

The role of covariance in mechanistic explanations of cognition

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META 

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Intro



- Explanations in cognitive neuroscience both representational and mechanistic
- Covariance accounts of representational content based on:
 - Relations between stimulus/response pairings
 - Conditional probabilities of responses and stimuli
- Representational contents are not constituents of mechanistic explanations of cognition

Outline

1) Covariance

2) Mechanisms

3) Probabilities

4) Locality

5) Mutual manipulability





1. Covariance

- Response R_a represents stimulus S_a , if mutual information between R_a and S_a is higher than
 - mutual information between R_a and all $S \neq S_a$
 - mutual information between S_a and all $R \neq R_a$

$$\frac{p(R, S)}{p(R)p(S)} = \frac{p(R \subset S)}{p(R)} = \frac{p(S \subset R)}{p(S)}$$

2. Mechanisms

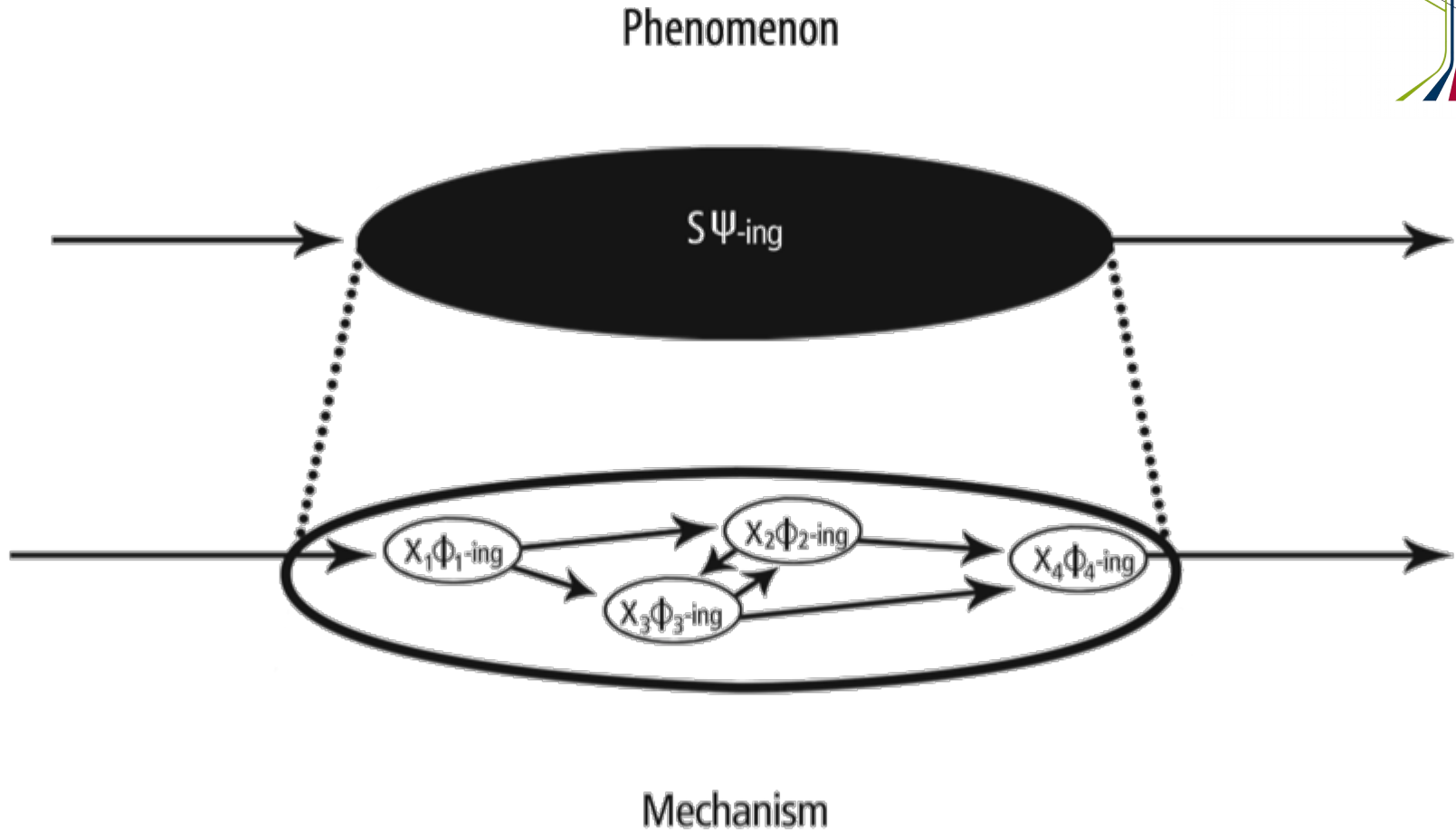


- Explain by decomposition into constituent entities and activities

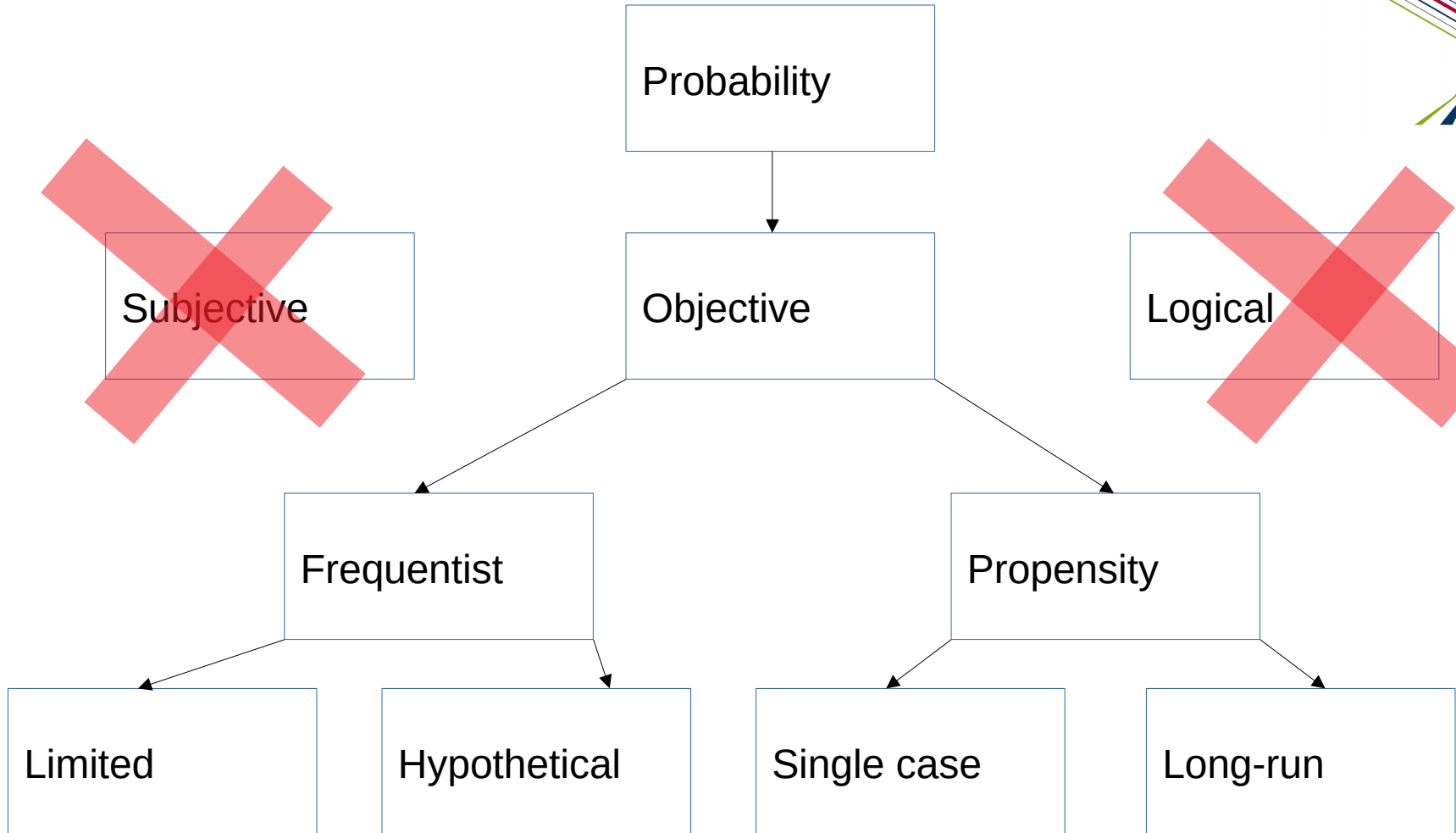
According to the mutual manipulability account, X 's ϕ -ing is a constituent of S 's ψ -ing iff:

- (i) X is part of S ;
- (ii) in the conditions relevant to the request for explanation there is some change to X 's ϕ -ing that changes S 's ψ -ing; and
- (iii) in the conditions relevant to the request for explanation there is some change to S 's ψ -ing that changes X 's ϕ -ing (Craver 2007b, 153)

2. Mechanisms



3. Probabilities



3. Probabilities – frequentism



- Key idea: probabilities just are frequencies
- Limited frequentism: frequencies of actual outcomes of a type from set of outcomes
- Hypothetical frequentism: limiting frequencies of outcomes in an infinite collective of outcomes



Dots on die	Times rolled (use tally marks)	Percentage of rolls
1		
2		
3		
4		
5		
6		



3. Probabilities - propensities

- Key idea: probabilities are dispositions to produce outcomes
- Long-run: dispositions to produce certain limiting frequencies on repetition
- Single-case: dispositions to produce particular outcomes



4. Locality

- Mechanistic explanation local
- Constituent entity must be in spatiotemporal region of phenomenon to be part of the mechanism
- Constituent activities must take place during the occurrence of the phenomenon to be part of the mechanism



4. Locality - properties



- Applies to properties analogously as to activities
- Relational properties: only if all relata are also local
- Jack's being widowed = that Jack's spouse has died

4. Locality - relation



- Contents depend on relation between stimulus/response pairings
- Only some of these pairings are instantiated in the spatiotemporal region of the phenomenon
- Others might be instantiated in other phenomena
- But they might also remain uninstantiated or counterfactual
- So contents are non-local to cognitive phenomena

4. Locality – frequentist probabilities



- $P(R|S)$ and $P(S|R)$ are frequencies of R and S respectively in conditions characterised by S and R respectively
- At most one instance of the appropriate conditions is local to cognitive phenomena
- The frequencies into which probabilities resolve depend on all instances of the appropriate conditions
- In case of infinite frequentism, probabilities depend on hypothetical frequencies



4. Locality - propensities

- $P(R|S)$ and $P(S|R)$ are dispositional properties of chance setups – dispositions (propensities) to produce some outcomes
- Propensities are local if chance setups are local
- For $P(R|S)$, the chance setup includes the stimulus conditions by definition
- $P(S|R)$ might be unintelligible on the propensity account



5. Mutual manipulability (MM)



(CR1) When φ is set to the value φ_1 in an ideal intervention, then ψ takes on the value $f(\varphi_1)$ (Craver 2007b, 155)

(CR2) When ψ is set to the value ψ_1 in an ideal intervention, then φ takes on the value $f(\psi_1)$ (Craver 2007b, 159)

5. MM – ideal interventions



- (I1c) the intervention I does not change ψ directly;
- (I2c) I does not change the value of some other variable ϕ^* that changes the value of ψ except via the change introduced into ϕ ;
- (I3c) ... I is not correlated with some other variable M that is causally independent of I and also a cause of ψ ; and
- (I4c) ... I fixes the value of ϕ in such a way as to screen off the contribution of ϕ 's other causes to the value of ϕ . (Craver 2007b, 154; see also Woodward 2003, 98)

5. MM – frequentist probabilities



- Hypothetical frequentism: no top down interventions on probabilities
- Inserting a finite number of divergent outcomes into the infinite collective will not change the limiting frequency of the different outcome types in the collective



5. MM - propensities



- Propensities are properties of chance setups
- Boundaries of chance setups unclear, as we saw
- Interventions on the phenomenon with respect to representational contents will not set the propensity in an identical chance setup, but change the chance setup altogether
- $P(R|C_1) - P(R|C_2)$ – these are different propensities





Thanks for attention.