

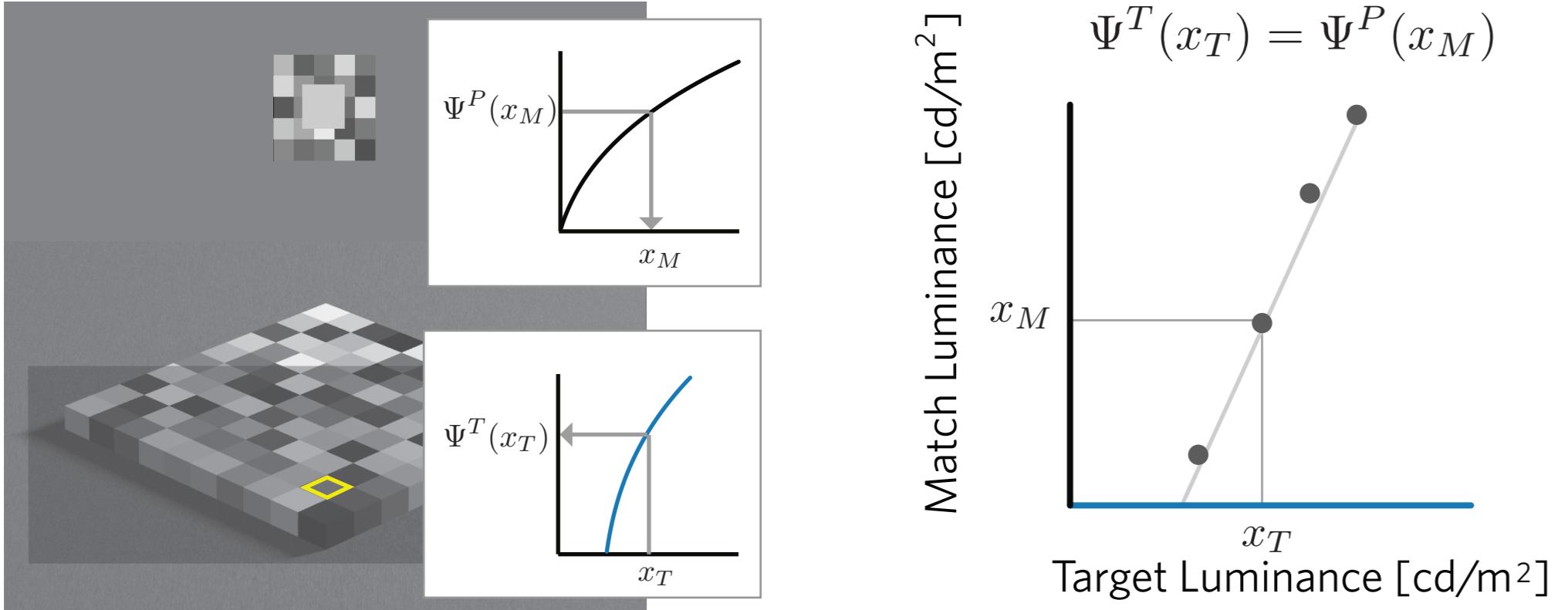
Linking assumptions: towards reliable measurements of perceptual scales

