



ConCreTe: CONCEPT CREATION TECHNOLOGY

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Studying Creativity via Computational Modelling

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and ConCreTe project colleagues



LIMITED SEASON
22 FEB - 5 MAR



ARTS THEATRE, London
020 7836 8463 artstheatrewestend.co.uk

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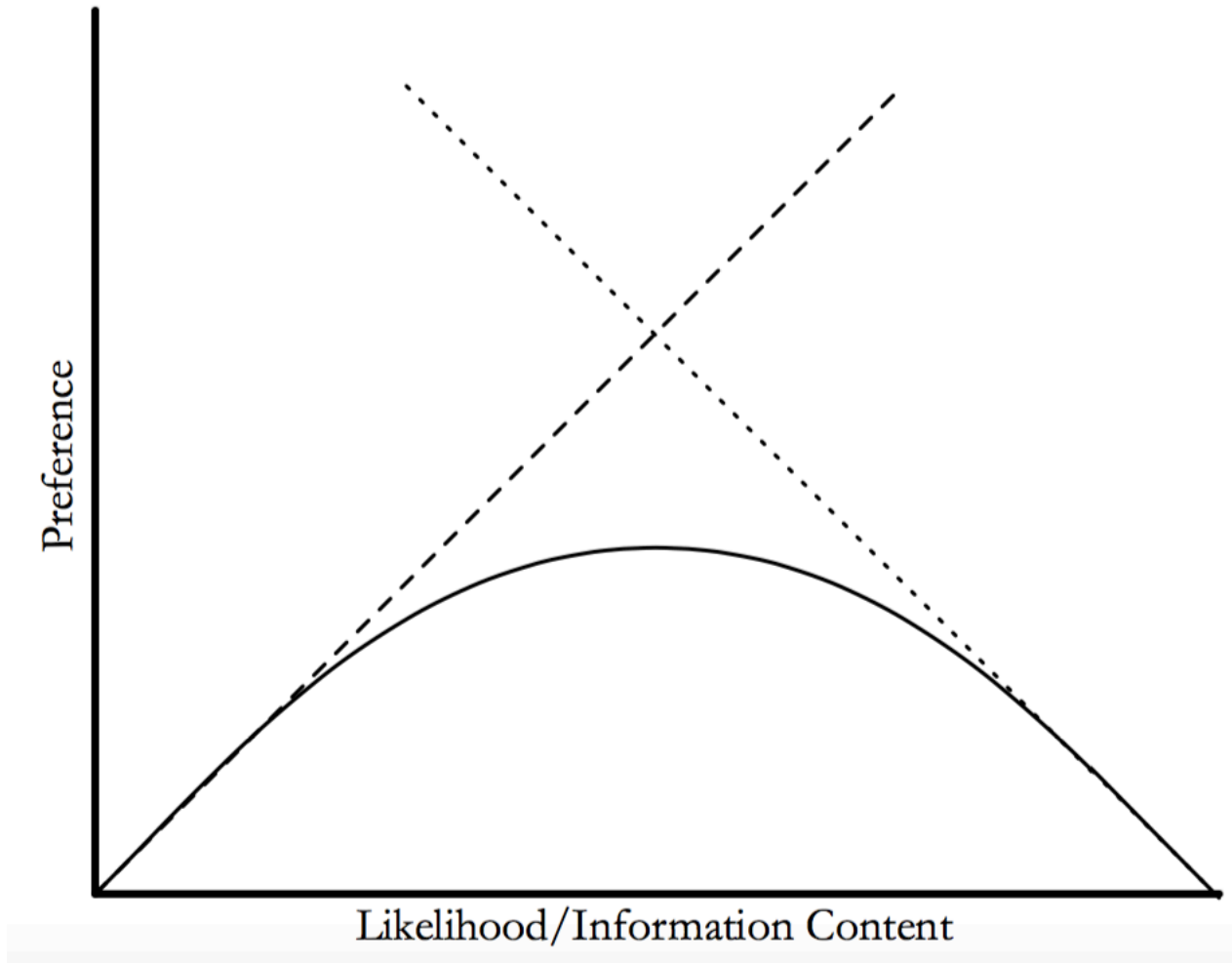
🐦 **f BeyondTheFence**

