Shape affects numerical comparisons, although (seemingly) irrelevant to the task
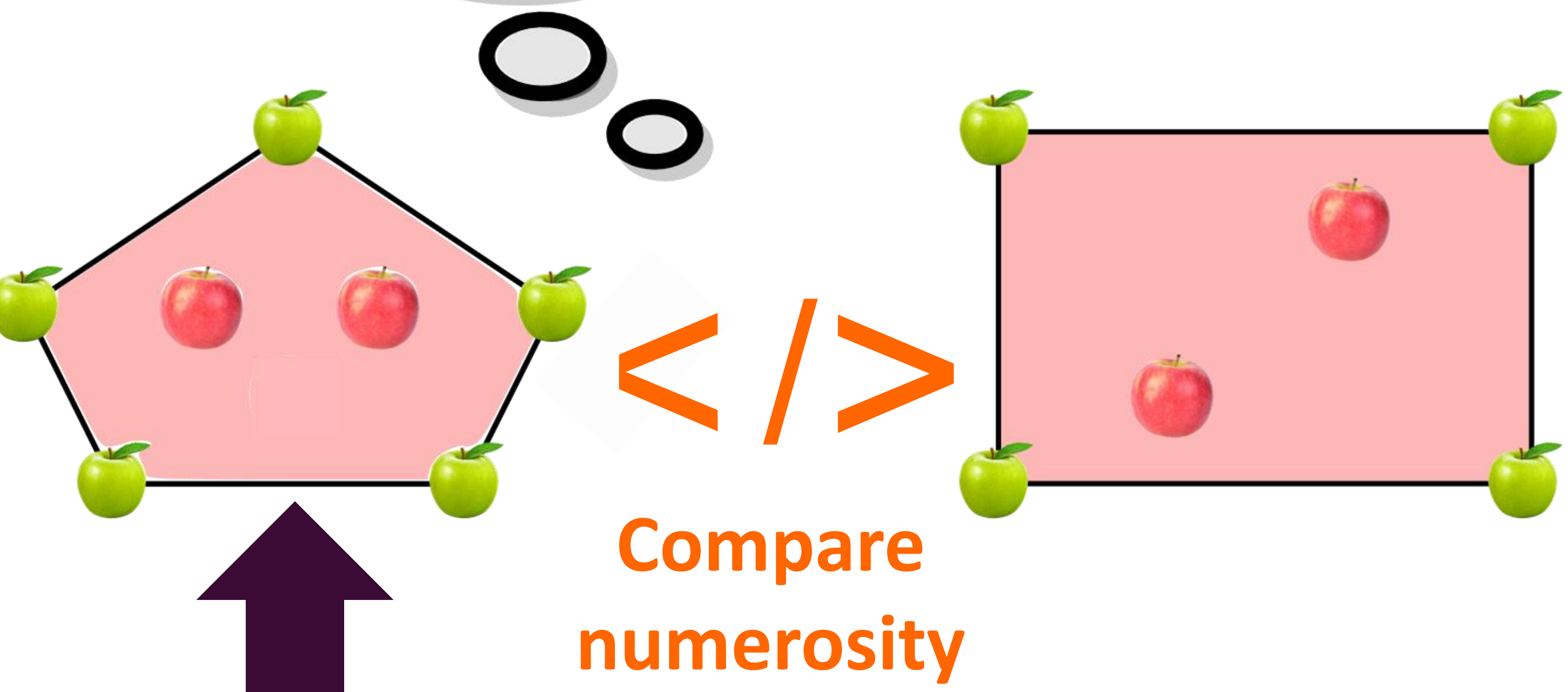
Max Probability =
