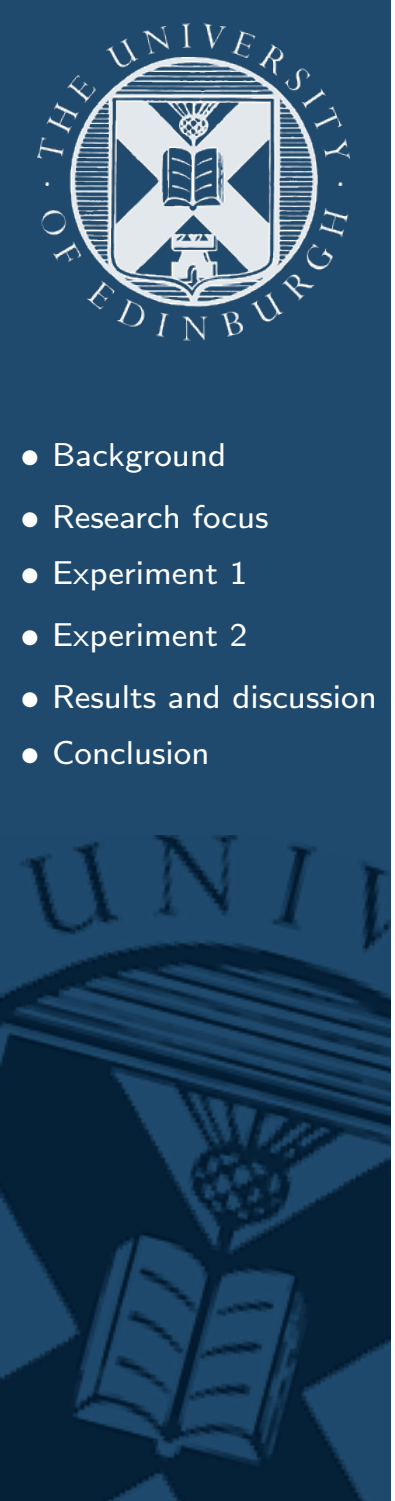

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Cognitive biases and how they shape typology

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Supervisors:
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Typological Patterns and Universals

Typology is the study and classification of the world's languages based on their structure and features [1].

Greenberg first expressed many typological patterns under the name 'Universals'.[2]

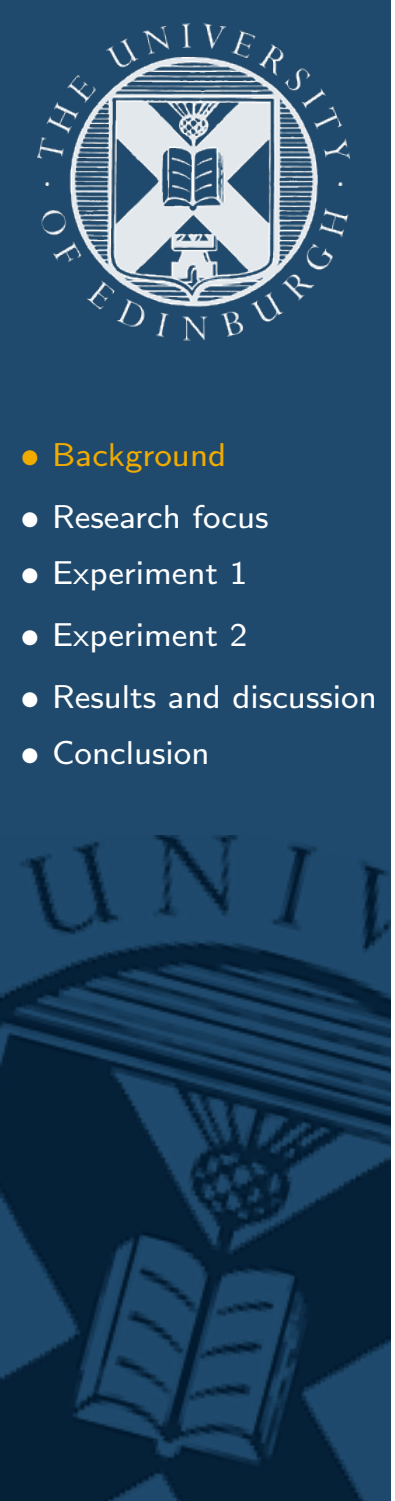
> Universal 18: *"When the descriptive adjective precedes the noun, the demonstrative, and the numeral, with overwhelmingly more than chance frequency, does likewise."*

For example: *these two red swans*

Phrases with all dependents on one side of the head are called harmonic phrases.[3]

(p.68)

[1] Bickle, 2007
[2] 1963
[3] Culbertson and Newport, 2015



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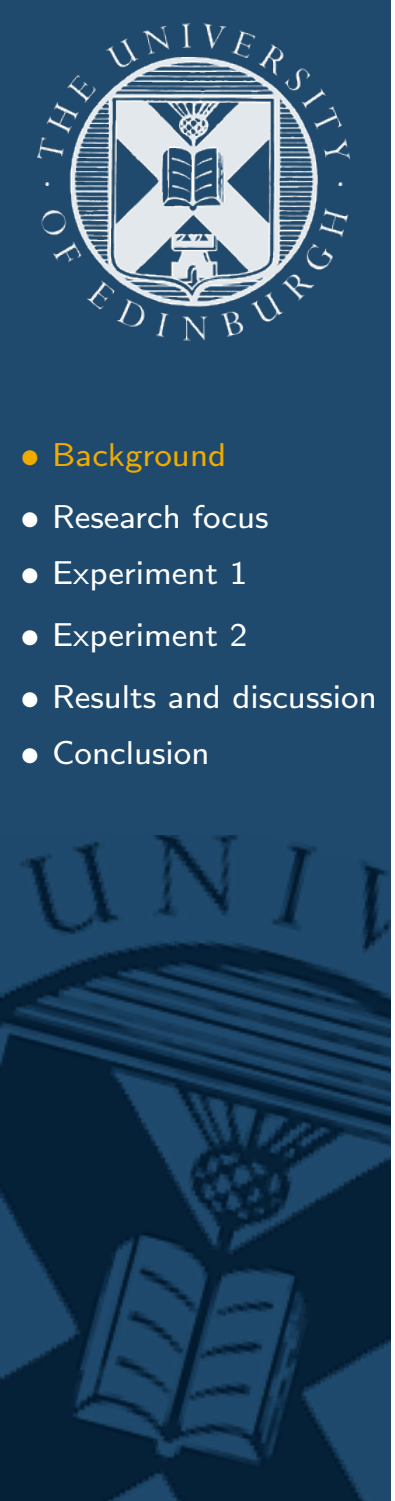
Harmony in Other Phrases

Universal 2: PreP = N-Gen

Universal 3 and 4: VO = PreP and OV = PostP[4]

[4] Greenberg, 1963
[5] WALS, Dryer, 2013



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Harmony in Other Phrases

Universal 2: PreP = N-Gen

Universal 3 and 4: VO = PreP and OV = PostP[4]

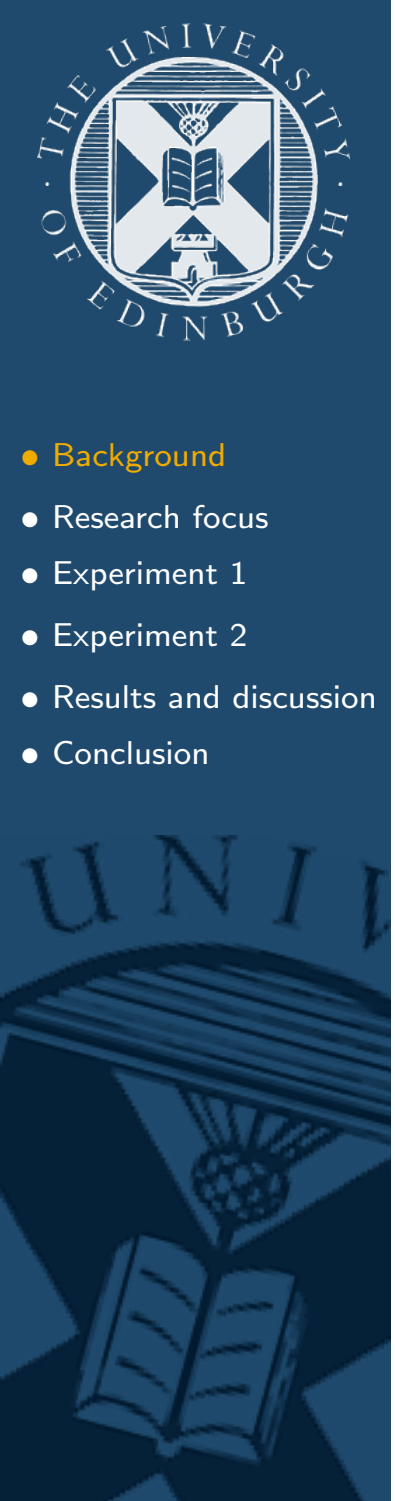
These are not exceptionless.

