

Adaptive Speech Perception: Empirical Indeterminacy and a Path Forward

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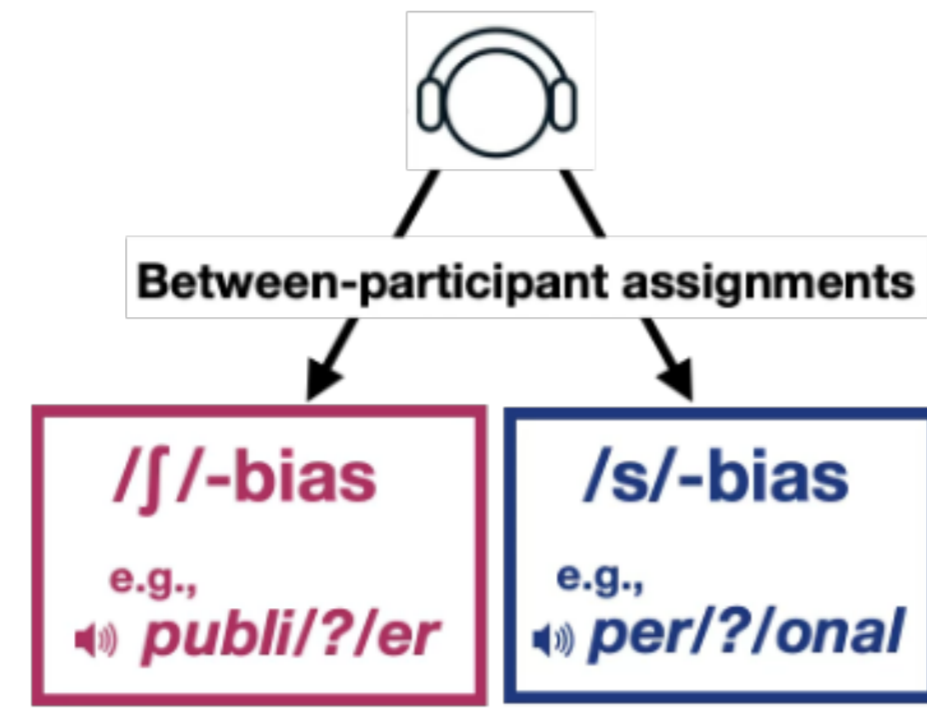


Motivation

- Acoustics of phonetic contrasts vary across talkers.
- Speech perception adapts rapidly to accommodate this talker variability.
- Numerous proposals exist^[1-4], but predictive accuracy of **competing mechanisms has not been compared against listeners' perception.**

A highly popular behavioral experimental paradigm:

