

Cross-Modal Matching and Internal References

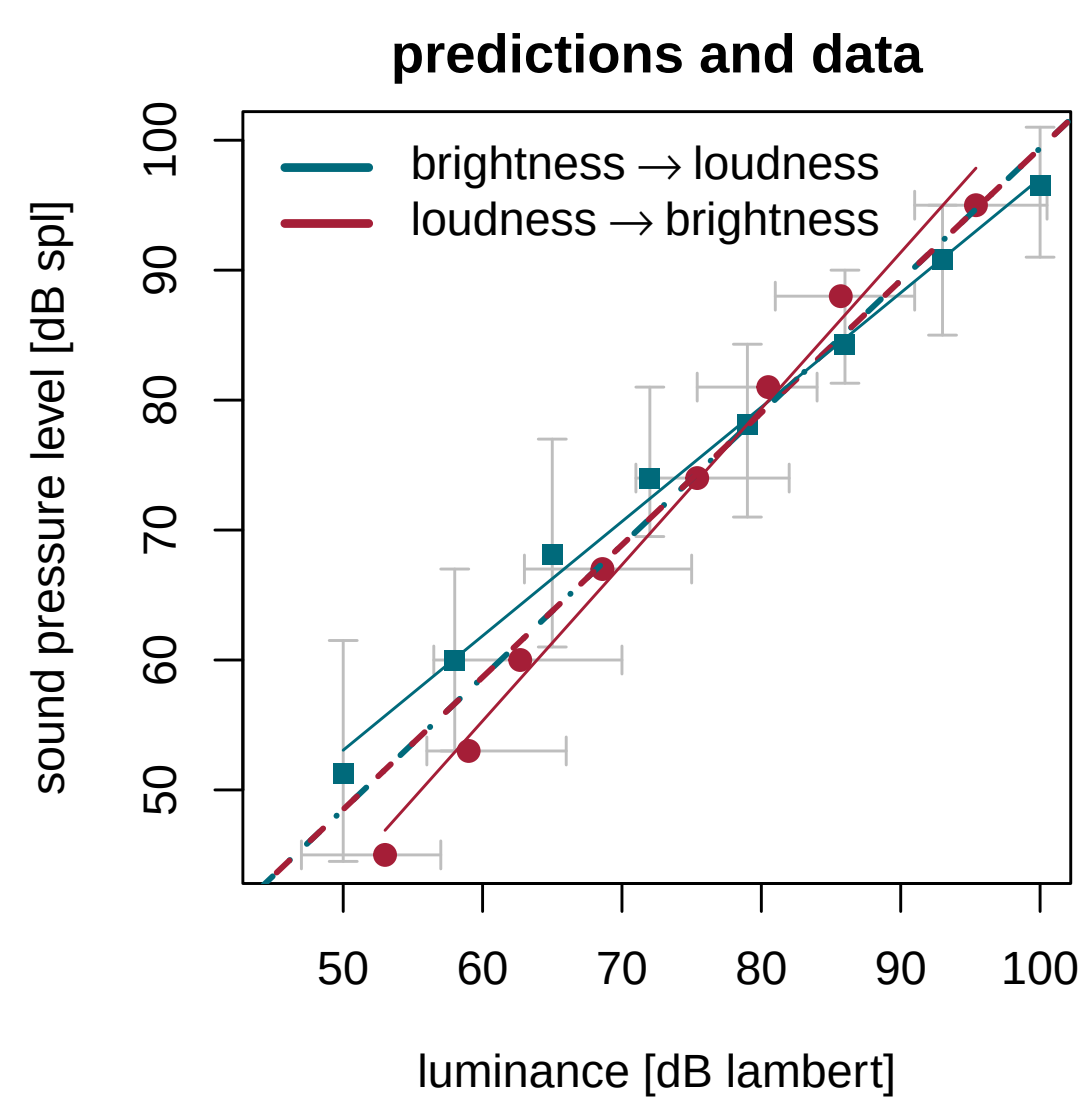
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Theory