P (Number | Shape)
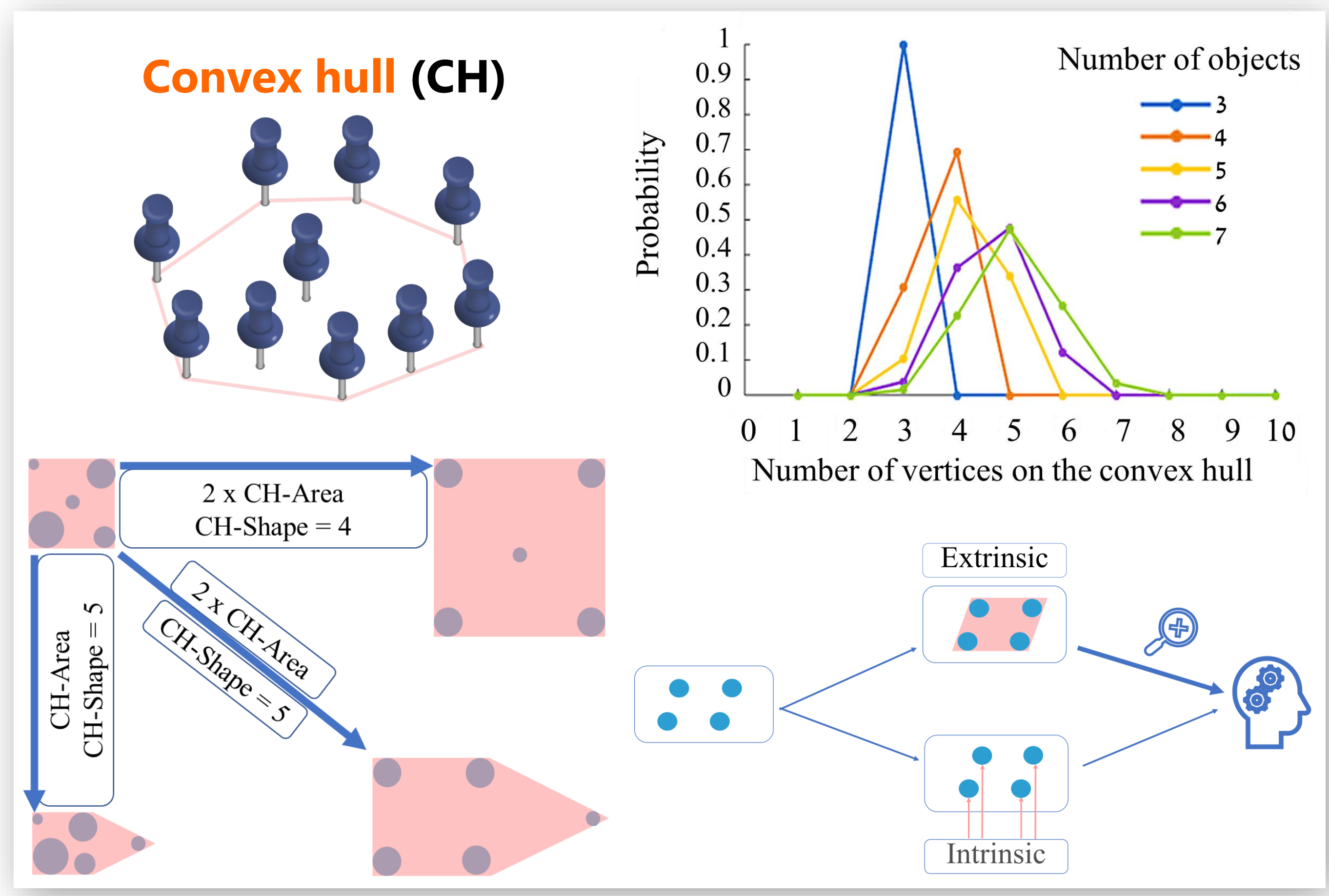
Compare numerosity
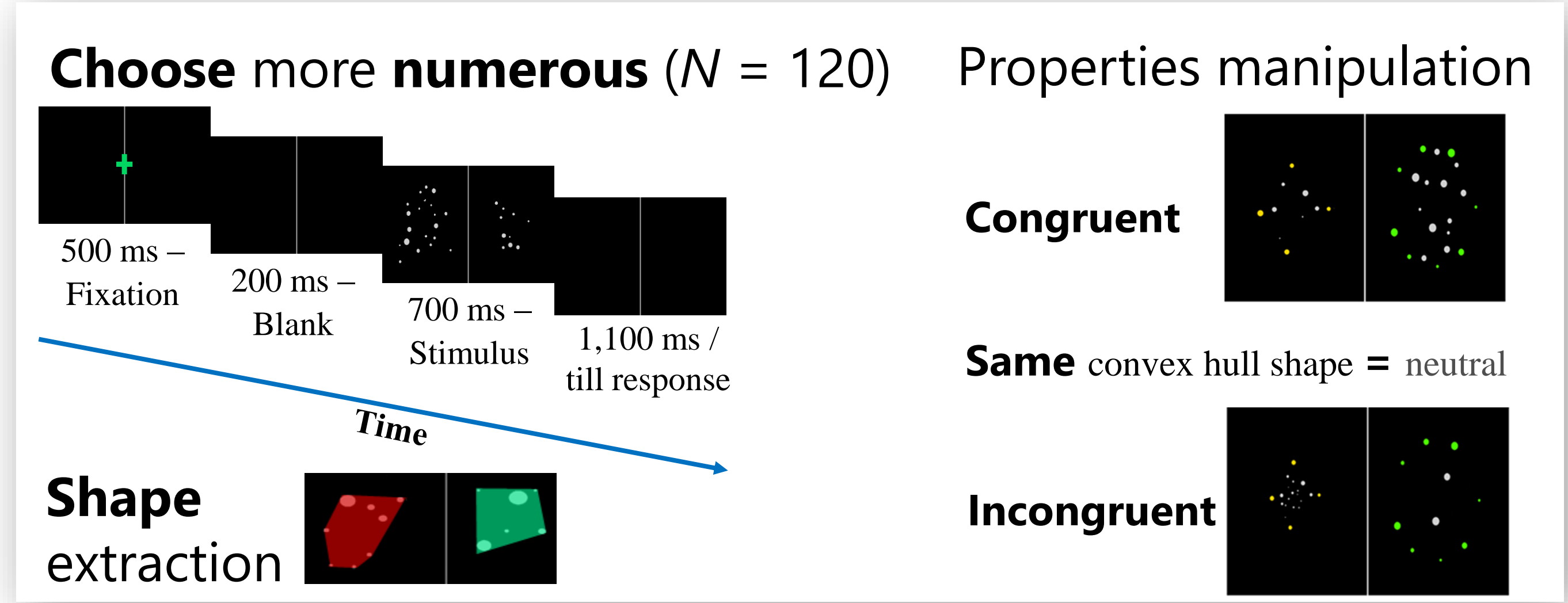
< / >