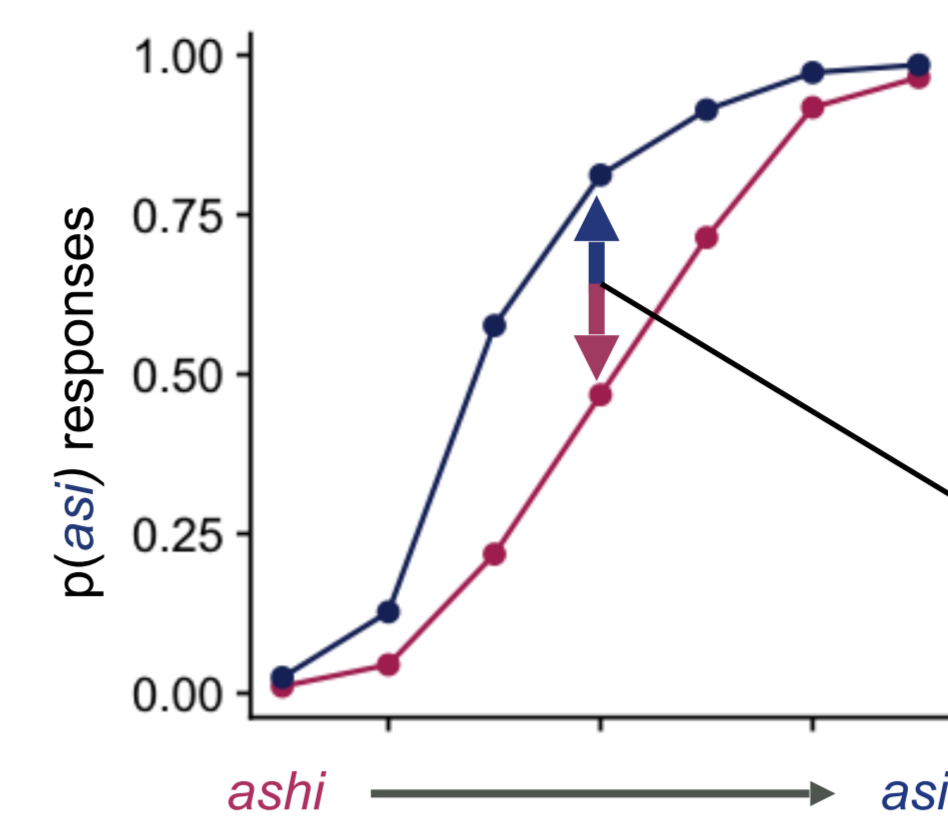
Lexically Guided Perceptual Learning^[5] (LGPL)



Exposure (lexical decision)

- word/non-word judgments