Guillermo Aguilar and Marianne Maertens

Computational Psychology, Technische Universität Berlin, Germany

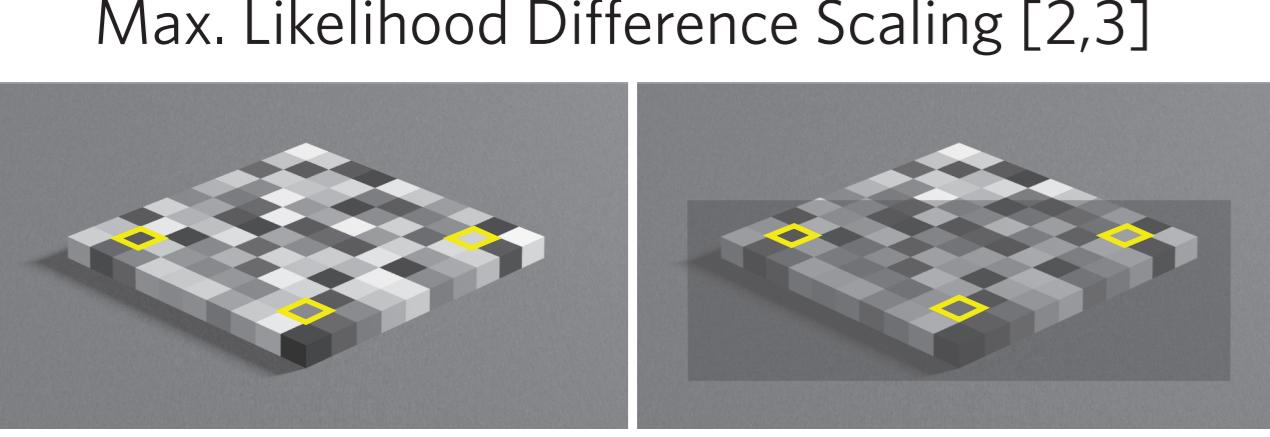
Asymmetric matching

- Widely used method to measure psychological experiences, e.g. lightness perception
- Captures perception in units of physical variables e.g. luminance
- Goal: characterize internal dimensions of perceptual experience



Perceptual scales

MLDS



Task

"Which pair is more different?"
(x_1, x_2) or (x_2, x_3)

Decision model

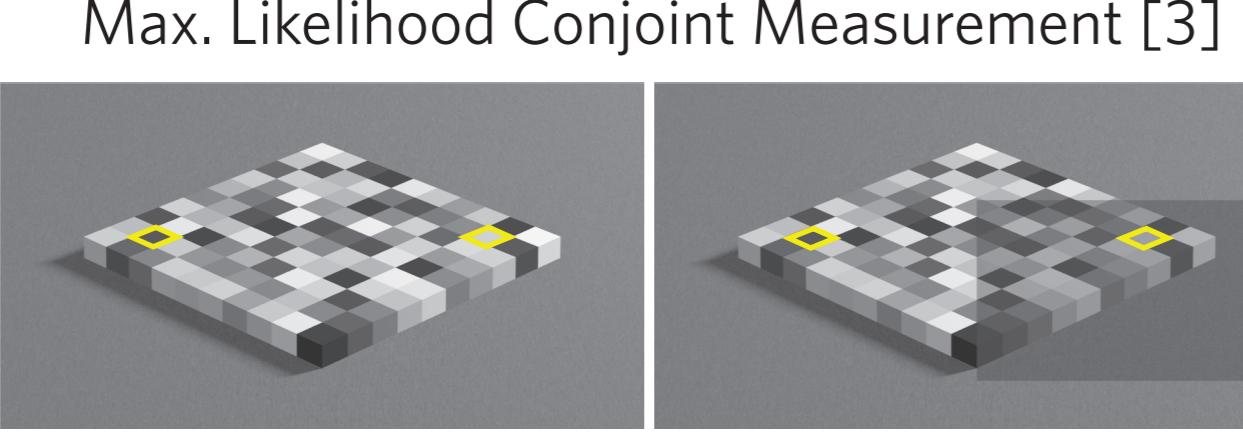
$$\Delta_{\text{MLDS}} = [\Psi^i(x_3) - \Psi^i(x_2)] - [\Psi^i(x_2) - \Psi^i(x_1)] + \epsilon$$

$$\epsilon \sim \mathcal{N}(0, \sigma^2)$$

Comparisons

within context

MLCM



"Which one is lighter?"
(x_1) or (x_2)

