An agent-based iterated learning model for understanding language evolution

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- Main measurements are:
  - **Expressibility**: The portion of the meaning space that can be represented by an individuals language.
  - **Stability**: How similar two agents languages are.

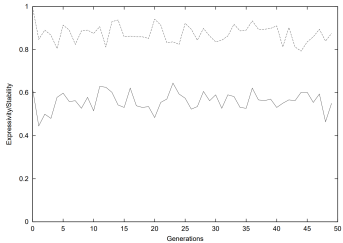
Obverter Procedure

α	β	γ	δ	R
0.2	0.25	0.1	0.3	a
0.2	0.25	0.1	0.4	b
0.4	0.25	0.1	0.3	c
0.2	0.25	0.7	0.0	d

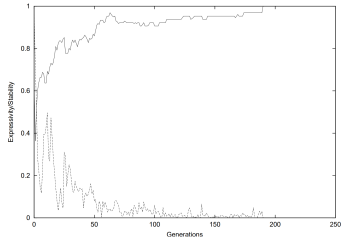
$\Rightarrow$

S	α	β	γ	δ
a	0.0	0.0	0.0	1.0
b	0.0	0.0	0.0	1.0
c	1.0	0.0	0.0	0.0
d	0.0	0.0	1.0	0.0

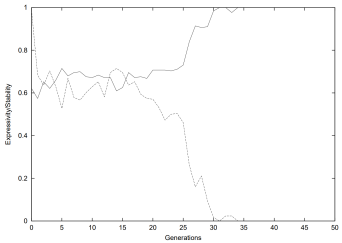
ILM Behaviour



(20 Utterances per generation)



(2000 utterances per generation)



(50 utterances per generation)

Expansion to Agent-Based Model

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- Agents have two states, child and adult. At end of childhood perform Obvert procedure and allow agent to communicate.
- Agents have an increasing chance to die with age and be replaced with a new child agent.
- Child agents learn in the same way as the ILM, adults still use back-propagation but will only **partial-obvert**.

Expansion to Agent-Based Model (Partial Obvert)

α	β	γ	δ	R
0.2	0.25	0.1	0.3	a
0.2	0.25	0.1	0.4	b
0.4	0.25	0.1	0.3	c
0.2	0.25	0.7	0.0	d

$\Rightarrow$

S	α	β	γ	δ
a	0.0	0.0	0.0	1.0
b	0.0	0.0	0.0	1.0
c	1.0	0.0	0.0	0.0
d	0.0	0.0	1.0	0.0

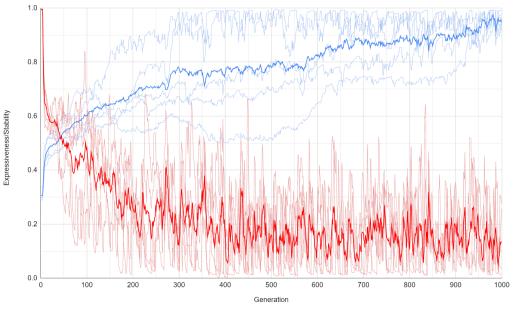
Receive (δ,c)

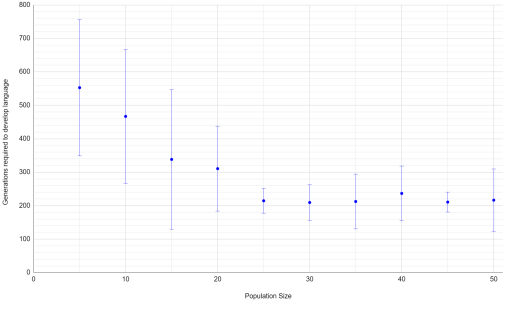
α	β	γ	δ	R
0.2	0.25	0.1	0.2	a
0.2	0.25	0.1	0.2	b
0.4	0.25	0.1	**0.6**	c
0.2	0.25	0.7	0.0	d

$\Rightarrow$

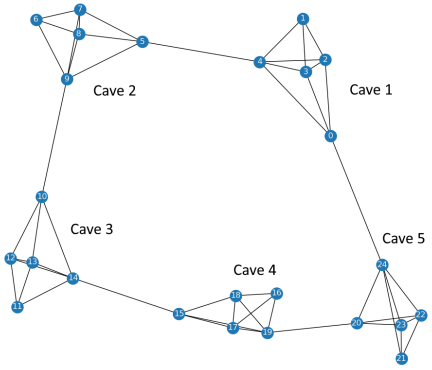
S	α	β	γ	δ
a	0.0	0.0	0.0	*1.0*
b	0.0	0.0	0.0	*1.0*
c	0.0	0.0	0.0	**1.0**
d	0.0	0.0	1.0	0.0

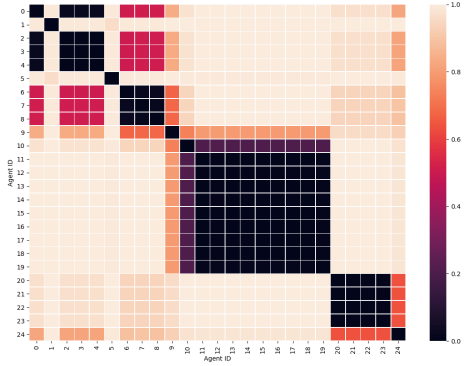
Results


Expressiveness/Stability
Generation
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
600
700
800
900
1000


Generations required to develop language
Population Size
0
100
200
300
400
500
600
700
800
0
10
20
30
40
50

Small-World Theory [Telesford et al., 2011]





Future Work

- Alternative to the Obvert procedure as it's **computationally costly**.

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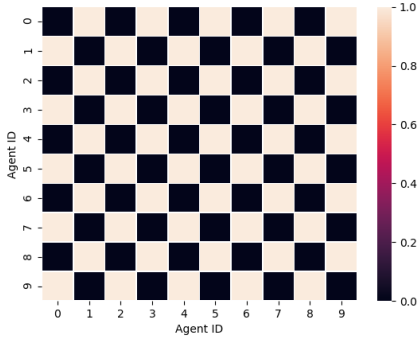

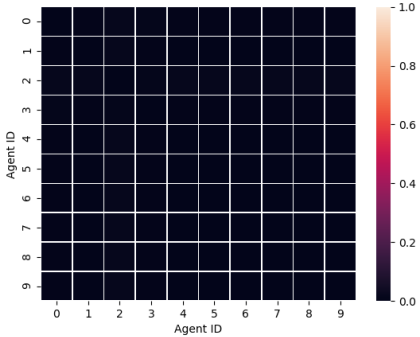

Thank you! Any questions?

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