Category learning 2.0?

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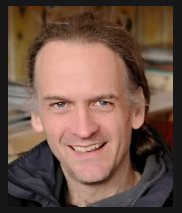

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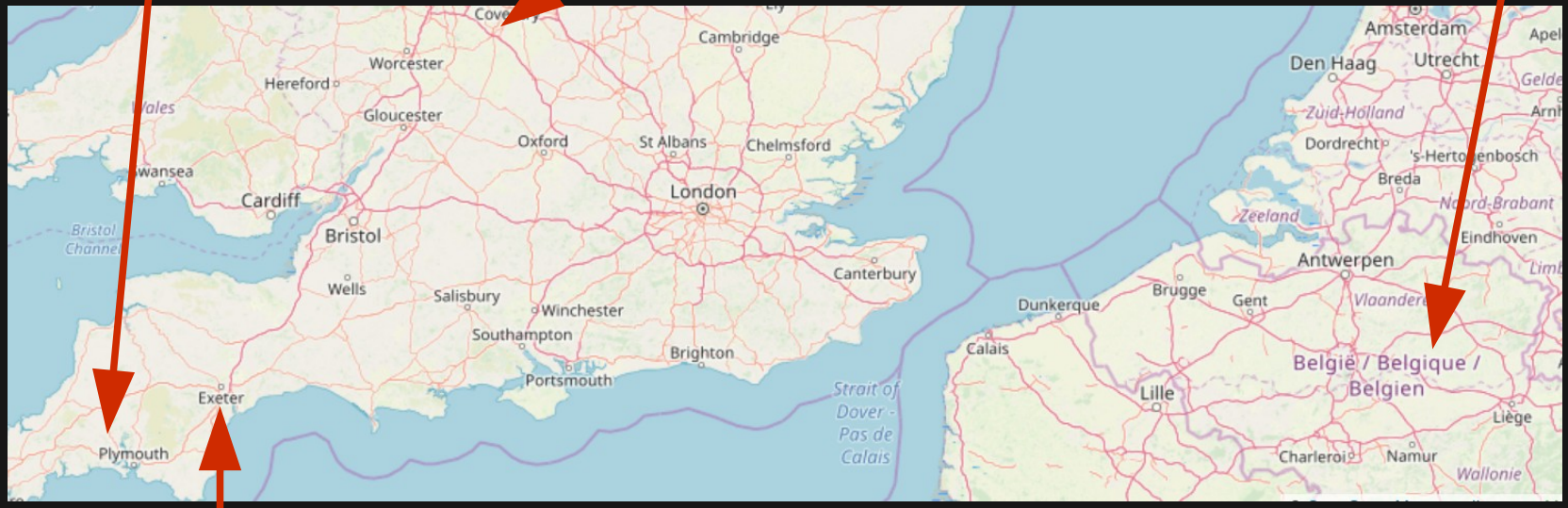

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Category learning 2.0

Categorization is the result of the action of two competing systems. One is rule-based and explicit, the other is based on overall similarity and is implicit (or at least procedural). The overall similarity system takes control when time or cognitive resources are scarce.

Ashby & Maddox (2010)

Brooks (1978)

Kemler Nelson (1984)

Combination Theory

Categorization is based on the combination of evidence, which takes time and mental resources. With more of these things, more information is used, or is combined in more complex ways.

Wills, Inkster & Milton (2015)

Neisser (1967)

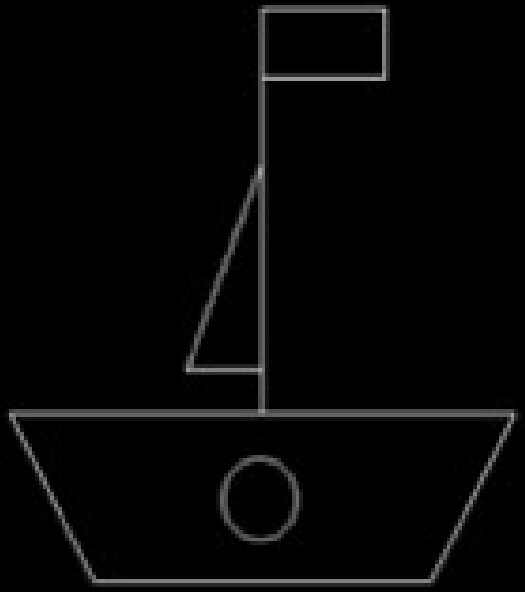
“Synthesis of any particular letter or figure takes an appreciable time”

