# How We Learned A Language Before Duolingo

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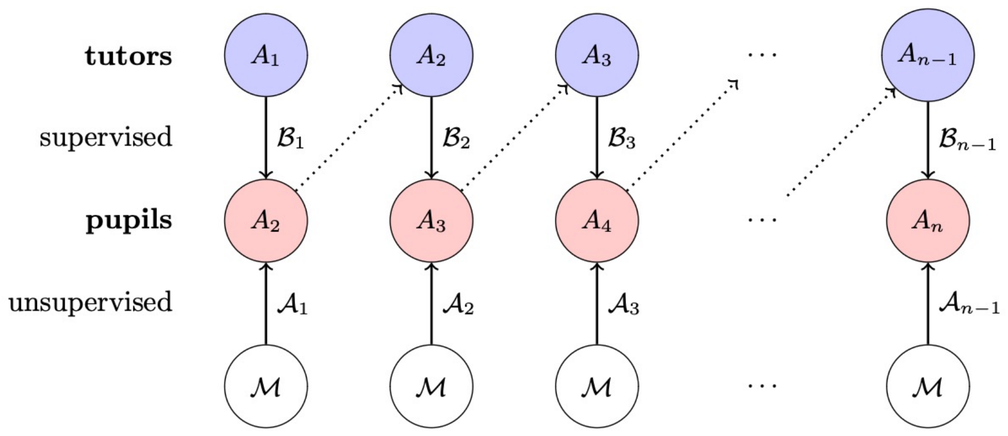
## Introduction & Objectives

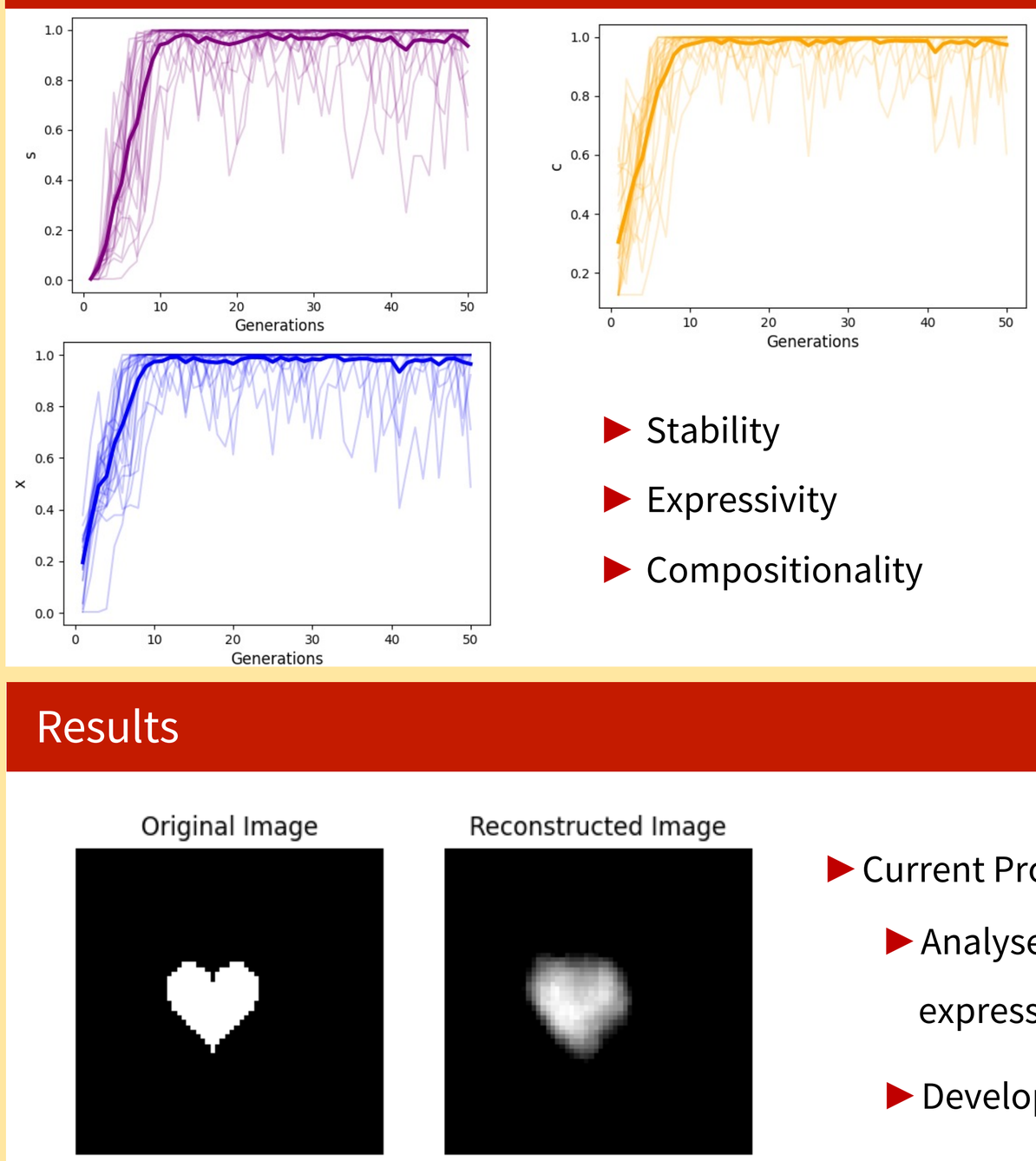
- Linguistics is the scientific study of language, focusing on structure, grammar, meaning, and evolution.
- Computational modelling help explore key questions:
  1. What properties make human languages learnable and interpretable for communication?
  2. How do languages obtain these properties?
- I built an ILM using a Variational Autoencoder and explore whether image-based meaning space exhibits similar properties.

