

# Teaching and Making Mechanisms

## **Fifth Joint Workshop on Integrated History and Philosophy of Science ‘What is HPS for?’**

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# Mechanistic theories of Causality

- Machamer, Darden and Craver, 2000
- Craver, 2007
- Glennan, 2002
- Bechtel and Abrahamsen, 2005
- Woodward, 2002

# Mechanistic theories of Causality

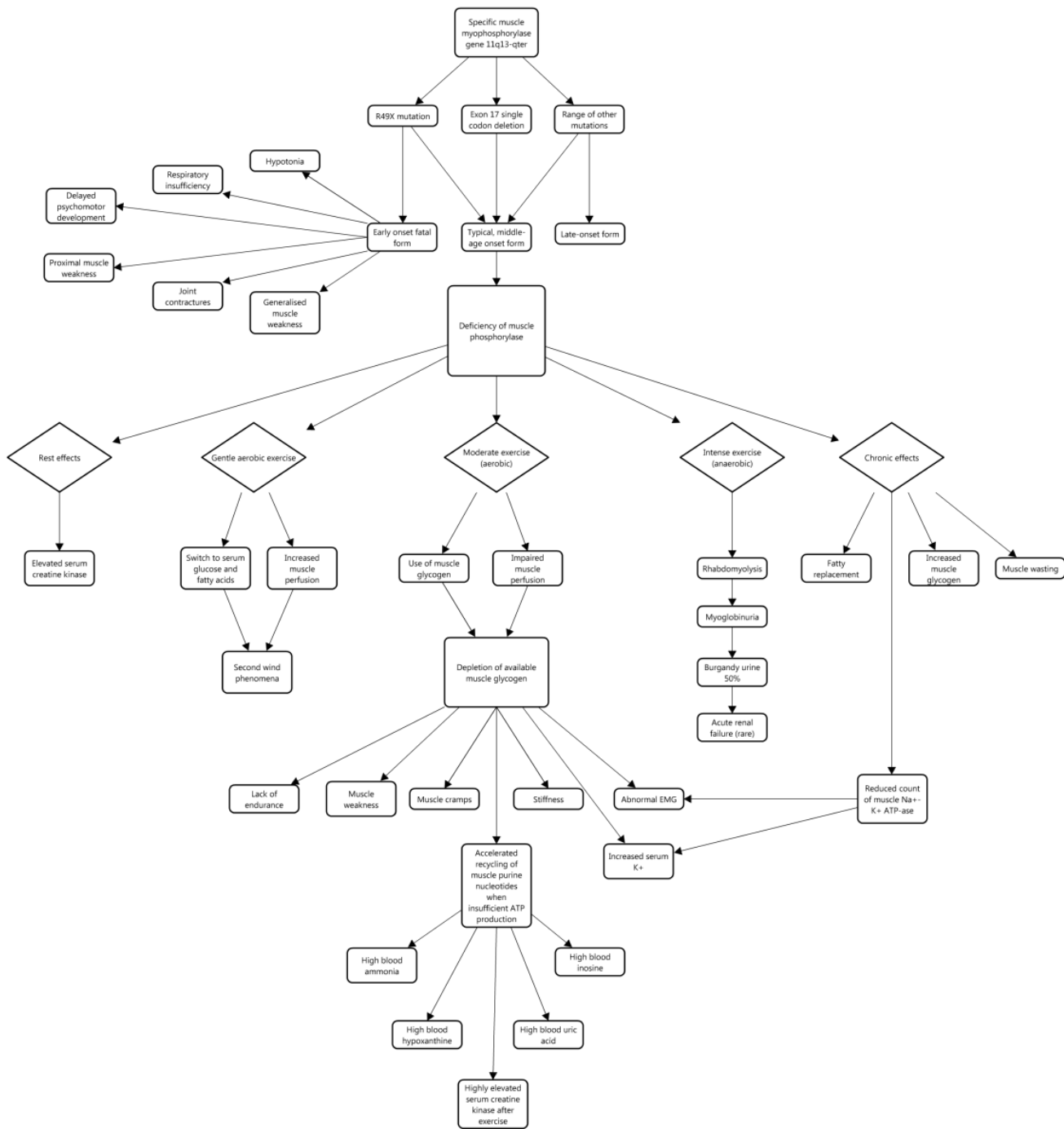
- Machamer, Darden and Craver, 2000
  - “Mechanisms are entities and activities organized such that they are productive of regular changes from start or set-up to finish or termination conditions”
- Craver, 2007
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# MDC

