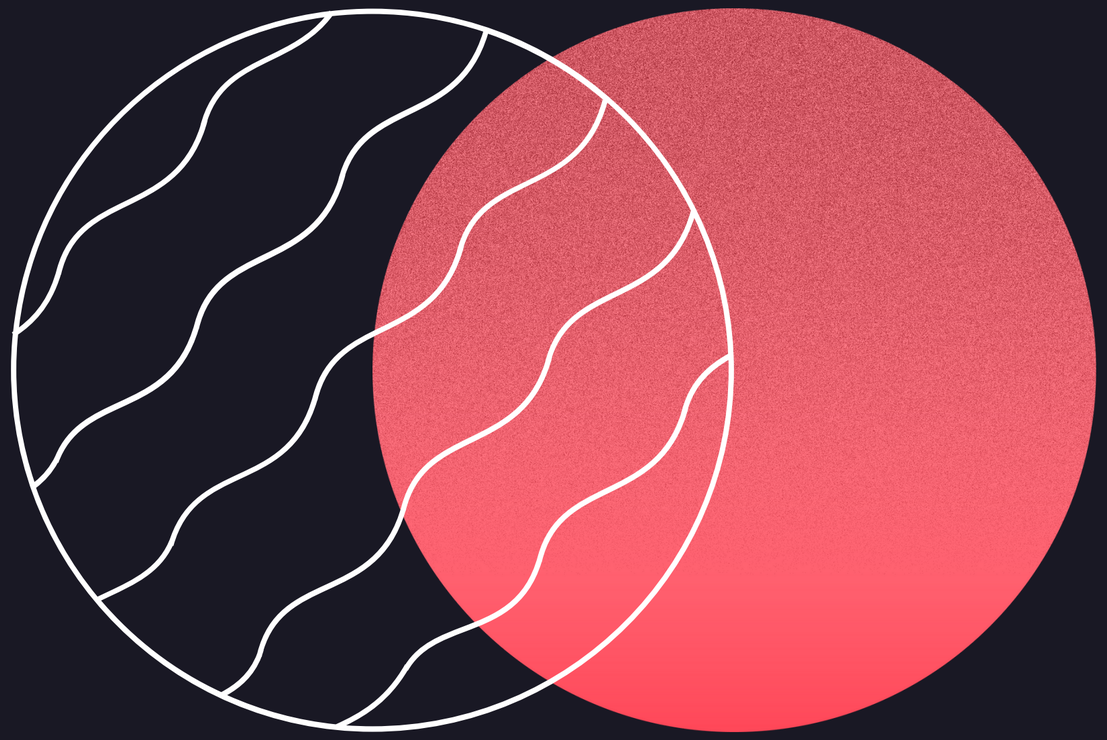
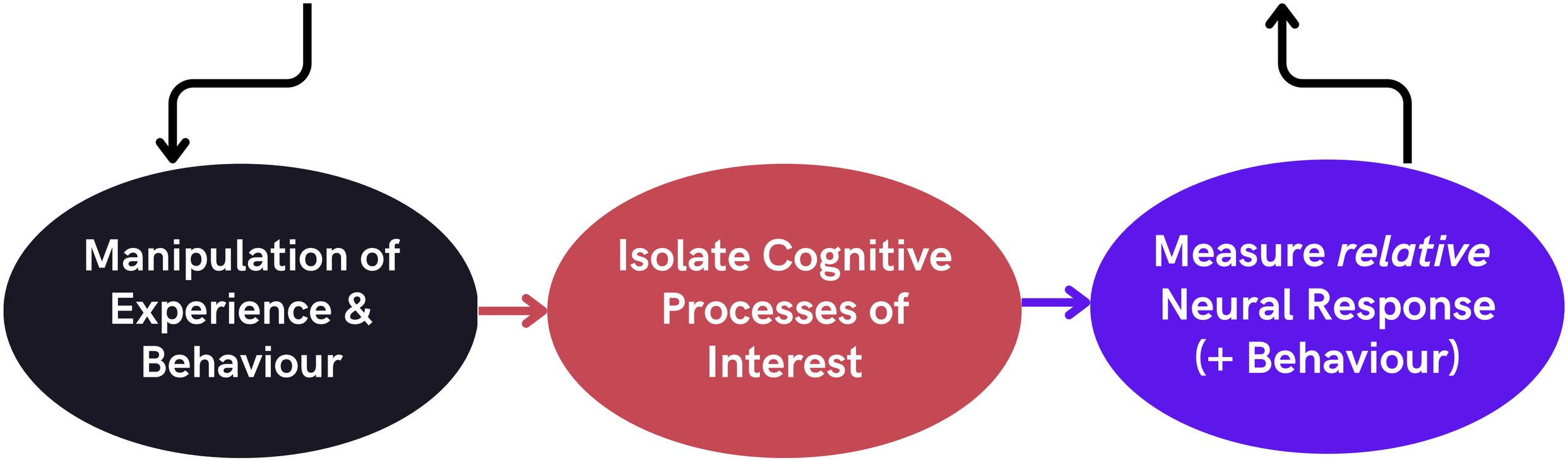


Study Design

Methods for Dummies 2023

ULTIMATE GOAL:
TEST SPECIFIC HYPOTHESIS



MANIPULATION: TOOLS

- Stimulus type and properties
  - What they see
- Stimulus timing
  - When they see it
- Subject Instructions
  - What they are told