$$\Delta_{\text{MLCM}} = [\Psi^j(x_2) - \Psi^i(x_1)] + \epsilon$$

$$\epsilon \sim \mathcal{N}(0, \sigma^2)$$

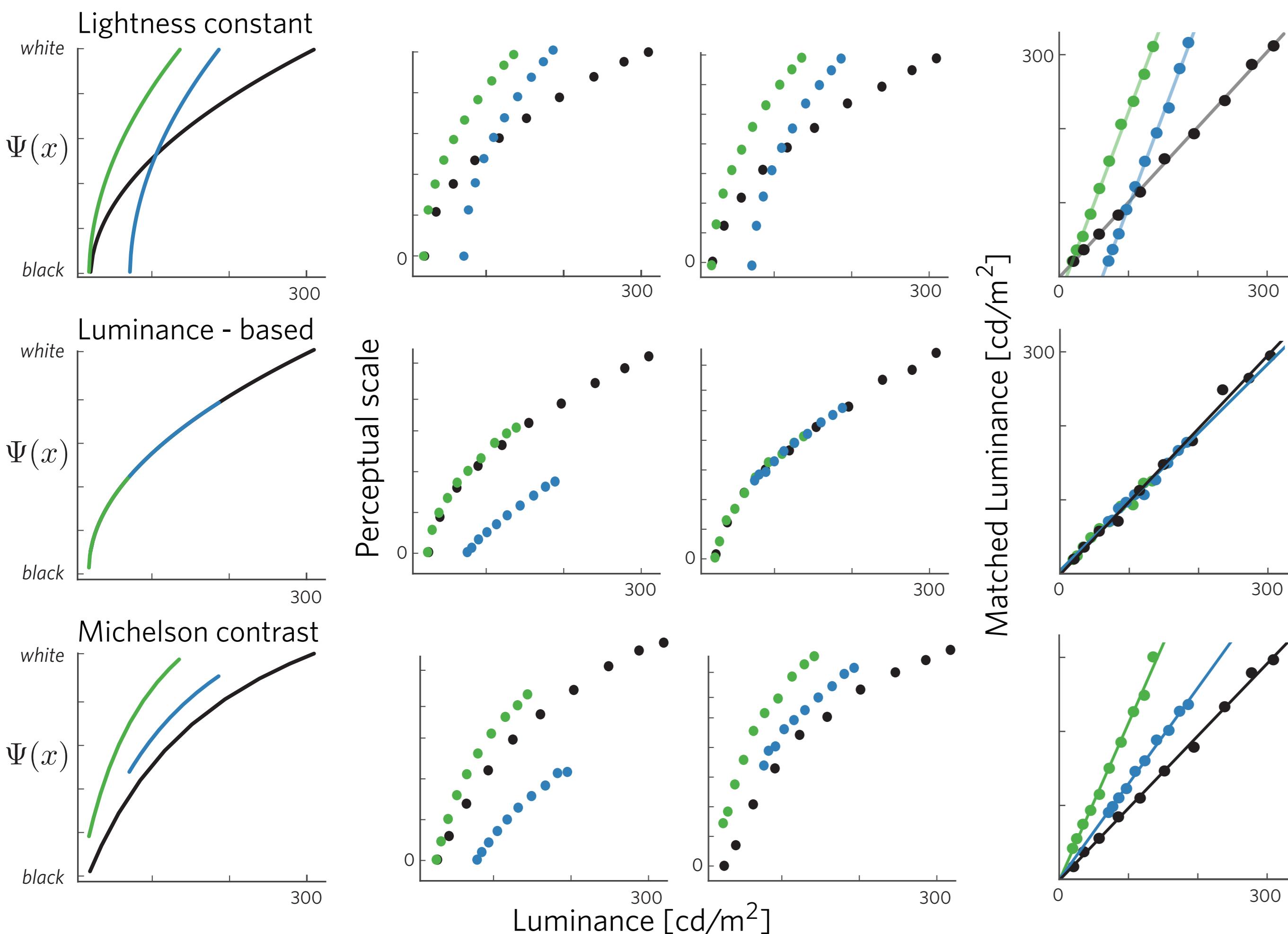
Comparisons

within and across-context