	OV	VO
PreP	14	454
PostP	472	41

5

[4] Greenberg, 1963

[5] WALS, Dryer, 2013



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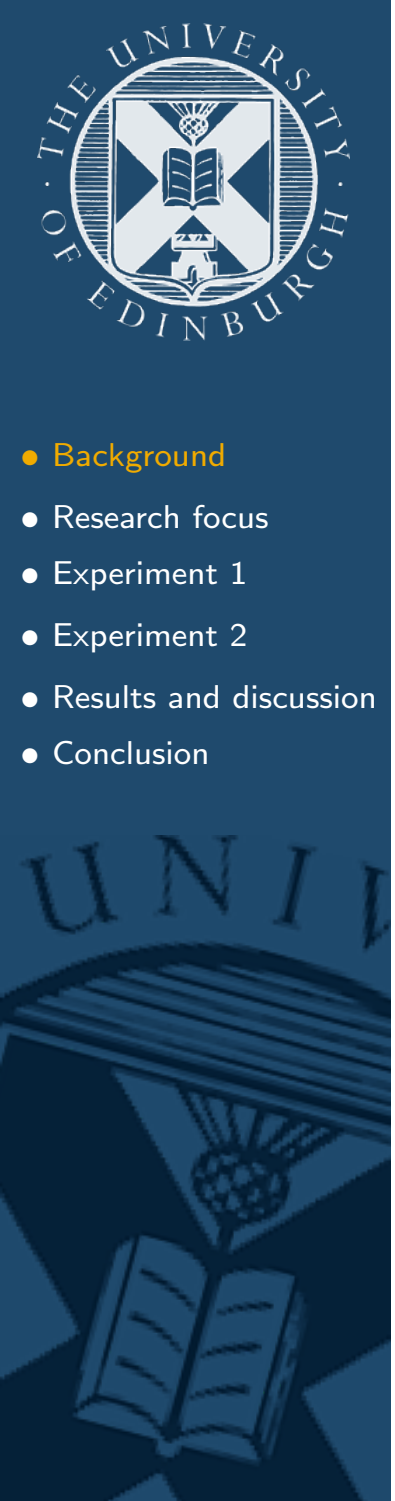
Harmonic Conspiracy

In this way Universal 18, 2, 3 and 4 all conspire to reveal a corss-linguistic preference for consistent branching across phrases within a language.[6]

[6] Dryer, 1992



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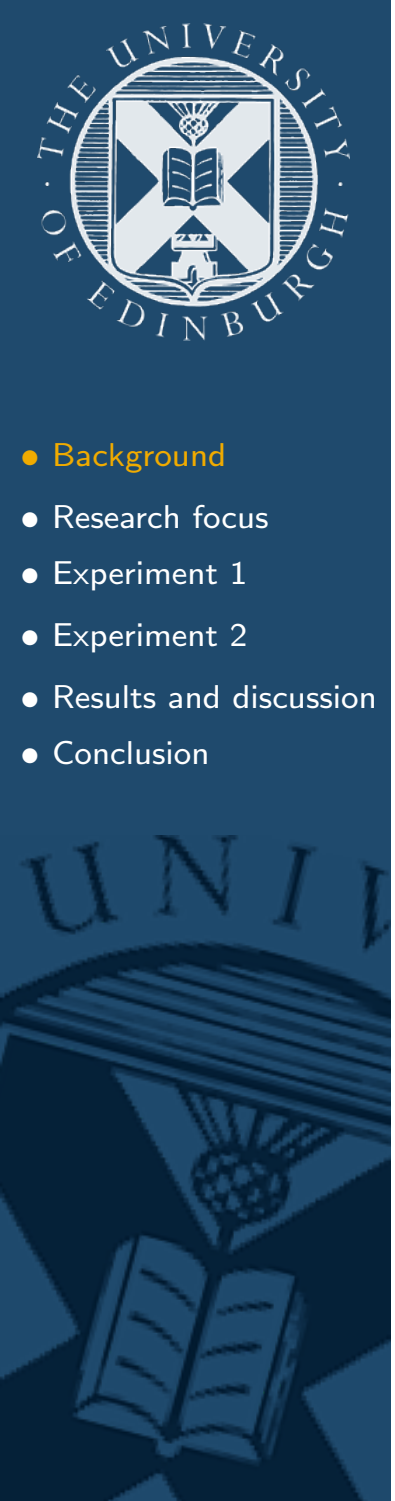
Recent Explanation

My approach follows recent trend:

[7] Culbertson, Smolensky and Wilson, 2013; Eifring and Theil, 2005



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Recent Explanation

My approach follows recent trend:

- Cognitive biases[7]

[7] Culbertson, Smolensky and Wilson, 2013; Eifring and Theil, 2005

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A Bias for Simplicity

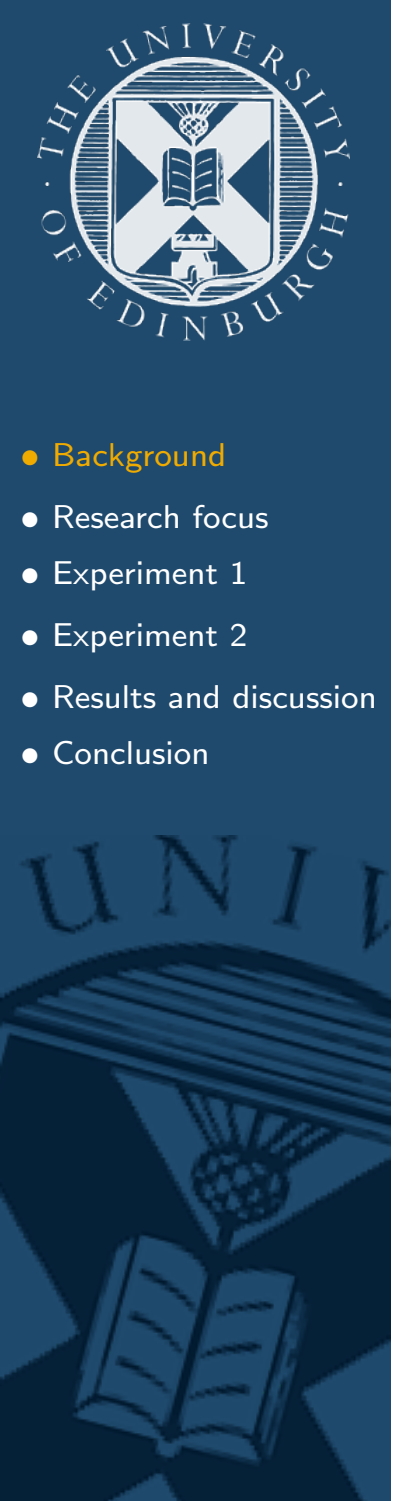
This is used for general reasoning about data and hypothesis selection.[8]

Harmonic word orders generate simpler (more compressible) grammars.

Especially active during learning.[9]

[8] Culbertson and Kirby, 2016

[9] Culbertson and Newport, 2015; Kirby et al., 2008; Raviv and Arnon, 2018



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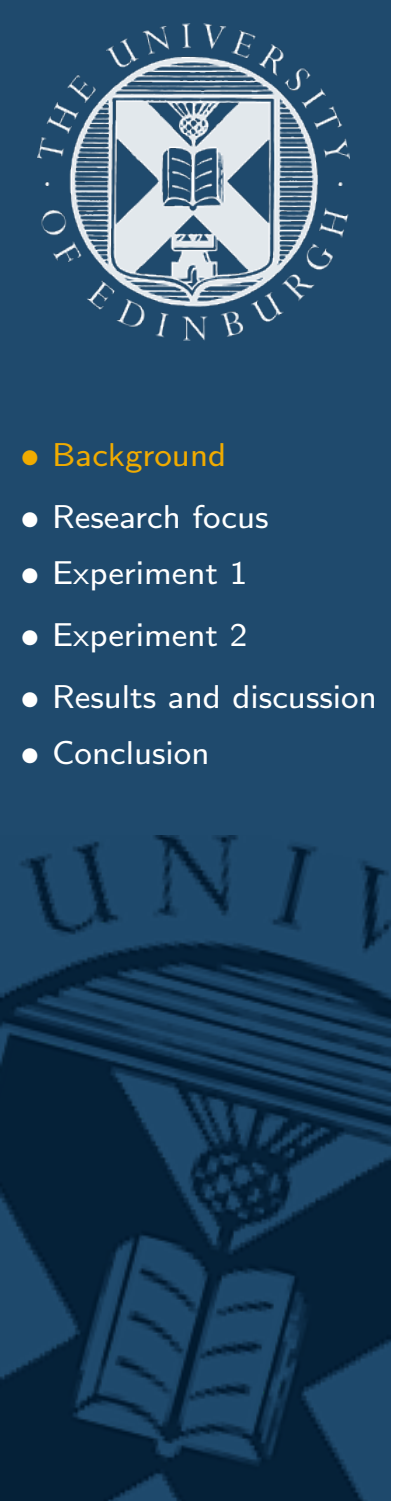
Universal 20

Greenberg elaborates on typological patterns in noun phrases.[10]