- Critical words include ambiguous sound midway between /s/ (e.g., sip) and /f/ (e.g., ship) in *biasing lexical context*

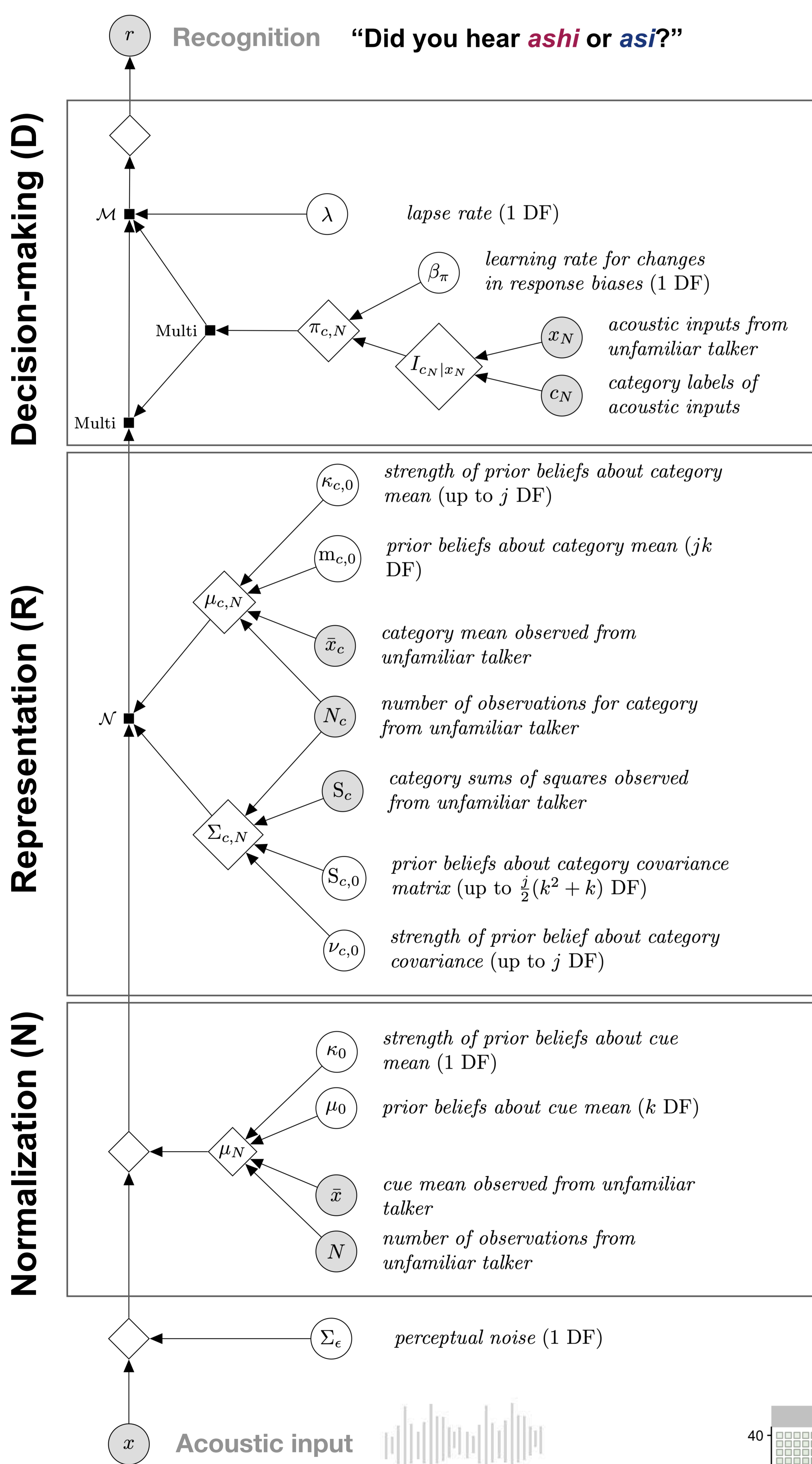
Test (categorization)