Goal: Evaluate scaling methods for estimating perceptual scales

Simulations

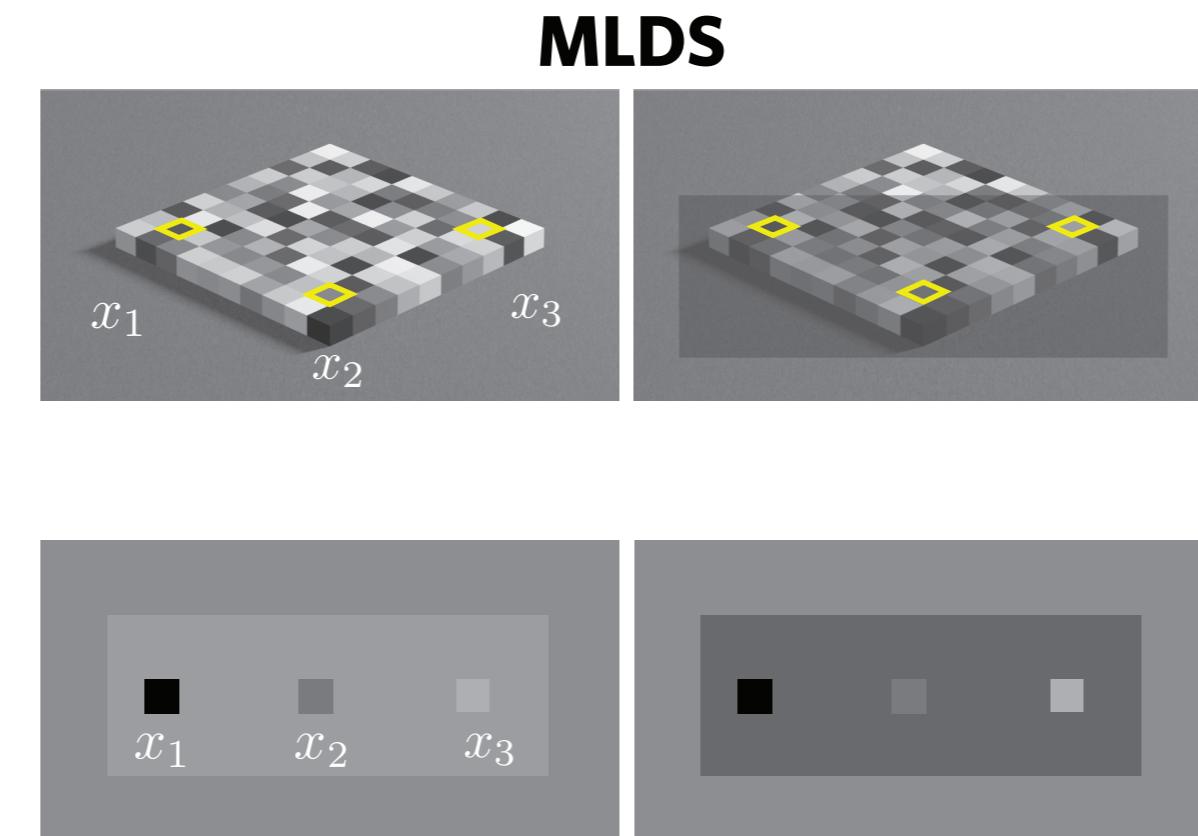
Ground Truth



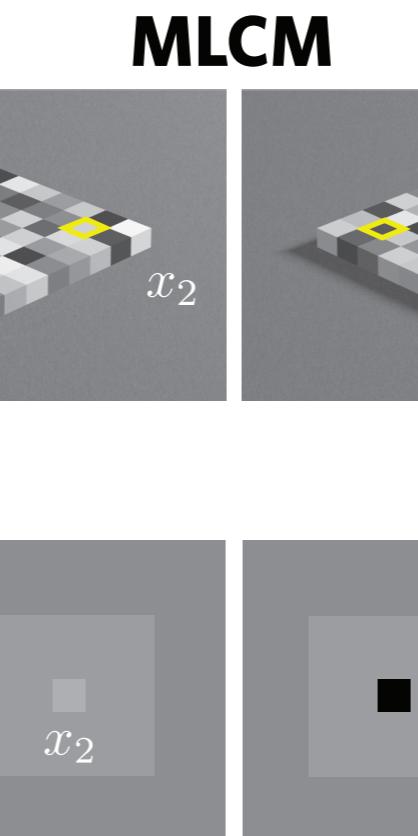
