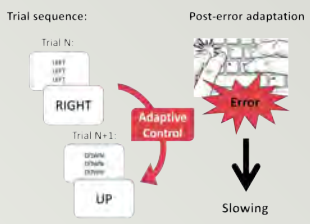
- Diffusion modelling results: 10 mg morphine (M) vs. placebo (P) increased preference for high-reward stimulus (starting point) and efficiency of evidence accumulation (drift rate). 50 mg naltrexone (N) produced opposite effect.



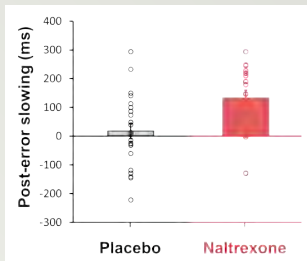
Eikemo et al. (2017). NPP

Highlight from Leiden lab

- Endogenous opioid tone might dampen the aversiveness of errors and conflict.
- Blocking the mu-opioid system using 50 mg naltrexone should increase the aversiveness of errors and conflict, which in turn should increase conflict-driven control.



- In line with predictions, naltrexone increased adaptations after errors (post-error slowing). Naltrexone did not increase conflict adaptation.



van Steenbergen et al. (2017). PNEC

Want to know more?
Check out our review paper:

van Steenbergen[¶], Eikemo[¶], & Leknes (2019). CABN

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