a **feast** site

Novelty & Value

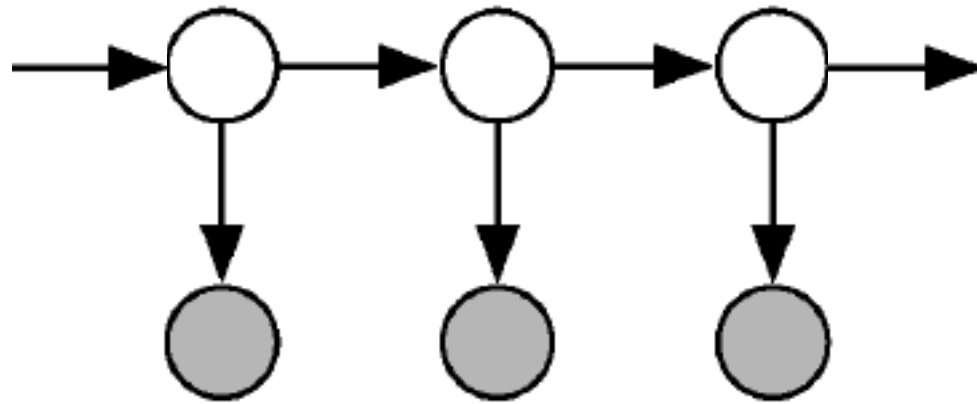
- Can a computer produce creative output?
- Novelty relative to individual
 - (P-creativity)
- Novelty relative to context
 - (H-creativity)
- Not just novel, but good / valuable ...
 - Involves artefact, author, audience, context

Novelty vs Chaos



Modelling vs Generation

- Statistical models e.g. Markov chains
 - Symbol sequences of arbitrary lengths



- Generation by sampling

Generating Choral Music

- Pearce & Wiggins (2007)



Based on Bach, BWV 359,
Jesu meiner Seelen Wonne

Evaluation via experts

“How successful is the composition as a chorale melody?”

(1-7 Likert scale)

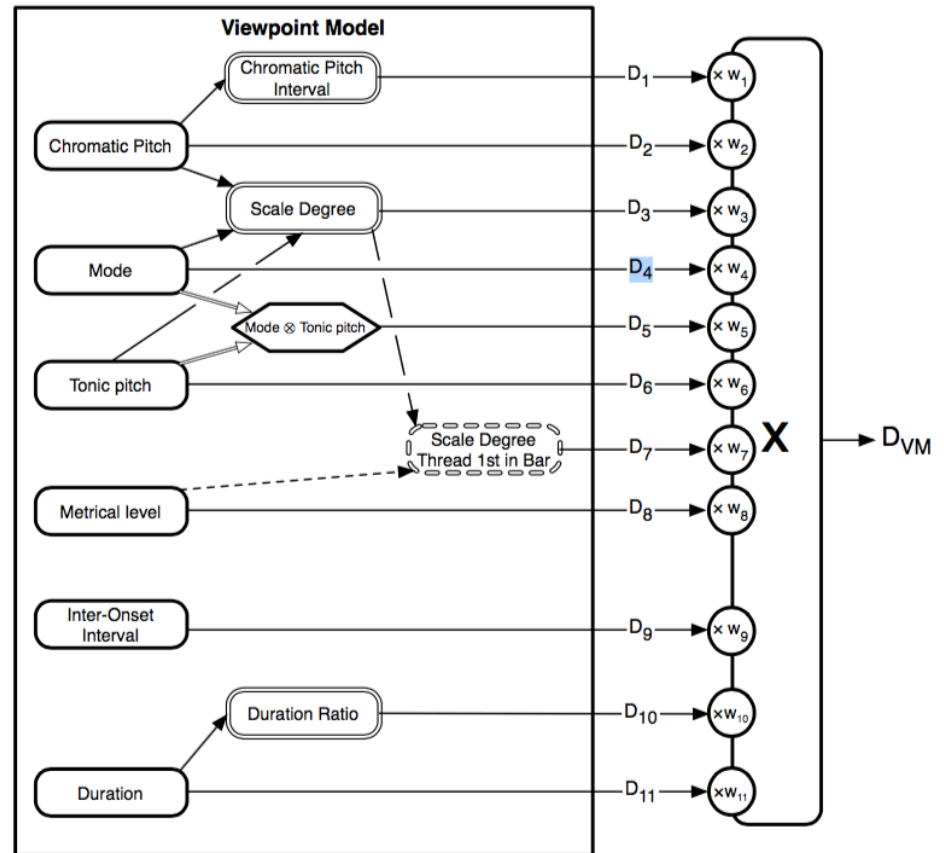
Base	System A	System B	System C	Original	Mean
249	2.56	2.44	5.00	6.44	4.11
238	3.31	2.94	3.19	5.31	3.69
365	2.69	1.69	2.50	6.25	3.28
264	1.75	2.00	2.38	6.00	3.03
44	4.25	4.38	4.00	6.12	4.69
141	3.38	2.12	3.19	5.50	3.55
147	2.38	1.88	1.94	6.50	3.17
Mean	2.90	2.49	3.17	6.02	3.65