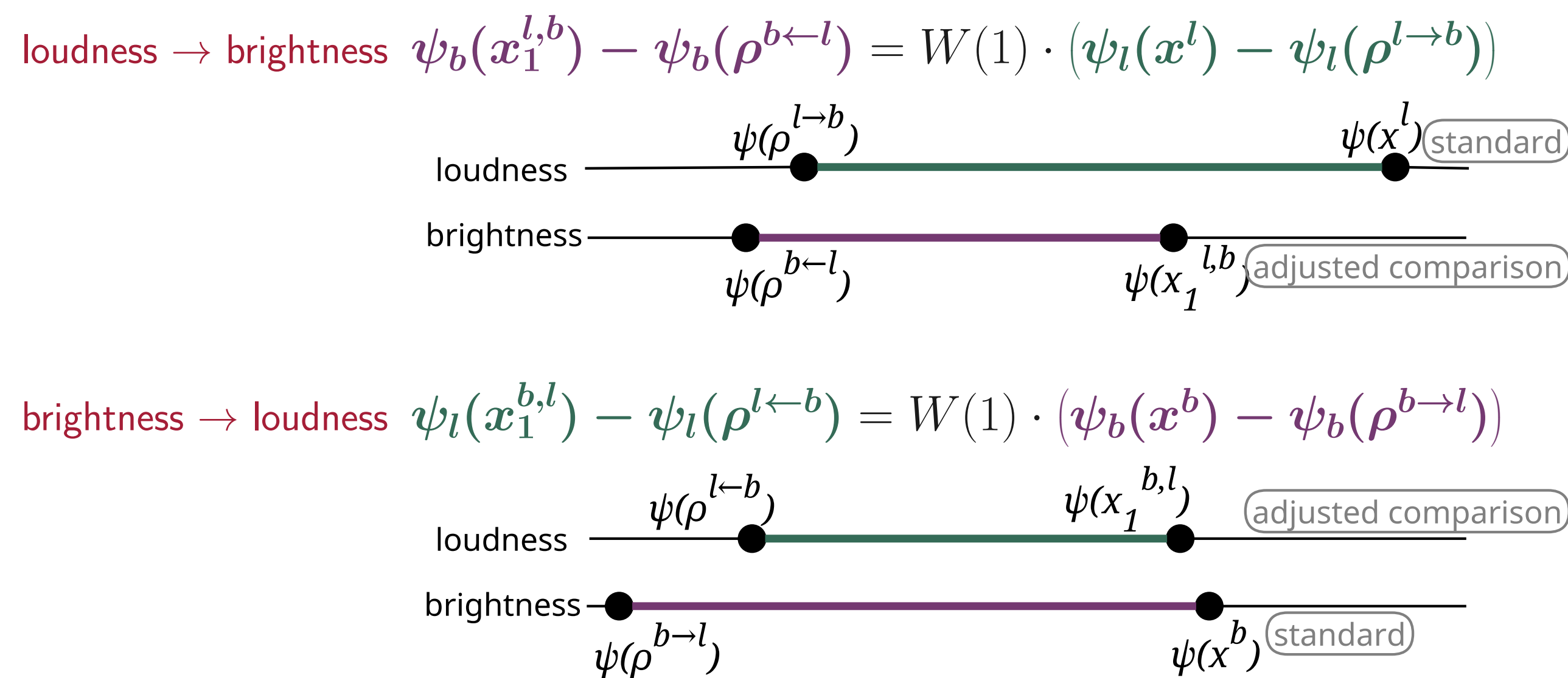
Regression Effect

Mean matching data (IQR) from Stevens and Marks (1965) with 10 subjects



Global Psychophysics Model

(Heller, 2021; Luce et al., 2010)



x^l stimulus level of standard, e. g. sound pressure level of auditory stimulus
 $\rho^{l \rightarrow b}$ reference level on standard dimension
 ψ_l and ψ_b psychophysical functions; here $\psi_l(x) = \alpha_l x^{\beta_l}$ and $\psi_b(x) = \alpha_b x^{\beta_b}$
 $x_1^{l,b}$ adjusted stimulus level, e. g. luminance of visual stimulus
 $\rho^{b \leftarrow l}$ reference level on dimension of comparison
 W cognitive weighting function; $W(1)$ is not necessarily 1.
 1 adjustment ratio, 'adjust light so that it appears equally intense as sound'

