Linking Emergent and Natural Languages via Corpus Transfer

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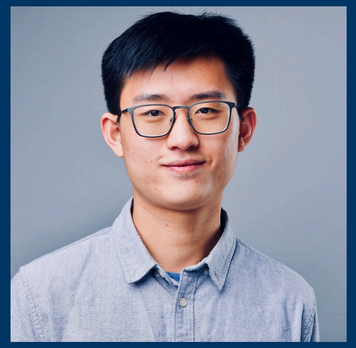
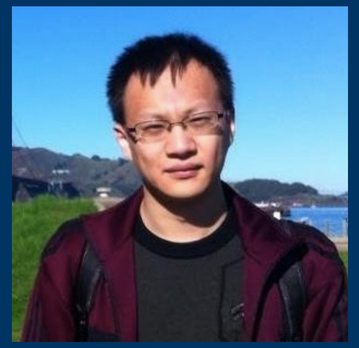
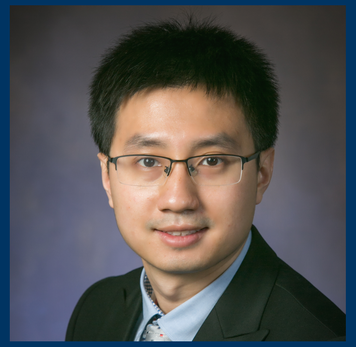




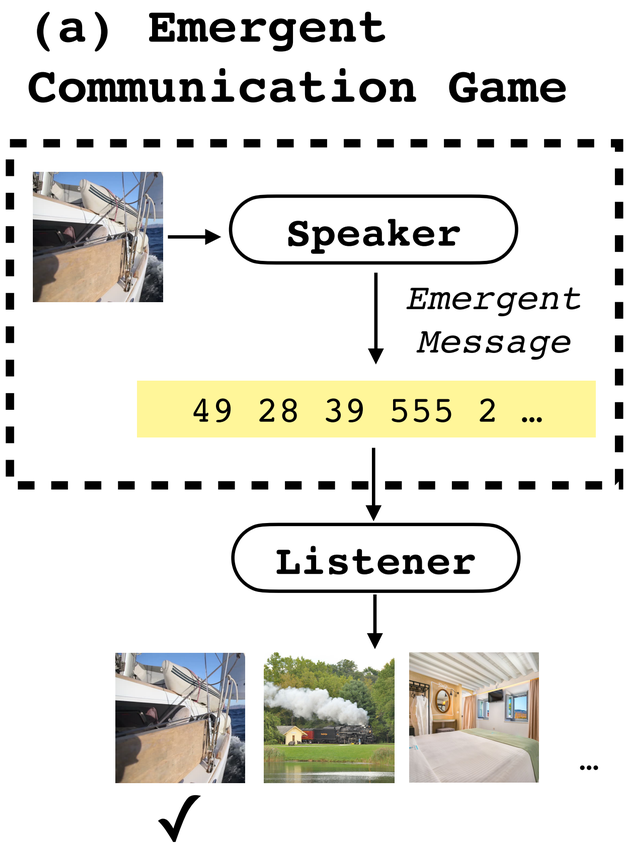

ICLR 2022 (Spotlight)

Emergent Communication (EC)

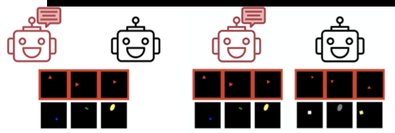
Emergent Language Generalization and Acquisition Speed are not tied to Compositionality

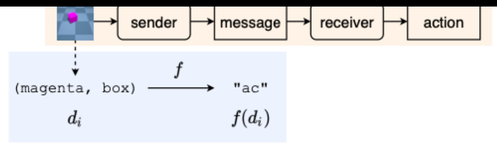
Measuring non-trivial compositionality in emergent communication

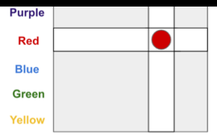
Structural Inductive Biases in Emergent Communication

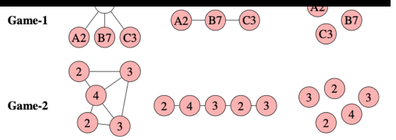


- Many papers with various setups/metrics/claims…
- Scientific: How to establish metrics/claims with respect to natural language, instead of over-approximations?
- Practical: How can emergent language be useful for real-world tasks?