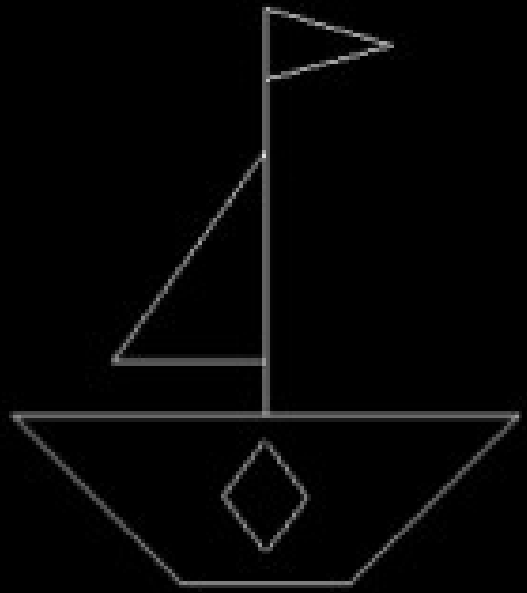
Neisser, 1967, p. 103

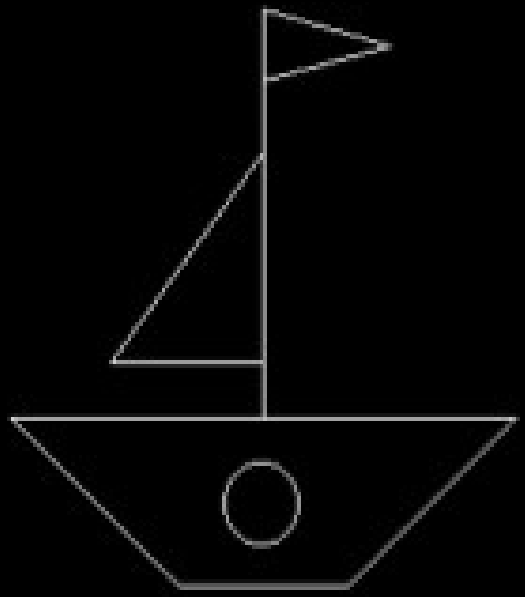
As time or mental resouces become more scarce...

Category Learning 2.0 predicts that **more** stimulus attributes are used

Combination Theory predicts that **fewer** stimulus attributes are used.







As time pressure increases...

Category Learning 2.0 predicts **more** overall similarity classification

Combination Theory predicts **less** overall similarity classifcation

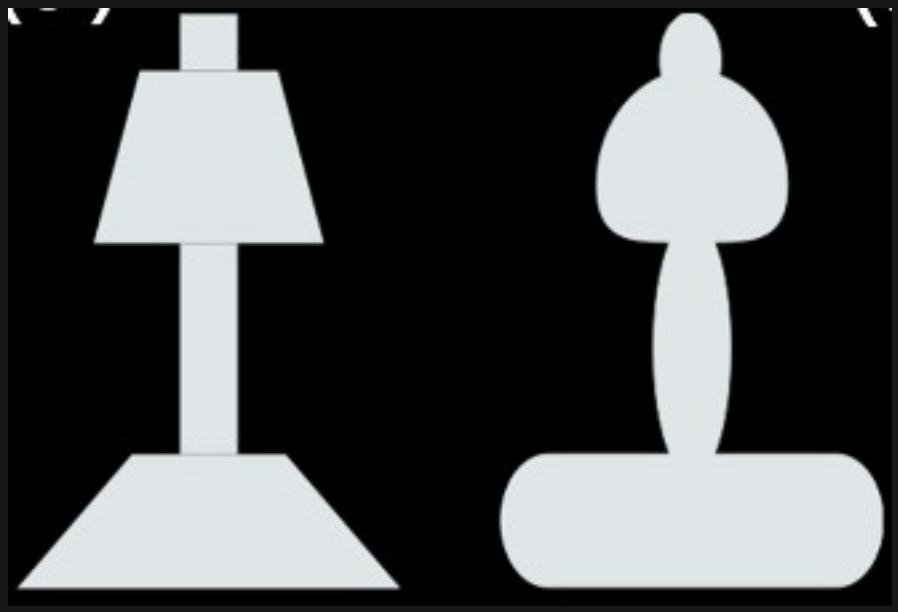
Stimulus presentation time

	UD	**OS**	**Other**
1024 ms	.61	.18	.22
4096 ms	.29	.58	.13

Milton et al. (2008)

Concurrent load

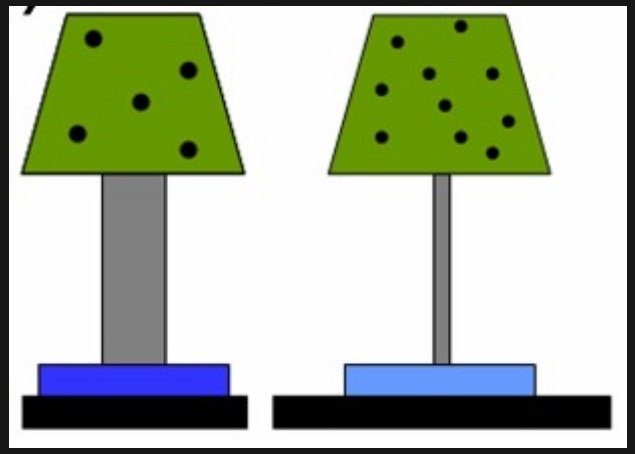
23 ... 87 ... 19 ...