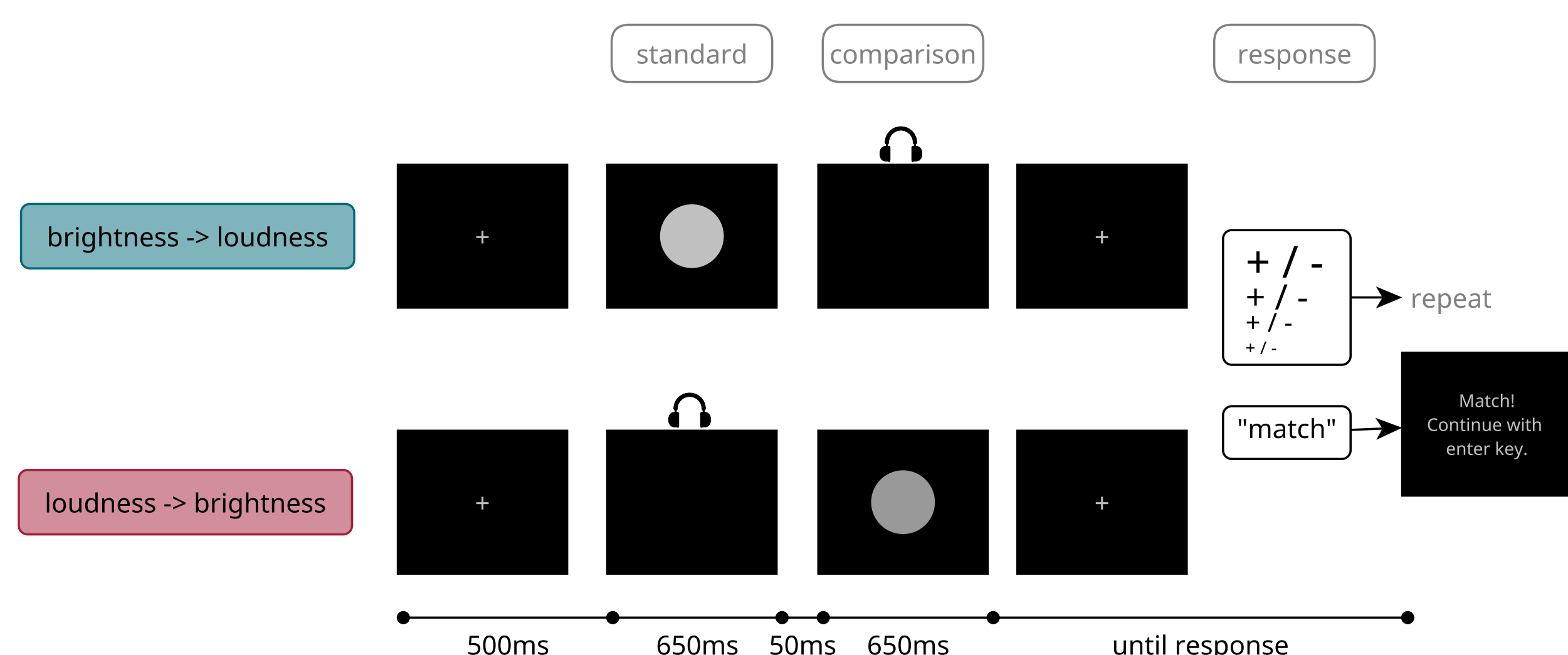
Methods

Visual stimuli grey circles on black background with diameter 4° visual angle and luminance range: I. 67.6 – 93.1 and II. 52.1 – 85.9 dB re 10^{-10} lambert

Acoustic stimuli pink noise bursts in the range of I. 20 – 80 and II. 10 – 95 dB spl