Use shape - convex hull probability

Shilat, Salti, & Henik. (2021). Shaping the way
from the unknown to the known: The role of convex
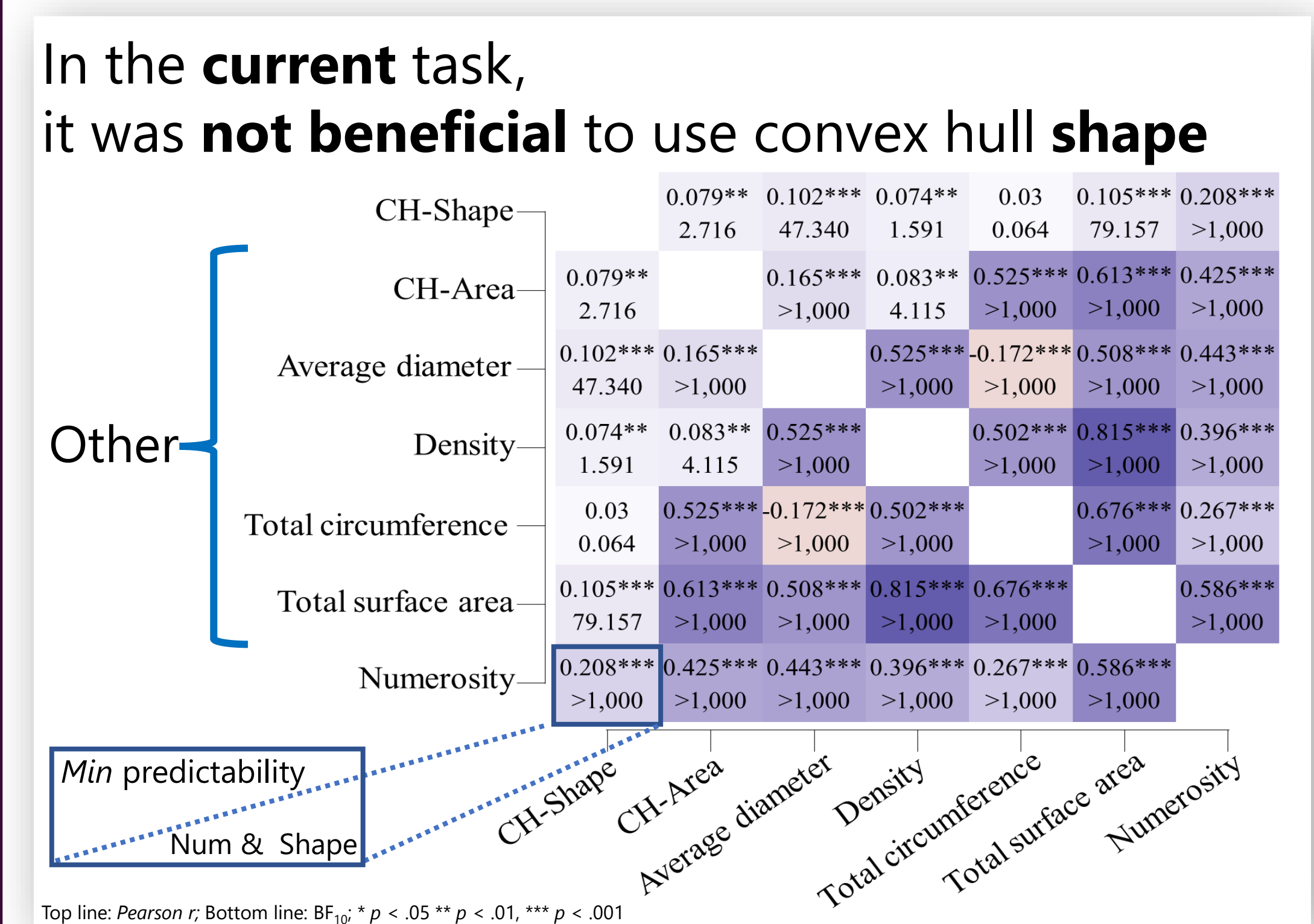hull shape in numerical comparisons.
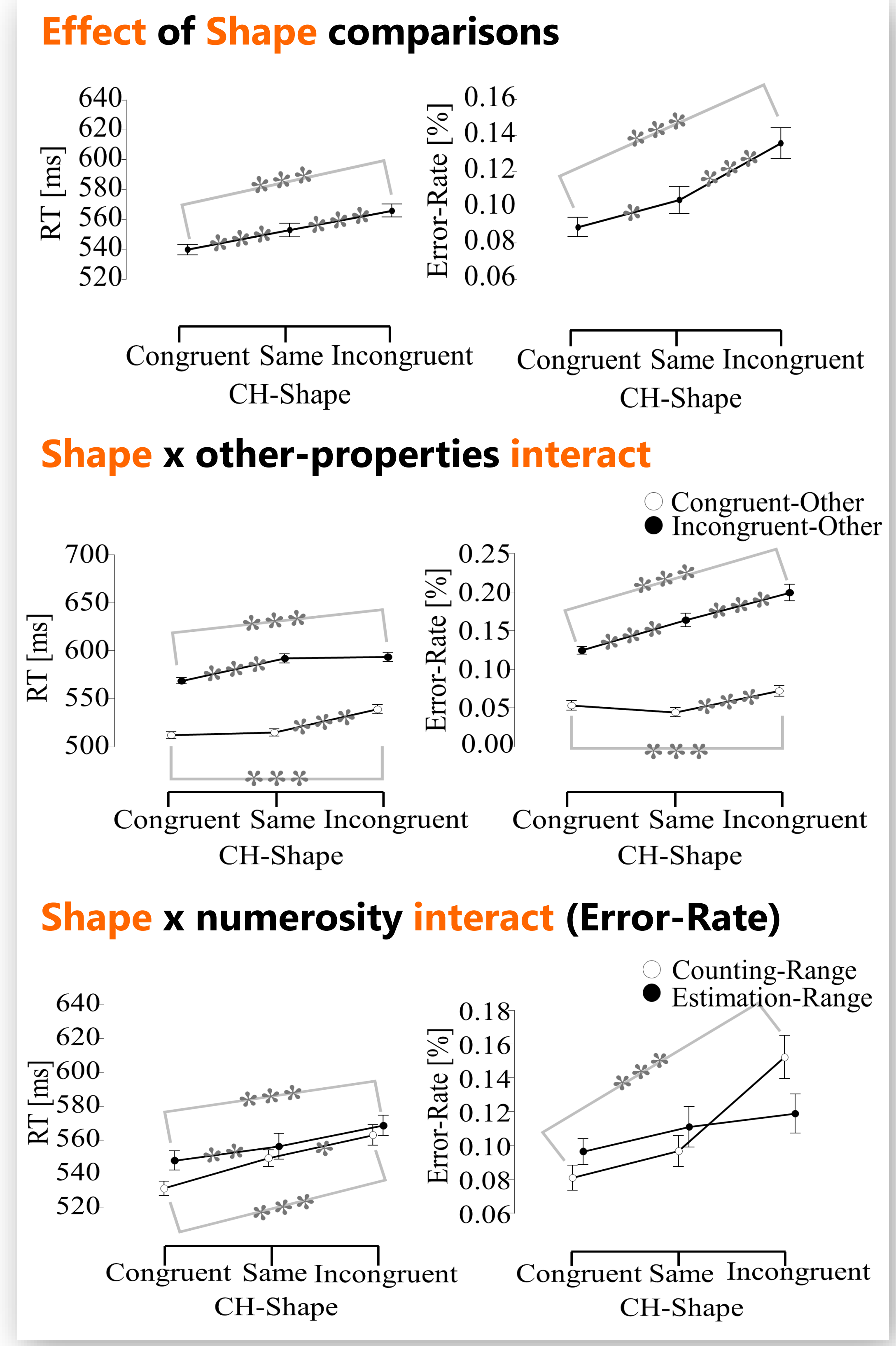*Cognition, 217*, 104893.