Demonstratives, numerals, and adjectives tend to appear in precisely that order if they precede the noun, or in the opposite order if they follow it

i.e. either Dem-Num-Adj-N or N-Adj-Num-Dem

[10] 1963



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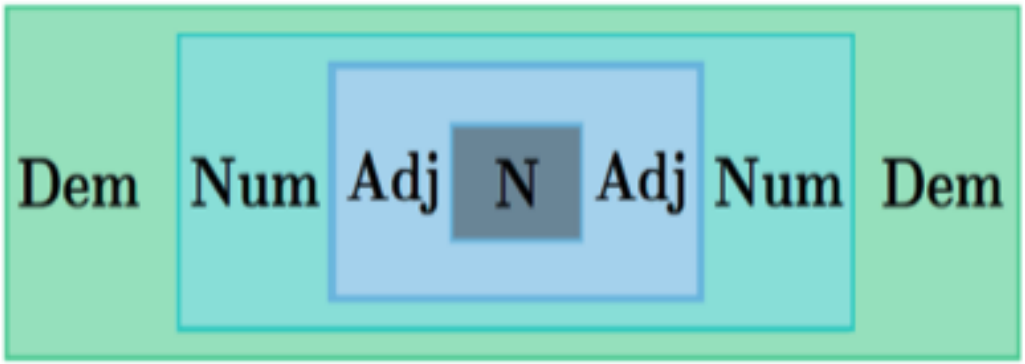
Isomorphism

Semantic relationships?[11]

Isomorphism refers to structure preserving constructions (Hosch, 2009) where the 'structure', in the case of noun phrases, is the meaning that the phrase is encoding



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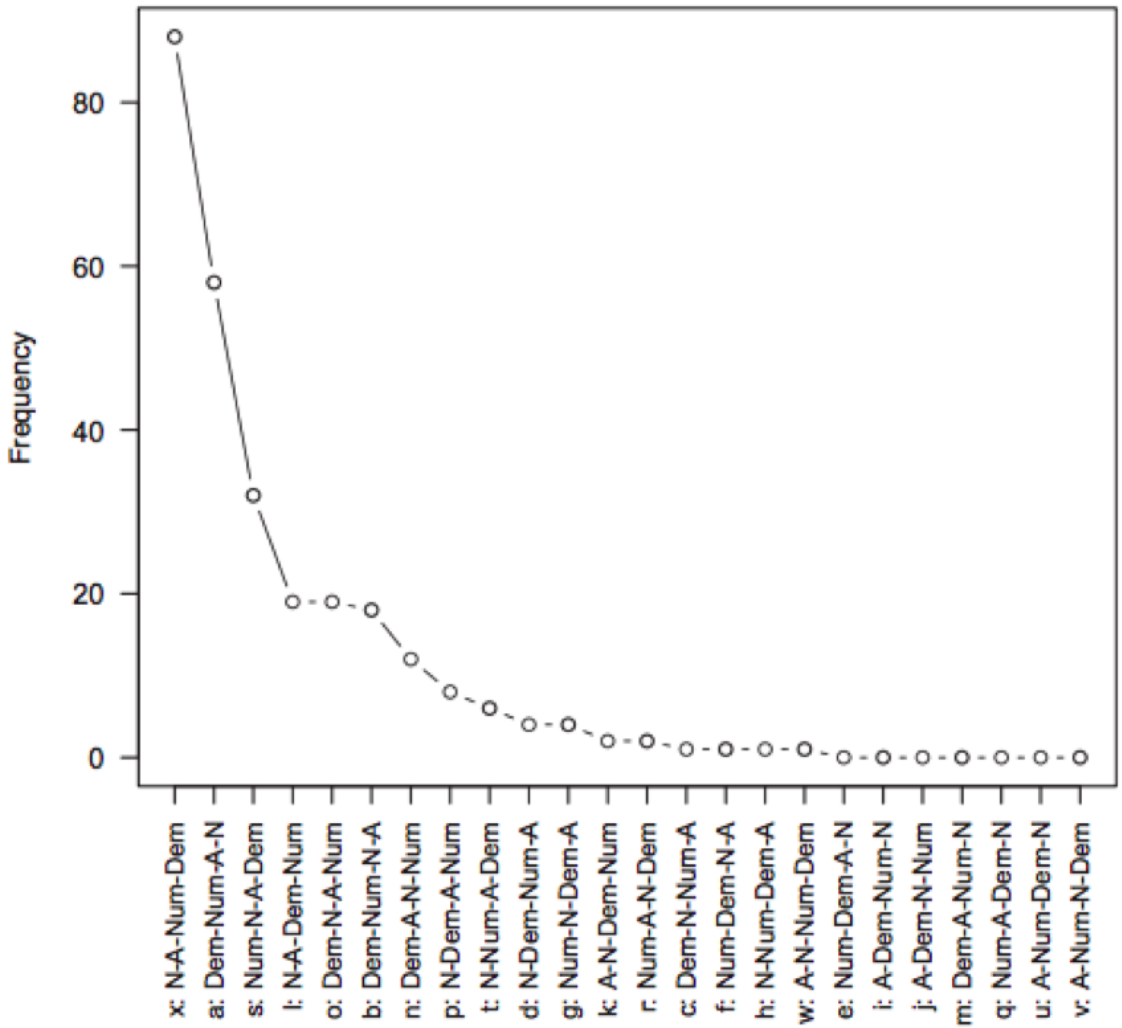
[11] Culbertson and Adger, 2014; Schwoustra et al., 2017

[12] Culbertson and Adger, 2014

Typology of Isomorphism

Noun phrases with orders that are isomorhpic to this semantic structure are more common across languages.



[13] Cysouw, 2010

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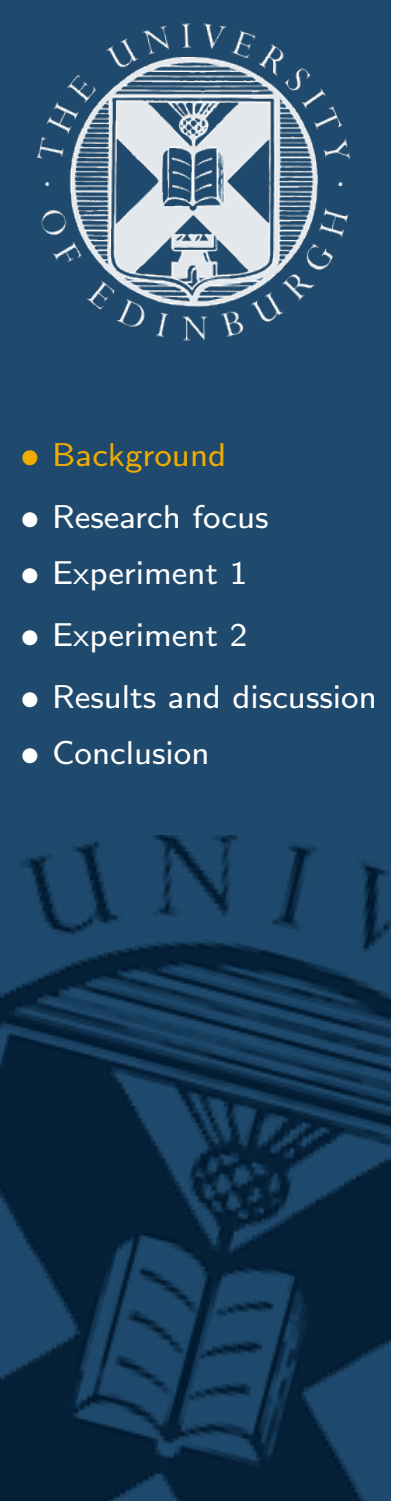

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Explaining Isomorphism: Naturalness

A cognitive bias for naturalness would make us favour language structures that reflect the structure of meaning itself.[14]

Isomorphic orders is one way to create this structural reflection in noun phrases.

Studies often use silent gesture paradigm.

Improvisation?

[14] Siewierska and Bakker, 2013

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Bias Interaction

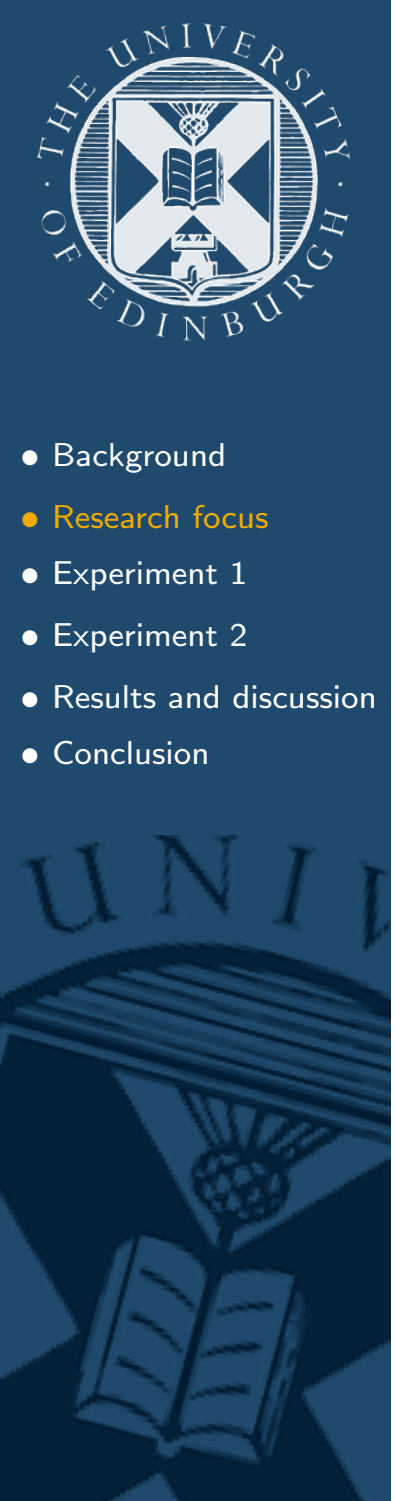
Most common orders are both harmonic *and* isomorphic.[15]

- Dem-Num-Adj-N and N-Adj-Num-Dem

Simplicity and naturalness are active under two distinct conditions, learning and improvisation.