Experimental testbed

Experimental testbed

variegated
checkerboard
center-surround
stimuli

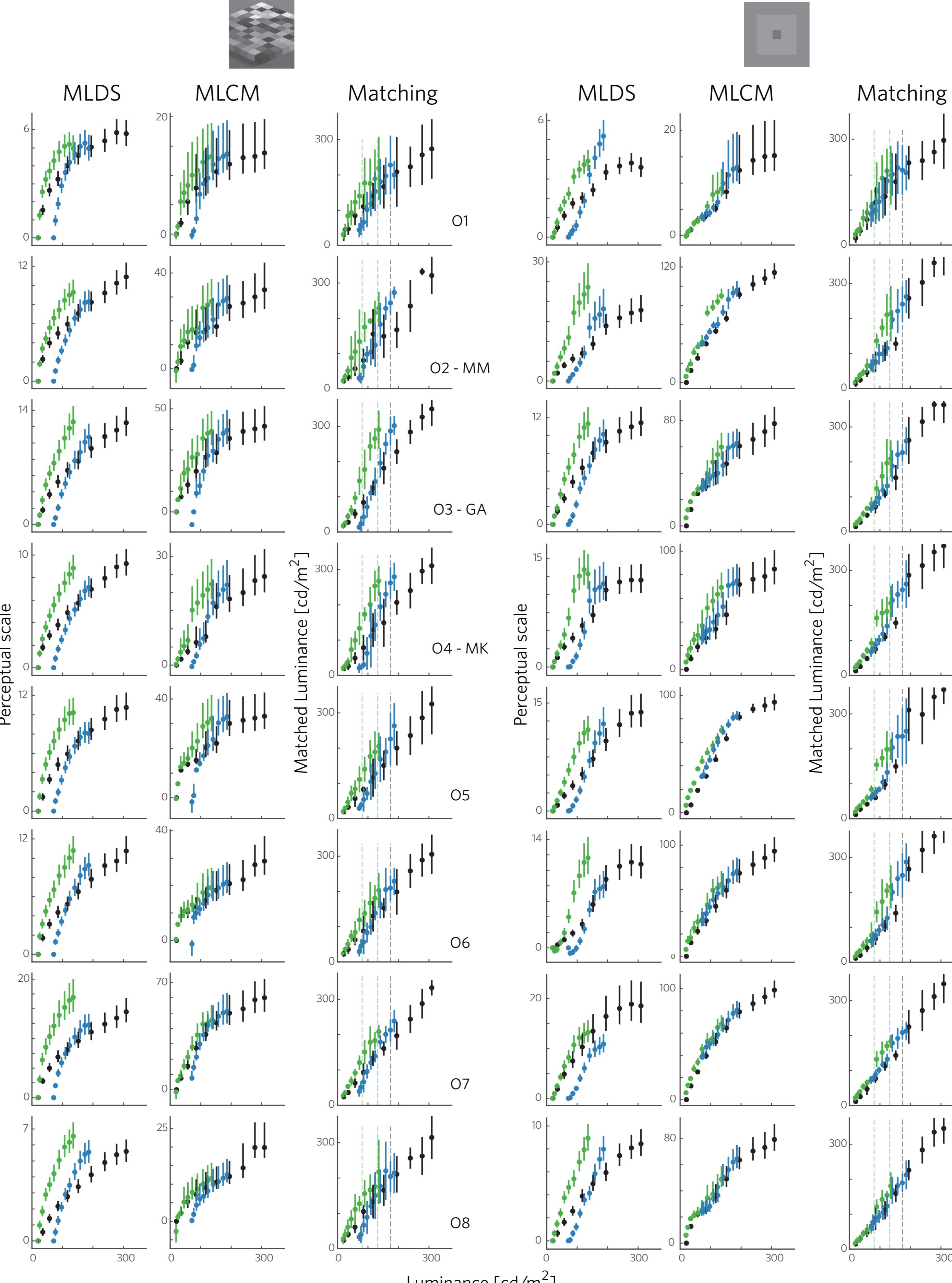


"Which pair is more different?"
(x_1, x_2) or (x_2, x_3)

