

# WP6:

Mechanisms of instrumental learning  
and the conscious experience of agency

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# Roadmap

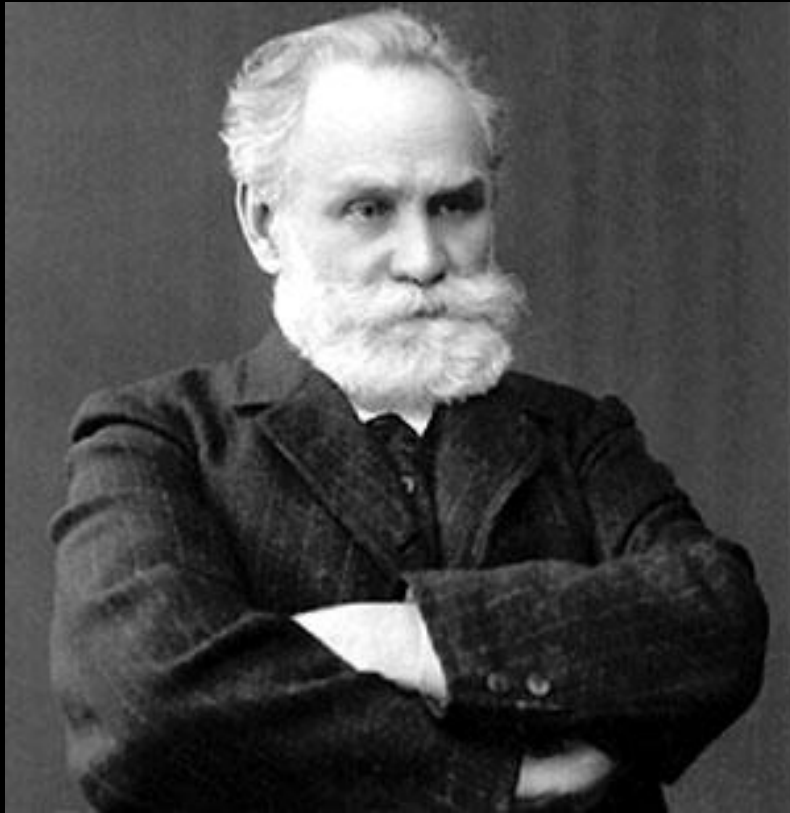
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1. Who cares about instrumental action?
2. How can we measure “Sense of agency”?  
What factors influence it?
3. EEG studies of prospective agency
4. Altered prospective agency in psychosis

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Ivan Pavlov (1849-1936)  
Stimulus → response



BF Skinner (1904-1990)  
Response → stimulus

# Impact and importance

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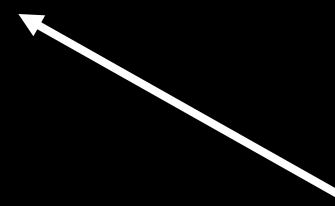
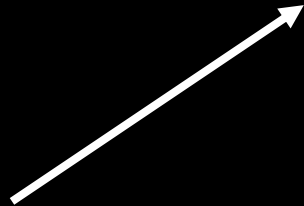
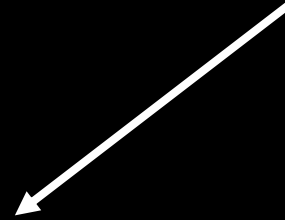
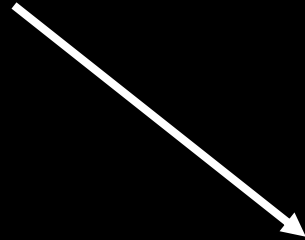
Technology

Psychopathology

Sense of agency

“Free will”