## SSILM Training Process (Replication)[1]



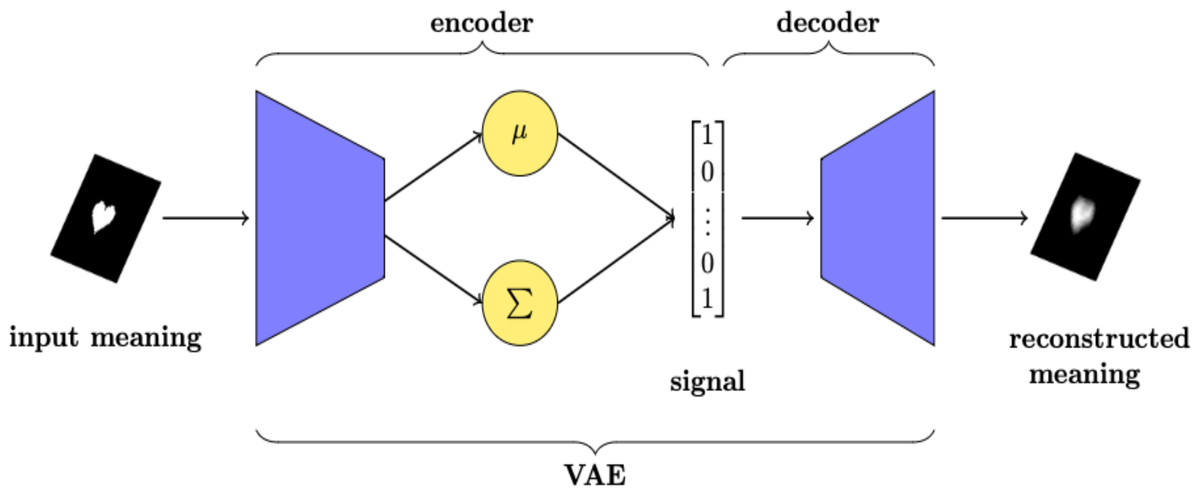

- Supervised: child-directed language learning
- Unsupervised: child hearing utterances related to some situations they are engaged in

## Replicated SSILM Evaluation (Metrics)




- Stability
- Expressivity
- Compositionality

## Image-based SSILM with VAE




- Limitations of SSILM:
  - n-bit binary vectors are too simplistic to capture the richness of human language
  - Enforce a 1-to-1 mapping between meaning-signals
- Implementation of SSILM with VAE:
  - Samples a probabilistic distribution and a latent representation via reparameterisation trick
  - Enables larger meaning space with visual meanings
  - Better reflects human uncertainty and variability by matching a distribution with single meaning

## Results




- Current Process & Goals:
  - Analyse if the new model follows the same trends in stability, expressivity, and compositionality as prior models.
  - Develop a new calculation method for compositionality.

**Reference**
[1] Jack Bunyan, Seth Bullock, and Conor Houghton. An iterated learning model of language change that mixes supervised and unsupervised learning. 2024. arXiv:2405.20818.