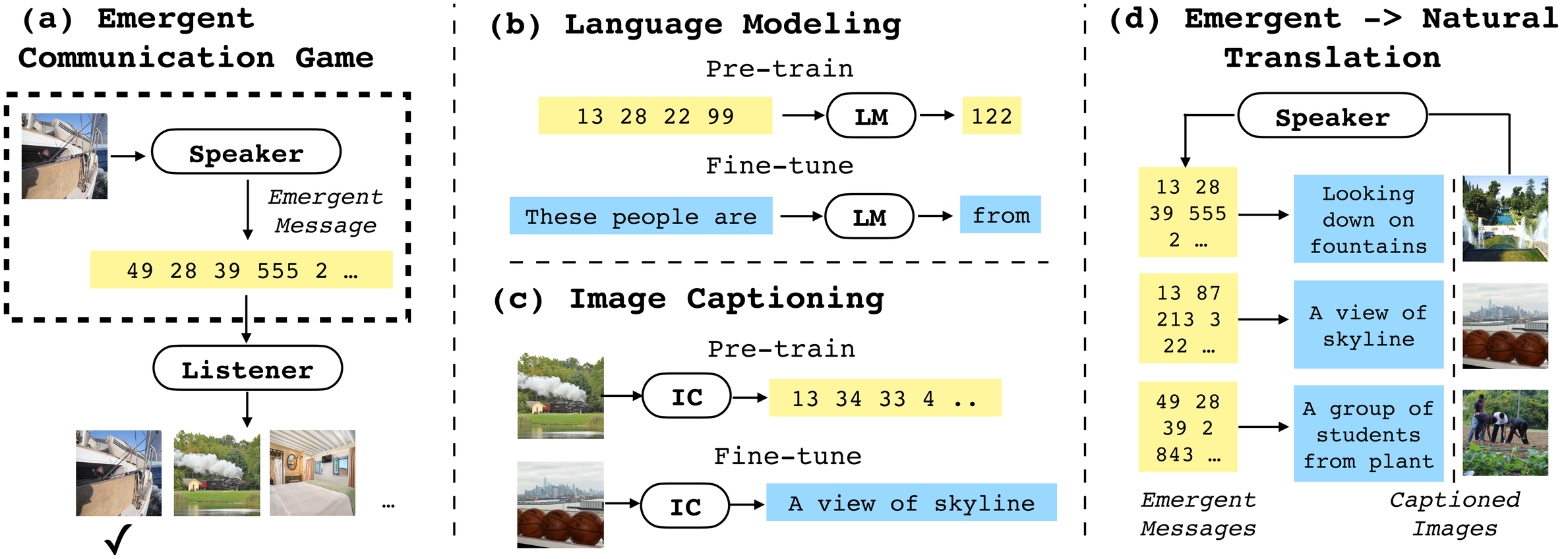






Linking Emergent and Natural Languages

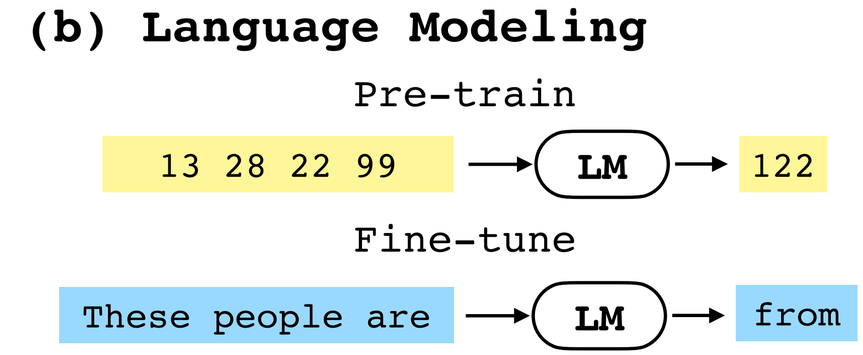
Transfer and Translate

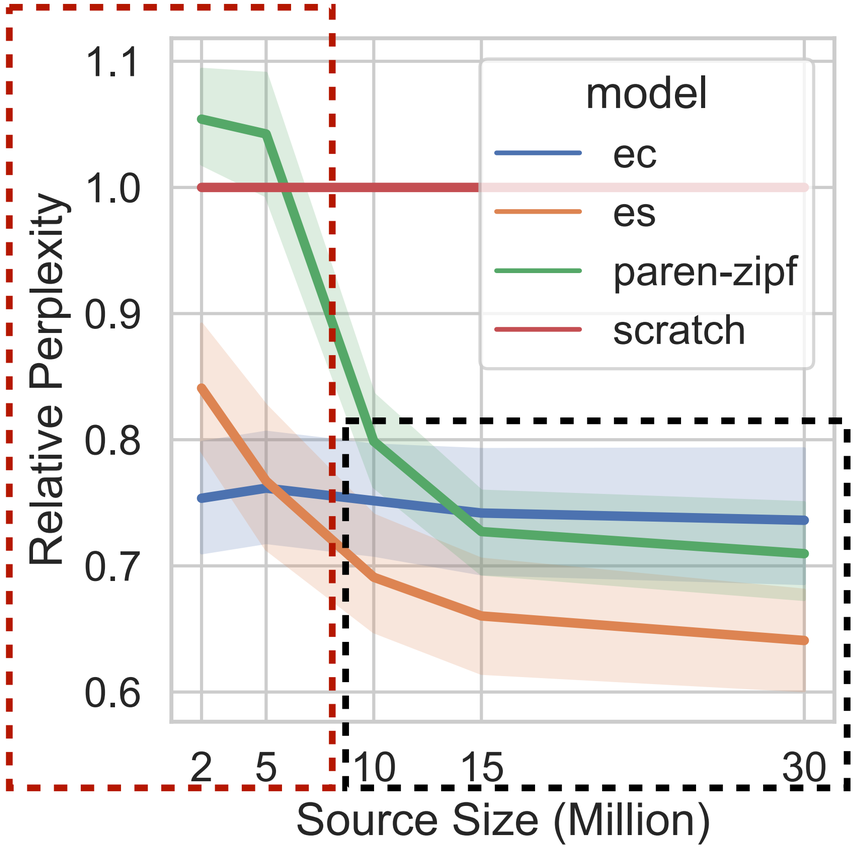


EL -> NL Transfer

Language Modeling

- Fine-tune: Wikipedia corpora of 10 languages (2M tokens, “low-resource”)
- Pre-train: corpora size 2/5/10/15/30M tokens
  - Expect ***scratch*** (no pre-train) < {***ec***, ***paren-zipf*** (nested parentheses)} < ***es*** (Spanish wikipedia)
  - Pre-train size ≤ 5M: ***ec ≥ es!!***
  - Pre-train size >15M: *ec ~ paren-zip < es*
  - More discussion & ablations in the paper



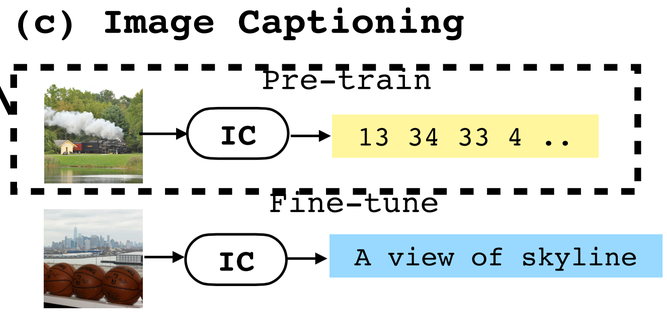


EL -> NL Transfer

Image Captioning

- Can use abundant unlabeled images!
- Cannot use ungrounded languages (dyck/music/code…)