	UD	OS	Other
Load	.52	.14	.35
No Load	.34	.63	.03

Wills et al. (2013)

Working memory



MTS, then:

2 x 3 + 1 = 17 BED

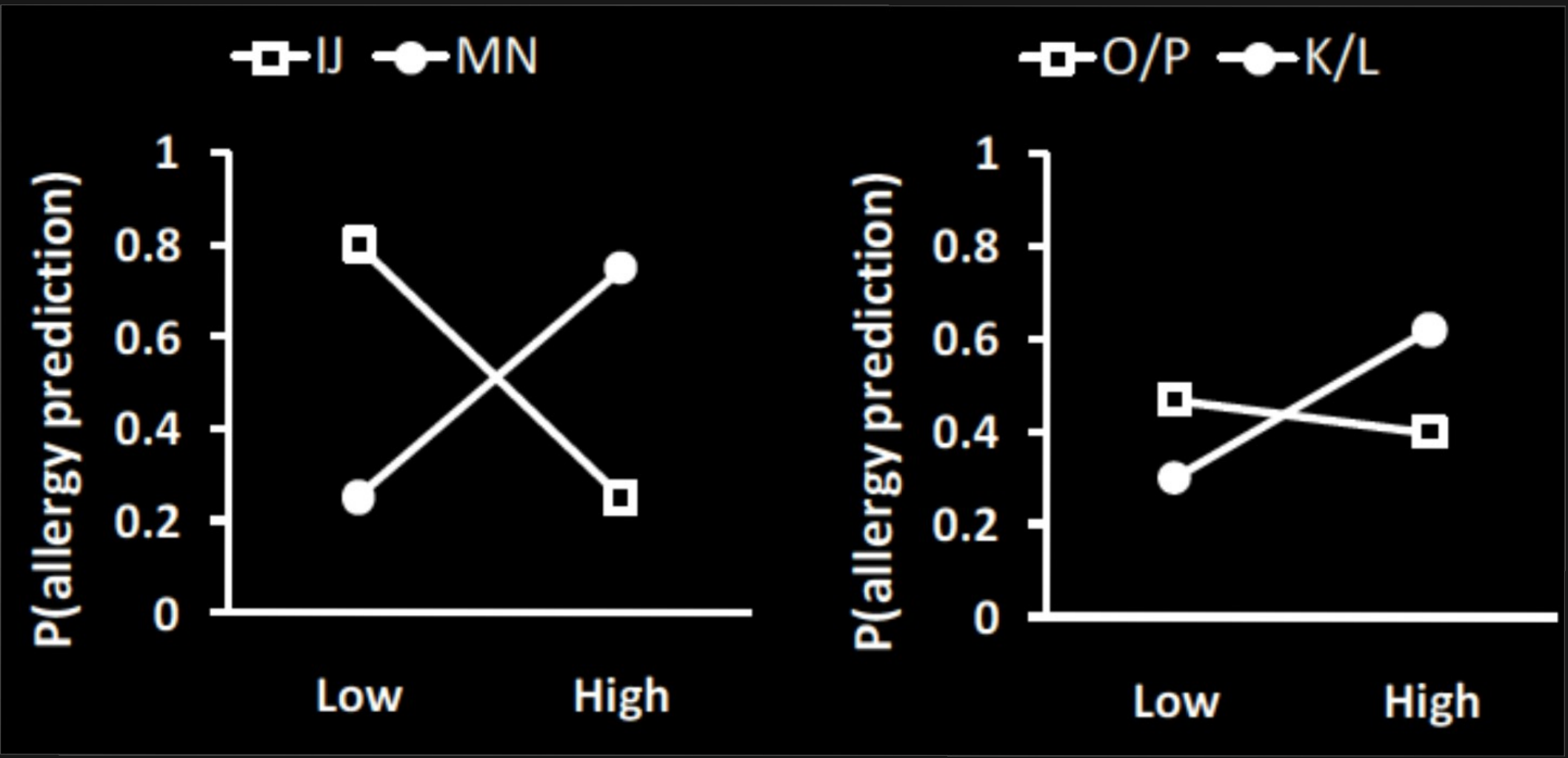
	span	**N**
UD sorters	2.39	31
OS sorters	3.73	15

