Proto-Language as a Structurer and Enhancer of Perception

James Scott[1], Robert Foley[2], Mirjana Bozic[1]

UNIVERSITY OF CAMBRIDGE

1 Department of Psychology
2 Leverhulme Centre for Human Evolutionary Studies
University of Cambridge, Cambridge, UK
Contact: jhs74@cam.ac.uk

1. Background

Language evolution is hotly debated, though most likely a protracted and mosaic process[1]. The present study investigated factors which might have contributed to the evolution of semantics and formation of concepts. We hypothesised that non-communicative functions of language (NCF), which refer to the ability of language to alter and enhance cognition[2], might have provided one important selective advantage. In addition, iconicity or the non-arbitrariness of some form-meaning mappings[3], may have provided a foothold for the development of semantics by providing links between sound and meaning. To investigate NCF and iconicity as possible adaptive advantages and ontogenetic facilitators in the evolution of semantics, we trained participants on novel semantic categories that were paired with either iconic labels, non-iconic labels, or no labels. Match to Sample (MTS) task was then used to assess whether labelling and iconicity manipulations affected visual recognition of category members.

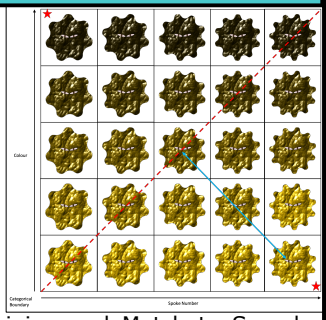
2. Conditions

This was a between-subjects design, with each participant exposed to only one condition. The purpose of Training was for participants to learn the novel semantic categories of aliens, and their associated labels. The purpose of MTS was to assess rapid visual recognition of category members, and how this was facilitated by labels. For MTS, the online/offline subconditions meant that labels used in Training were either presented (1a & 2a) or not (1b & 2b) at the beginning of each trial.

Training Condition	Match to Sample Condition
1 Iconic label	1a Iconic online
	1b Iconic offline
2 Non-iconic label	2a Non-iconic online
	2b Non-iconic offline
3 No-label	3 No-label

3. Methods

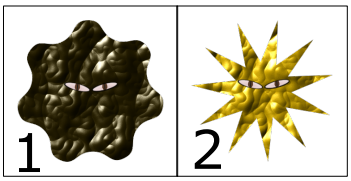
Stimuli: Visual stimuli were 625 unique 'aliens' which varied along 4 dimensions (spoke number, spikiness, body size, and colour). Aliens were generated using a tensor, and segregated into 2 categories; see right for 2D example. Auditory stimuli consisted of 2 iconic and 2 non-iconic pseudoword labels.



Participants: 141 neurotypical adults with good command of English, recruited online.

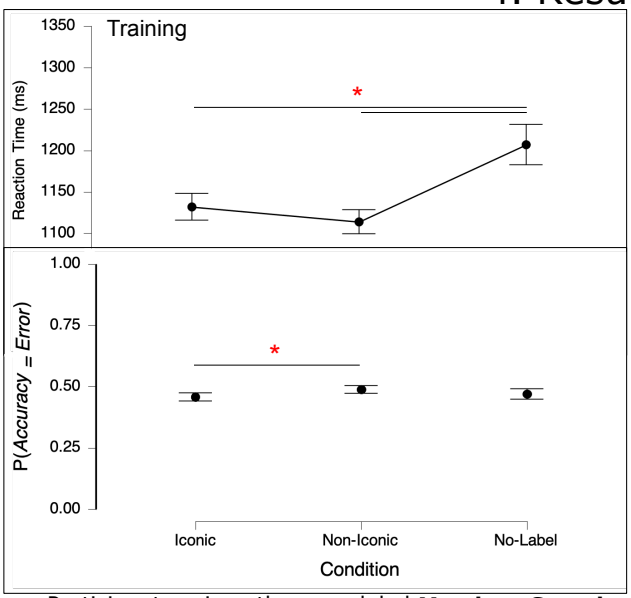
Procedure: Online game, with 2 blocks: Training and Match to Sample (MTS). Data: RTs and accuracy. In Training (180 trials), adapted from[4], participants learnt alien categories by interacting with them and receiving accuracy feedback (with auditory label presentation in the label conditions). In MTS (200 trials), participants were presented with a novel target and 2 distractor aliens (1 from each category); and asked to match categorically. In online conditions participants heard the relevant label before stimuli presentation, to distinguish learning from online effects.

