

Predicting the Age of Acquisition of Concepts from Sensorimotor Experience

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Collaborators



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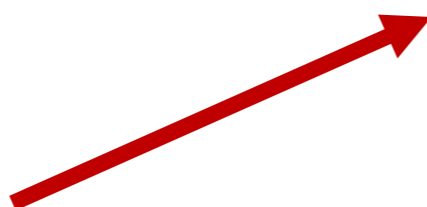


Dermot Lynott



The Leverhulme Trust

Background



[Image source](#)

Background



[Image source](#)

Background



[Image source](#)

Background



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Background

“If it looks like a duck, and quacks like a duck, we have at least to consider the possibility that we have a small aquatic bird of the family Anatidae on our hands”

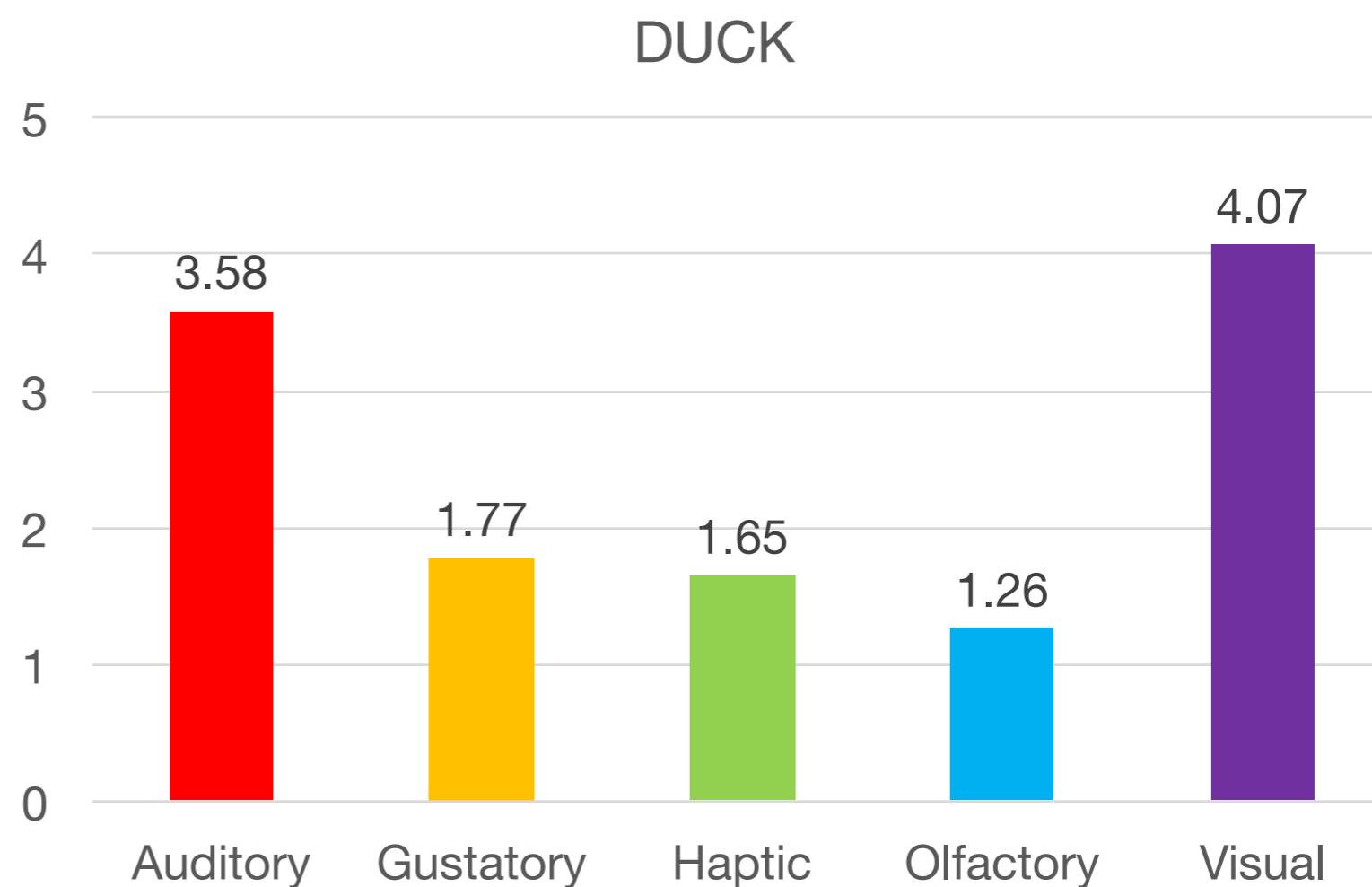


Douglas Adams

Dirk Gently's Holistic Detective Agency

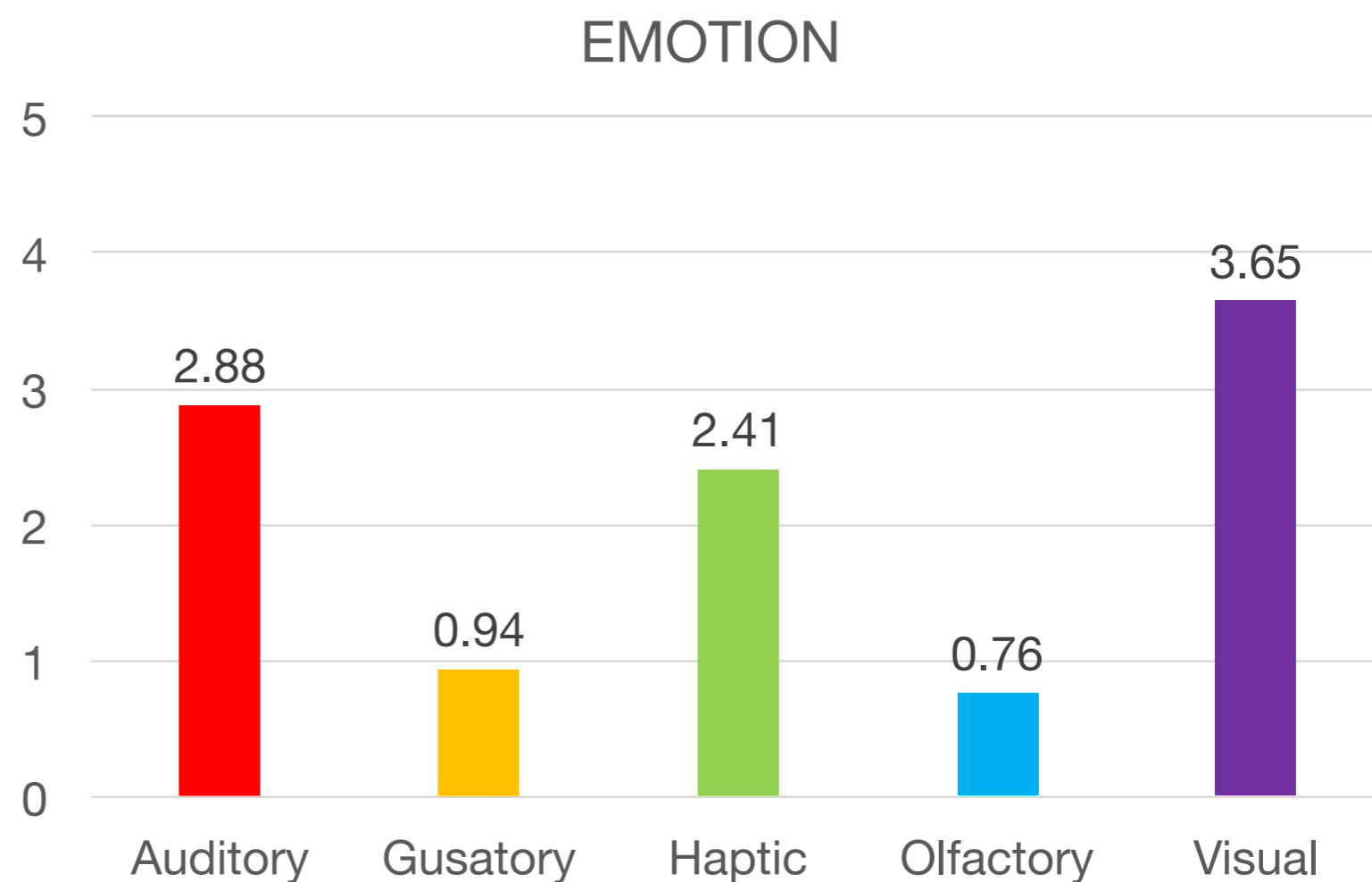
Background

Modality specific perceptual strength for 1,002 words
(Lynott & Connell, 2009; 2013)



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Modality specific perceptual strength for 1,002 words
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Why?