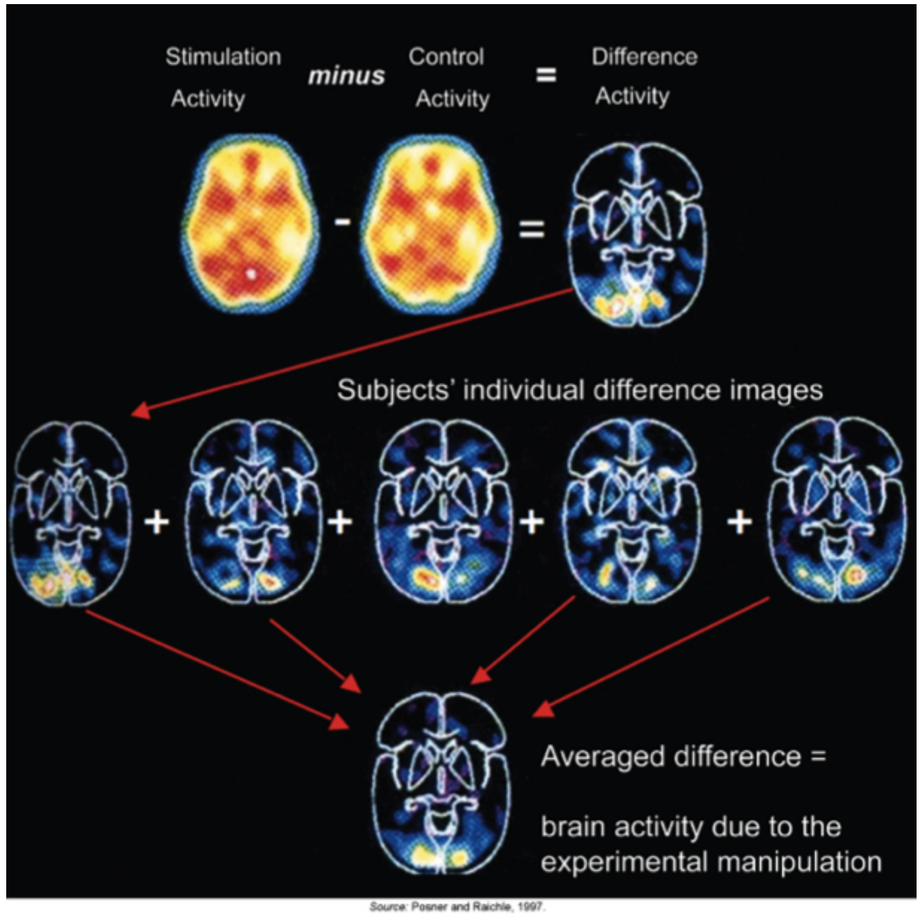
CATEGORICAL DESIGNS: SUBTRACTION

1. Task A contains Process X
2. Task B does not contain Process X
3. Activation C is found in A but not B

→ Activation C underlies Process X

Assumption of "Pure Insertion"

(Amaro & Barker, 2006 but Friston et al., 1996)



CATEGORICAL DESIGNS: SUBTRACTION

Task A: "When you see a word on the screen, repeat it.

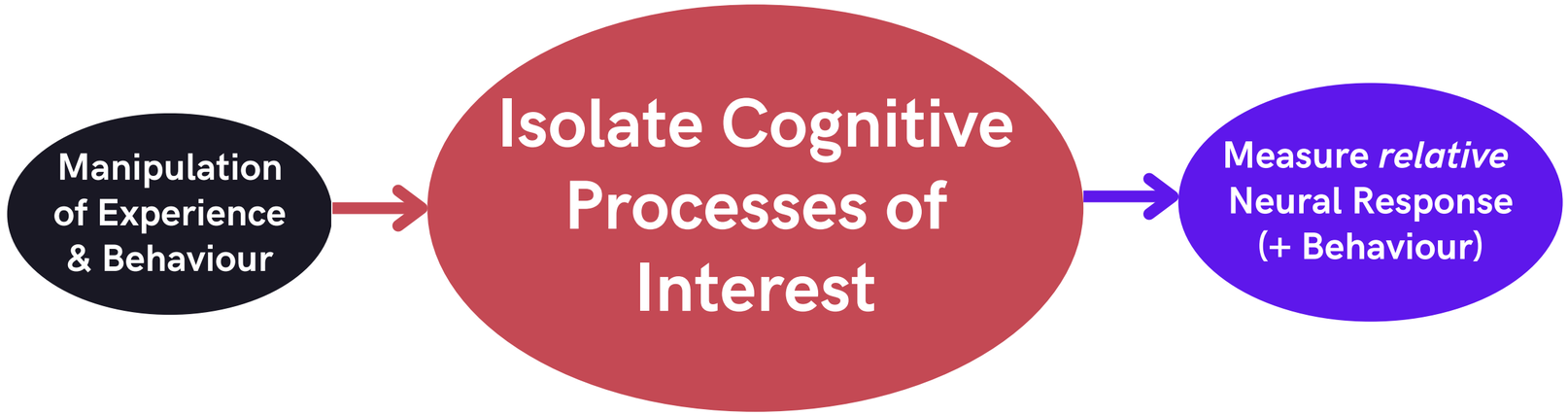
Task B: "When you see a word on the screen, don't repeat it".