Generating Choral Music

- Pearce & Wiggins (2007)



Based on Bach, BWV 359,
Jesu meiner Seelen Wonne



Better Models?

- Recurrent LSTM neural networks
 - Sequences with long- and short-term structures

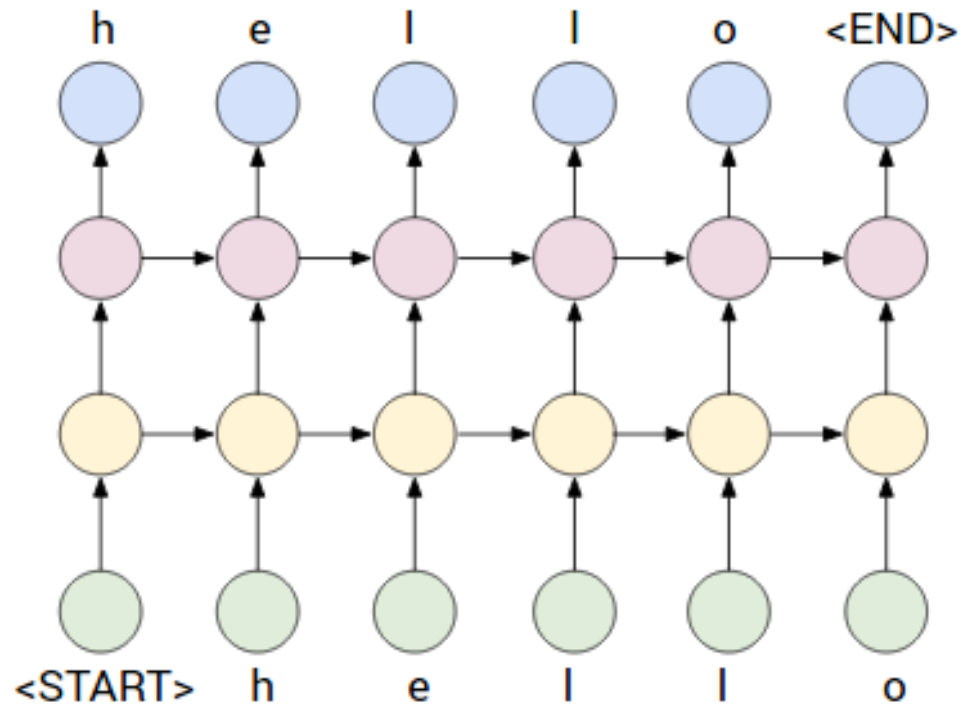


Image: Andrej Karpathy

Generating Folk Tunes

- Sturm et al (2015)
 - Generating tunes with titles
 - Input:

```
X: 1
T: Scottish Horse, The
Z: Weeje
S: https://thesession.org/tunes/12696#setting21449
R: jig
M: 6/8
L: 1/8
K: Amix
A|c3 ecA|d>ef a2 f|edc cAe|B3 B<BA|
c3 ecA|d>ef afd|ecA B2e|A3 A<A:|
|:e|a2 e A<Ae|d2 f a2 f|e>dc cAe|B3 B<Be/d/|
[1 ceA eaA|faA dfA|ceA B2 e|A3 A<A:|
[2 c3 ecA|d>ef afd|ecA B2 e|A3 A<A||
```

Generating Folk Tunes

- Sturm et al (2015)
 - Generating tunes with titles
 - Output:

```
T: Bornity Horse
M: 4/4
L: 1/8
K: Dmaj
|:FG A2 BGBd|AFGE DEdB|AF A2 BGBd|(3cBA cd eAFG|
FA B2 ABde|fedB AF F2|BG G2 ABdf|1 afea fdd2:|2 afea ~d3z||
|:d3e fd d2|Bd d2 Adfd|effe dff2|afeg fd d2 |
defd ed B2|ABde faaf|a2 fd Bd d2|AFde fdeg||
```

Bornity Horse



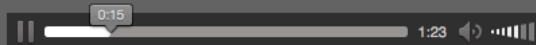
The Endless Traditional Music Session

<http://www.eecs.qmul.ac.uk/~sturm/research/RNNIrishTrad/>

The Endless Traditional Music Session

Music generated and titled by a **recurrent neural network**,
trained on over 23,000 tunes from ABC code posted on **The Session**