Modality specific perceptual strength more sensitive measure than:

- Concreteness
- Imageability
- Sensory experience

Known to outperform these semantic predictors in language processing tasks (Connell & Lynott, 2012; 2016)

Why?

- Human conceptual system comprises ~40,000 concepts (Brysbaert et al., 2014; Warriner et al., 2013)
- Only 1,002 words with sensory ratings
- Megastudies provide richer data with greater statistical power


[Behavior Research Methods](#)

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Concreteness ratings for 40 thousand generally known English word lemmas

Authors

[Authors and affiliations](#)

Marc Brysbaert , Amy Beth Warriner, Victor Kuperman

How?

- Sensory and motor ratings for ~40,000 concepts using MTurk
- Each concept has ~19 participant ratings
- Each participant rates 48 words
- Overall, $N = 31,851$
- 11 dimensional dataset (6 sensory, 5 motor) ratings for each concept

How?

To what extent do you experience DUCK

	<i>not at all</i>							<i>greatly</i>
	0	1	2	3	4	5		5
By sensations inside your body	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By feeling through touch	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By tasting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By hearing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By seeing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By smelling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Don't know the meaning of this word

To what extent do you experience DUCK by performing an action with the

not at all

0

1

2

3

4

greatly

5



foot / leg



torso



hand / arm



head excluding mouth



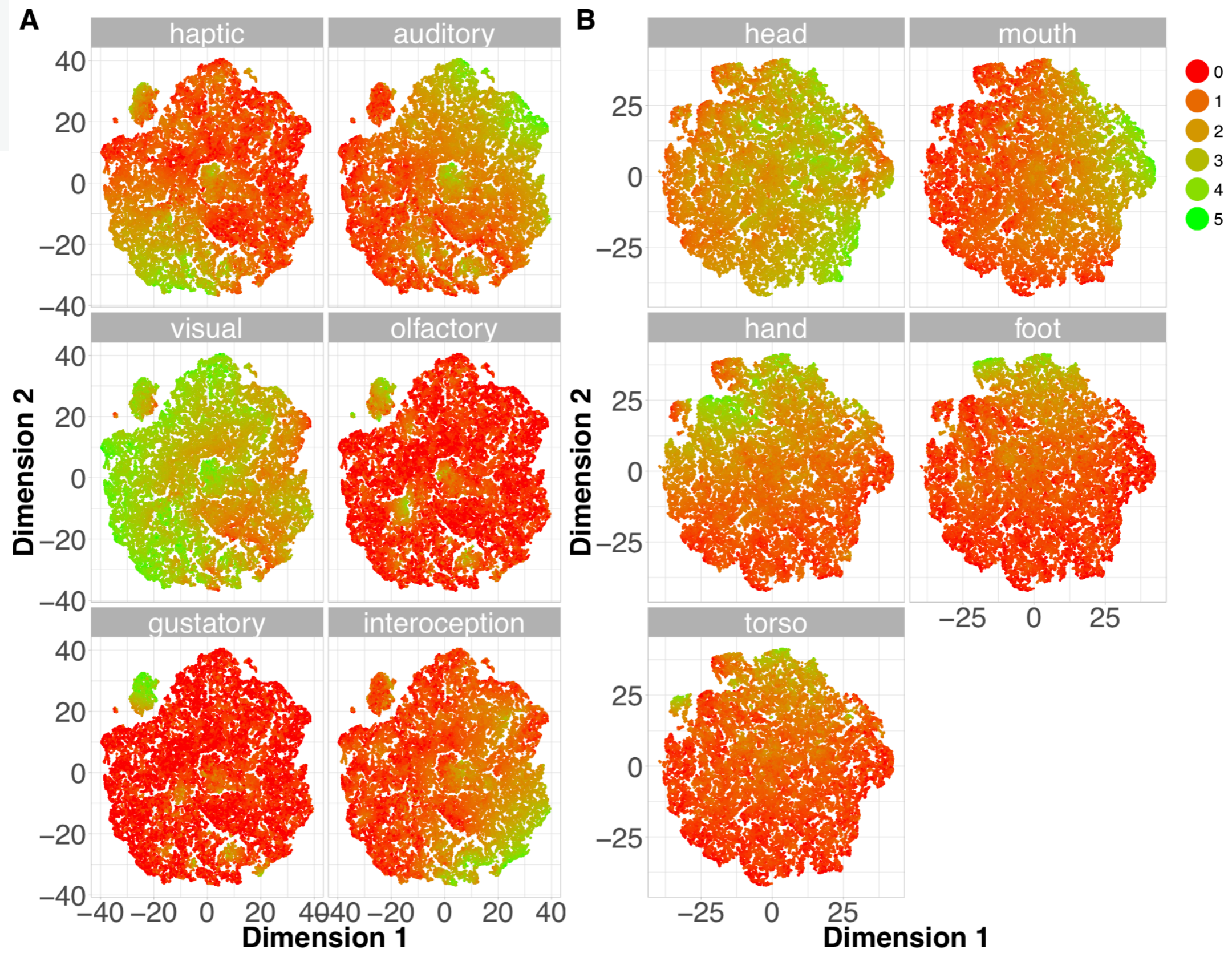
mouth / throat



Don't know the meaning of this word



AoA and Sensorimotor information





Hypotheses

- If sensorimotor information benefits language processing (Connell & Lynott, 2012; 2016), it could also be important for learning and the acquisition of words
- Visual and haptic strength should be really good predictors of AoA for concrete words
- Interoceptive strength should also predict AoA, but mainly for abstract words

Methods

- Sensorimotor norms (40,000 words)
- AoA norms (30,000 words - Kuperman et al., 2012)
- Concreteness norms (40,000 words – Brysbaert et al, 2014)
- Frequency (log - SUBTLEX)
- Valence (14,000 words - Warriner et al., 2012)
- Orthographic word length

= 13,182 words

(nouns, verbs, adjectives)



Results

- Hierarchical regression - sensory

Stage	Predictor	Estimate	Std. error	t	<i>p</i>	<i>R</i> ²	ΔR^2
1	intercept	16.08	0.13	121.33	.001***	.442	
	frequency	-0.81	0.01	-66.50	.001***		
	length	0.12	0.01	14.14	.001***		
	concreteness	-0.73	0.02	-42.00	.001***		
	valence	-0.24	0.01	-17.67	.001***		
2	vision	-0.25	0.02	-10.57	.001***	.465	.023
	haptic	-0.33	0.02	-14.71	.001***		
	audition	-0.16	0.02	-8.89	.001***		
	olfaction	0.01	0.03	0.23	.82		
	gustation	-0.07	0.03	-2.17	.03*		
	interoception	-0.16	0.02	-7.46	.001***		