Responsibility



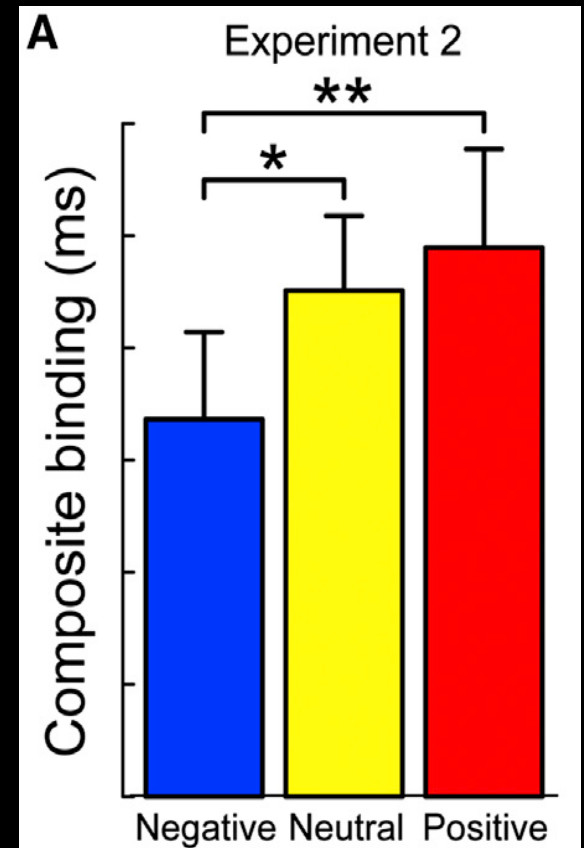
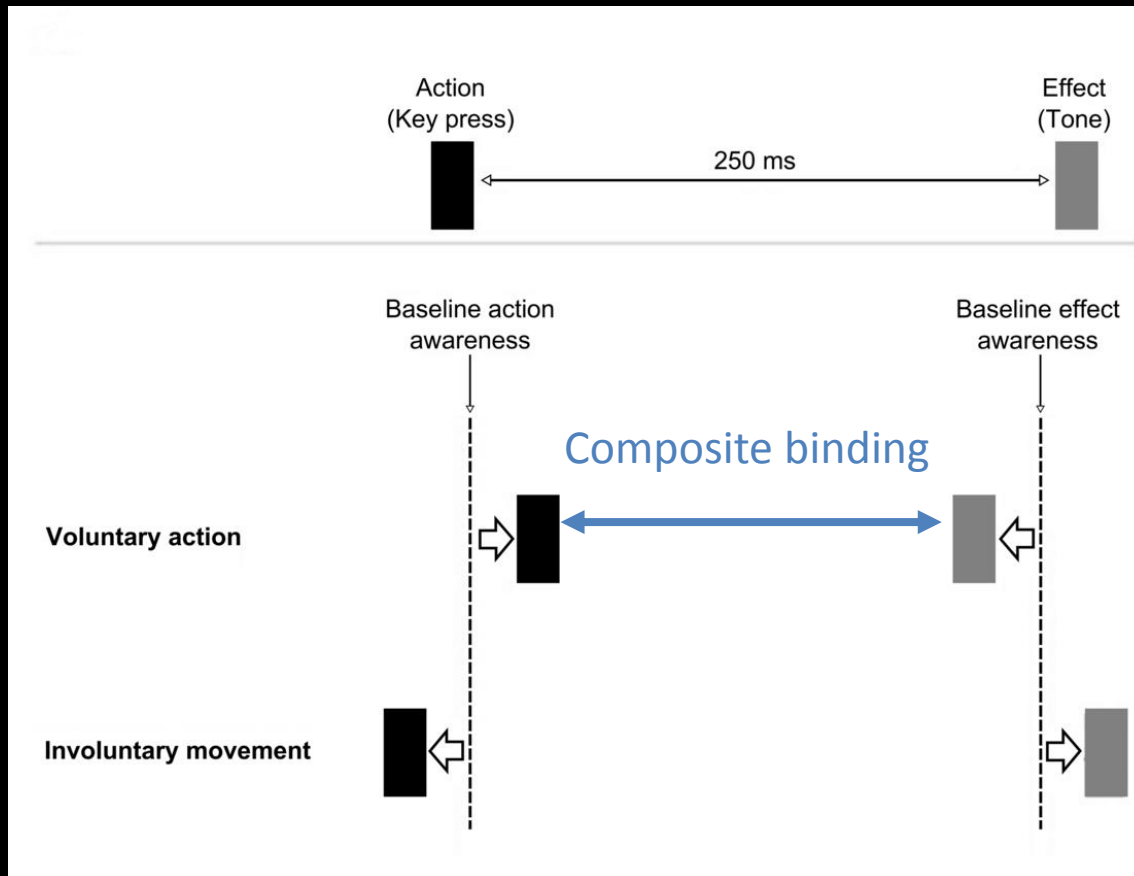
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# Sense of Agency