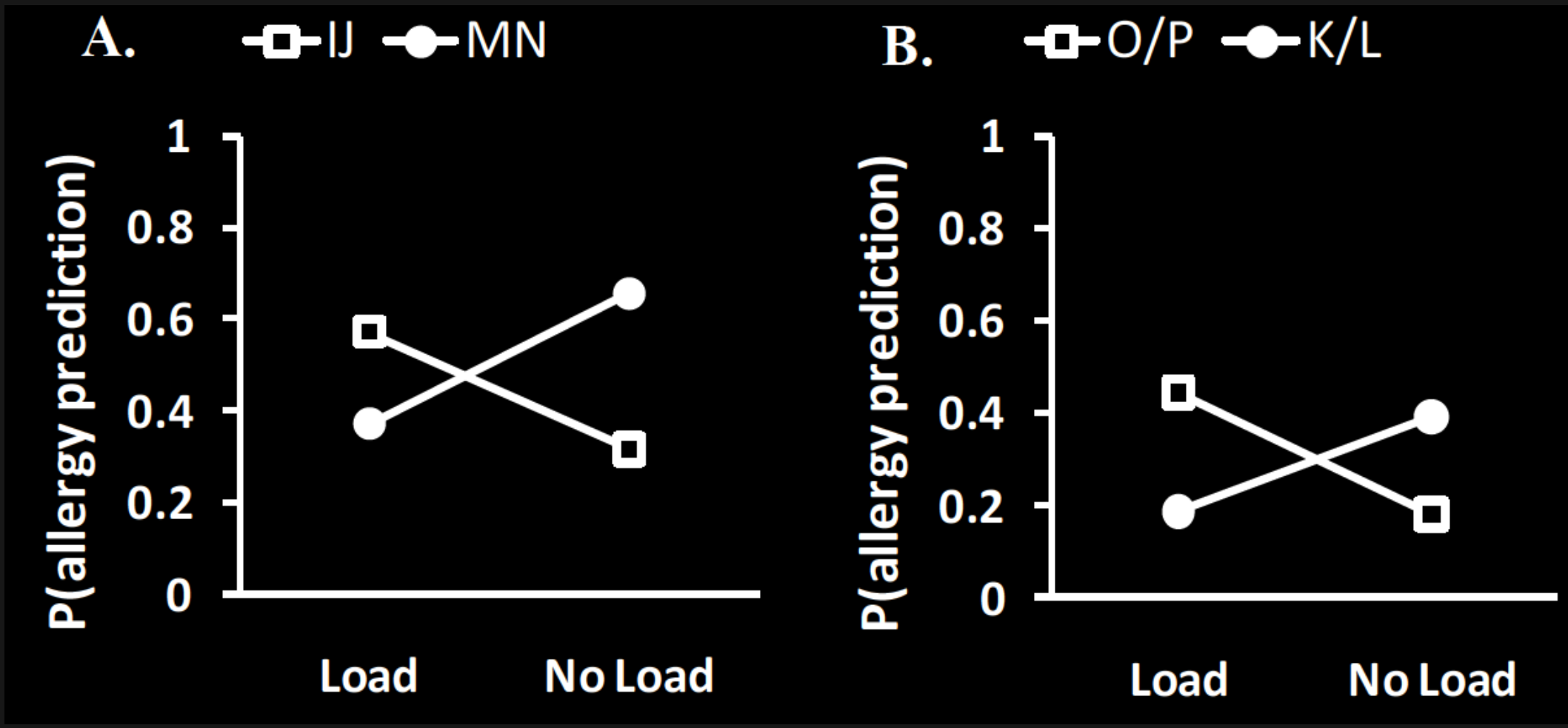
Wills et al. (2013)

$OS_{sorters}$ - $UD_{sorters}$

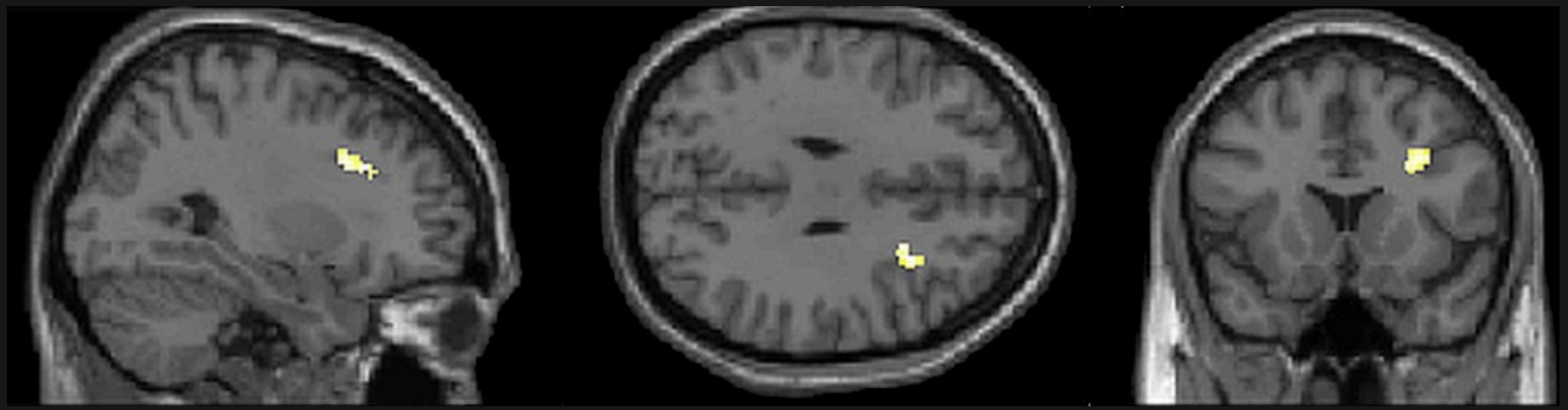
Milton et al. (2009)