1. Task A contains word repetition
2. Task B does not contain word repetition
3. pSTG activation is found in A but not B

→ pSTG activation underlies word repetition

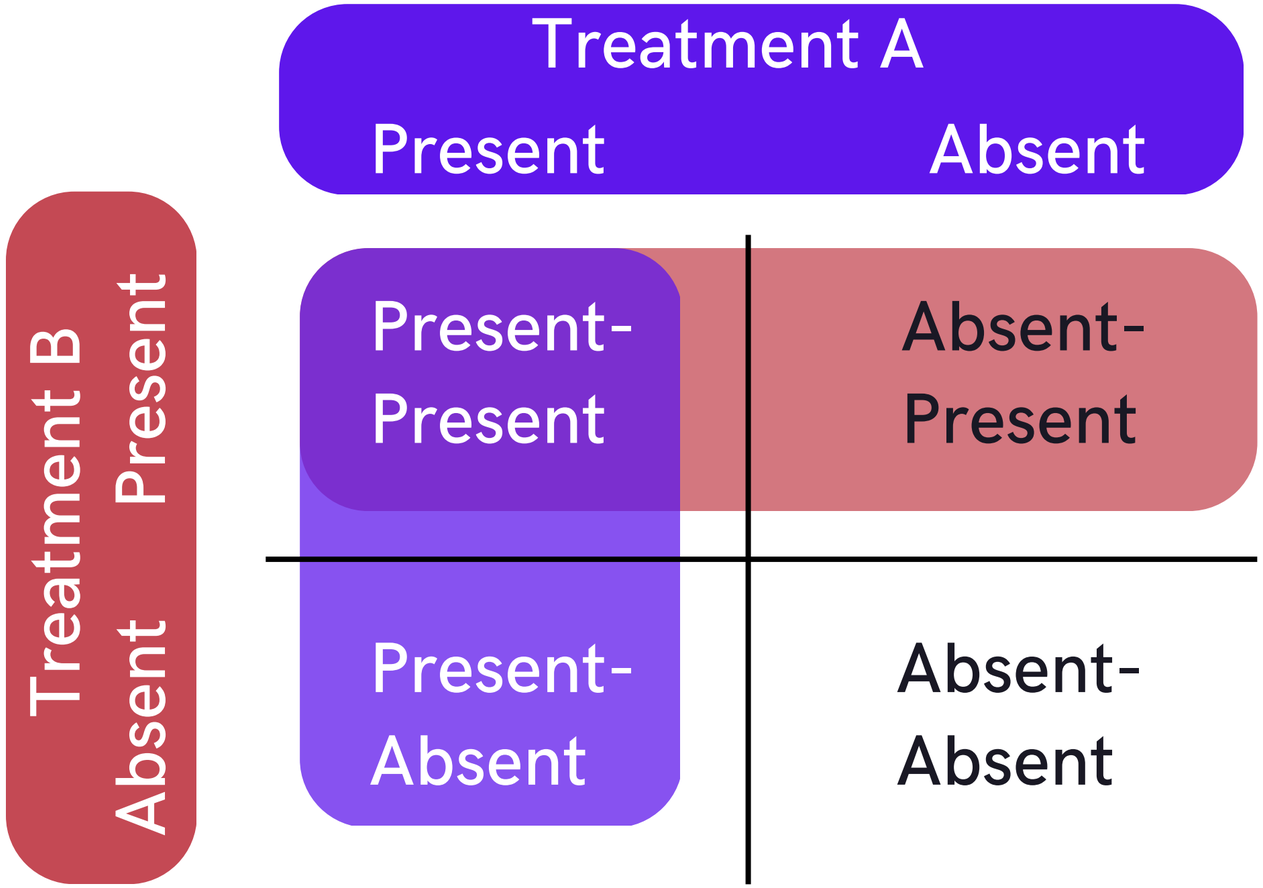
CATEGORICAL DESIGNS: SUBTRACTION

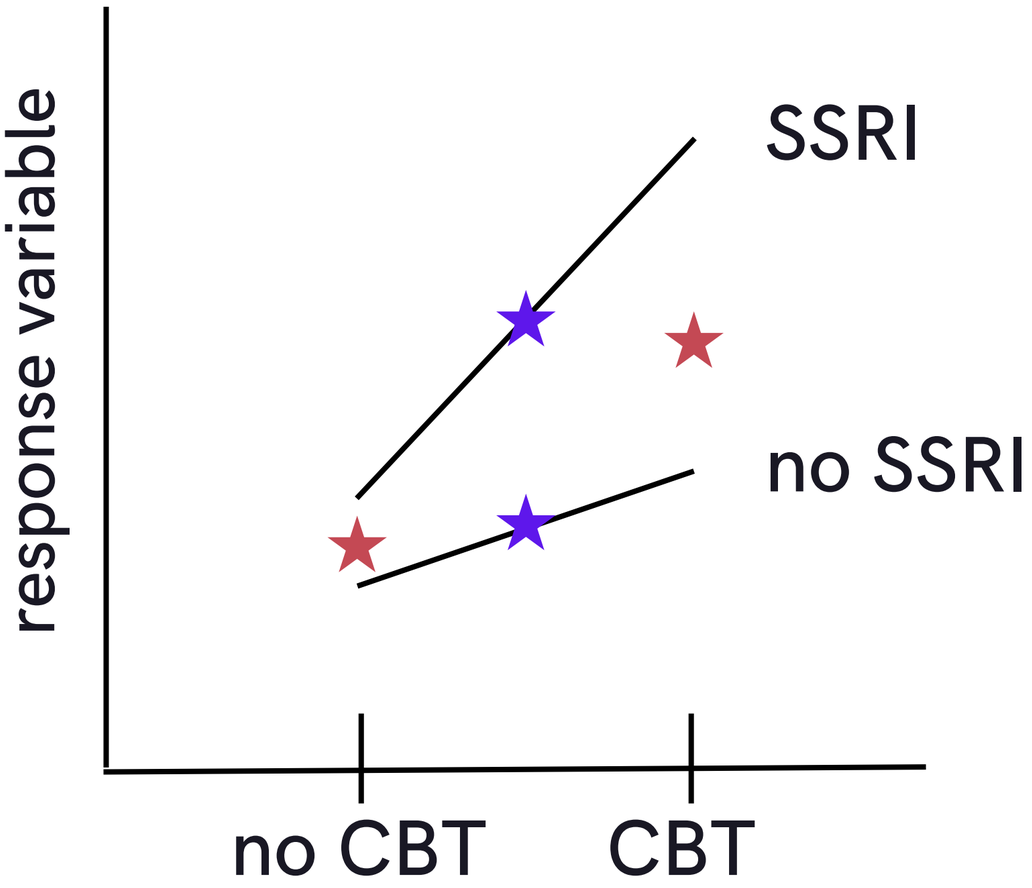
BUT: Can we rule out that word repetition may have interacted with the other processes at hand (e.g. reading) and changed their neural implementation?