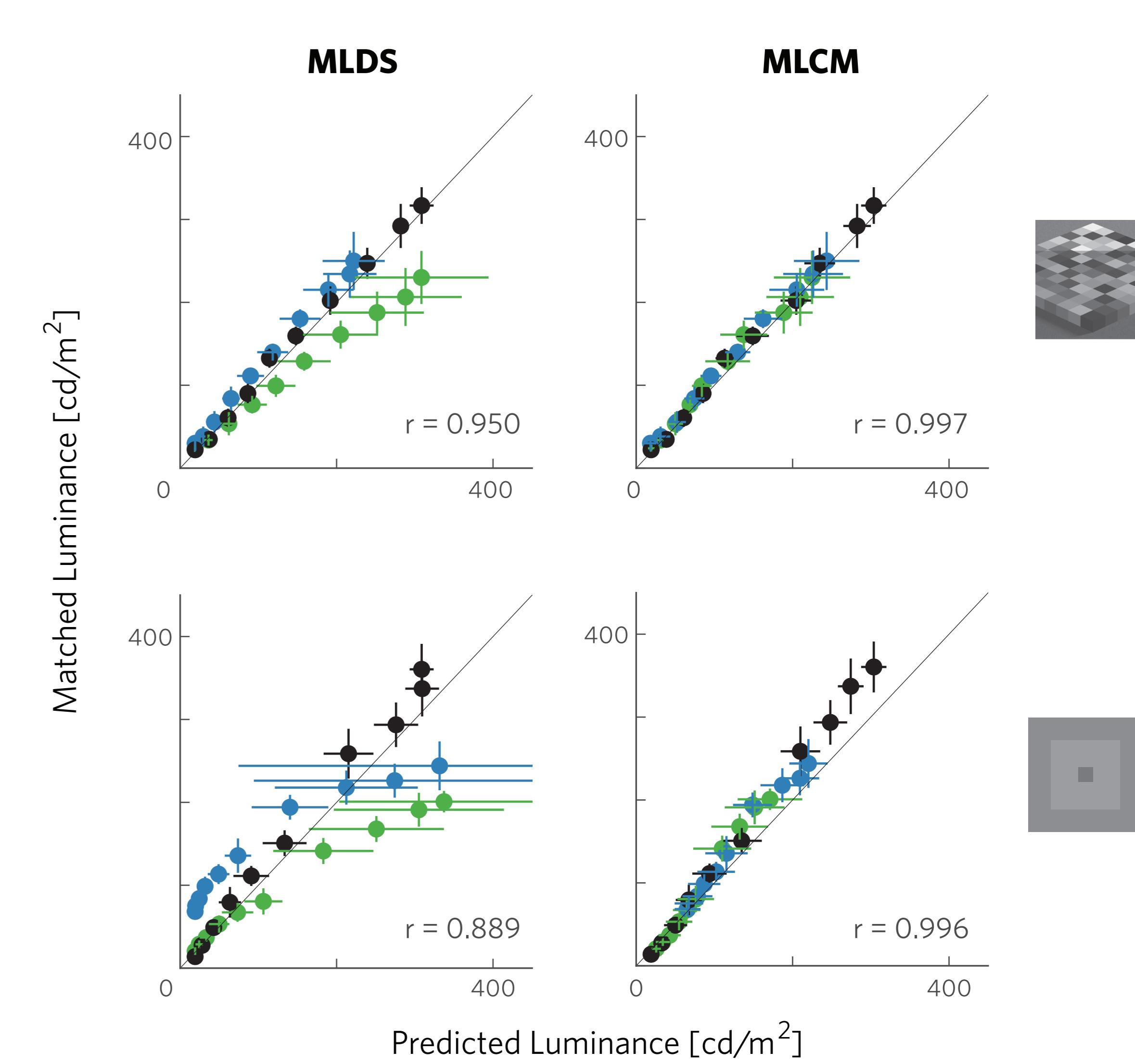


"Which one is lighter?"
(x_1) or (x_2)

Results - individual examples



Relating scales and matches



Method comparison

	MLDS	MLCM	Matching
context comparison	within	within and across	across
perceptual judgment	interval difference	simple difference	equality
task	triad comparison	paired comparison	adjust until equal
subjective difficulty	xx	x	xxx
method's outcome		perceptual scales	matches in physical units
# trials	3600/obs	3350/obs	300/obs

Discussion

- MLDS' anchoring policy is problematic when several scales are estimated and need to be compared
- In the present study MLCM seem to provide more valid scales estimates, in simulations and in experiments
- Adequacy of one or the other method needs to be evaluated in each experimental scenario
- Correspondence between MLCM and matches suggest that MLCM based scales provide a more direct estimate of the internal dimension of interest

Acknowledgements

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References

- [1] Wiebel, Aguilar, Maertens (2017). JoV, 17(4):1
- [2] Maloney & Yang (2003). JoV, 3(8): 573:85
- [3] Knoblauch & Maloney (2012).