"Did you hear *ashi* or *asi*?"

Diverging categorization functions → adaptation

ASP: A Computational Framework^[4]



Q: Which mechanism(s) explain the adaptation?

Categorization model

- Prior category representations ($\mu_{c,0}, \Sigma_{c,0}$) from typical /s/-/f/ in 2D acoustic space (P1 & P3)
- Nuisance parameters (λ, σ_{noise}) from no-exposure perception data^[6] or fixed ($\pi_{c,0} = .5$)

Change models

- Used to update categorization model with exposure
- Varied only in adaptive mechanism (D, R, N)

Largest LGPL dataset

- 32 LGPL experiments
- 16 talkers X 2 biasing conditions
- 1280 participants
- 89,600 post-exposure /s/-/f/ categorization responses

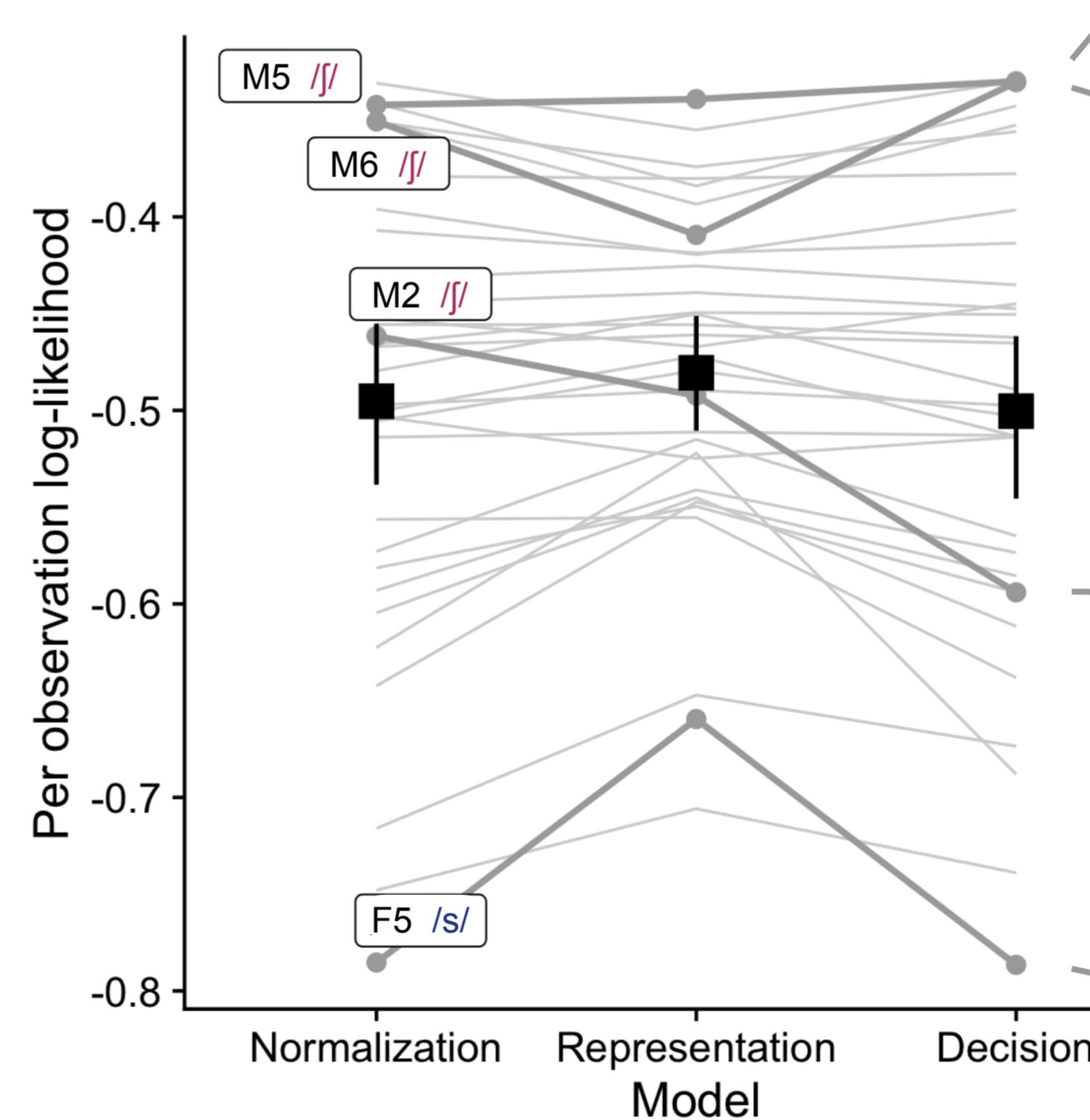
Quantitative model comparison

Parameters for change models **N** (κ_0, R ($\kappa_{c,0}, \nu_{c,0}$), and **D** (β_π) were fit to human categorization responses across all experiments (5-fold by-subject CV)