FACTORIAL DESIGNS

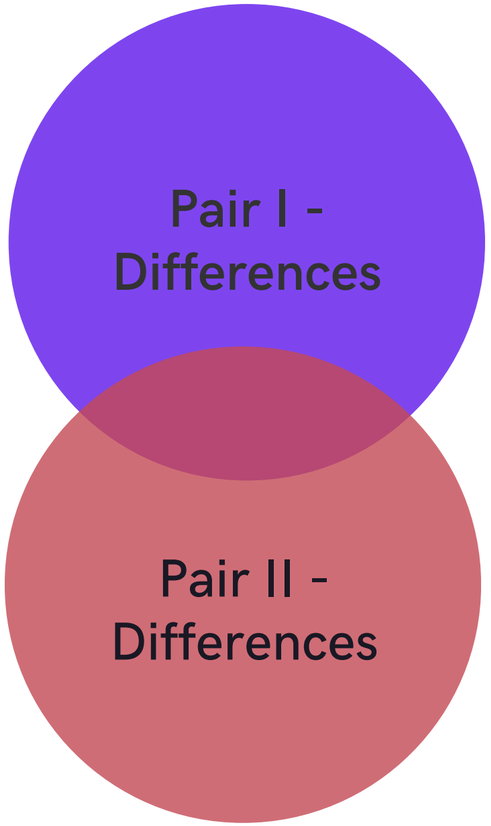
→ Explicitly testing for interactions (besides main effects)





CATEGORICAL DESIGNS: CONJUNCTION

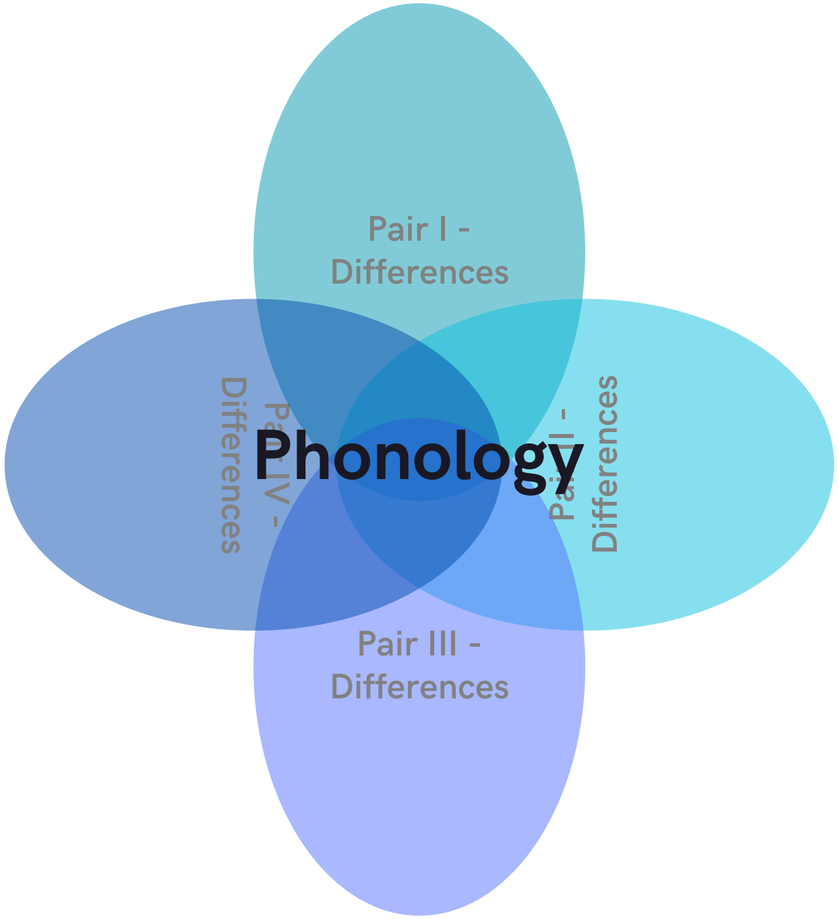
Process	Task Pair I		Task Pair II	
	Task I-A	Task I-B	Task II-A	Task II-B
1	✓	✓		
2	✓		✓	✓
3			✓	
4 (PI)	✓		✓	
5	✓	✓		



Price and Friston, 1997

CATEGORICAL DESIGNS: CONJUNCTION

	Task Pair I		Task Pair II		Task Pair III		Task Pair IV	
	Words		Letters		Objects		Colours	
Tasks:	A	B	A	B	A	B	A	B
	1	2	3	4	5	6	7	8
Cognitive Processes								
Form processing	■	■	■	■	■	■	■	■
Colour processing					■	■	■	■
Lexical orthography	■							
Sublexical orthography	■		■					
Object structure					■	■		
Semantics	■				■	■		
Phonology	■		■		■		■	
Articulation	■	■	■	■	■	■	■	■



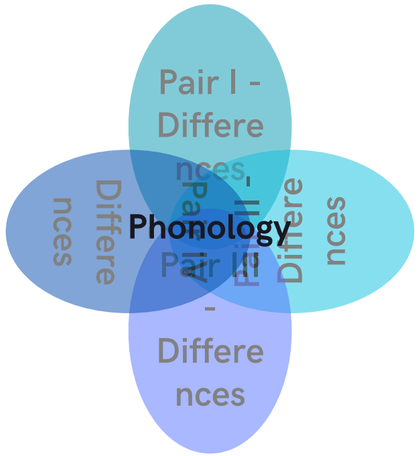
Price and Friston, 1997

CATEGORICAL DESIGNS: CONJUNCTION

True conjunction defined logically by ∧ ('AND' / &&)

