Resting state functional connectivity (RSFC) studies discovered coherent patterns of endogenous brain activity in the absence of a cognitive task, but the functional role of this activity remains disputed. 

Bechtel has argued that endogenous activity plays a direct role in cognition [1]. I argue that he overlooks the alternative view that endogenous activity is an enabling condition for cognition because it maintains functional systems [2]. 

After reconstructing the arguments for both views, I assess their empirical support and suggest a schema to experimentally test between them.

### Direct role view

- RSFC studies measure endogenous activity
- Cognition is operationalized as information processing relevant to behavior [3]
- Endogenous activity modulates behaviorally relevant information processing [4]
- Endogenous activity in RSFC studies plays a direct role in cognition [1]

### Enabling condition view

- RSFC studies measure endogenous activity
- Cognition is enabled by maintenance of functional systems in the face of decay [5]
- Endogenous activity contributes to maintaining brain-wide functional organization [6]
- Endogenous activity in RSFC studies is an enabling condition for cognition [2]

### Research questions

- Are the views experimentally distinguishable?
- If yes, are they mutually exclusive?

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**DIRECT ROLE VIEW**

**Overt behavior**

Endogenous BOLD activity in left somatomotor cortex (A) predicts difference in strength of button push (yellow bar) as well as contralateral BOLD activity (B) [7].

**Conscious cognition**

- Increased BOLD activity in default mode network (green arrows) and executive control network (blue arrows) before subjects reported mind-wandering within experience sampling reports [8].

**Information processing function**

- Containing system for functional analysis [9]: behaving organism
- Endogenous activity directly contributes to mechanisms responsible externally directed behavior and internally directed mentation

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**ENABLING CONDITION VIEW**

**Stability across global states of the organism**

- Seed-based connectivity analysis in waking (i) and light NREM sleep (ii) conditions show that endogenous BOLD fluctuations remain stable in default mode and executive network and other cortical systems [6]

**Biological repair functions**

- Elevated aerobic glycolysis levels (A) coincide with endogenous BOLD fluctuations in the default mode (B) and cognitive control network (B) [10].

**Homeostatic function**

- Containing system [9] for functional analysis: living brain
- Endogenous activity enables cognition by coordinating biosynthetic repair functions within large-scale functional systems

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**EXPERIMENTALLY TESTING THE TWO VIEWS**

**Rsf studies and causal role testing** [11]

**Intervention**

- System change
- Intervention on component
- e.g., disrupt posterior cingulate cortex in the default mode network [12]

**Predictions differ in causal specificity** [13]

**Direct role view:** Changes specific aspect of information processing mechanism, e.g. multimodal integration while mind-wandering [14]

**Enabling condition view:** Changes many aspects or switches entire mechanism on/off (e.g. mind-wandering)

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**DISCUSSION**

Are the views experimentally distinguishable?

The views predict different degrees of causal specificity for interventions on network components: changing an individual aspect of vs. changing the entire cognitive mechanism. However, current noninvasive intervention techniques may be too coarse-grained to manipulate specific network components.

Moreover, if endogenous and task-induced activity always co-occur, cognitive and maintenance roles will be difficult to distinguish experimentally. Finally, the BOLD signal could trace activities from both cognitive and homeostatic mechanisms. In this case, disambiguation via other methods is required.

Are they mutually exclusive?

Although both views make different predictions, direct and enabling roles of endogenous activity may not be mutually exclusive. To know whether resting state studies trace both roles, further analysis and experiments of what the BOLD signal refers to are needed.

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**REFERENCES**