This set is performed by *The Melling Of The Histrens* (playlist updated every 5 minutes).



1. Cock The Briggbal
2. Jack's Rant
3. Jane's
4. Michael Luscenson's
5. Reels Of Dustles
6. Arrin's
7. The Predicau Drinker

Total number of tunes generated now: 35809

Created by: **Bob L. Sturm** and **João Felipe Santos**. ([More info.](#))



Images: Google Deep Dream



Generating Language?

Genesis 1:37

I have not abhorred a mighty man to eat of the house of Joses, and reigned in the land of the congregation of the LORD.

Genesis 1:38

There is no captains of the name of the LORD, and the doors was the lamb, and for the earth.

Genesis 1:39

Leten think about the king's house, and hath delivered them which the LORD shall go forth to the generations, and they have found of seven and fifty and lands the children of Israel: his sons is the second, and the commandment of the Luttite, and the word of the LORD; whereof they have brought forth to the truth.

Genesis 1:40

Saying, Why bear down the family of the children of Israel; who will join of a linen of the land of Egypt: he shall not come to pass from the man, that I have set before the LORD.

Bob Sturm, 2015: <https://highnoongmt.wordpress.com/2015/05/26/ behold-molten-children-recurrent-neural-networks-for-generating-even-more-word-of-god/>

Natural Language Generation

- E.g. text summaries from car telemetry
 - (Braun et al, 2015)