Thus: H1: n(Contrasts) = n(Significant Effects)
H0: n(Contrasts) > n(Significant Effects)

} Conjunction NHST



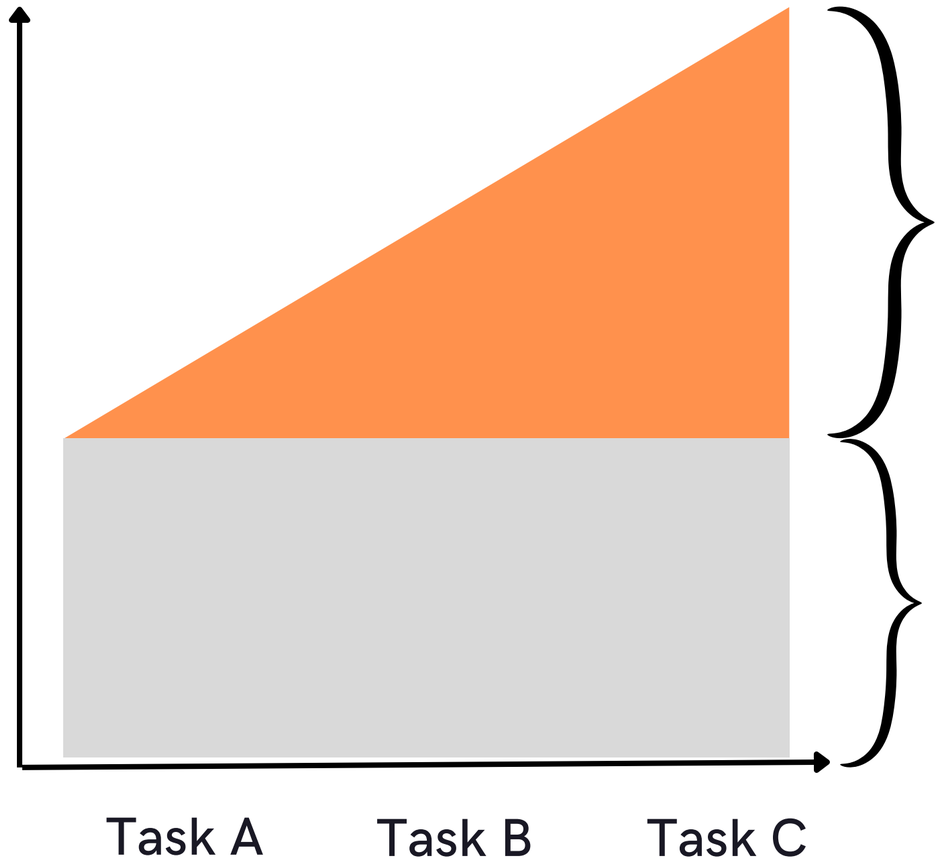
As opposed to more lenient Global Null Hypothesis

- Significant set of consistent effects
- Not necessarily all individually significant