- Activity-entity ontic dualism
- Presented, initially, as a means of giving causal explanations
- Normative account

# How useful are mechanisms for teaching?

- About what?
- Science
- Causality and explanation



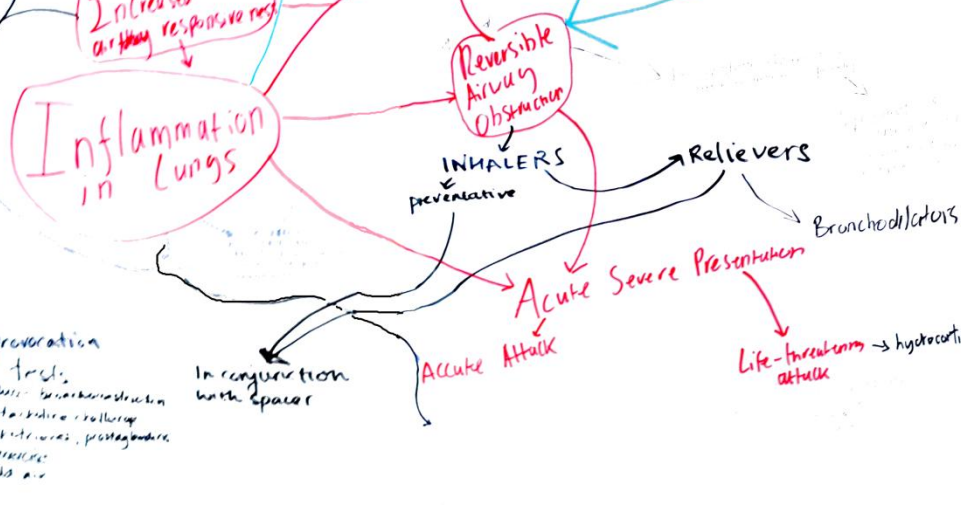
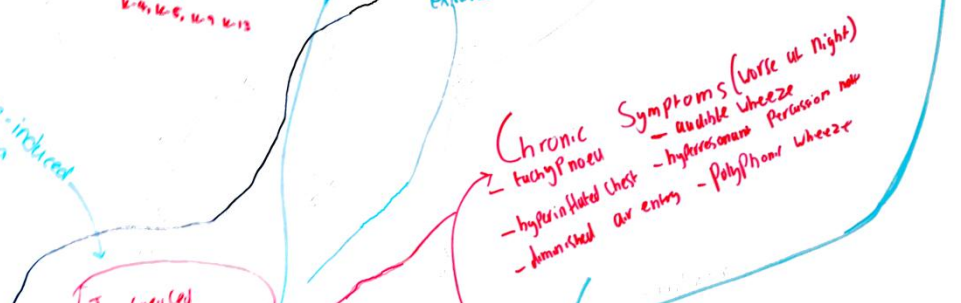
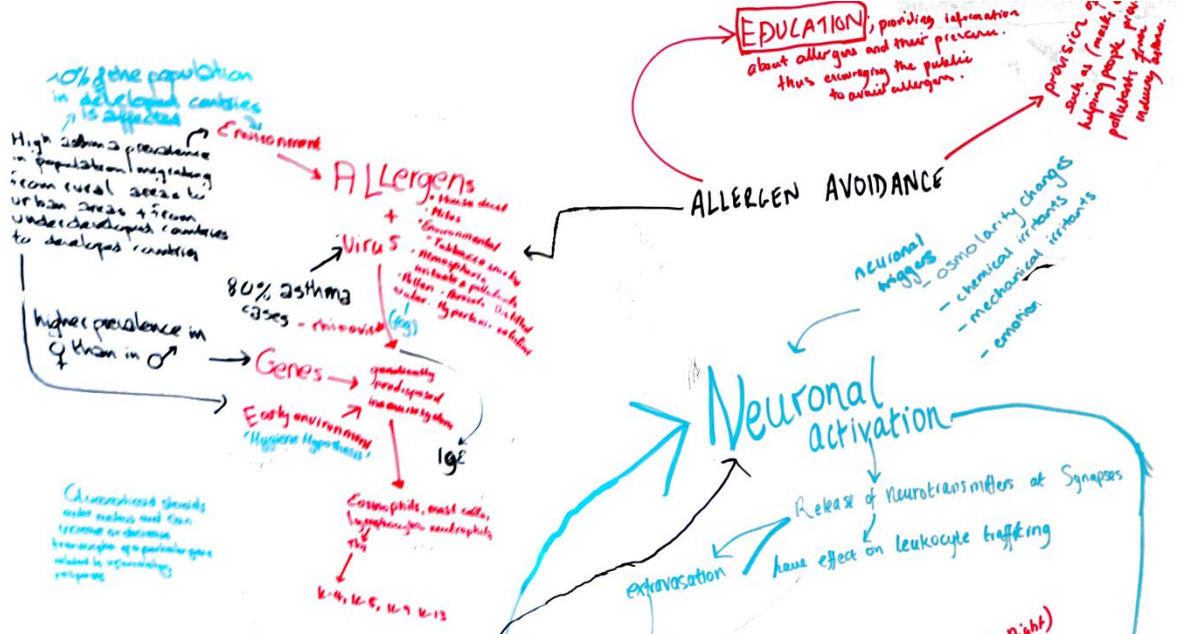
# Mechanisms for teaching