Training			Test		
A+	B+	AB-	A?	B?	AB?
C-	D-	CD+	C?	D?	CD?
E+	F+	EF-	E?	F?	EF?
G-	H-	GH+	G?	H?	GH?
I+	J+		I?	J?	**IJ?**
		KL-	**K?**	**L?**	KL?
M-	N-		M?	N?	**MN?**
		OP+	**O?**	**P?**	OP?

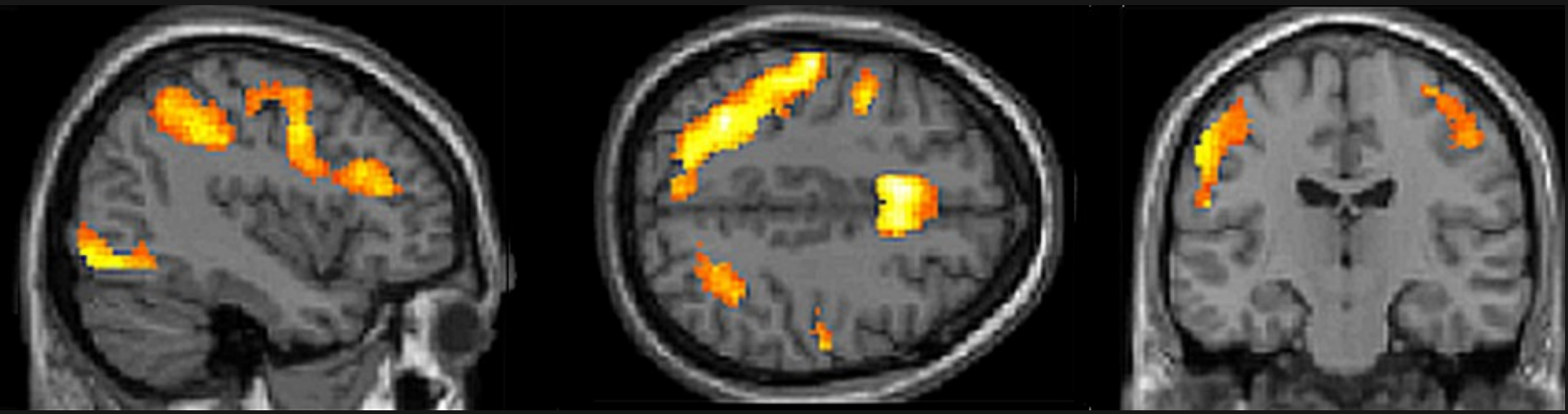

IJ
MN
P(allergy prediction)
1
0.8
0.6
0.4
0.2
0
Low
High
O/P
K/L
P(allergy prediction)
1
0.8
0.6
0.4
0.2
0
Low
High



Wills et al. (2011)



Milton et al. (2017)



Milton et al. (2017)

Maes et al. (2015)