Tomiello, 2017

PARAMETRIC DESIGNS

Incremental increase of process involvement

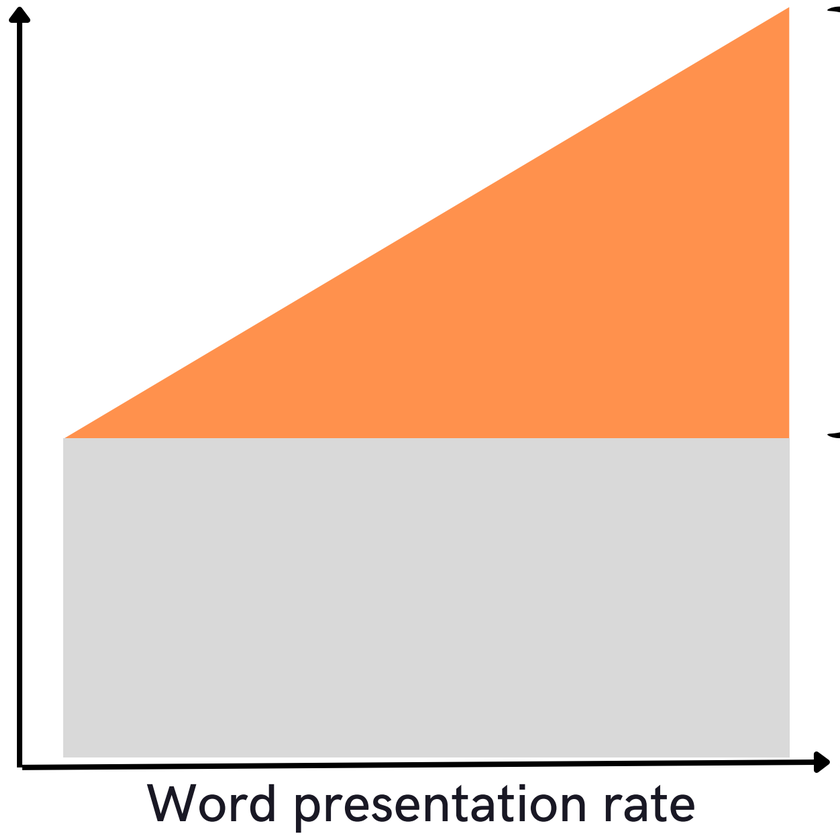


Effect = f(PI) - Other

Amaro and Barker, 2006

PARAMETRIC DESIGNS

→ Process involvement modelled by basic functions



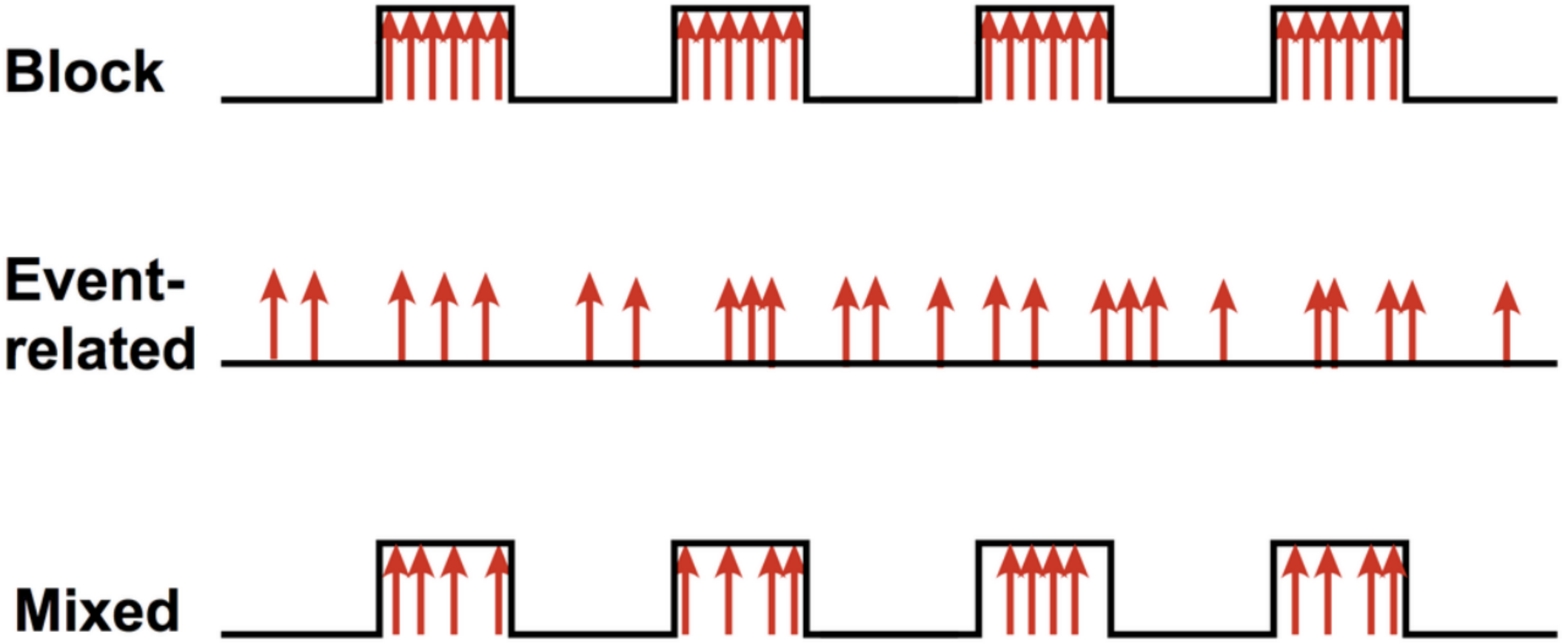
Demand on rate-dependent processing

Demand on other processes

→ Which voxels show this activation pattern?

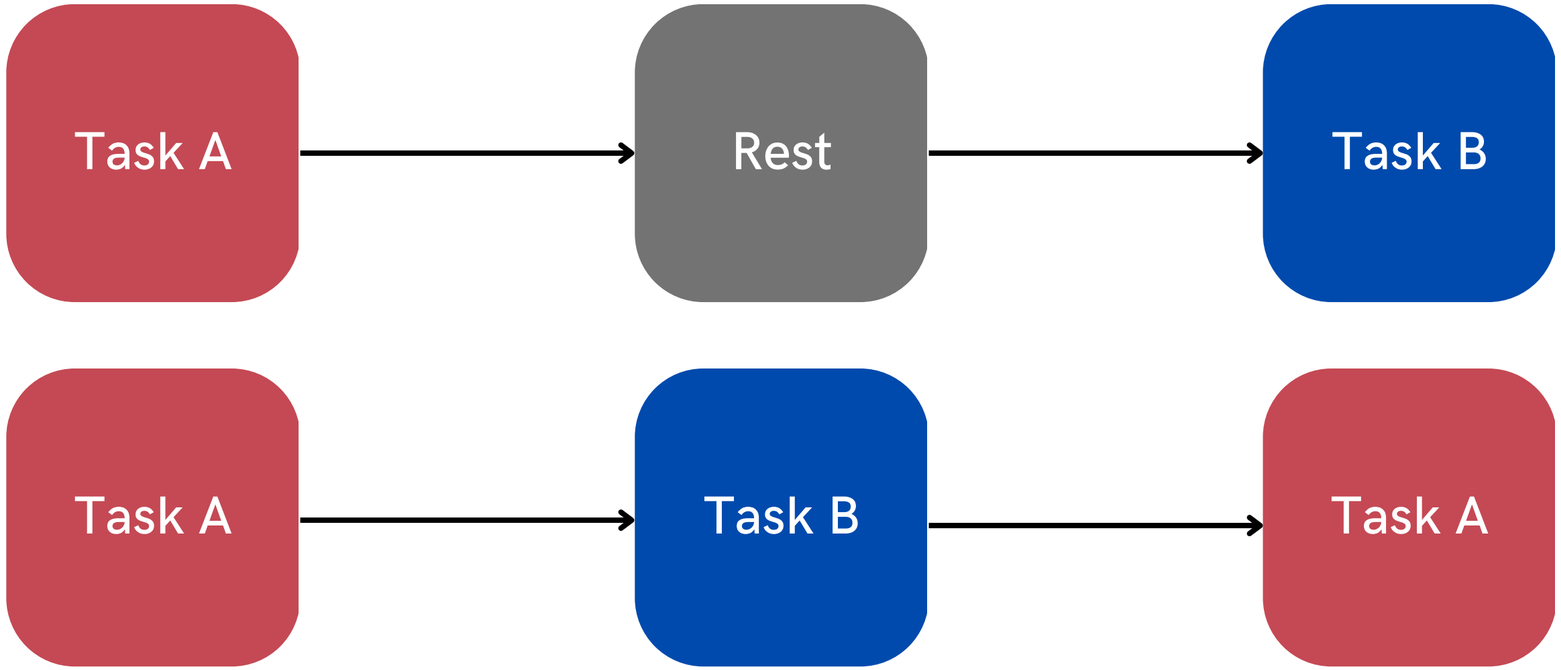
- functions may also take other, nonlinear forms