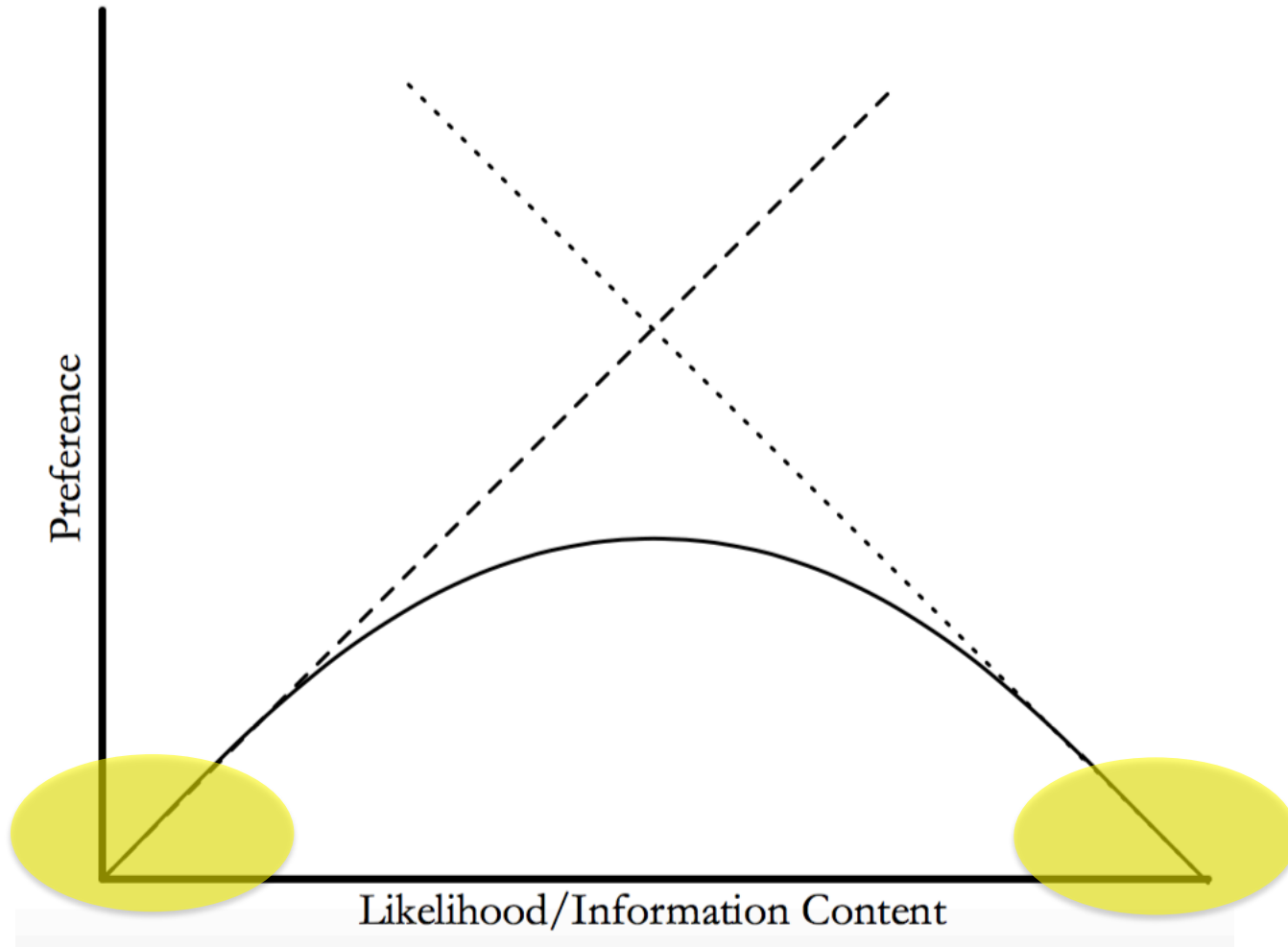
Driving Report 19 - 25 January

You drove **390 miles in 10 hours and 50 minutes** during the last week. You reduced the number of speeding incidents per mile by **more than 10 %**, well done!

Five times you drove more than 30 mph too fast: On Castle Road, on Kirkton Road, on North Deeside Road and twice on A92. Going 30 mph slower could shorten your braking distance by 108 yards. You also **speeded on 175** other occasions, 7 times on **roads with 20 mph speed limit** and 12 times **on weekends on roads with 30 mph speed limit**.