Maybe the chronological ordering of when these are active in language evolution can generate the typological spread we see today.

[15] Cysouw, 2010



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Hypothesis and Predictions

- From isomorphic and non-harmonic to harmonic.
- Respect underlying isomorphic structure when harmonising.
- Dem-N-Adj-Num to N-Adj-Num-Dem

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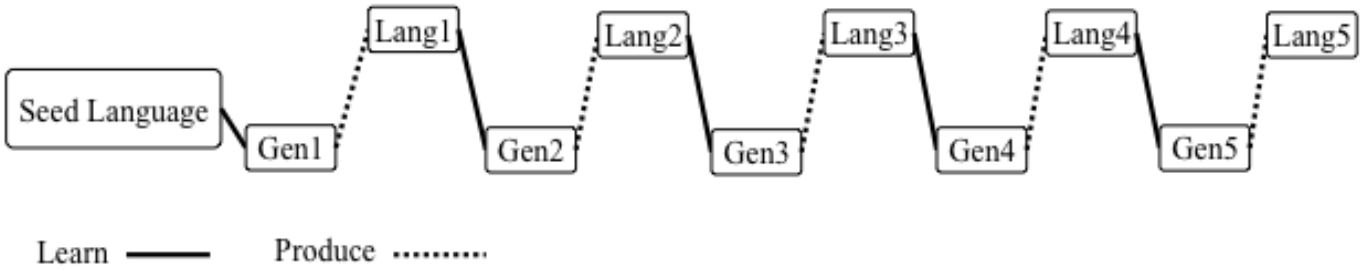
Experiment 1

Mixture of silent gesture and iterated learning.



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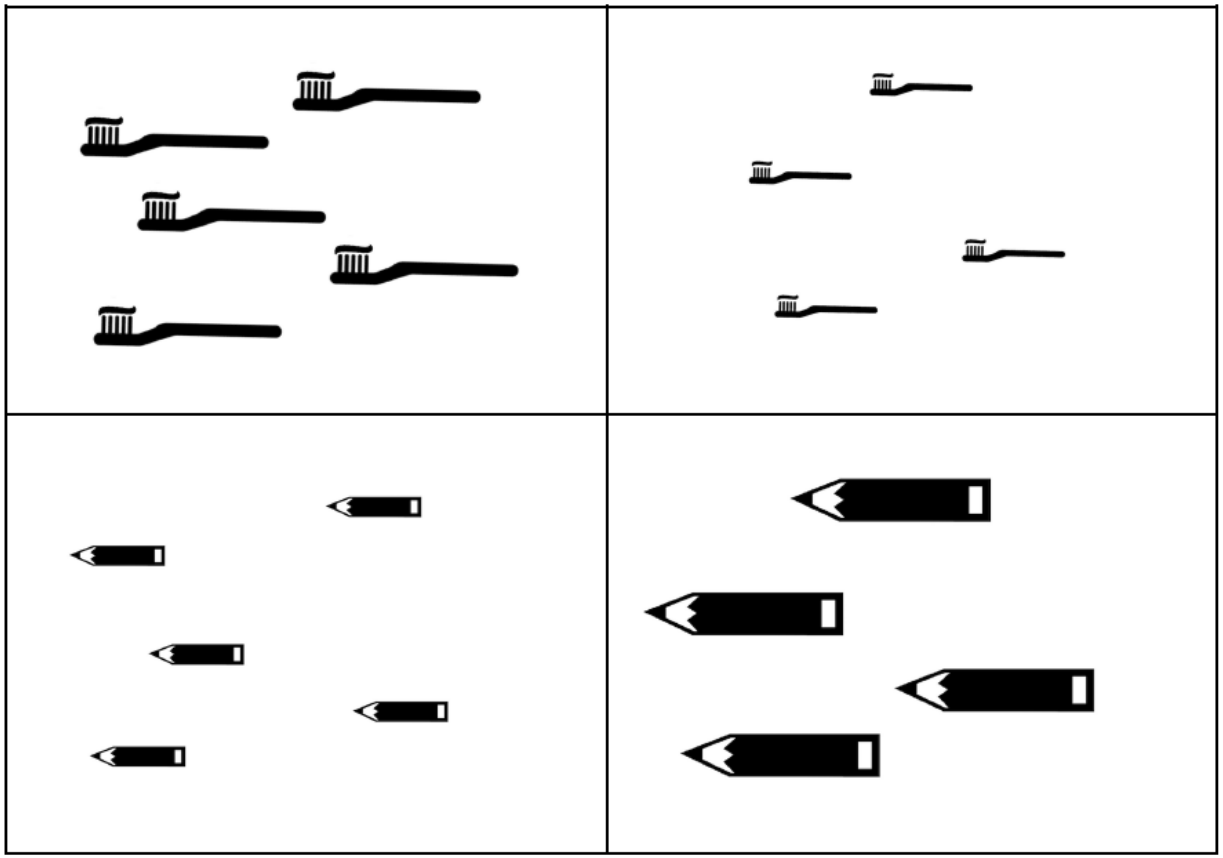
Procedure and set-up

Two conditions:

- 1 - trained on videos with Dem-Num-N-Adj
- 2 - trained on videos with Dem-N-Adj-Num