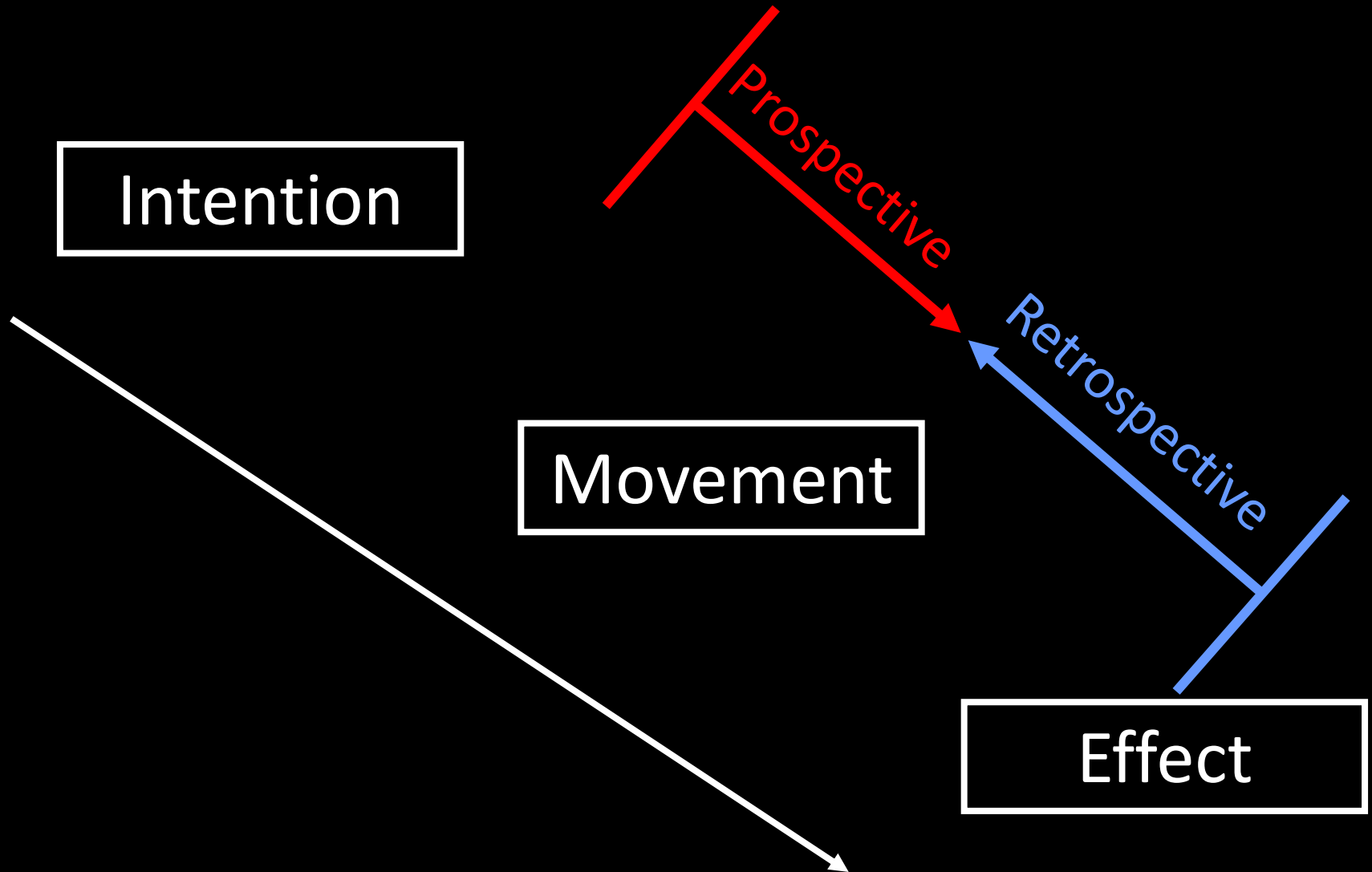
## Implicit Measurement and Sensitivity



# Sense of Agency

Prospective experience or post-hoc inference

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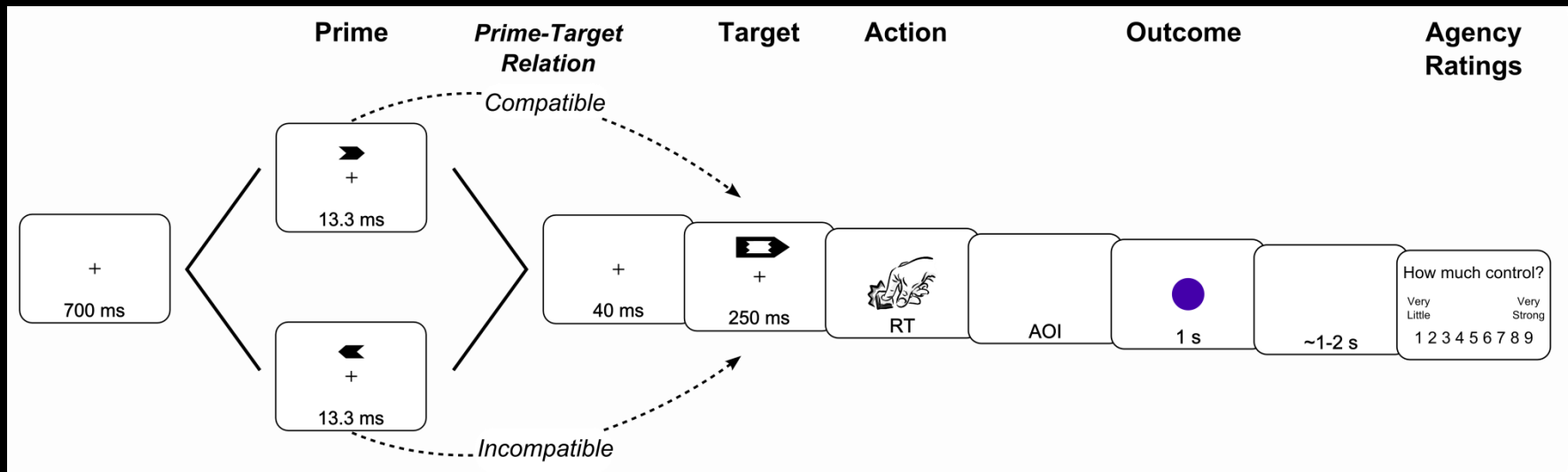
# Roadmap