	Novel
Ax	.13
Bw	.19
Fe	.25
He	.21
Mo	.06
Ta	.38

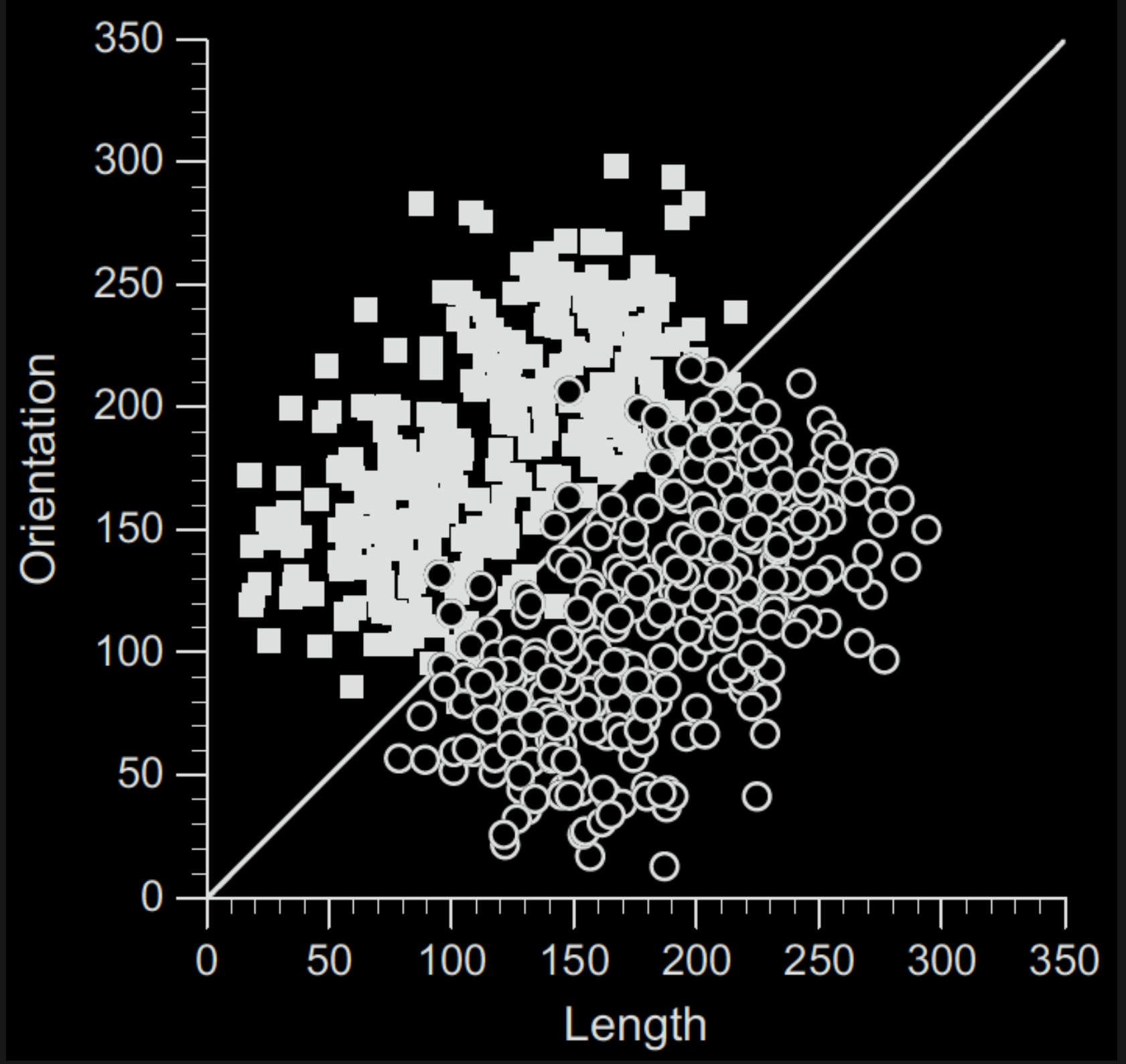
Maes et al. (2015)

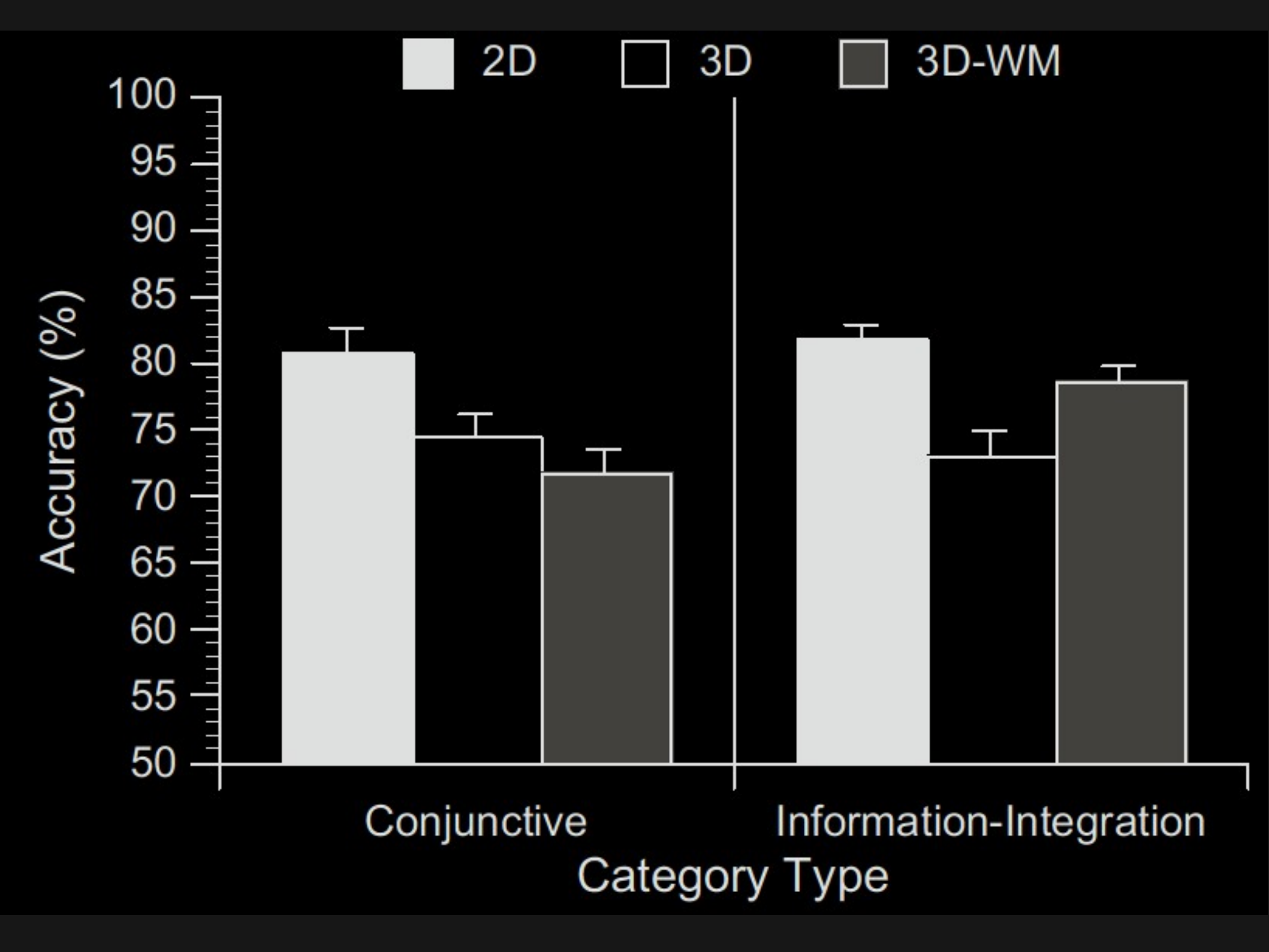
	Novel
Ax	.13
Bw	.19
Fe	.25
He	.21
Mo	.06
Ta	.38