Results

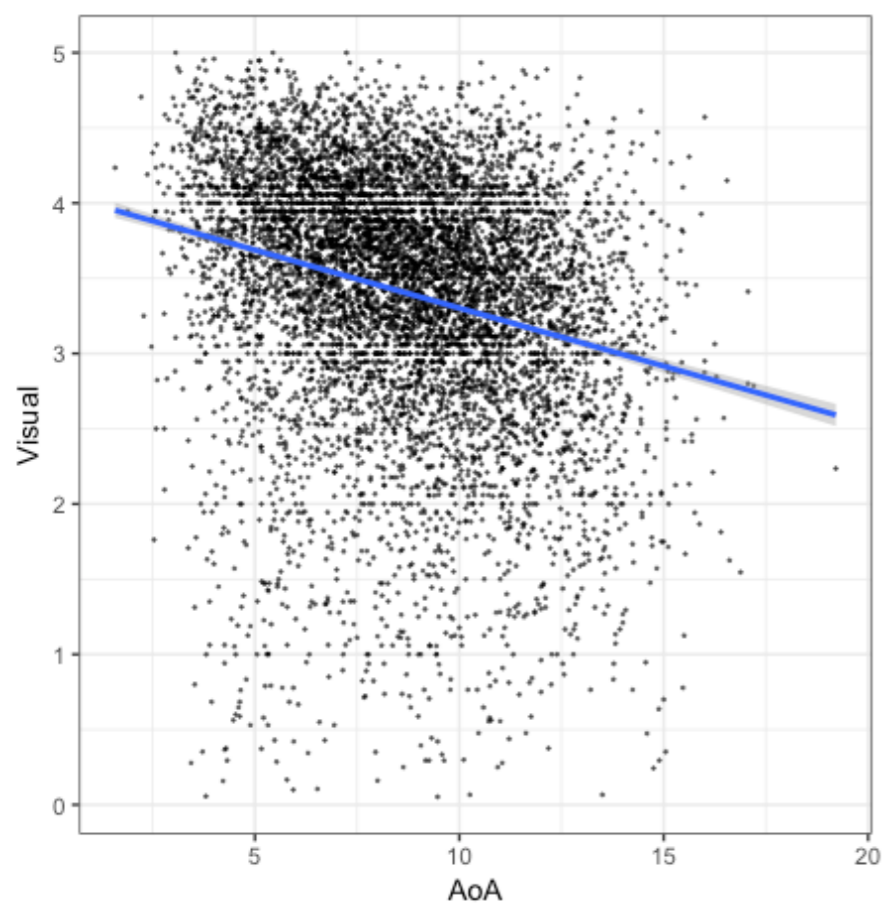
- Hierarchical regression - sensory concrete

Stage	Predictor	Estimate	Std. error	<i>t</i>	<i>p</i>	<i>R</i> ²	ΔR^2
1	intercept	17.53	0.22	78.72	.001***	.40	
	frequency	-0.76	0.02	-44.51	.001***		
	length	0.16	0.01	13.56	.001***		
	concreteness	-1.05	0.04	-26.04	.001***		
	valence	-0.38	0.02	-18.07	.001***		
2	vision	-0.26	0.03	-7.75	.001***	.43	.03
	haptic	-0.39	0.03	-14.59	.001***		
	audition	-0.21	0.02	-9.23	.001***		
	olfaction	0.01	0.04	0.34	.73		
	gustation	-0.04	0.03	-1.33	.18		
	interoception	-0.05	0.03	-1.61	.11		