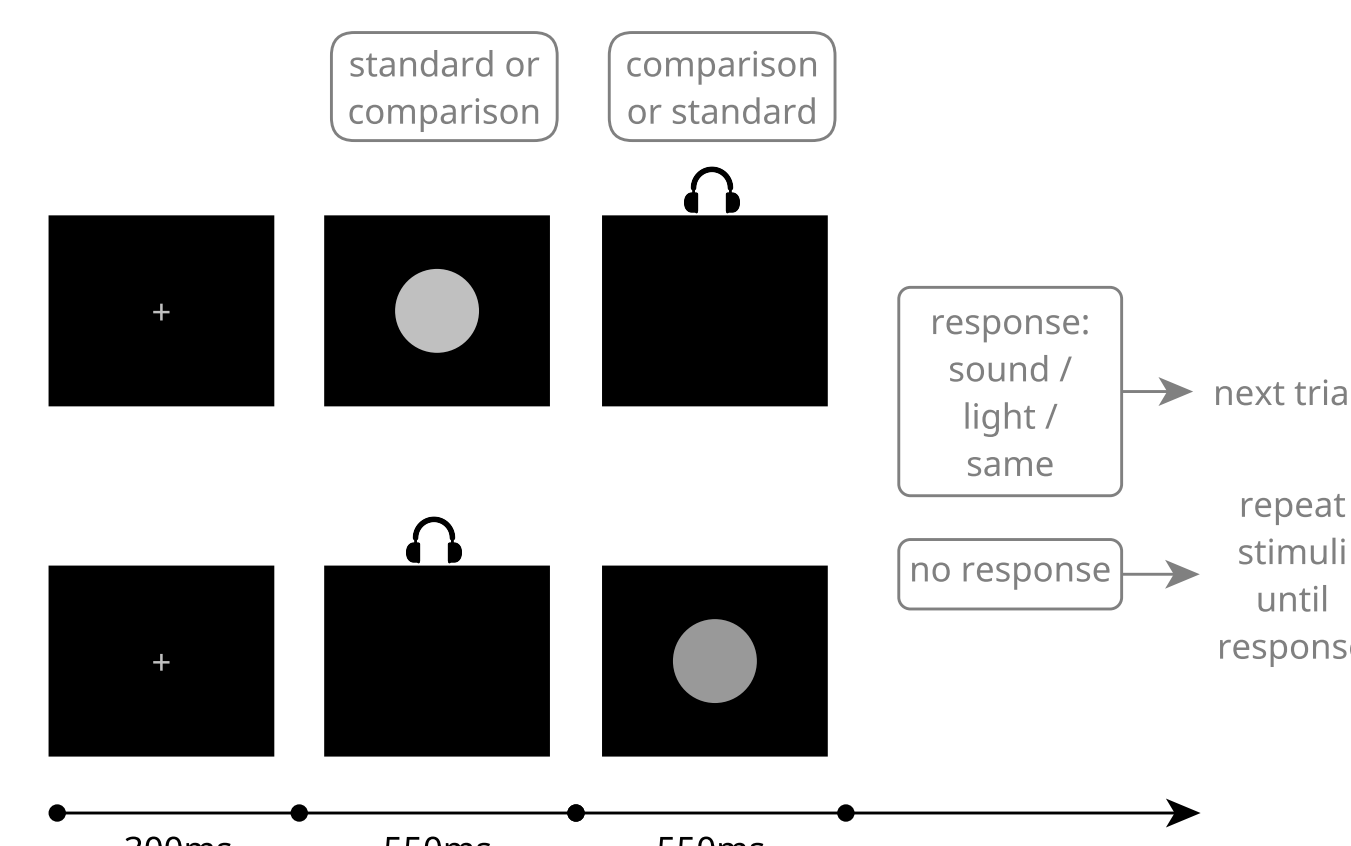
I. Magnitude production (role-dependent ρ 's?)

'Make the light as bright as the sound is loud.'