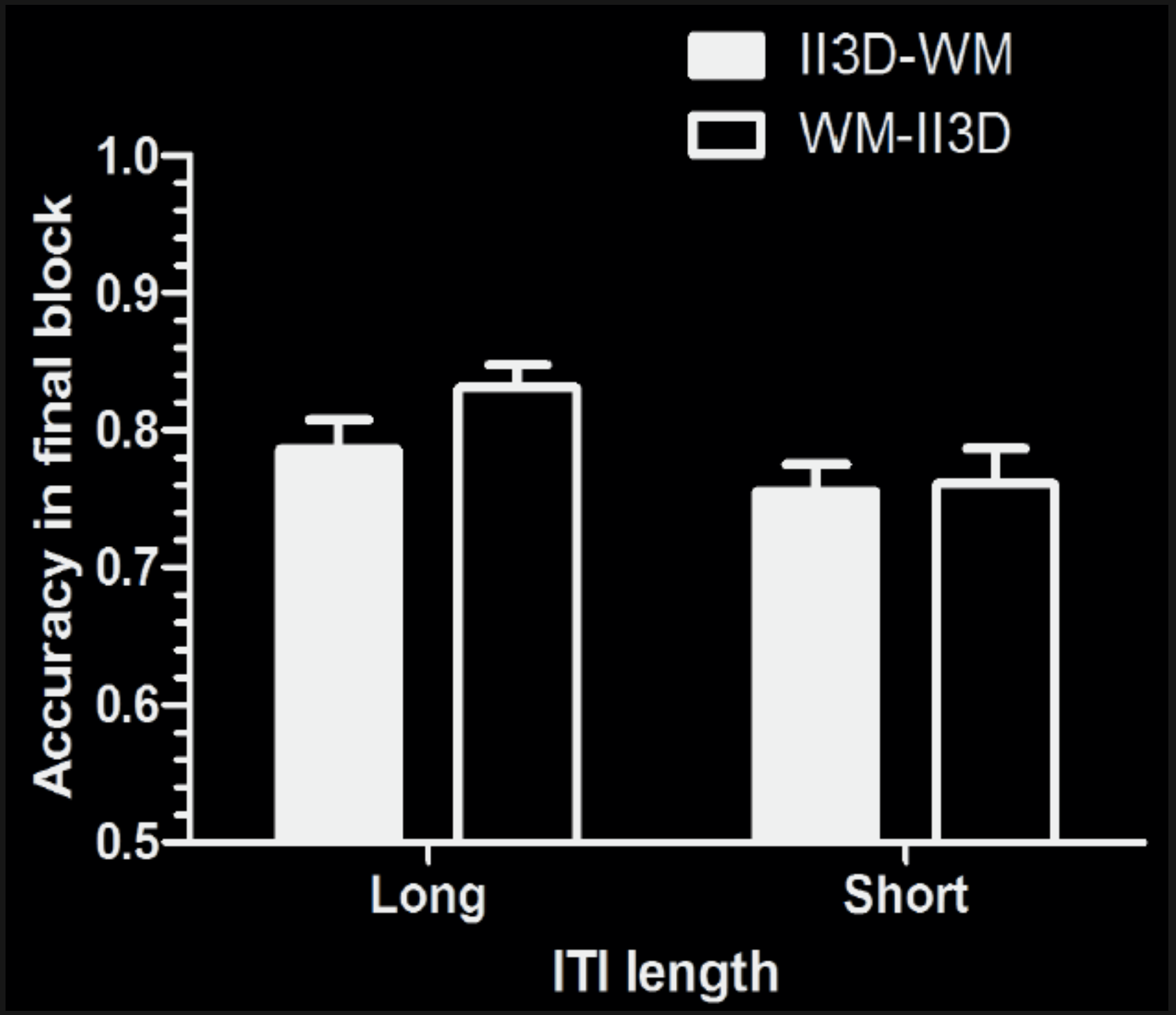
	Novel
23	.88
13	.88
10	.75
17	.75
28	.71
18	.71
9	.71
1	.67
5	.67
24	.62
25	.62
29	.62
5	.62
20	.58
26	.58
12	.54