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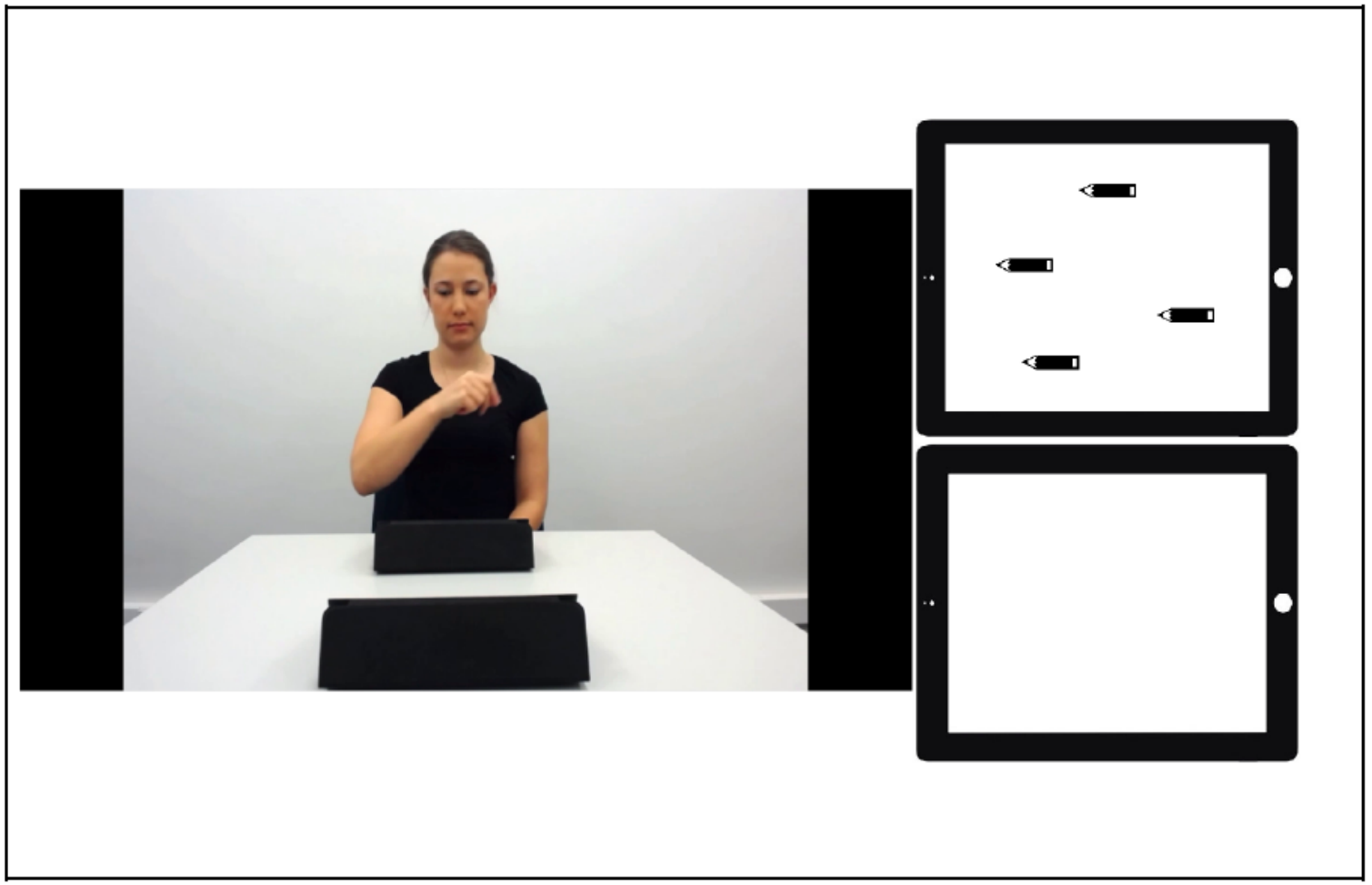
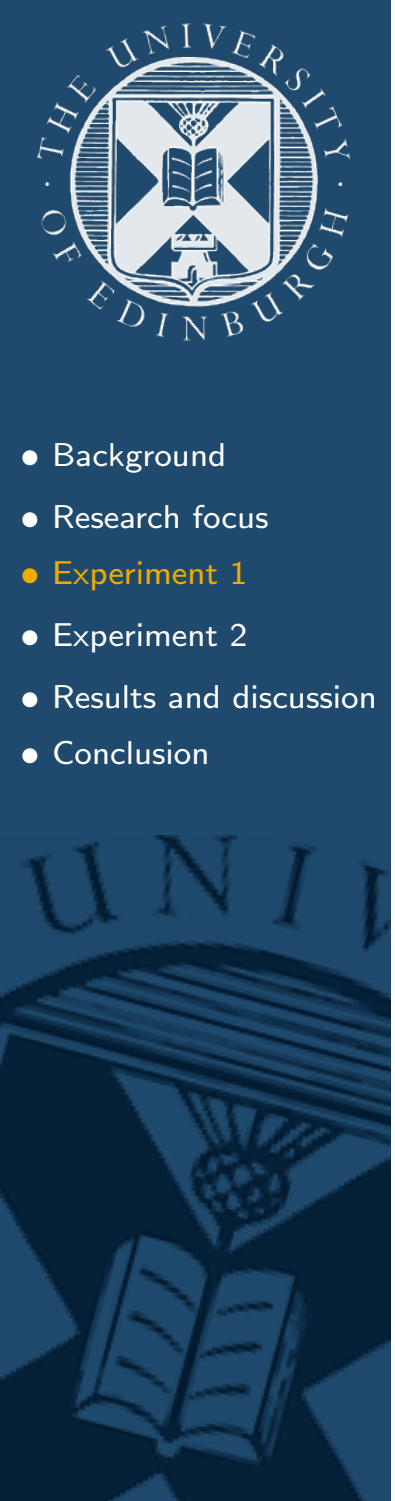
Training and Testing

16 training trials and 16 test trials



Training was designed to look lika a previous testing phase.



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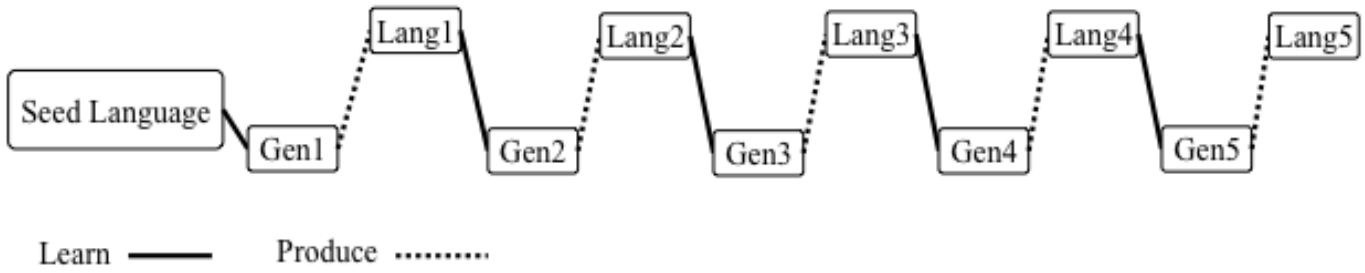
Coding

Notations made for which order participants gestured the demonstrartive, numeral adjective and noun elements.

If the gesture orders were isomorphic, harmonic or both

Based on this coding the training phase for the next generation was adapted so the training orders matched the output orders of the previous generation.



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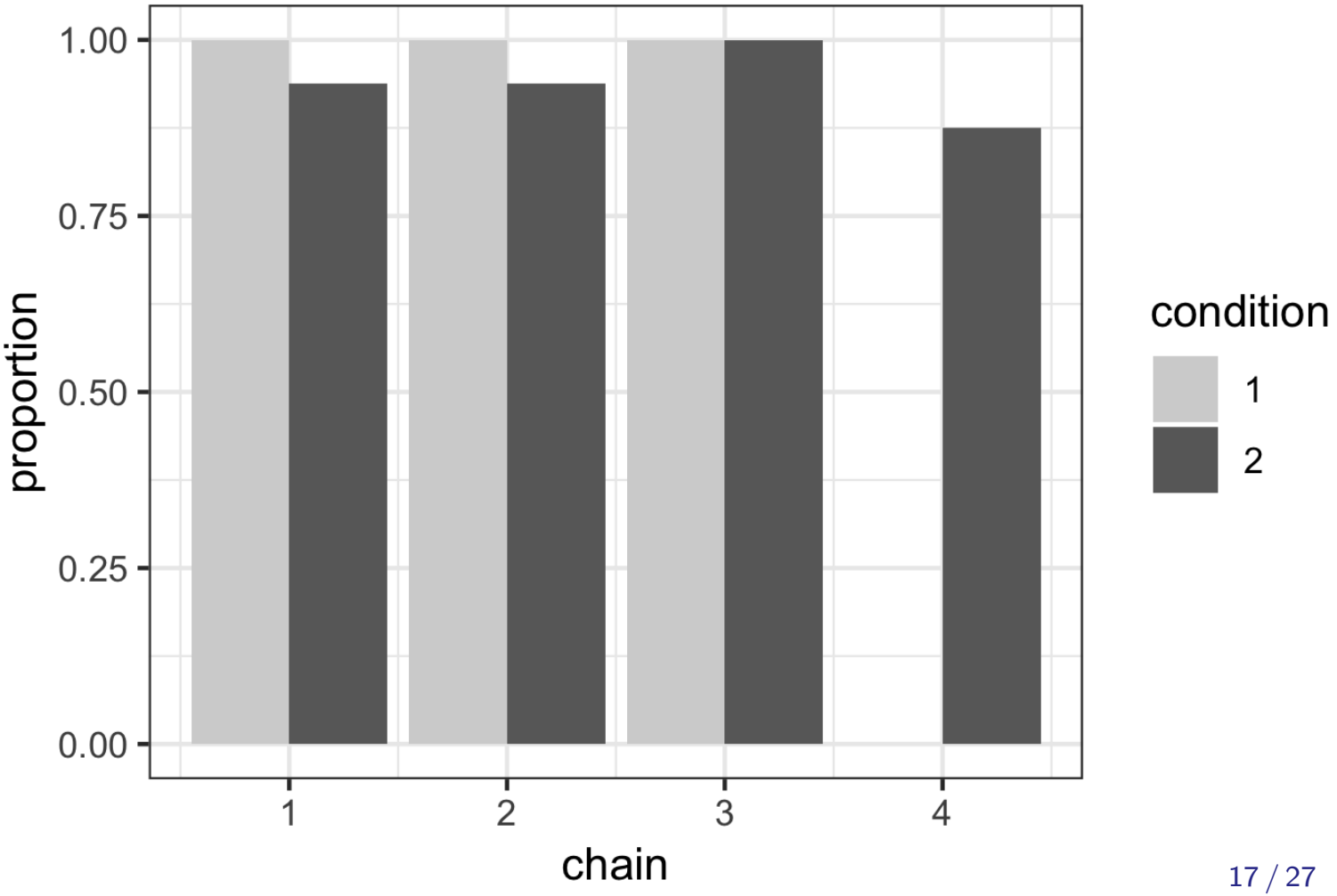
Experiment 1: Results

Aborted experiment.
From a total of 112 coded tokens only 4 were different from the training order.



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Experiment 2: New design

Introduce variation by training participants on 50/50 split of Dem-N-Adj-Num and N-Adj-Num-Dem.

Slightly different questions:

- Will there be regularisation?
- Predict regularisation to the harmonic *and* isomorphic order N-Adj-Num-Dem.

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Experiment 2: Procedure

Total of 25 participants.

Experimental set-up, procedure and materials were identical to Experiment 1, only difference was the order in which the training videos.