- LM transfers **structural** properties (e.g. *dyck* has no explicit meanings), what about **semantics**?
- **Pre-train:** Conceptual Captions (~3M pairs)
  - Expect ***base*** *(no pre-train)* <***+ec*** < ***+nl***
- **Fine-tune**: MS-COCO (~500k pairs)
  - Fine-tune size 5k/50k: match expectation
  - Fine-tune size 500k: even *+nl* cannot help…
  - Transfer helps if task language data is limited



Metrics	coco (*5k*) base	+ec	+nl
BLEU4	14.1	15.3	18.5

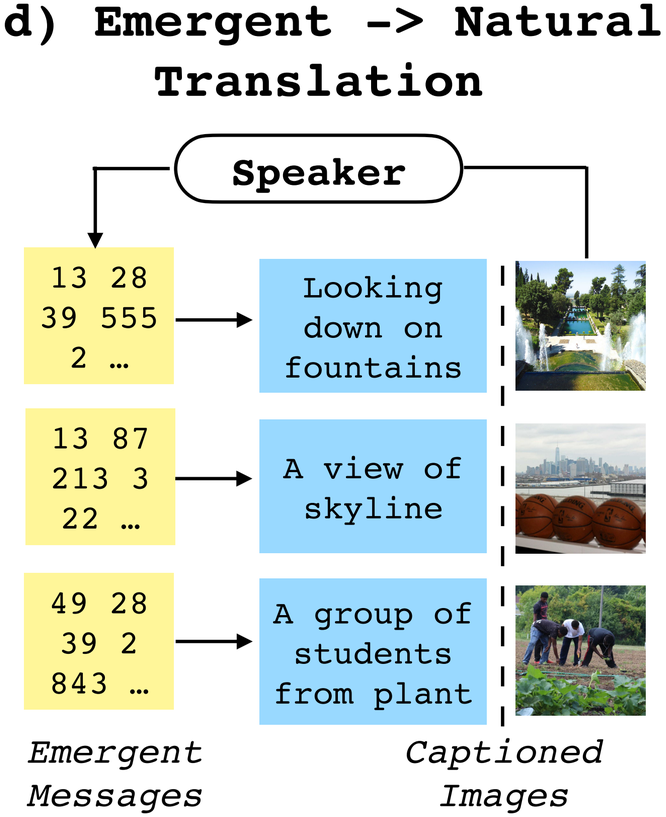
Metrics	coco (*50k*) base	+ec	+nl
BLEU4	26.3	27.2	28.2

Metrics	coco (*full*) base	+ec	+nl
BLEU4	35.8	36.2	36.0

EL -> NL Translation

Correlation across checkpoints

- Transfer tasks are “extrinsic” and varied
- **“Intrinsically”, closer languages translate easier**
- Image-caption pairs -> EL-NL pairs
- 5 setups (vocab, seqlen) x 4 trials/setup x 10 ckpts/trial = 200 ckpts of different EL
- **Translation metric** (ROUGE_L) better correlates with downstream LM performance (Romanian, Hebrew) than **validation accuracy** and **topographic similarity**
- More fine-grained analysis & discussion in paper



Metrics	LM (ro)	LM (he)
Accuracy	0.672	0.737
Topographic	0.030	0.003
Translation	**0.757**	**0.829**

Summary

- **Practical question:** how can emergent language be useful for real-world tasks?
  - Use emergent language corpus to pre-train for natural language tasks
  - Useful when natural language data (for pre-training/fine-tuning) is limited
  - **Future**: find tasks better suited for emergent pre-training
- **Scientific question:** how to measure properties resembling natural language?
  - Transfer to natural language tasks with different properties
  - Translation to natural language predicts transfer better than previous metrics
  - **Future**: disentangle language properties (syntactic/semantic/functional…)