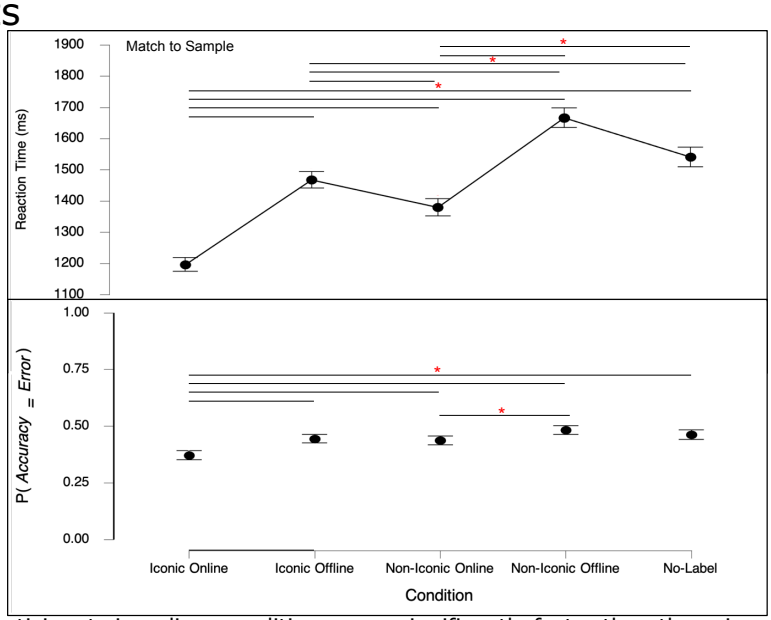
Data Collection and Analysis: Participants were recruited through Prolific[5] and Sona[6]; tested on PsyToolkit[7,8]. N=146, 13 excluded. RTs were analysed via independent three-way mixed ANCOVAs, with age as a covariate. Accuracy was coded binarily, and analysed via logistic regression with age as a covariate. Data were analysed in JASP[9].



Condition	Category 1	Category 2
Iconic	Glulge (/glʌldʒ/	Skysk (/ski:sk/)
Non-Iconic	Stoise (/stɔɪz/)	Phrav (/fræv/)
No Label	-	-

4. Results





Training: Participants in the no-label condition were significantly slower than those in label conditions. Participants in the iconic label condition were significantly more accurate than those in the non-iconic label condition.

Match to Sample: Participants in online conditions were significantly faster than those in offline conditions. Participants in iconic conditions were significantly faster than those in all other conditions. Participants in the iconic online condition were thus significantly faster than those in any other condition. Participants in the iconic online condition were also significantly more accurate than those in any other condition. Participants in the non-iconic online condition were also significantly more accurate than those in the non-iconic offline condition.

5. Conclusions

- Labels facilitate the learning of novel semantic categories
- This is enhanced by iconicity
- These learning advantages facilitate rapid visual recognition in MTS
- These effects are further exaggerated by online presentation of labels
- These effects were observed with very little training
- Labels were entirely redundant
- Targets were only ever novel, suggesting that participants learnt to abstract over the specifics of individual stimuli to learn category relevant dimensions in a similar manner to real semantic categories
- Labels may act as highly flexible priors to anchor these rules, and rapidly tune cognition for NCFs

Hence, NCFs may have been an important adaptive advantage, pushing the evolution of semantics. Iconicity may have facilitated this change by providing readily available links between sound and meaning.

6. References

1. Dediu, D. & Levinson, S. C. Neanderthal language revisited: not only us. Current Opinion in Behavioral Sciences vol. 21 49–55 (2018). 2. Lupyan, G., Abdel Rahman, R., Boroditsky, L. & Clark, A. Effects of Language on Visual Perception. Trends Cogn. Sci. 24, 930–944 (2020). 3. Dingemanse, M., Blasi, D. E., Lupyan, G., Christiansen, M. H. & Monaghan, P. Arbitrariness, Iconicity, and Systematicity in Language. Trends Cogn. Sci. 19, 603–615 (2015). 4. Lupyan, G. & Casasanto, D. Meaningless words promote meaningful categorization. Lang. Cogn. 7, 167–193 (2014). 5. Sona-Systems. Sona (2021). (2021). 6. Prolific. Prolific (2021). (2021). 7. Stoet, G. PsyToolkit: A Novel Web-Based Method for Running Online Questionnaires and Reaction-Time Experiments. Teach. Psychol. 44, 24–31 (2017). 8. Stoet, G. PsyToolkit: A software package for programming psychological experiments using Linux. Behav. Res. Methods 42, 1096–1104 (2010). 9. JASP Team. JASP (Version 0.14.1)[Computer Software]. (2020).