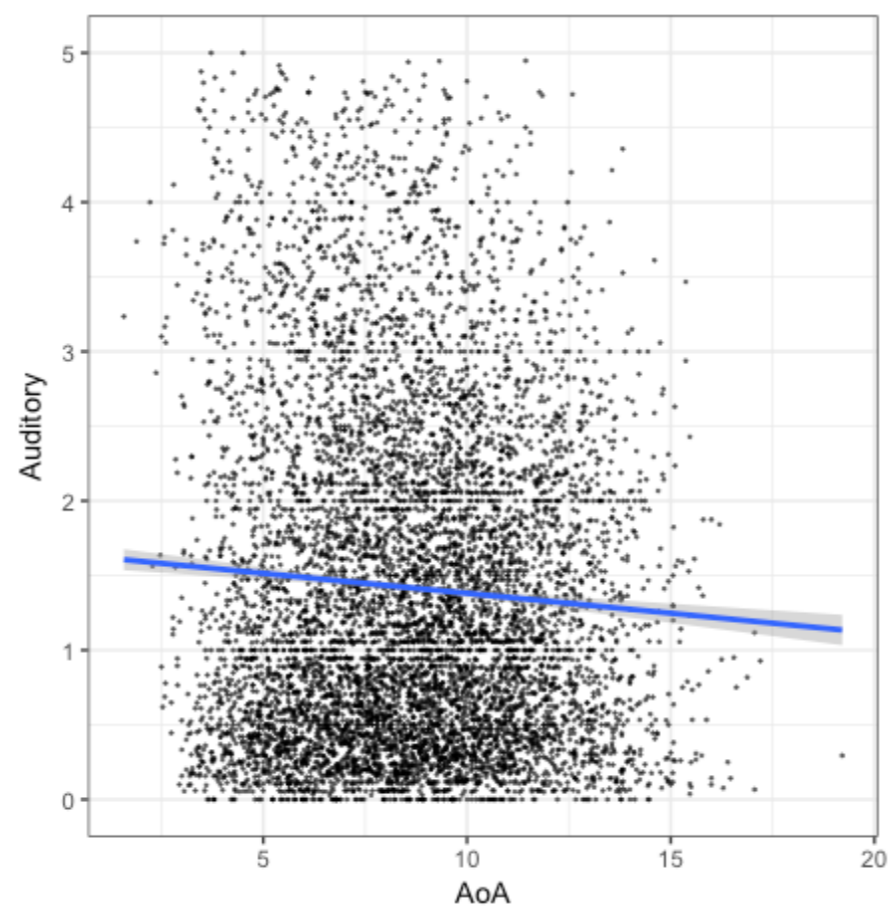


Results

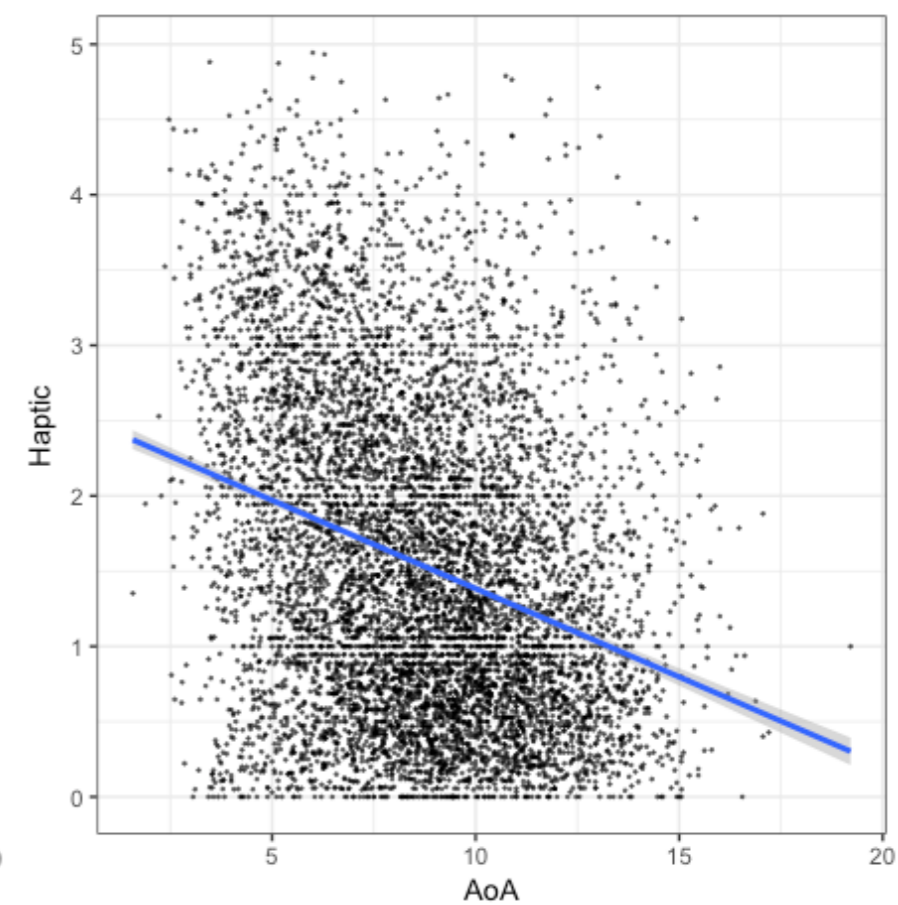
Visual



Auditory



Haptic





Results

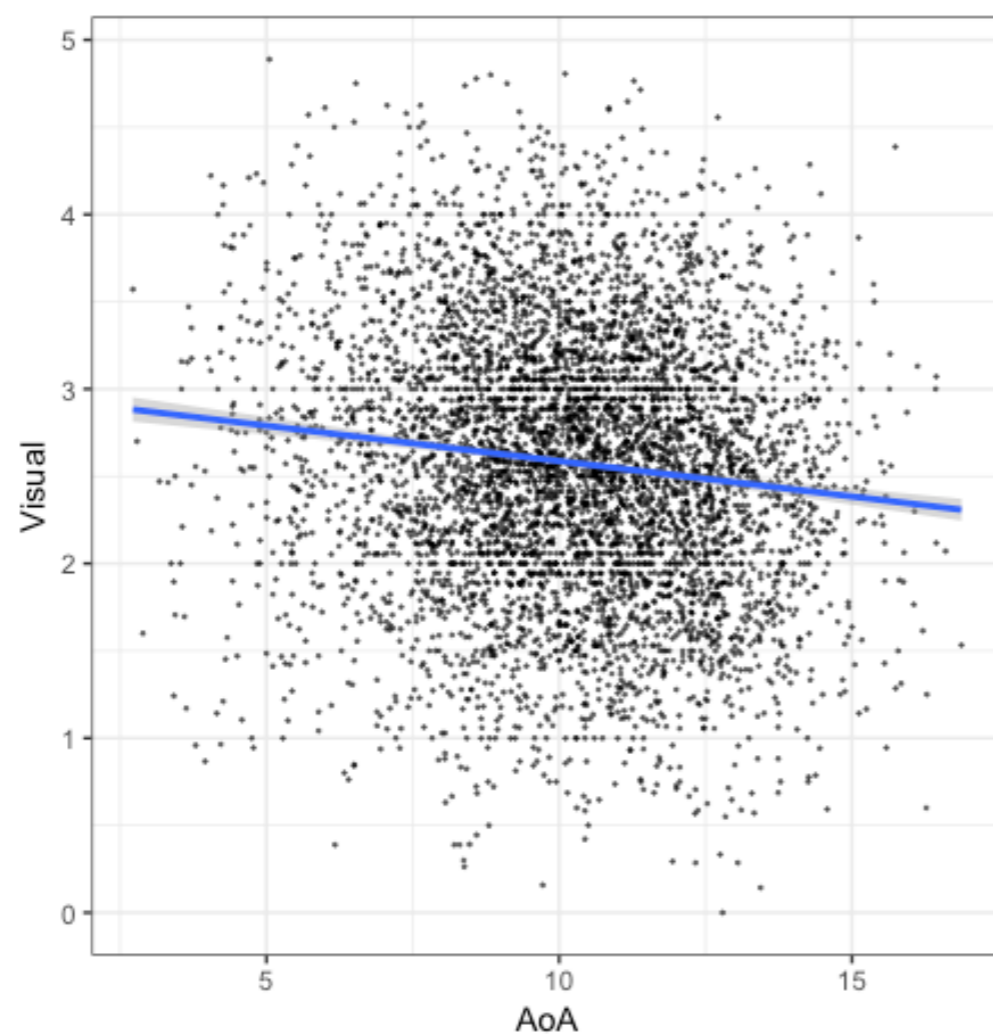
- Hierarchical regression - sensory abstract

Stage	Predictor	Estimate	Std. error	t	<i>p</i>	<i>R</i> ²	ΔR^2
1	intercept	15.06	0.21	70.05	.001***	.40	
	frequency	-0.87	0.02	-51.99	.001***		
	length	0.08	0.01	7.81	.001***		
	concreteness	-0.42	0.06	-7.01	.001***		
	valence	-0.08	0.02	-4.74	.001***		
2	vision	-0.26	0.03	-7.57	.001***	.43	.03
	haptic	0.00	0.05	0.01	.99		
	audition	-0.03	0.03	-0.94	.35		
	olfaction	-0.06	0.10	-0.63	.53		
	gustation	-0.11	0.09	-1.21	.23		
	interoception	-0.28	0.03	-10.76	.001***		