- Causality
- Bradford-Hill criteria ..
- strength (eg RR)
  - consistency, specificity
  - Temporal sequence
  - Biological gradient ( $\uparrow$  skin  $\rightarrow$   $\uparrow$  effect)
  - Coherence / plausibility
  - interventional evidence (reversibility)

# Mechanisms from teaching; or “Make me a mechanism...”

- 17 1<sup>st</sup> year medical students
- Familiar with MDC, 2000
- Make me the mechanism for asthma
  - Capable of giving causal explanations for likely clinical scenarios
    - Diagnosis
    - Treatment
    - Communication
    - ...





## Why so difficult?

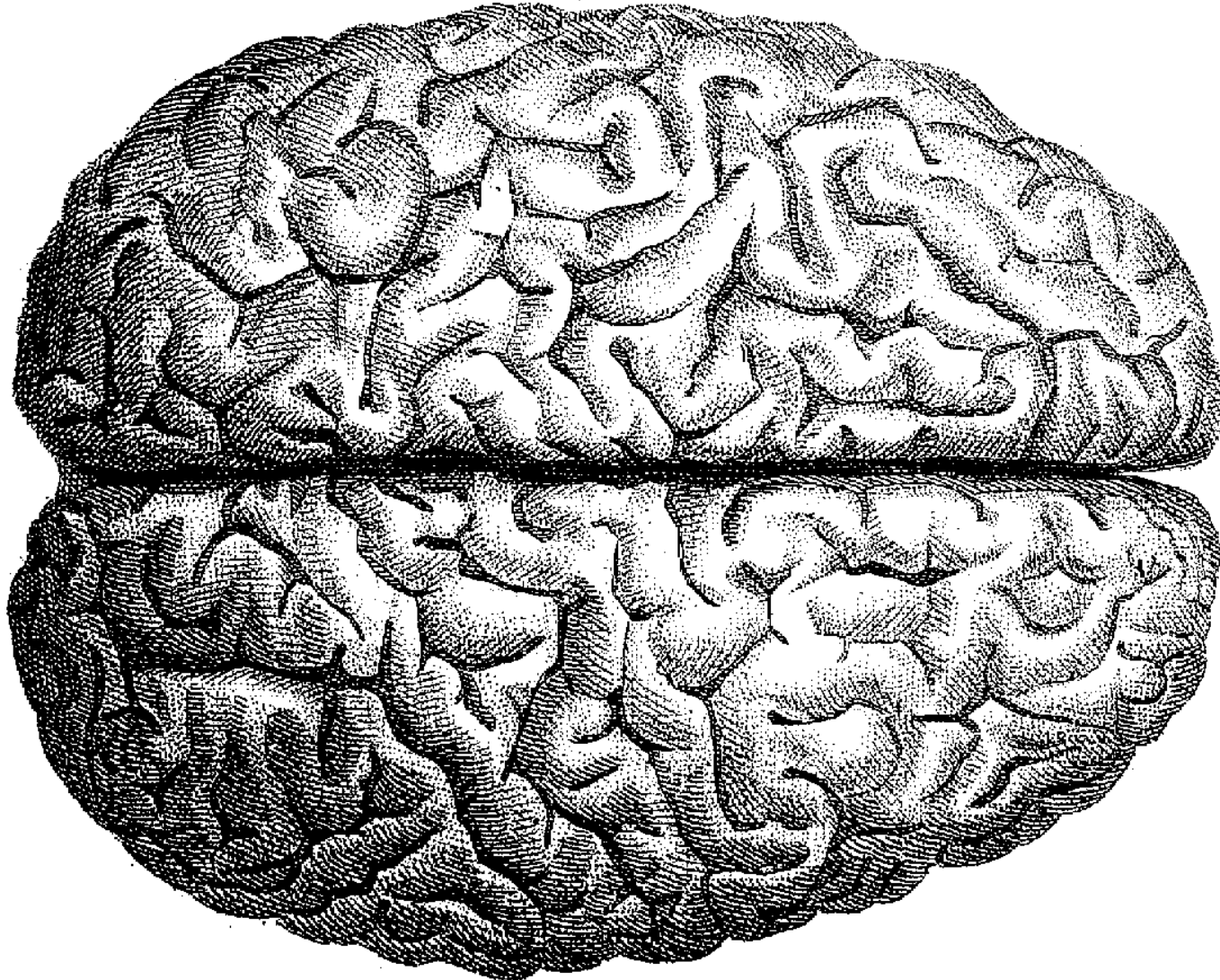
- Representation difficulties
- Model difficulties