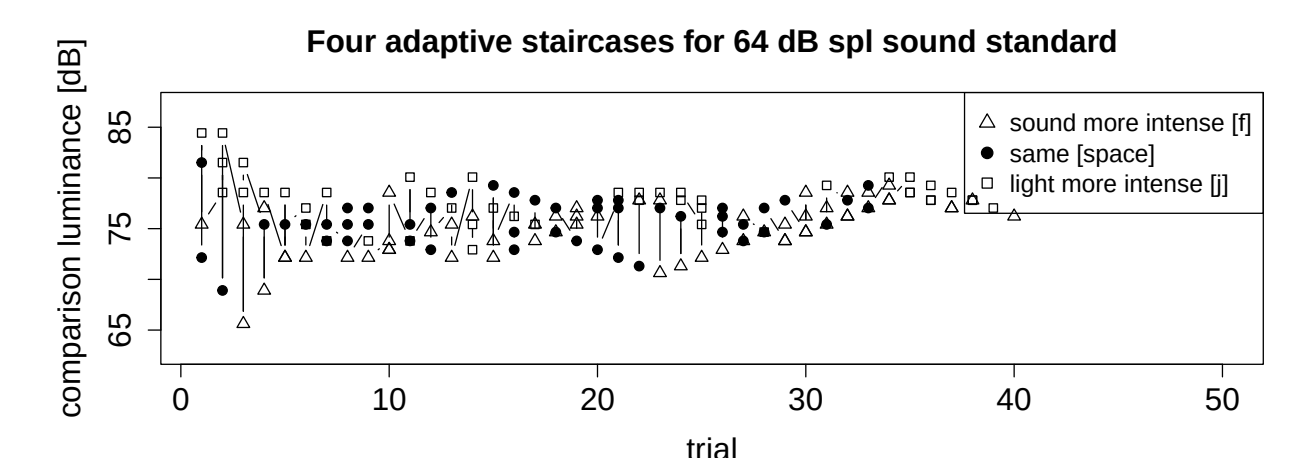


II. Adaptive pair comparison (role-independent ρ 's?)

'Which stimulus is more intense? — sound, light, or same?'