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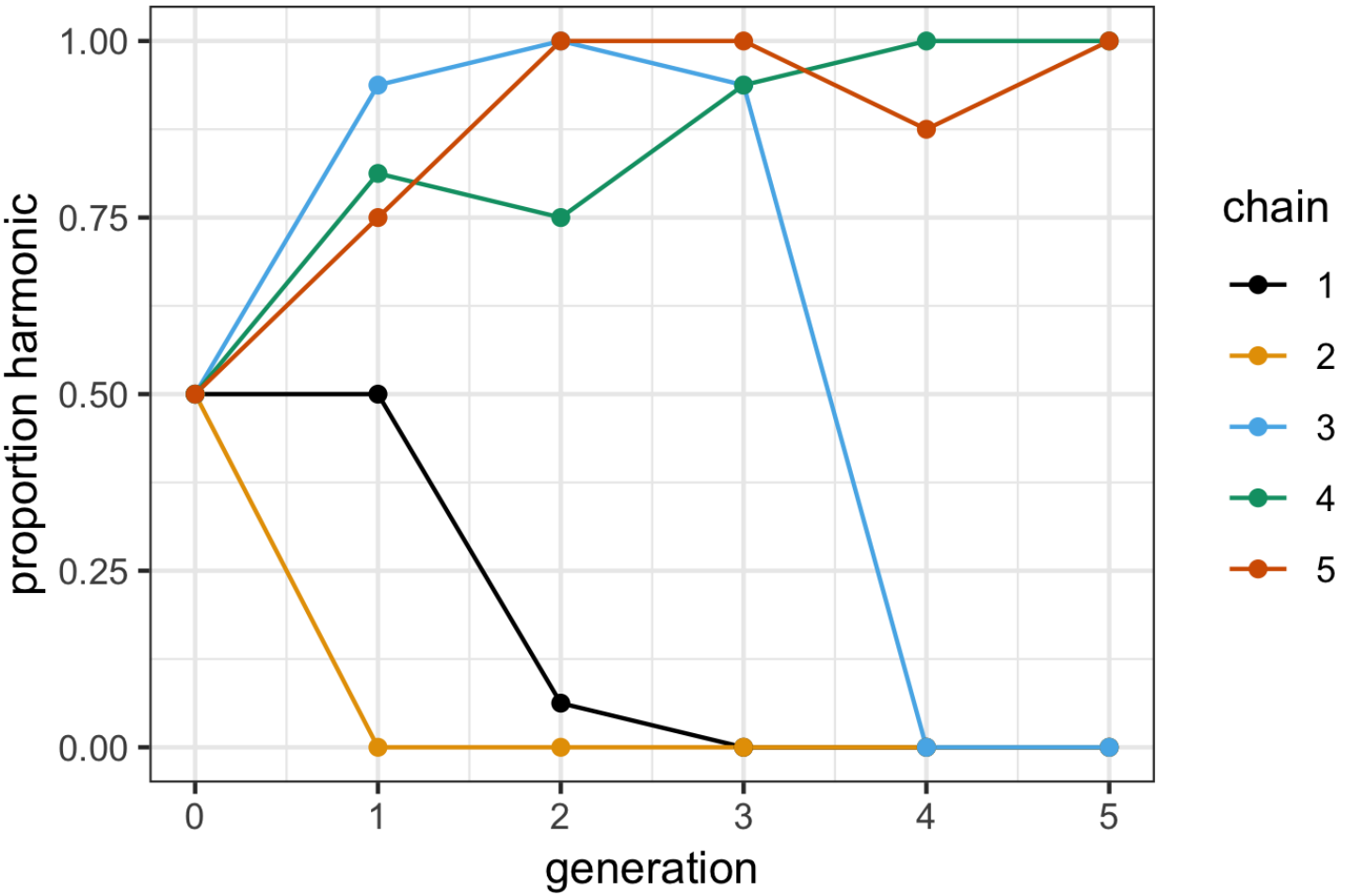
Experiment 2: Results for Harmony



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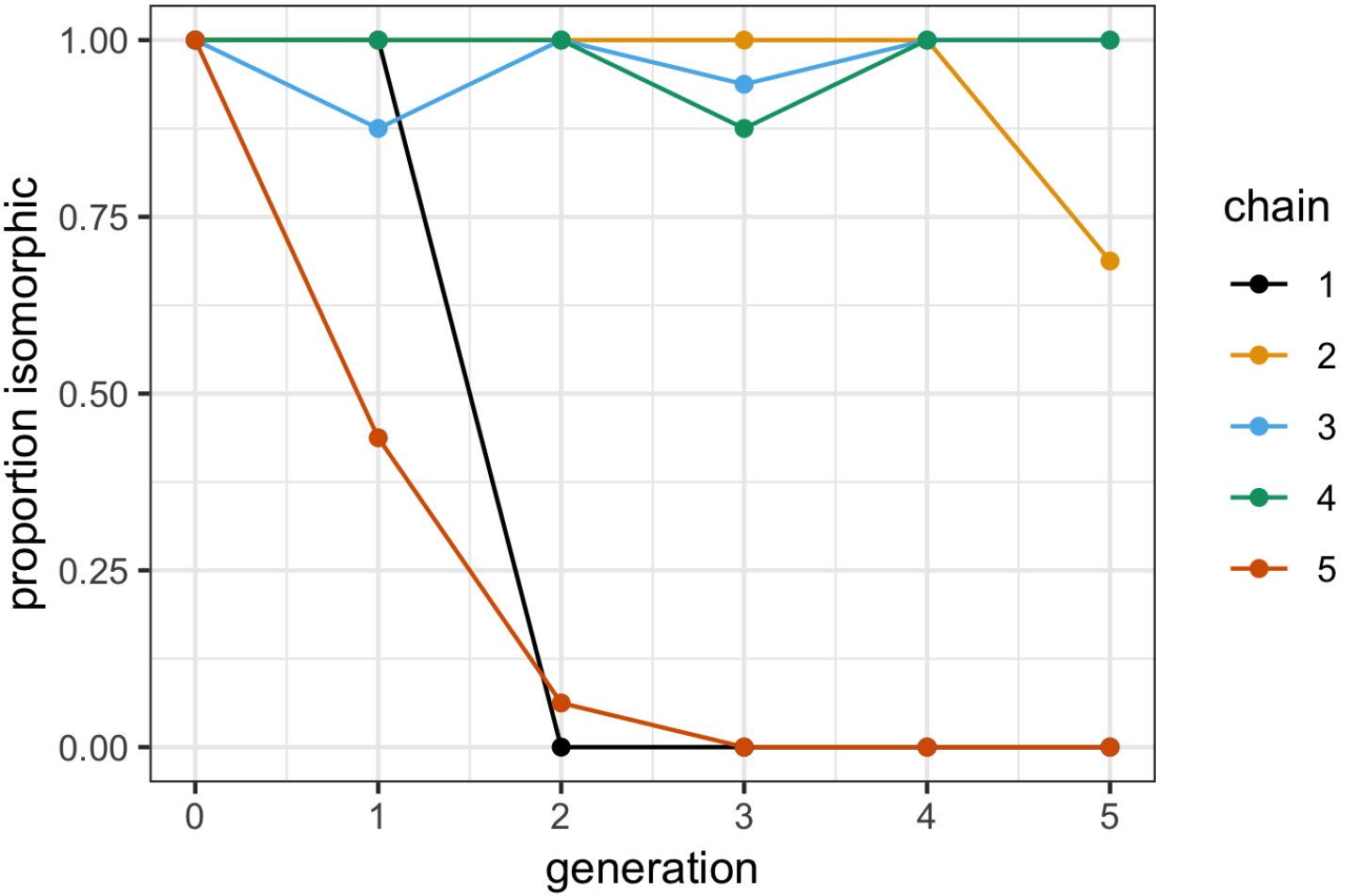
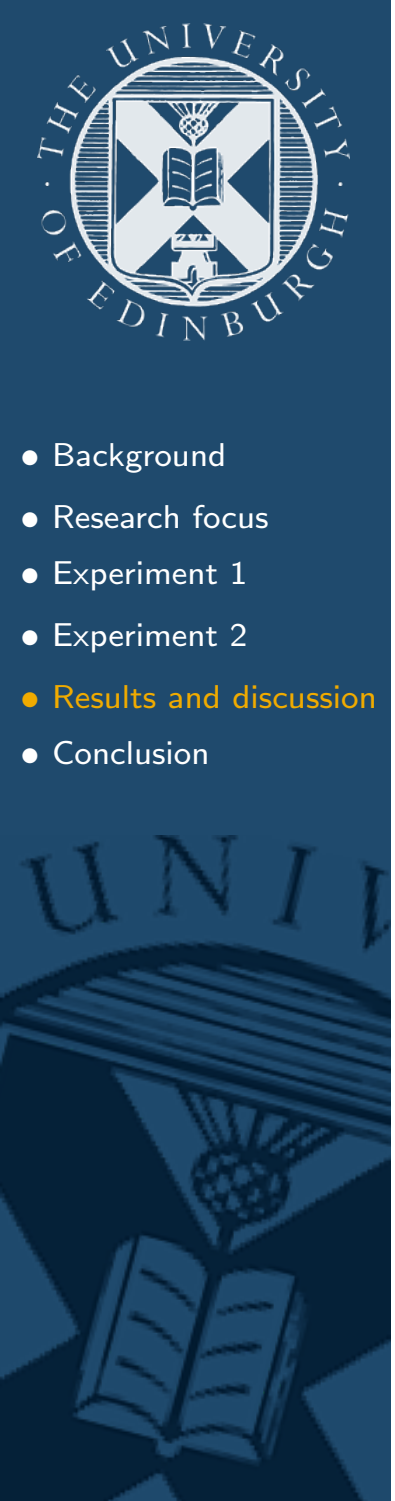
Experiment 2: Results for Isomorphism