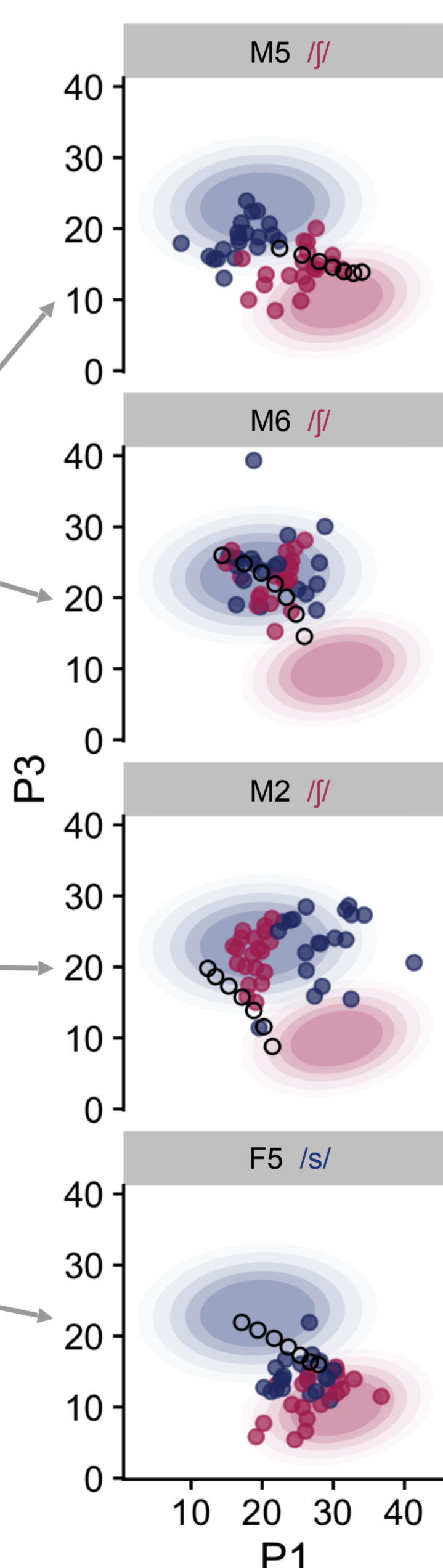
Results

A: No model consistently outperformed the others

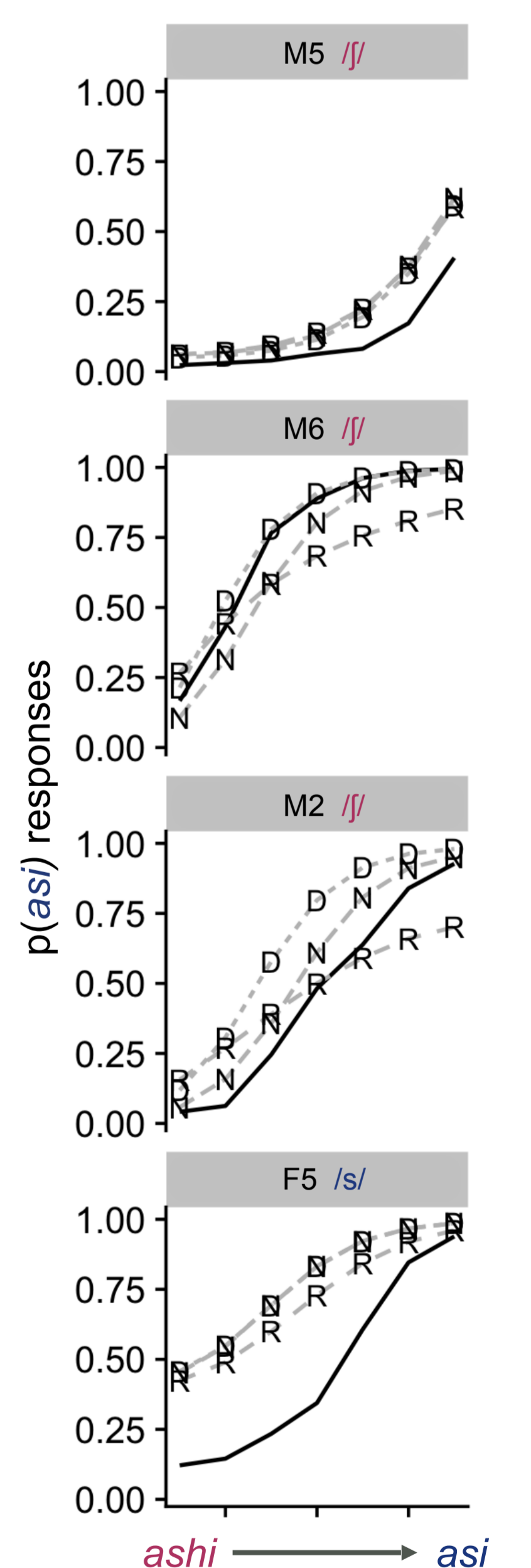
→ Empirical indeterminacy



Distinct acoustic distributions

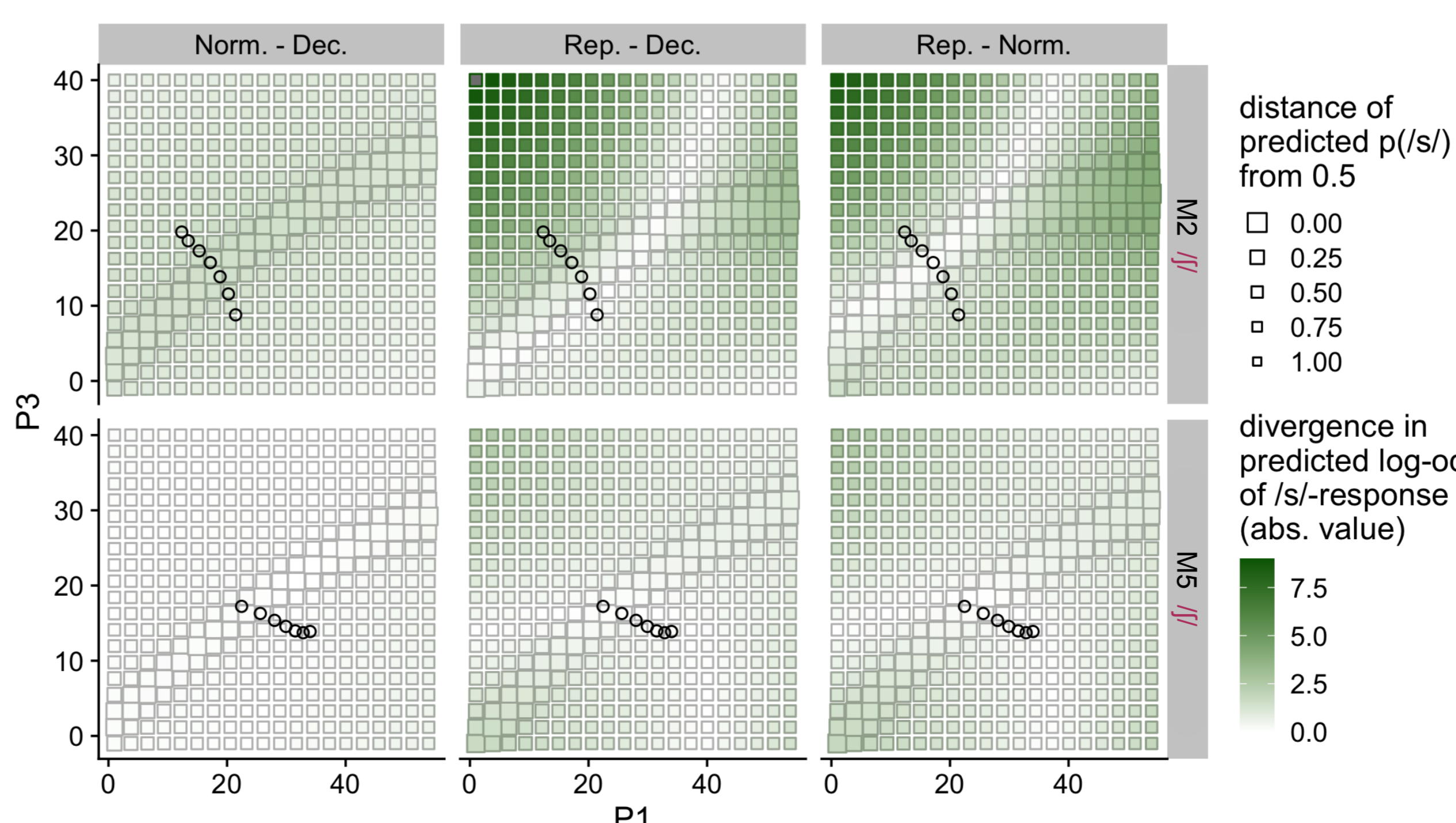


Goodness of model fits



A path forward

- Standard LGPL test tokens (circles) often fall outside regions where competing mechanisms diverge most (green).
- Model-guided stimulus selection** can increase the ability to distinguish competing mechanisms.
- Future work** can select exposure-test combinations where competing mechanisms make distinct predictions.



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References:

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