STIMULUS PRESENTATION STRATEGIES



Devlin, 2023

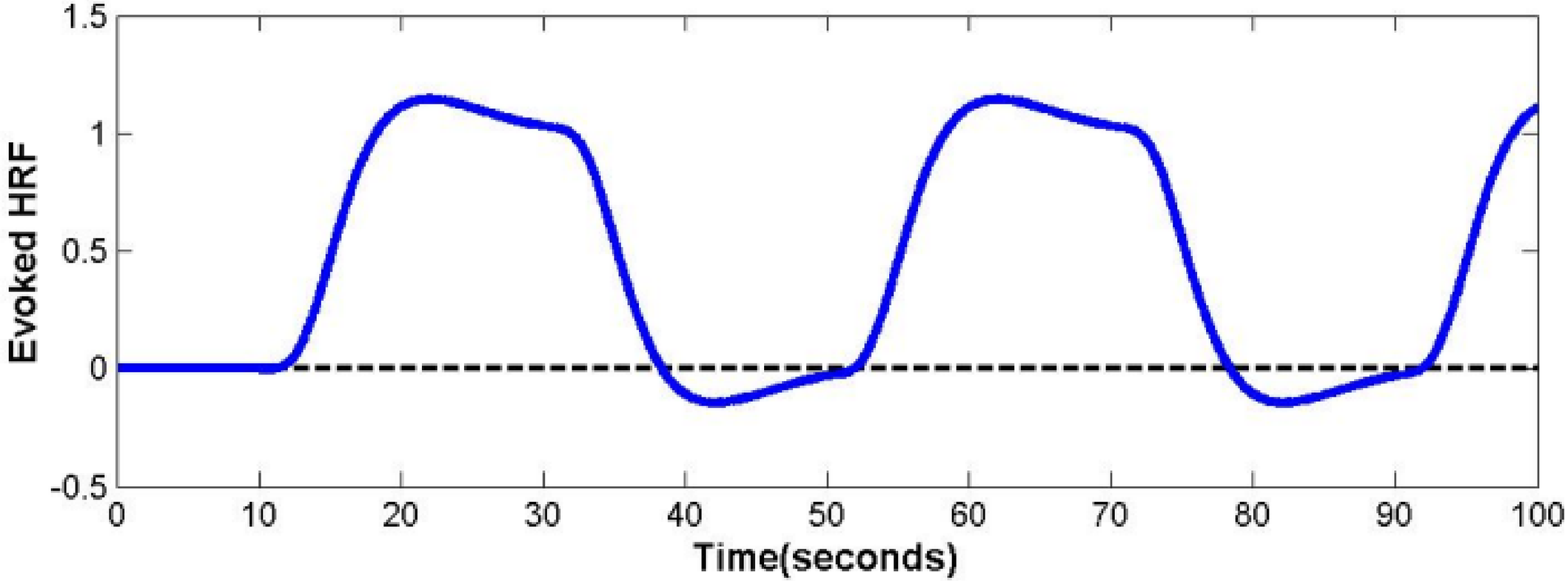
BLOCK DESIGNS



Baseline choice depends on RQ!