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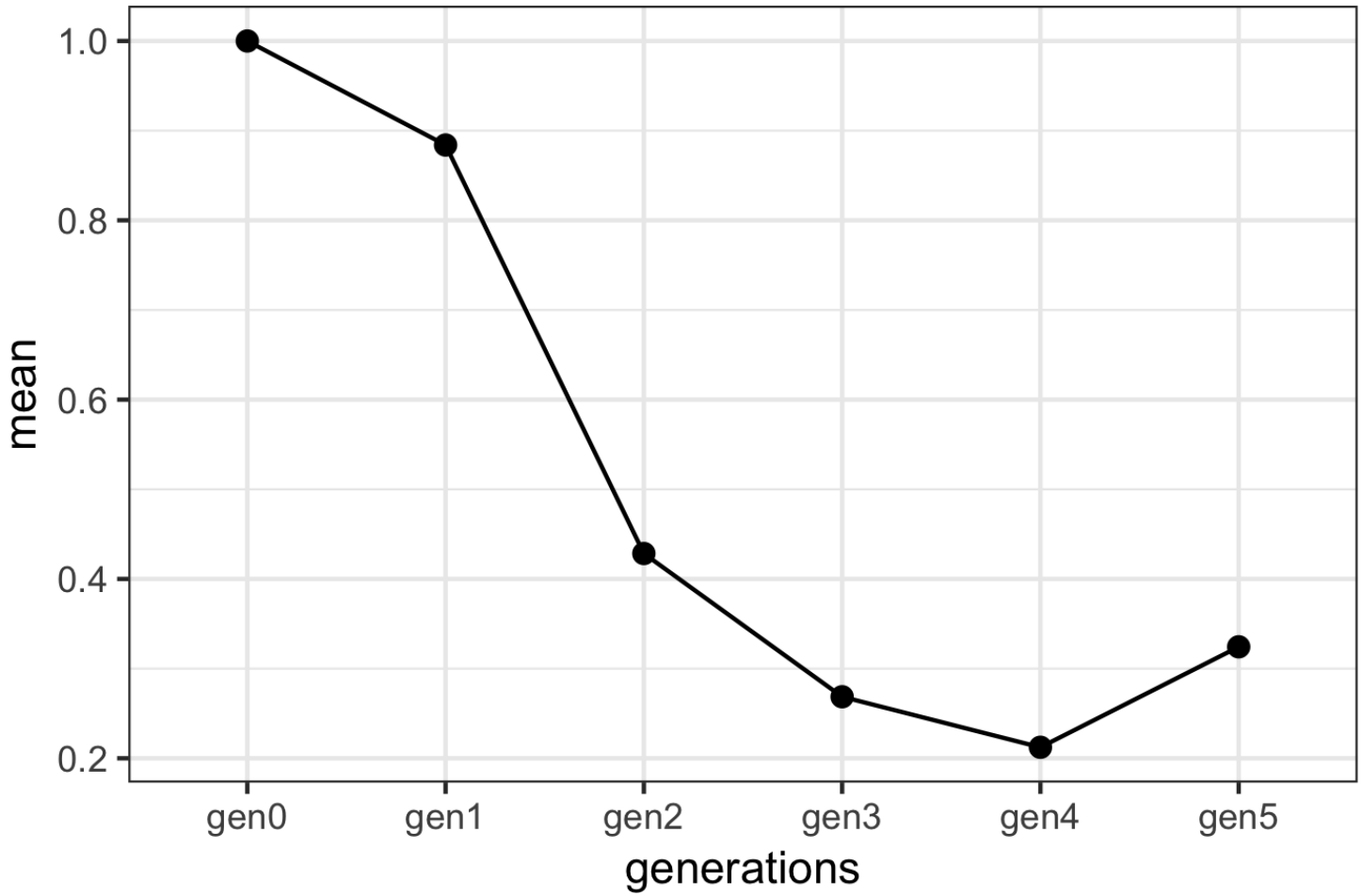
Experiment 2: Entropy



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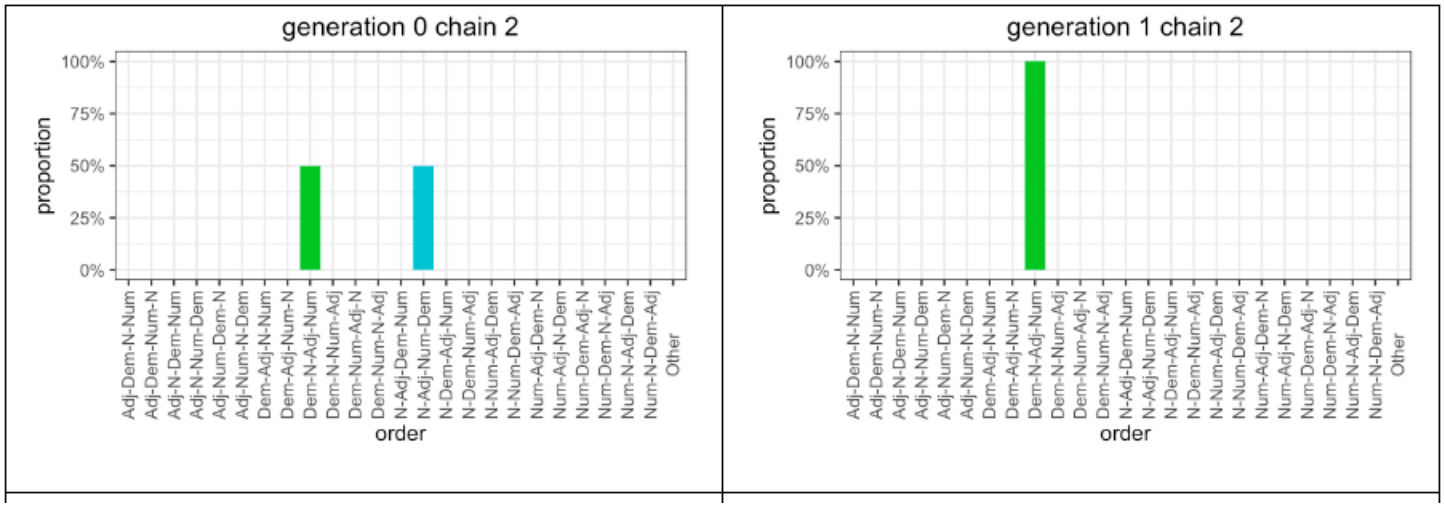
Experiment 2: Word Order Changes