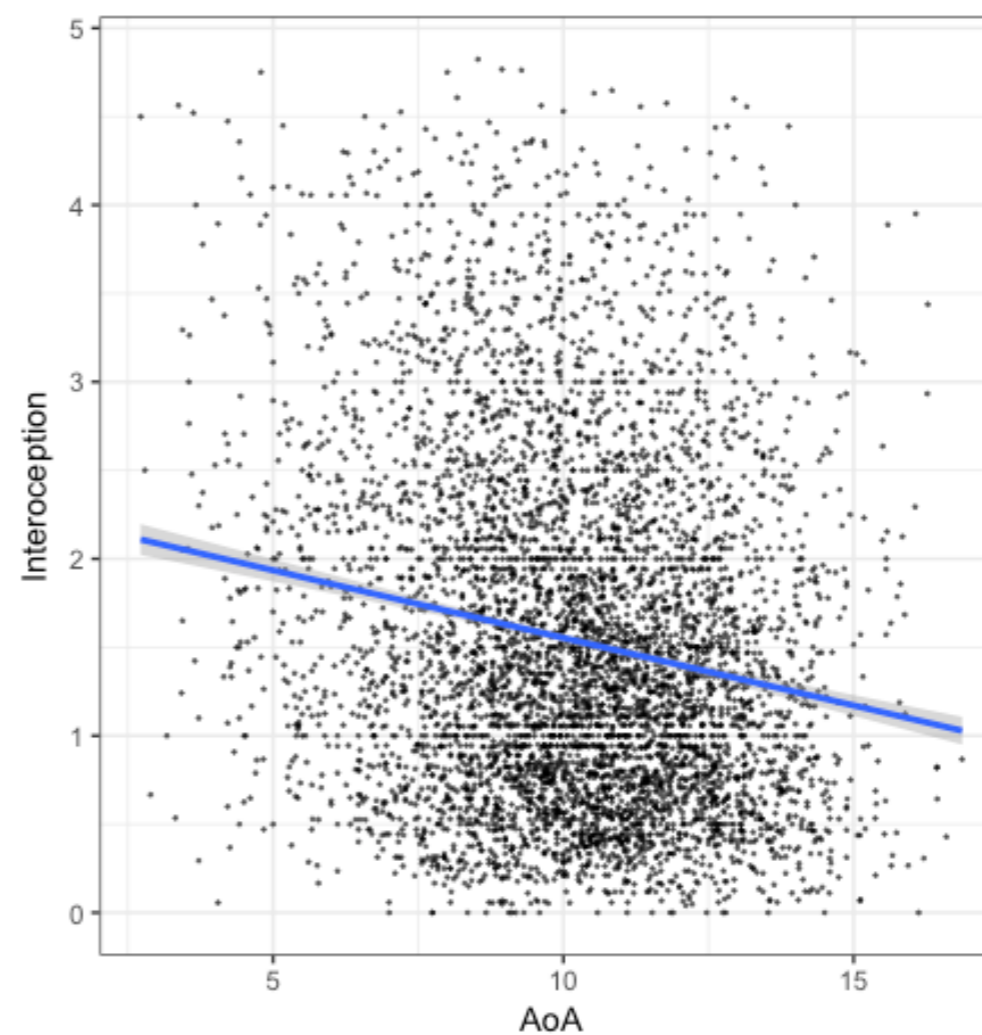


Results

Visual



Interoception





Next steps

- These are norms from adults...
- Look at CDI and CHILDES datasets (following from Thill and Twomey, 2016)
- Small scale norming from younger participants?
- Assess concreteness from sensorimotor dimensions (Connell et al., in prep)



Thanks



Results

- Hierarchical regression - motor

Stage	Predictor	Estimate	Std. error	t	<i>p</i>	<i>R</i> ²	ΔR^2
1	intercept	16.08	0.13	121.33	.001***	.442	
	frequency	-0.81	0.01	-66.50	.001***		
	length	0.12	0.01	14.14	.001***		
	concreteness	-0.73	0.02	-42.00	.001***		
	valence	-0.24	0.01	-17.67	.001***		
2	head	-0.11	0.03	-4.56	.001***	.456	.014
	hand	-0.28	0.02	-12.14	.001***		
	foot	-0.24	0.03	-8.22	.001***		
	torso	0.30	0.03	9.10	.001***		
	mouth	-0.13	0.02	-7.17	.001***		