1. Adaptive staircase procedure

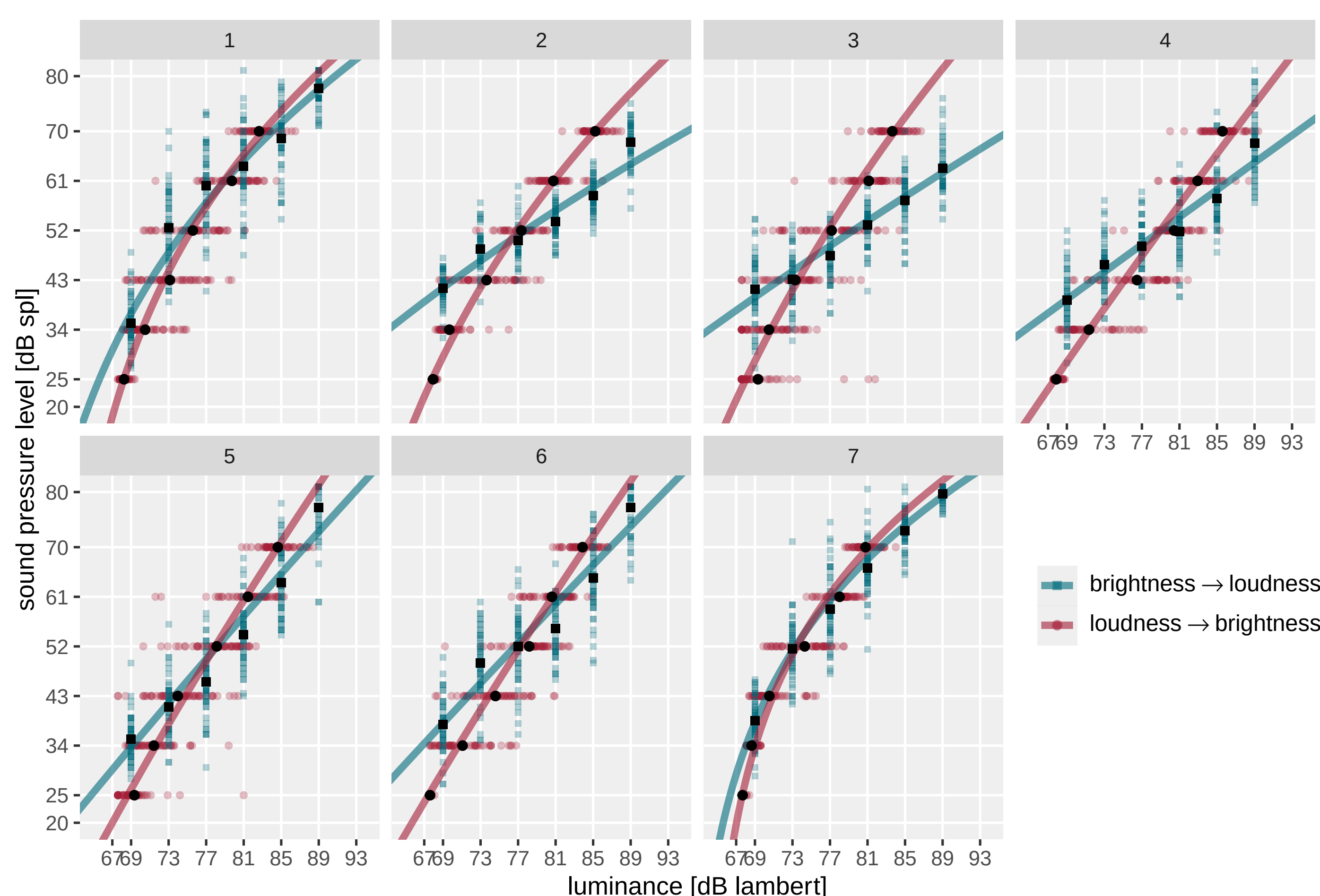


2. Method of constant stimuli (t.b.d.)

Results

Sample 7 subjects · 6 standards per modality · 48 matches · 4 h in two sessions

Crossmodal matches

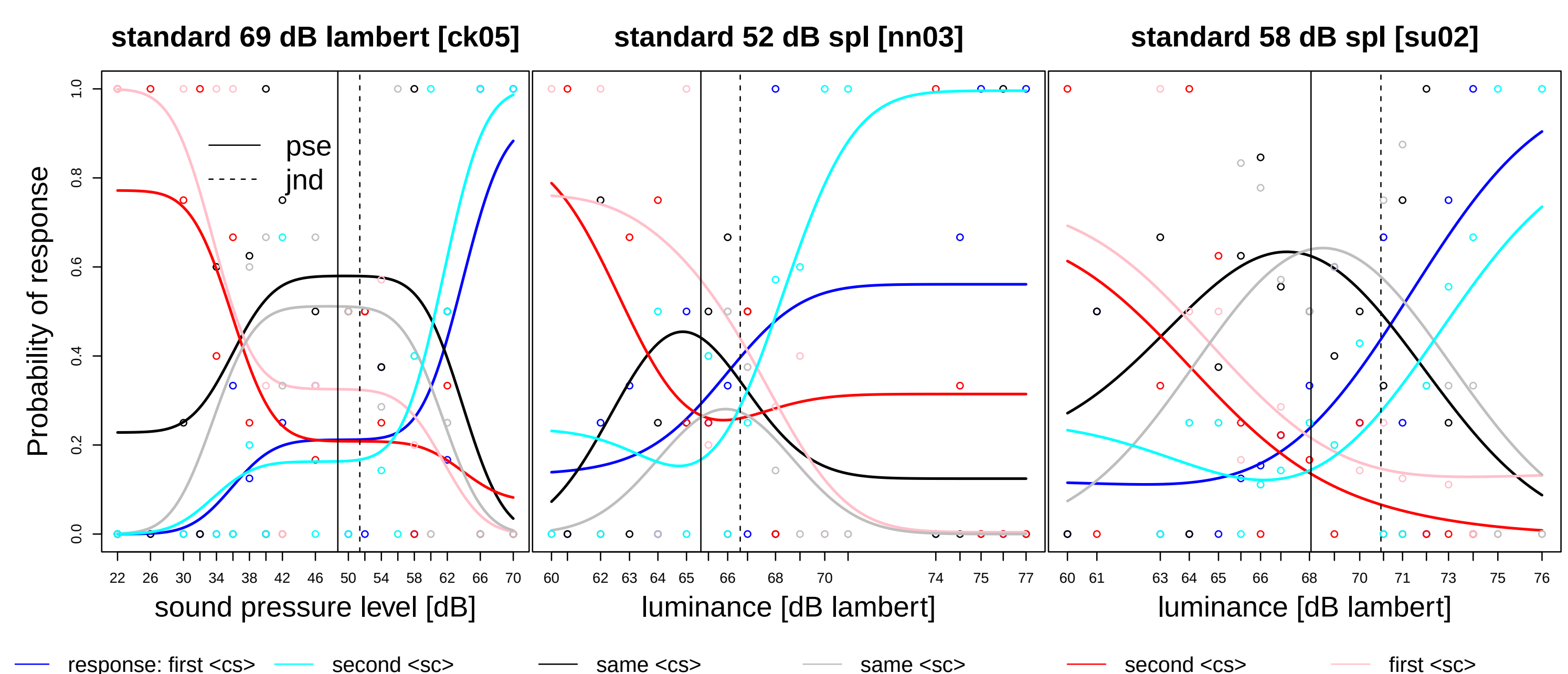


Pilot sample 3 subjects · 6 standards per modality with 4 adaptive staircases · 90 min