Regularisation



Experiment 2: Word Order Changes

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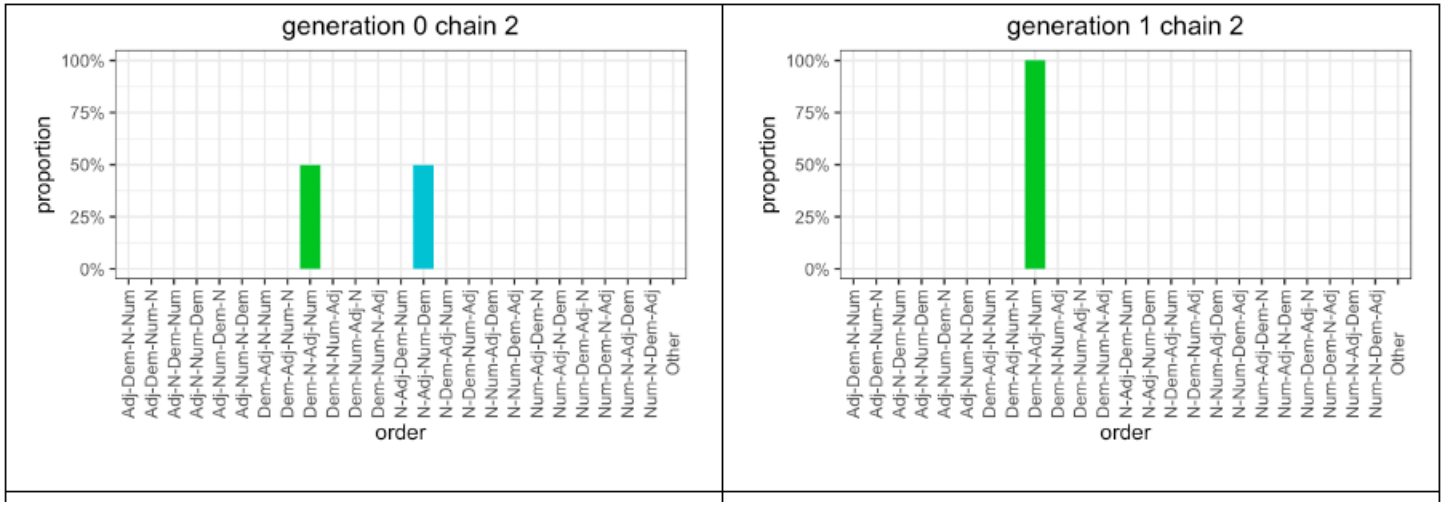
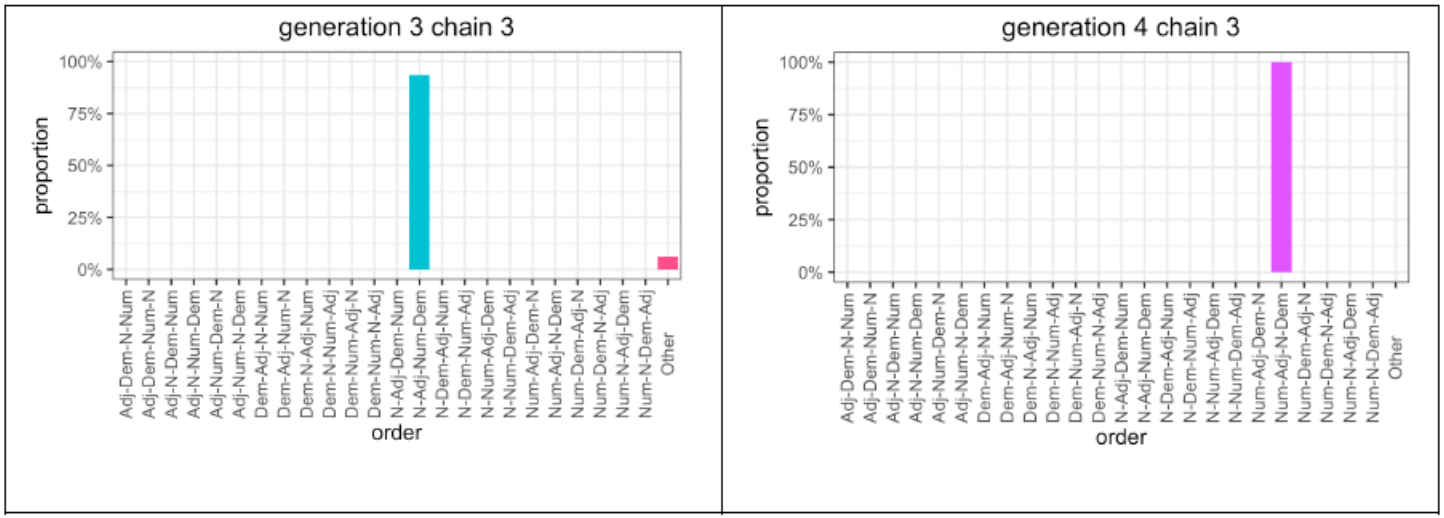
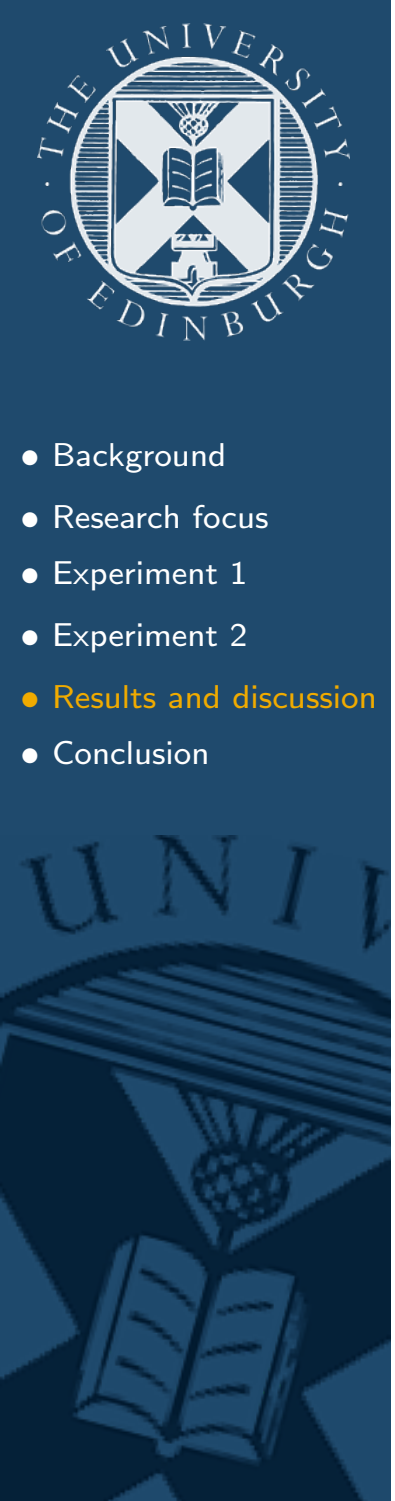
Regularisation



Shift





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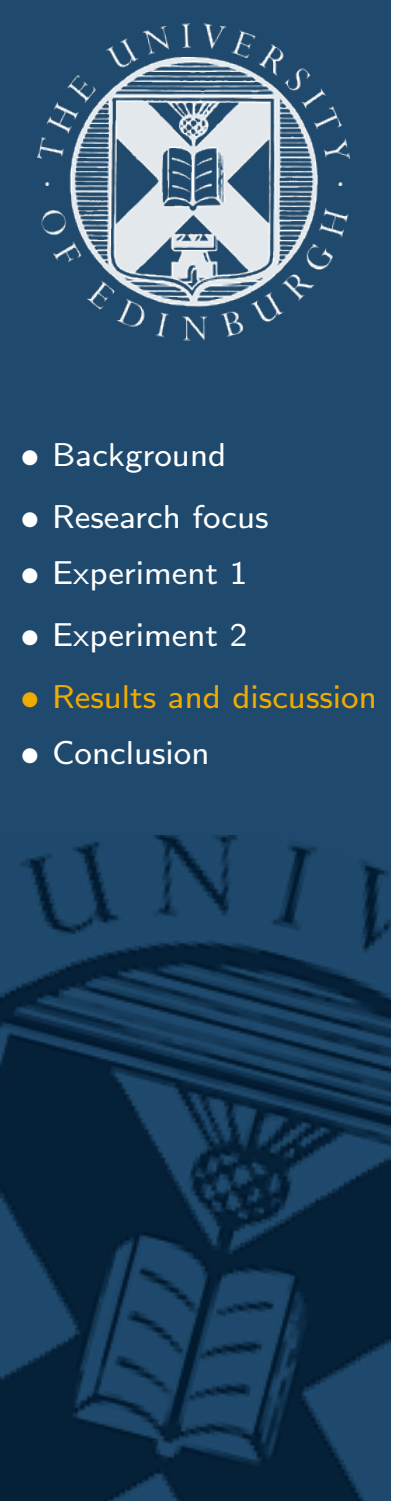
Source of non-isomorphism

Non-isomorphism always arises due to the position of Adj and Num.

	Generation 0	Generation 1	Generation 2	Generation 3	Generation 4	Generation 5
1	Dem-N-Adj-Num, N-Adj-Num-Dem	Dem-N-Adj-Num, N-Adj-Num-Dem	Dem-N-Num-Adj	Dem-N-Num-Adj	Dem-N-Num-Adj	Dem-N-Num-Adj
2	Dem-N-Adj-Num, N-Adj-Num-Dem	Dem-N-Adj-Num	Dem-N-Adj-Num	Dem-N-Adj-Num	Dem-N-Adj-Num	Dem-N-Adj-Num
3	Dem-N-Adj-Num, N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem	Num-Adj-N-Dem	Num-Adj-N-Dem
4	Dem-N-Adj-Num, N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem	N-Adj-Num-Dem
5	Dem-N-Adj-Num, N-Adj-Num-Dem	N-Num-Adj-Dem	N-Num-Adj-Dem	N-Num-Adj-Dem	N-Num-Adj-Dem	N-Num-Adj-Dem



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A New Design: Ordering Inference

Instead of providing the full noun phrase during training only partial phrases (e.g. Num-N, Dem-N, N-Adj etc.) would be presented.

Would allow for more of the original improvisation element from Schwoustra et al.[16]

The varaiation of which side the dependents are shown on would also alow for the simplicity bias to influence participants to generalise to a consistent branching direction.[17]

[16] 2017

[17] Culbertson el al.,2012; Culbertson and Newport, 2015

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Concluding Remarks

1. Research does not always go the way you think.

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Concluding Remarks

1. Research does not always go the way you think.

2. You can still learn some very interesting things.

- Background
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Concluding Remarks

1. Research does not always go the way you think.
2. You can still learn some very interesting things.
3. Gives you new questions to pursue.

- Background
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Thank you for listening!

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