example:
Task A: Forward Sentences
Task B: Reversed Sentences

BLOCK DESIGNS



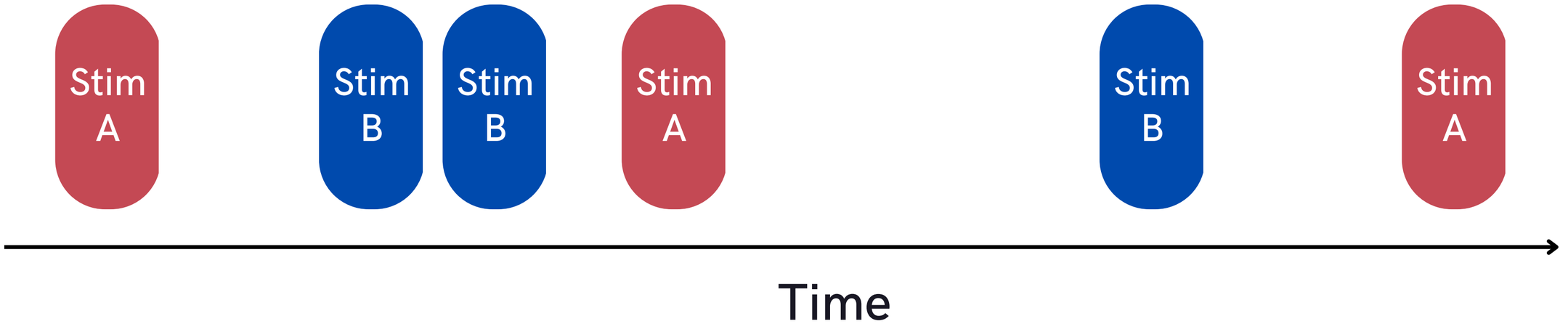
Devlin, 2023

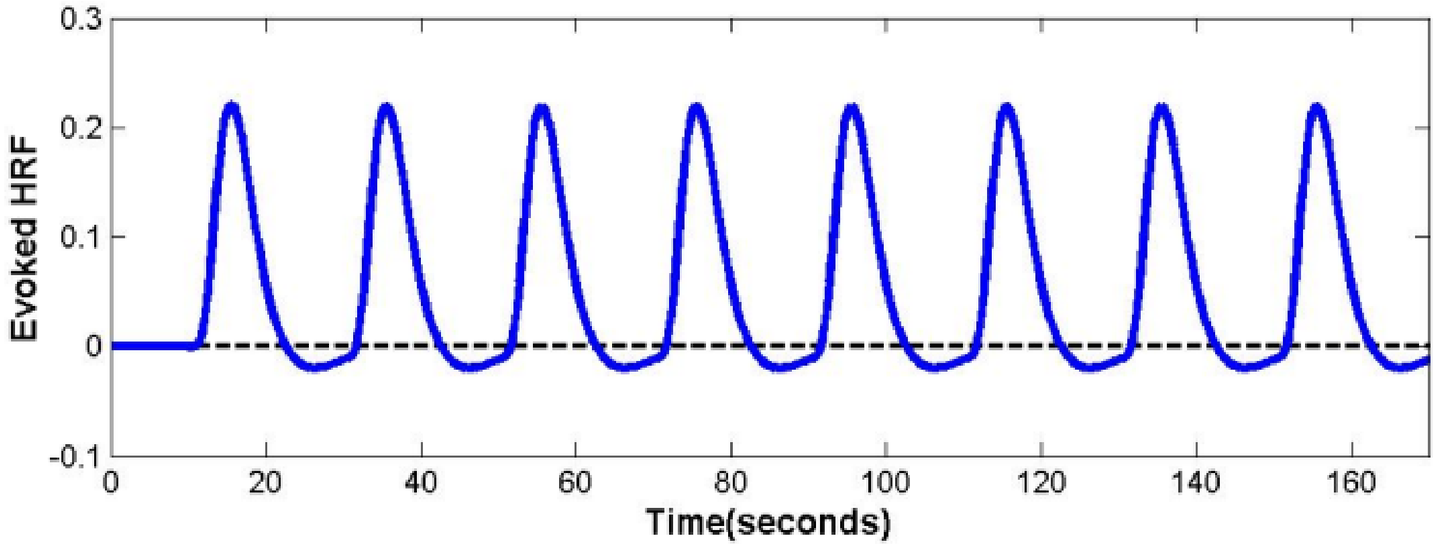
BLOCK DESIGNS

Pros	Cons
Good SNR: Power • max between-conditions var • min within-conditions var Less task switching costs Easy analysis	Insensitivity to HRF-shape Learning effects • strategies • expectancies • habituation Signal drift

Huettel, Song and McCarthy, 2008

EVENT-RELATED DESIGNS





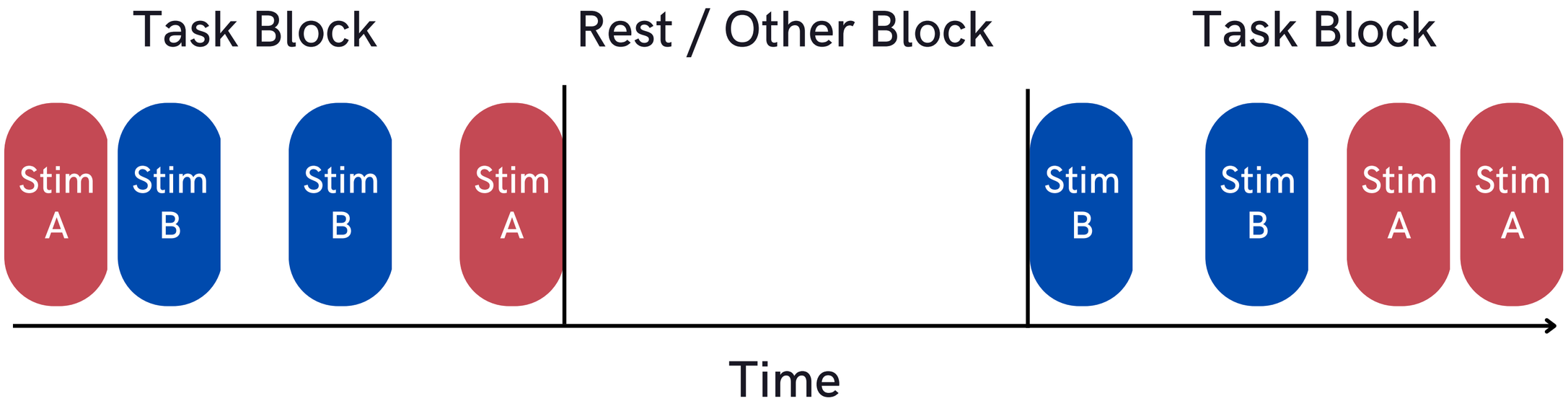
example:
Stim A: Congruent Words
Stim B: Incongruent Words

EVENT-RELATED DESIGNS

Pros	Cons
Better estimation of HRF • shape • timing	Lower statistical power • HRF not back at baseline • random jitter & order help
Trial-by-trial adjustments	Possibly task switching costs
More suitable for many tasks	More complex than block

Huettel, Song and McCarthy, 2008

MIXED DESIGNS



Several kinds of processes

- Across blocks: state-related
- Within blocks: item-related

example:
Stim A: Congruent Words
Stim B: Incongruent Words
Blocks: Forward / Reverse

Devlin, 2023