Ternary Indecision Model

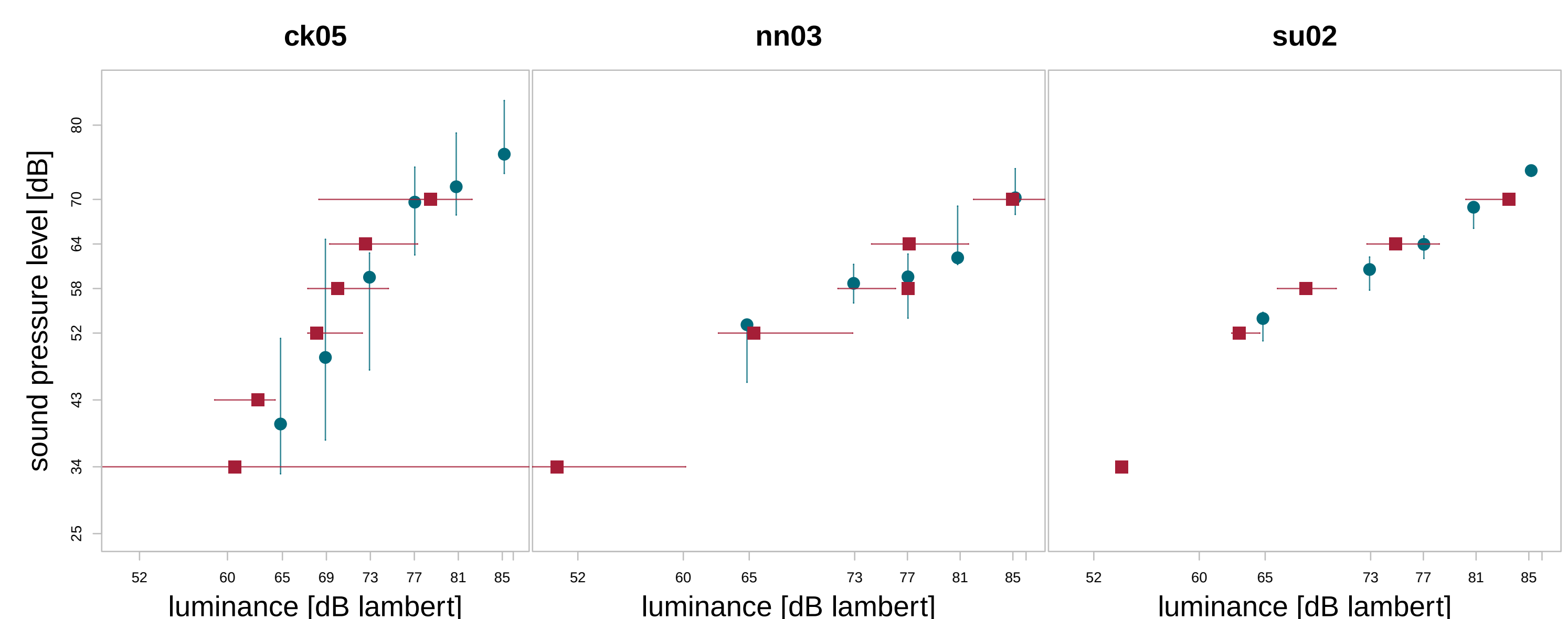
(García-Pérez & Alcalá-Quintana, 2017)

Ternary psychometric functions (with lapses)



Crossmodal points of subjective equality (pse)

pse's from ternary indecision model with 95%–bootstrap CI



References

- García-Pérez, M. A., & Alcalá-Quintana, R. (2017). The indecision model of psychophysical performance in dual-presentation tasks: Parameter estimation and comparative analysis of response formats. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.01142>
- Heller, J. (2021). Internal references in cross-modal judgments: A global psychophysical perspective. *Psychological Review*, 128(3), 509–524. <https://doi.org/10.1037/rev0000280>
- Luce, R. D., Steingrimsdóttir, R., & Narens, L. (2010). Are psychophysical scales of intensities the same or different when stimuli vary on other dimensions? theory with experiments varying loudness and pitch. *Psychological Review*, 117(4), 1247–1258. <https://doi.org/10.1037/a0020174>
- Stevens, J. C., & Marks, L. E. (1965). Cross-modality matching of brightness and loudness.. *Proceedings of the National Academy of Sciences of the United States of America*, 54(2), 407. <https://doi.org/10.1073/pnas.54.2.407>