Rational

Convex hull (CH)

2 x CH-Area
CH-Shape = 4

CH-Area
CH-Shape = 5

2 x CH-Area
CH-Shape = 5

Extrinsic

Intrinsic

Number of objects
3, 4, 5, 6, 7

Number of vertices on the convex hull

Method

Choose more **numerous** (*N* = 120)   Properties manipulation

500 ms – Fixation
200 ms – Blank
700 ms – Stimulus
1,100 ms / till response

Time

Congruent

Same convex hull shape = neutral

Shape extraction

Incongruent

Results I

In the **current** task,
it was **not beneficial** to use convex hull **shape**

	CH-Shape	CH-Area	Average diameter	Density	Total circumference	Total surface area	Numerosity
CH-Shape		0.079** / 2.716	0.102*** / 47.340	0.074** / 1.591	0.03 / 0.064	0.105*** / 79.157	0.208*** / >1,000
CH-Area	0.079** / 2.716		0.165*** / >1,000	0.083** / 4.115	0.525*** / >1,000	0.613*** / >1,000	0.425*** / >1,000
Average diameter	0.102*** / 47.340	0.165*** / >1,000		0.525*** / >1,000	-0.172*** / >1,000	0.508*** / >1,000	0.443*** / >1,000
Density	0.074** / 1.591	0.083** / 4.115	0.525*** / >1,000		0.502*** / >1,000	0.815*** / >1,000	0.396*** / >1,000
Total circumference	0.03 / 0.064	0.525*** / >1,000	-0.172*** / >1,000	0.502*** / >1,000		0.676*** / >1,000	0.267*** / >1,000
Total surface area	0.105*** / 79.157	0.613*** / >1,000	0.508*** / >1,000	0.815*** / >1,000	0.676*** / >1,000		0.586*** / >1,000
Numerosity	0.208*** / >1,000	0.425*** / >1,000	0.443*** / >1,000	0.396*** / >1,000	0.267*** / >1,000	0.586*** / >1,000	

Min predictability
Num & Shape

CH-Shape, CH-Area, Average diameter, Density, Total circumference, Total surface area, Numerosity

Top line: *Pearson r*; Bottom line: BF$_{10}$; * *p* < .05 ** *p* < .01, *** *p* < .001

Results II

Effect of Shape comparisons

***

Congruent Same Incongruent
CH-Shape

Shape x other-properties interact

○ Congruent-Other
● Incongruent-Other

***

Congruent Same Incongruent
CH-Shape

Shape x numerosity interact (Error-Rate)

○ Counting-Range
● Estimation-Range

***

Congruent Same Incongruent
CH-Shape

Conclusions

→ **Non-numerical** properties are involved in numerical judgments
→ Convex hull **shape**
    → Involved in numerical comparisons
    → Has a unique contribution
    → Should be **incorporated** in the future & get **more focus**

References

⬚ Buchta, C. (2006). The exact distribution of the number of vertices of a random convex chain. *Mathematika*, 53(2), 247–254.
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⬚ Salti, M., Katzin, N., Katzin, D., Leibovich, T., & Henik, A. (2017). One tamed at a time: A new approach for controlling continuous magnitudes in numerical comparison tasks. *Behavior Research Methods*, 49(3), 1120–1127.