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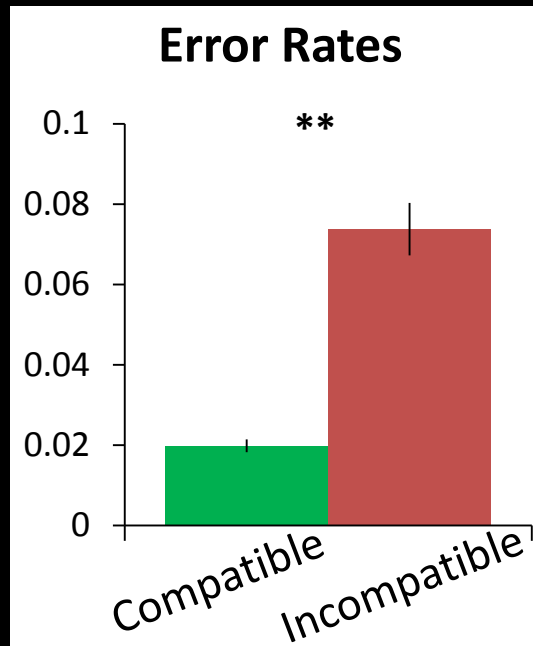
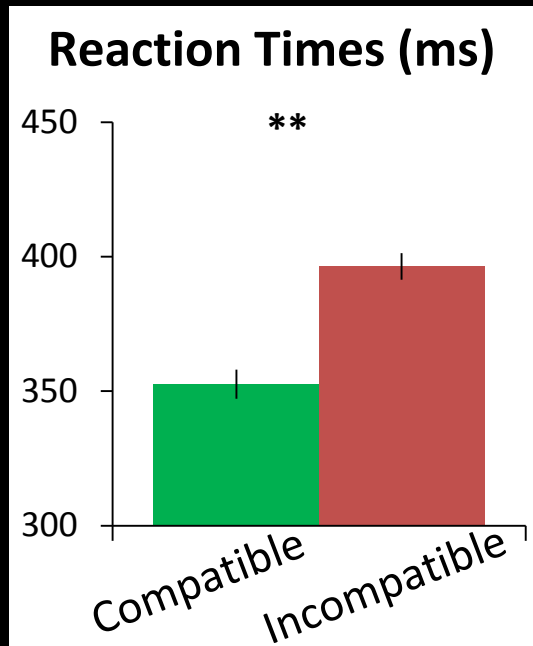
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# How we select an action influences sense of agency over action outcomes:

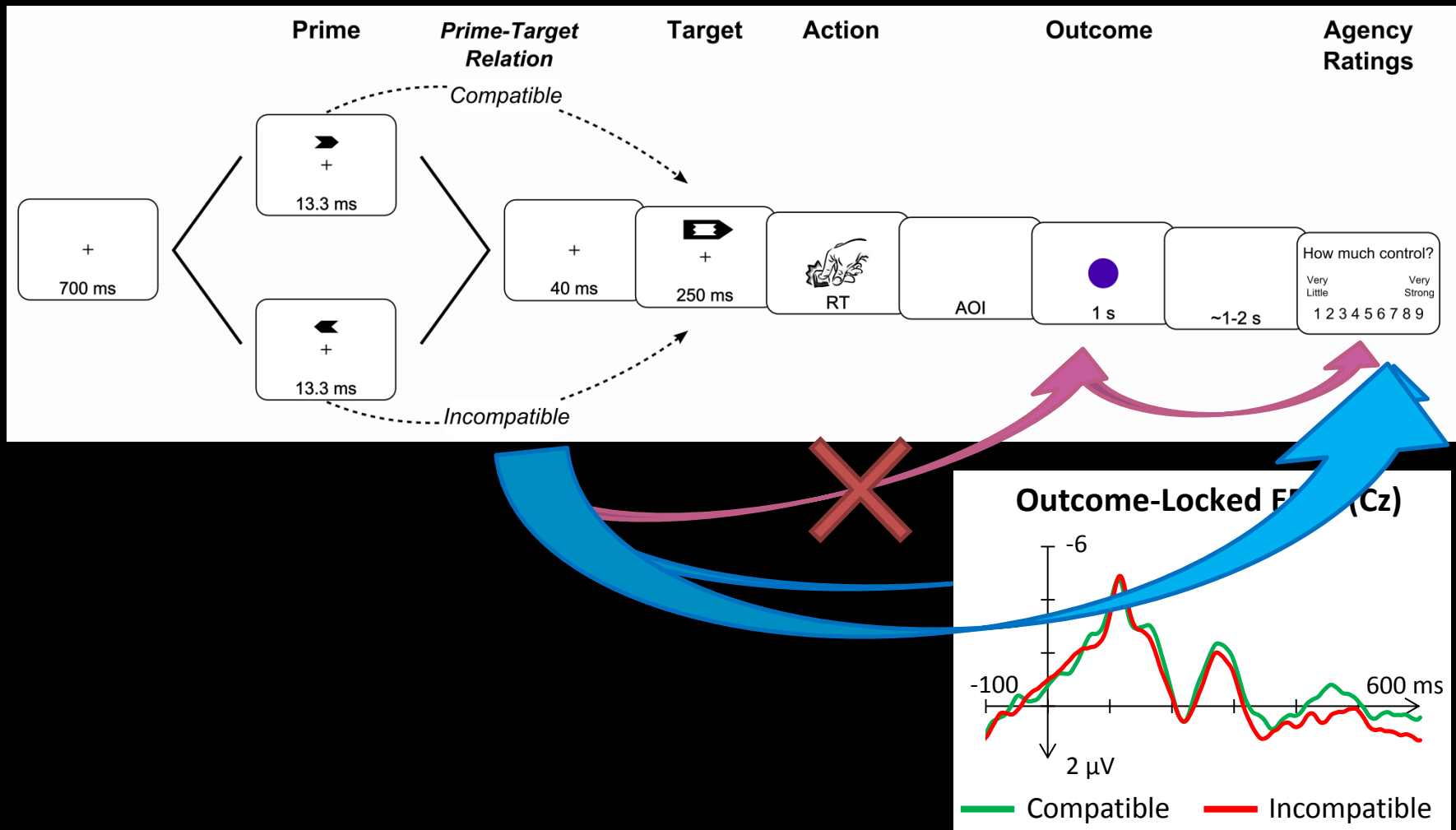
## Priming studies



# Action priming influences action selection... and sense of agency

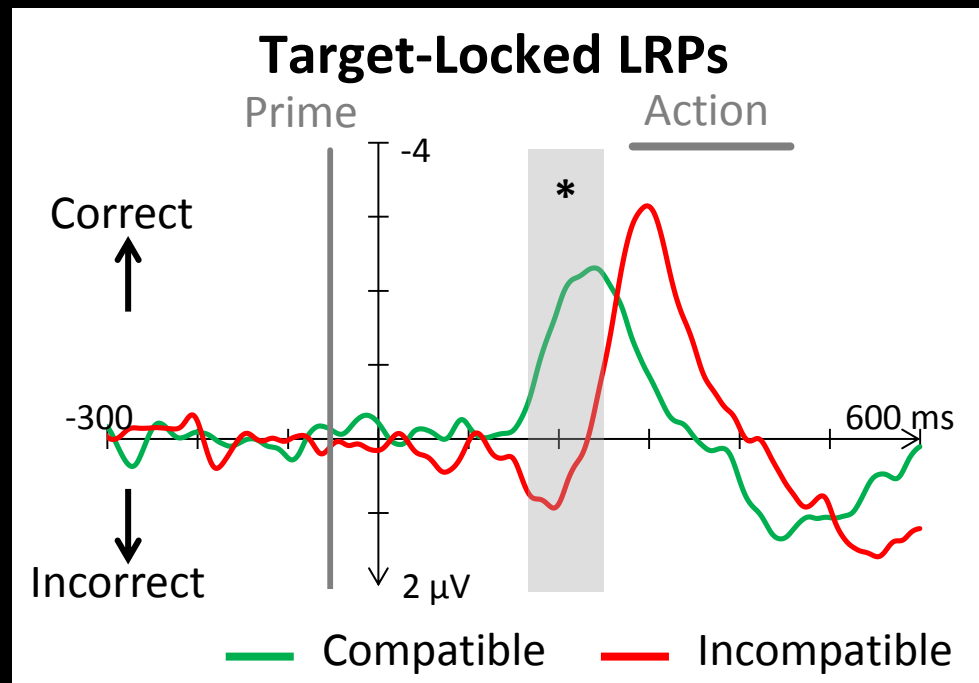


# EEG: what brain processes correlate with prospective Sense of Agency?



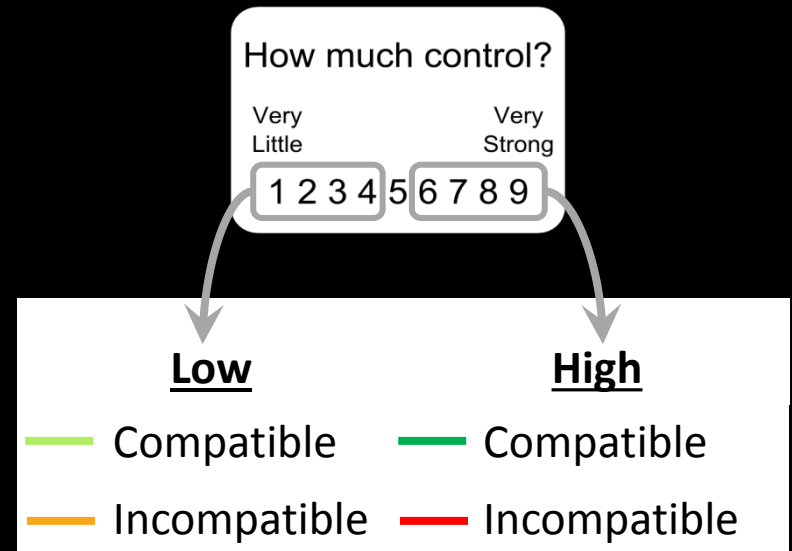
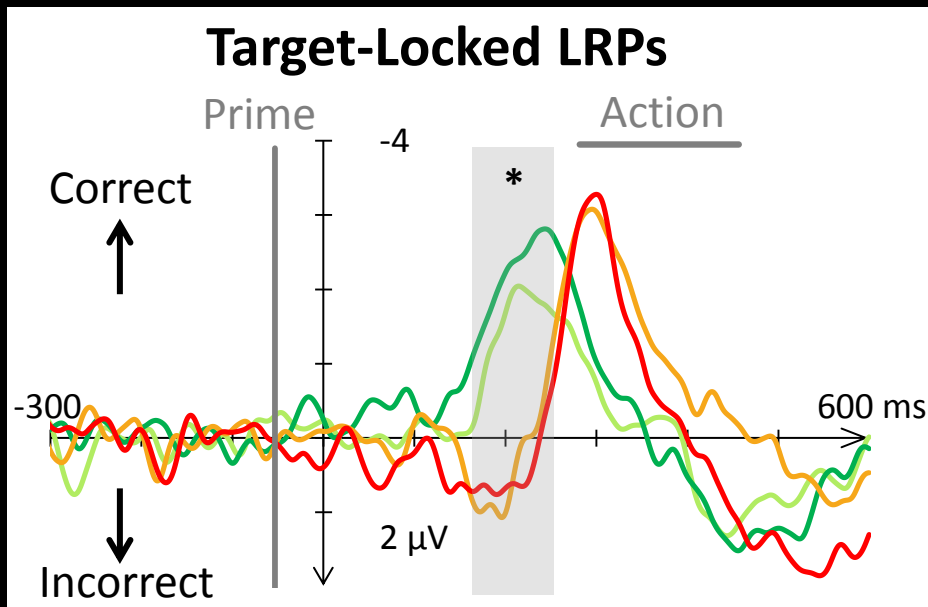
# Action priming affects neural correlates of action selection

- Lateralised Readiness Potentials (LRPs):
  - Reflect the degree of activation of the correct or incorrect response



# Fluent action selection leads to increased sense of agency

- Median split agency ratings. Compare LRPs for high and low agency ratings



For Compatible Priming:

- Trials with more successful, or fluent, action selection were associated with a higher Sense of Agency.