# Mechanisms, models and representations

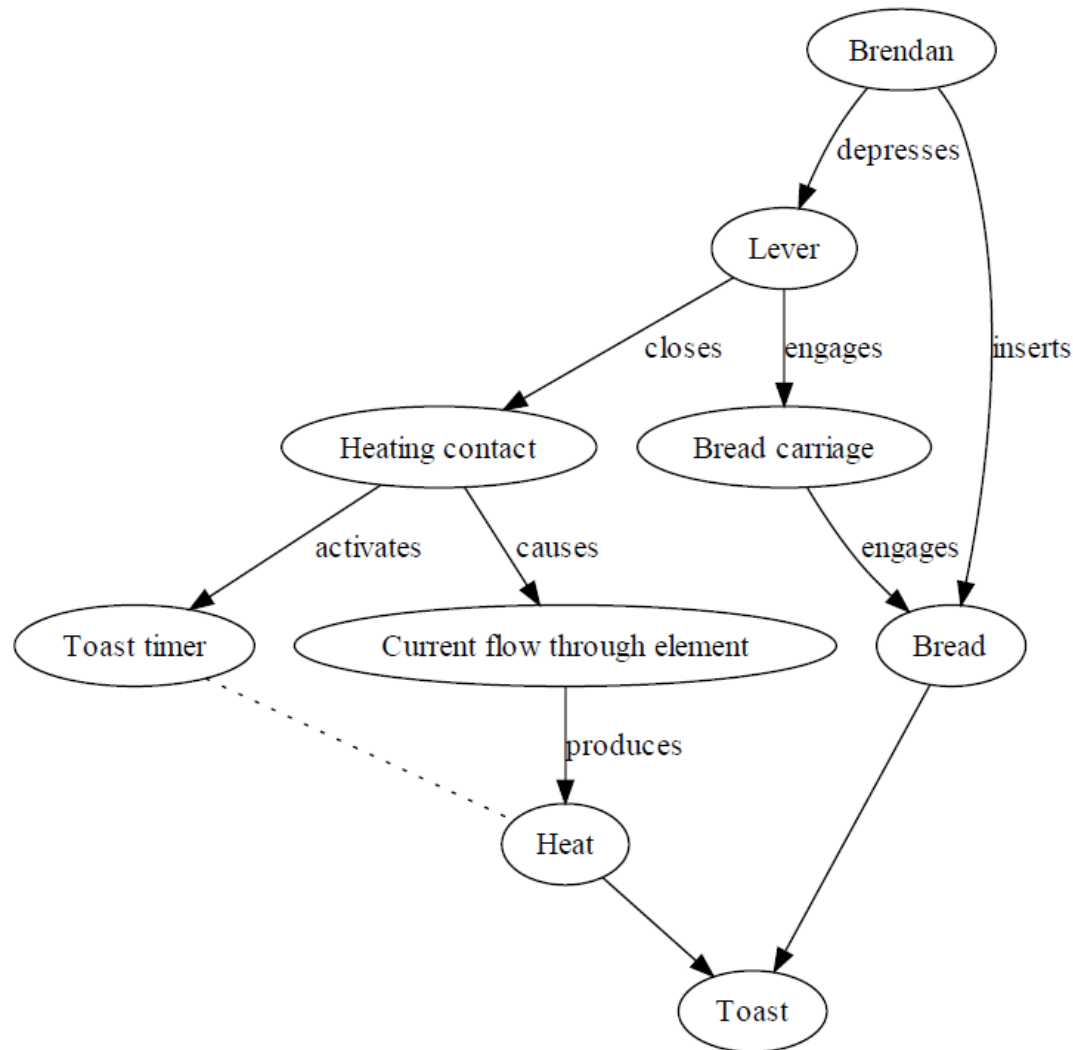
# Mechanism



# Mechanistic model



# Mechanistic model representation



# Representative difficulties

- Simple complexity
- Collaborative working
- Representational consistency versus conventions
- Gaps
- Stochastic / deterministic causes

## Model difficulties

- Complex complexity
- Local incommensurability
- Causes versus background conditions
- Level problems and bottoming-out
- Evidential complications



# The Complex Mechanism Browser

- Text input of causal claims
- Routing etc automated
- Ability to re-use sections of mechanism
- Clear visual differentiation between different relationships
  - *Causes*
  - *Similar*
  - *Background condition*
  - *Prevents*
  - *Dissimilar*
  - *Component*