	Novel
7	.46
11	.38
14	.38
16	.38
6	.37
19	.29
22	.25
8	.21
27	.21

Maes et al. (2015)


Orientation
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
Length


2D
3D
3D-WM
100
95
90
85
80
75
70
65
60
55
50
Accuracy (%)
Conjunctive
Information-Integration
Category Type



Newell et al. (2013)

BUNO

BUNA

BUPO

BYNO

KYPA

KYPO

KYNA

KUPA

BUNO
BUNA
BUPO
BYNO

KYPA
KYPO
KYNA
KUPA

BYPA

	Traditional		Response-set		
Condition	OS	CA	OS	CA	NCA
Concurrent load	.53	.47	.00	.48	.52
Full attention	.27	.73	.00	.74	.26

Willls et al. (2015)

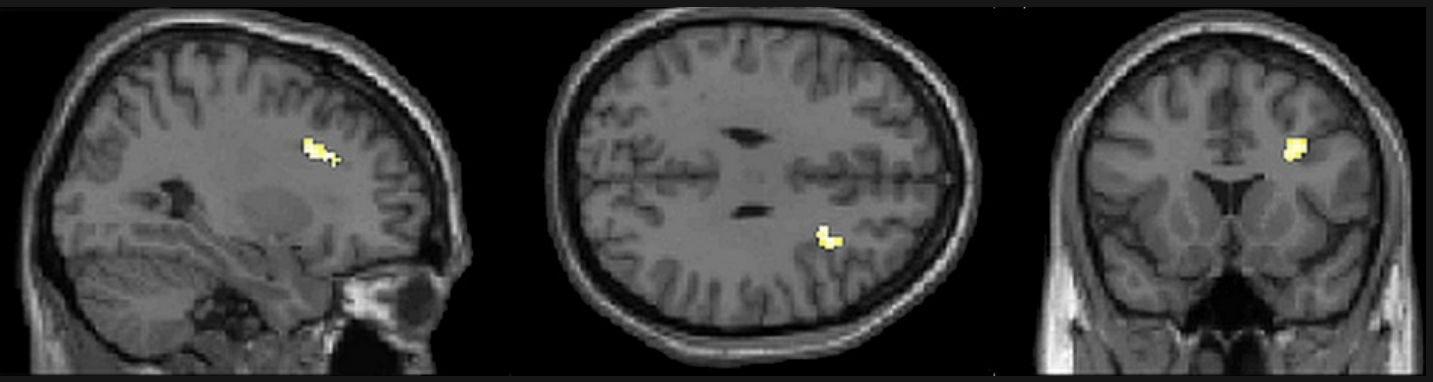
$OS_{sorters}$ - $UD_{sorters}$

Milton et al. (2009)

Table 3
Significant activation for overall similarity sorting compared to single-dimension sorting

Region	Cluster size	BA	Talairach Coordinates			*z*-score
			x	*y*	*z*	
Right ventrolateral frontal cortex	30	47	27	23	−4	3.87
Right anterior insula		47	33	17	−6	3.73
Left cerebellum	19	–	−12	−71	−21	3.82
Left precuneus	11	7	−27	−67	50	3.69
Left precuneus		7	−24	−77	43	3.58
Left postcentral gyrus	5	6	−45	−16	31	3.55
Right precuneus	7	7	30	−71	45	3.47
Right sub-lobar thalamus	5	–	6	−20	9	3.38
Right cuneus	12	18	9	−69	6	3.35

Note. BA = Brodmann's area. Indented rows indicate voxels in the same cluster as the non-indented row above them.



Milton et al. (2017)

ROI analyses:

- pFC
- right inferior parietal lobes
- bilateral occipital lobes
- thresholds of p< .001 and 64 contiguous voxels

Found:

- Rule – Similarity: right middle frontal gyrus (BA 9)