# Interim summary

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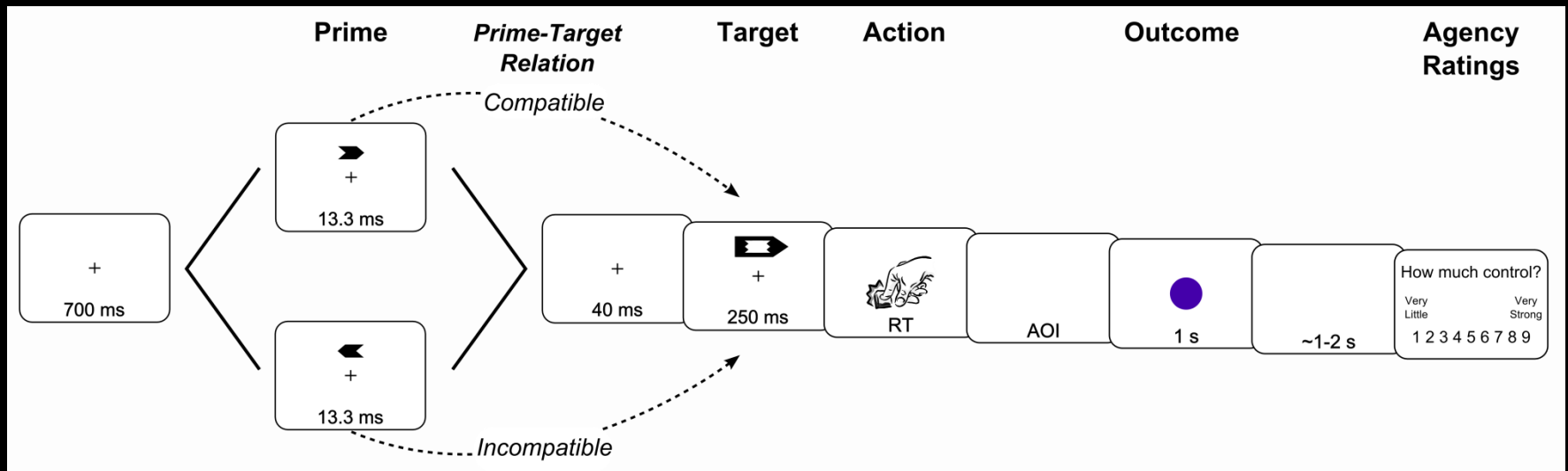
- Subliminally priming an action increases sense of agency over a subsequent outcome
- This prospective mechanism is based on action selection processes, not outcome monitoring

# Roadmap

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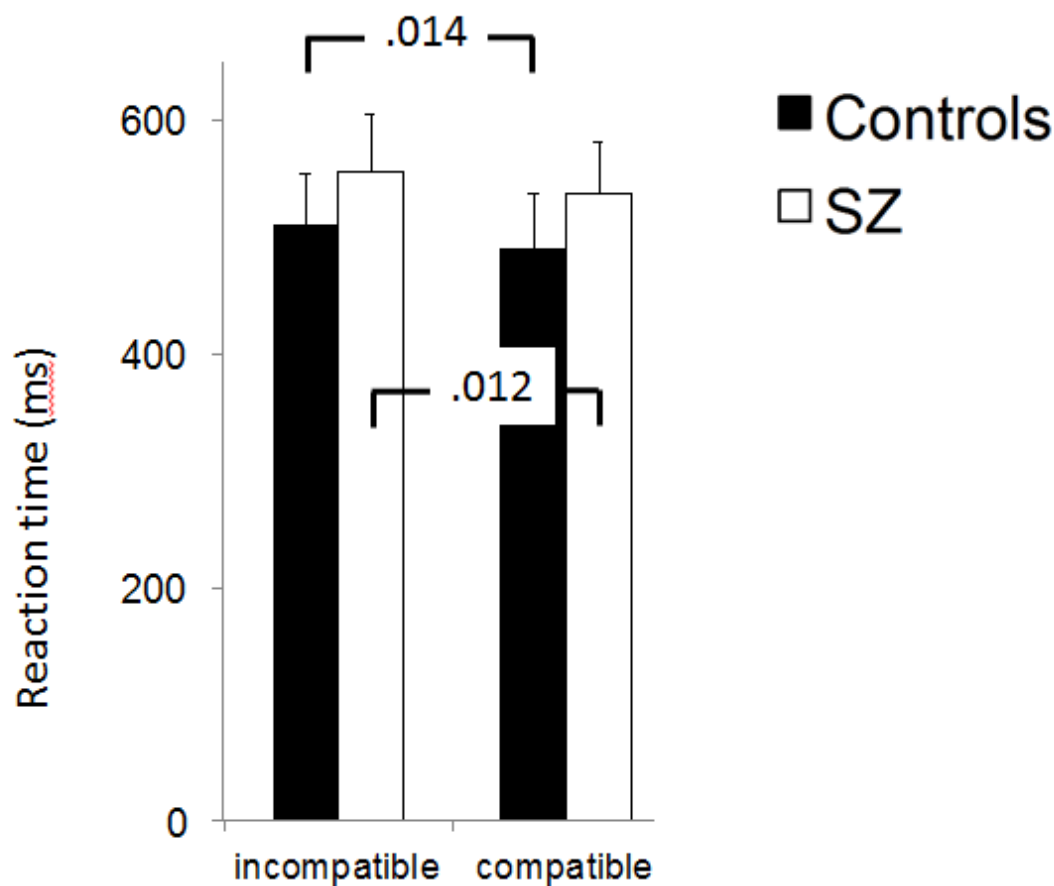
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# Action priming influences sense of agency over outcomes