# Glycogenolytic pathway

Muscle glycogen

causes

Glucose

causes

## Abnormal glycolysis

Abnormal glyceraldehyde phosphate dehydrogenase

?Iodoacetate

B.A.L

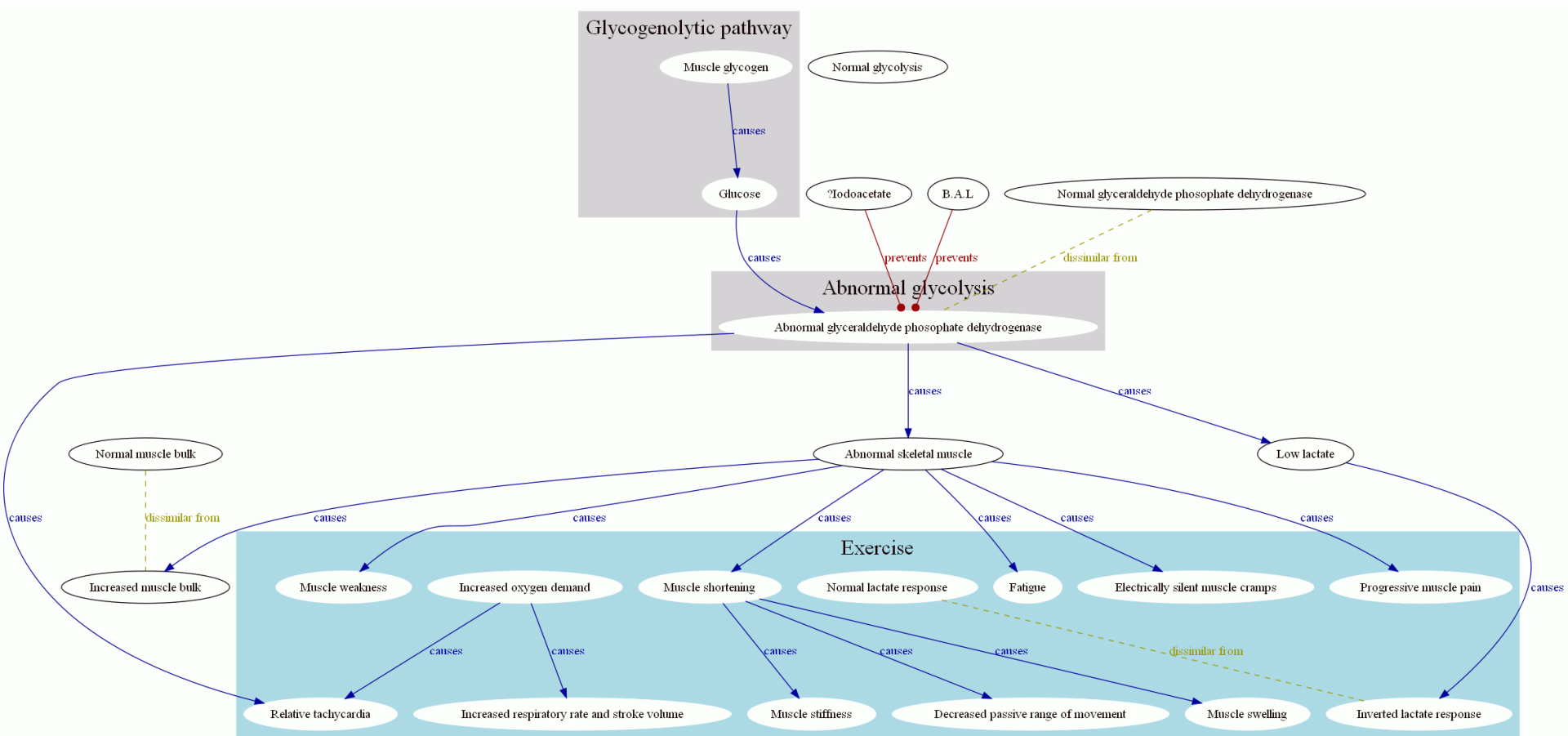
prevents prevents

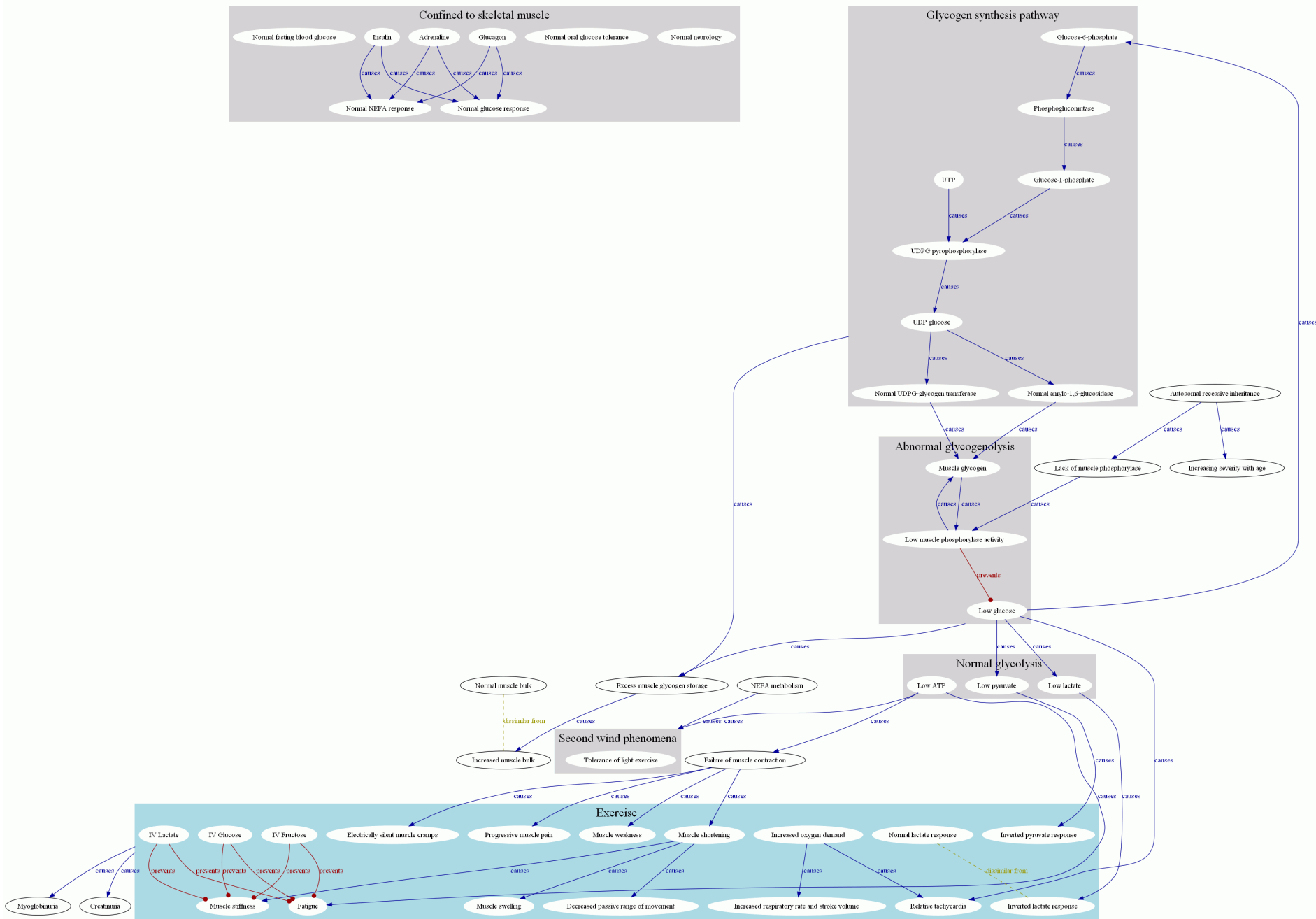
Normal glyceraldehyde phosphate dehydrogenase

dissimilar from

causes

causes





# Conclusions

- Mechanisms are normative
  - Teaching science
  - Teaching causality and explanation
- This normativity is challenged by the difficulties of constructing representations of mechanisms
  - Demonstrated in teaching
- Possible clarification:  
mechanisms/models/representations?
  - CMB
  - More teaching: more difficulties?

# Acknowledgements

- Year 1 SSC in Philosophy, Medicine and Society Students
- Graphviz - <http://www.graphviz.org>
- Carl Pappenheim (technical consultant on CMB)

# Bibliography

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  - “...a mechanism for a behaviour is a complex system that produces that behaviour by the interaction of a number of parts, where the interactions between parts can be characterized by direct, invariant, change-relating generalization.”
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- Woodward, 2002

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  - “A mechanism is a structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena.”
- Woodward, 2002

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  - “... a representation...of a mechanism...(i) describes an organized or structured set of parts or components, where (ii) the behaviour of each component is described by a generalization that is invariant under intervention, and where (iii) the generalizations governing each component are also independently changeable, and where (iv) the representation allows us to see how, in virtue of (i), (ii) and (iii), the overall output of the mechanism will vary under manipulation of the input to each component and changes in the components themselves.”