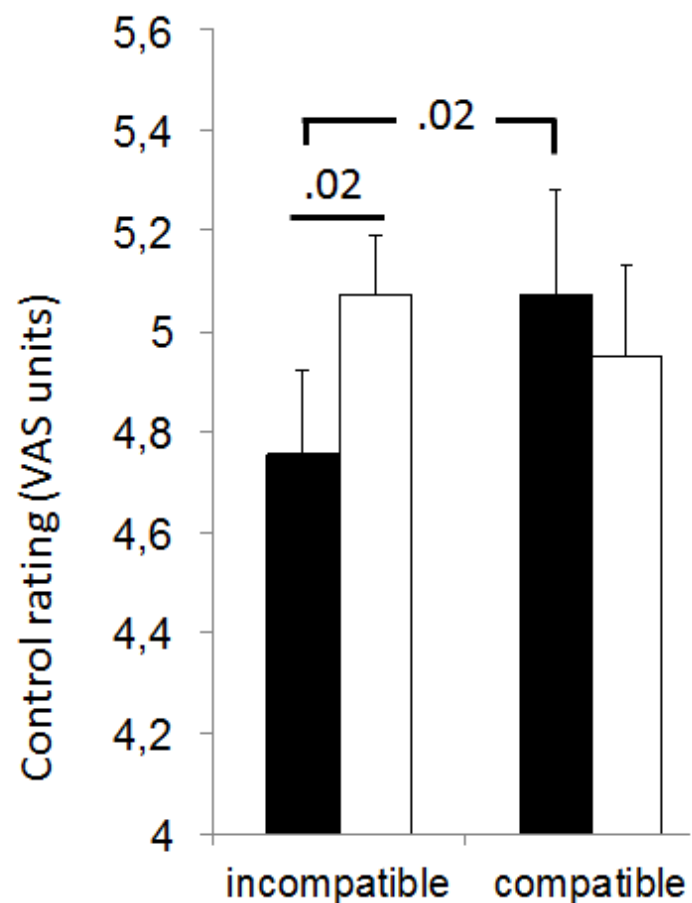


# Priming schizophrenics changes actions... but not sense of agency

## Reaction time

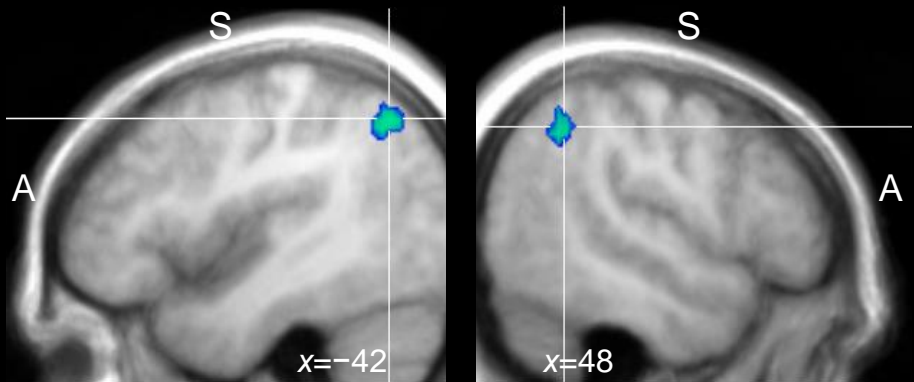


## Agency judgement

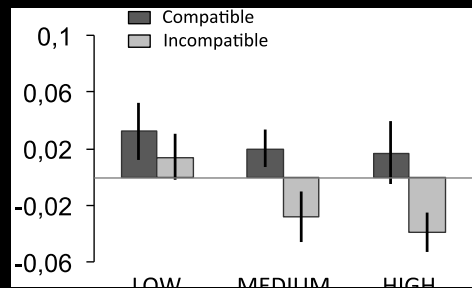


# Angular gyrus associated with *reduced* sense of agency for incompatible trials... but not in schizophrenics

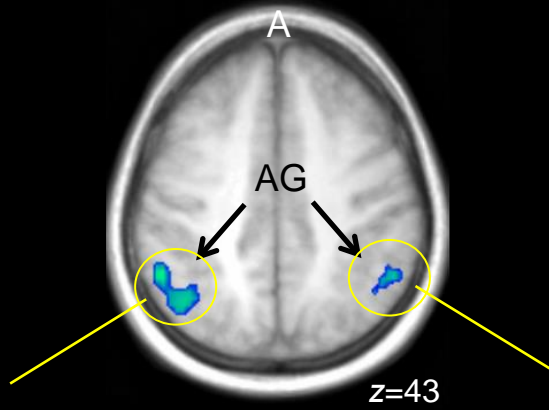
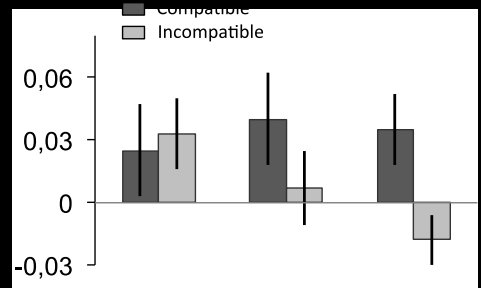
Group(control>patient) x Priming (incomp>comp)



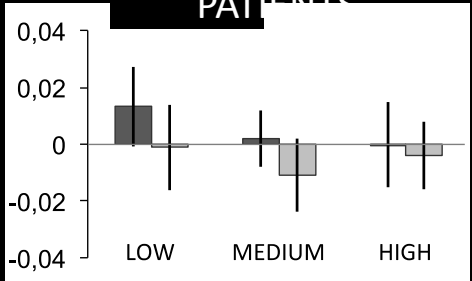
CONTROLS



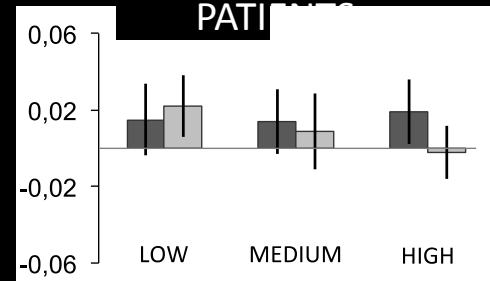
CONTROLS



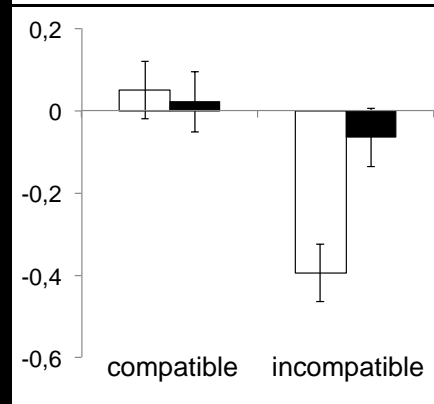
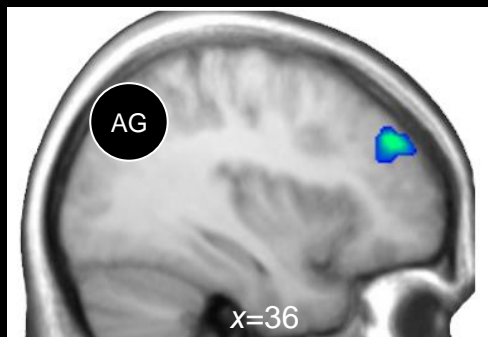
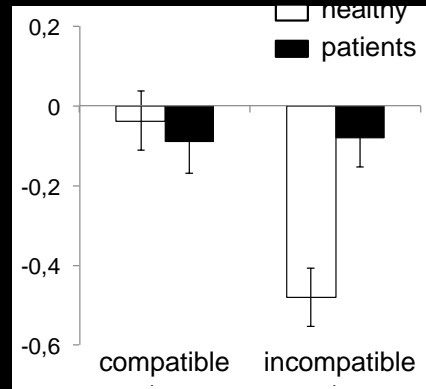
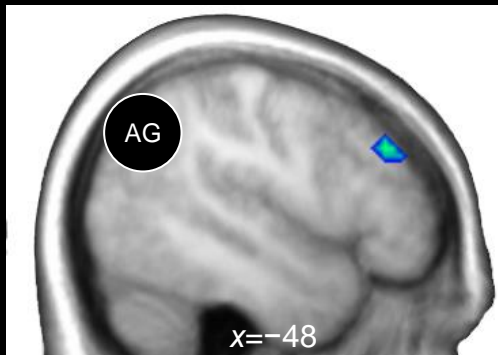
PATIENTS



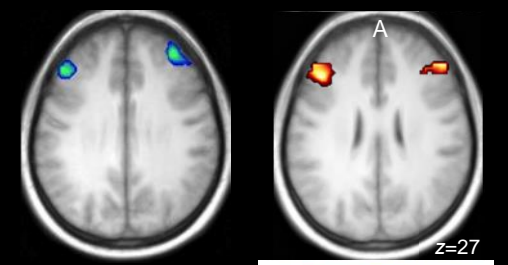
PATIENTS



# Fronto-parietal connectivity signals lack of control on incompatible trials... But not in schizophrenics



PPI with AG    Action selection



# Summary

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- Instrumental action produces a characteristic conscious experience
- But this experience is caused by unconscious mechanisms
- These mechanisms are predictive  
Therefore, it seems likely they are learned
- Disordered agency is common in psychiatry

# Research Questions, Future directions

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- Can we slow down action-outcome linkage to the timescale of neuroimaging?
- Why is agency learning so fast?
- Do we learn agency over our own body in the same way as over external events?

Thanks!

Collaborators: Nura Sidarus (UCL BELSPO)  
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Martin Voss (Charite Berlin, VW Stiftung)