You **accelerated or braked harshly 645** times, mostly on **highways** and on **roads with 20 mph speed limit**.

Novelty vs Chaos



Generating Poetry

- Add rhythmic constraints (Gervás, 2015):

Tus ojos. Vinos tintos
blancos rosados. Nardo.
Amo tus ríos claros.
Tal vez esta medalla.
Antes que este hachazo
nos sacude. Imagínate.
Séptimo. Pinté el tallo
luego el cáliz después.
Ganar. Solicitamos.
Sólo soy un prisionero.
Admitió que se estima
que mil michoacanas
acudan. Queretanos.
Valor. Acompañado
por Margarita Flores.

Your eyes. Red wines
whites rosés. Tube rose
I love your clear rivers.
Maybe this medal.
Before this axblow
shakes us. Imagine.
Seventh. I painted the stem
then the calyx afterwards.
Winning. We request.
I am only a prisoner.
He admitted that it is estimated
that a thousand Michoacans
turn up. Queretans.
Valour. Accompanied
by Margarita Flores.

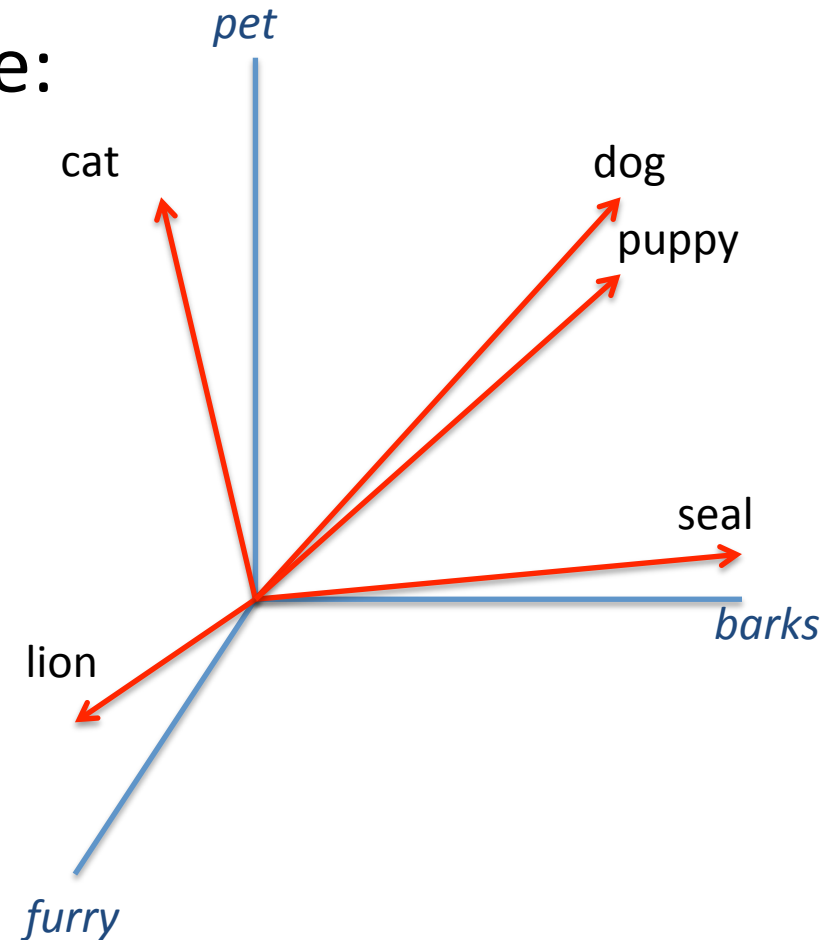
Adding constraints: Haiku

- **Syllables & word sequence:**

Kentucky is free
in an insect resistance
of economic

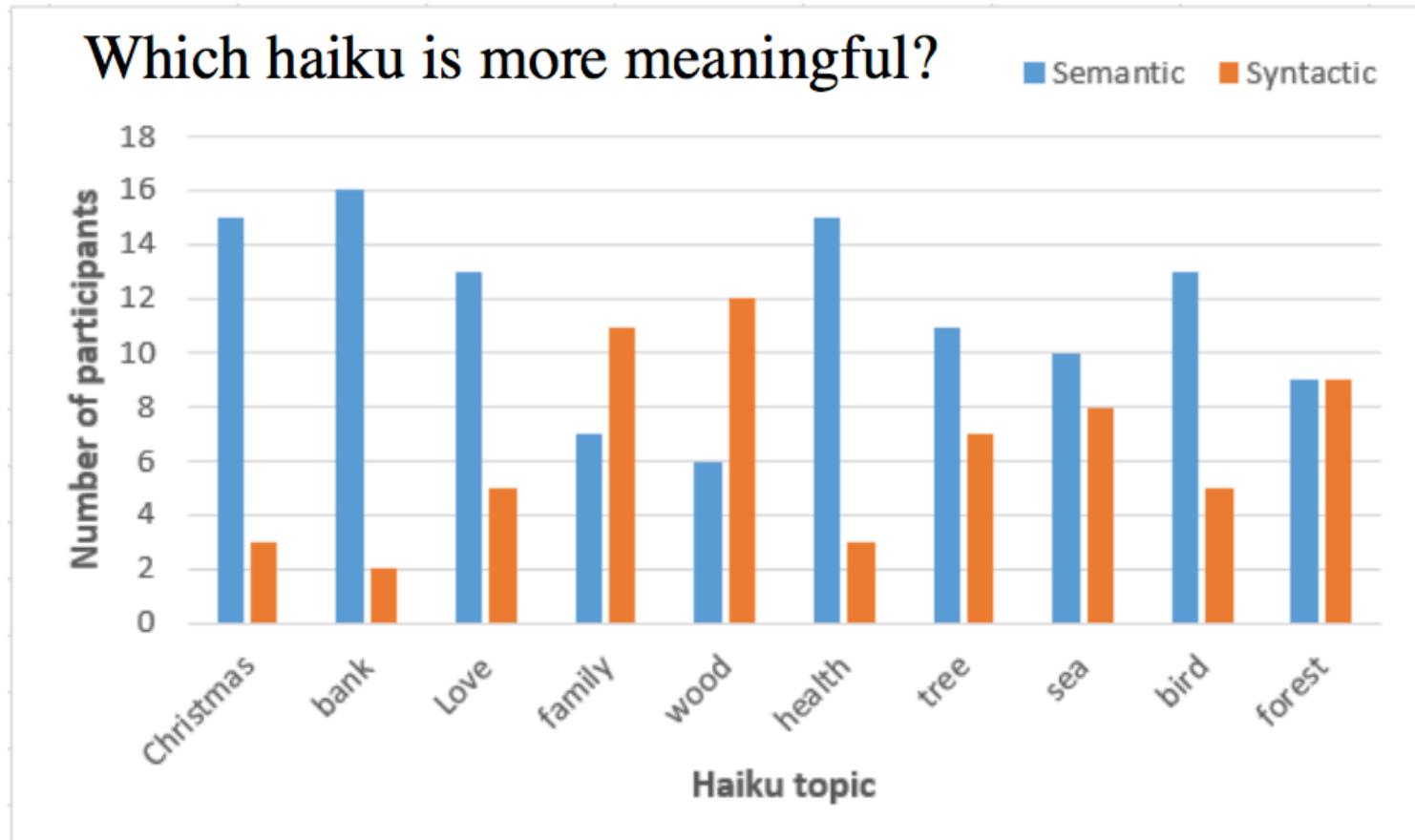
- **Add semantic similarity:**

Kentucky Derby
in agriculture in sin
of Evil Fried Chicken



Droog Hayes & Wiggins, 2015

Semantic constraints: Haiku



Droog Hayes & Wiggins, 2015

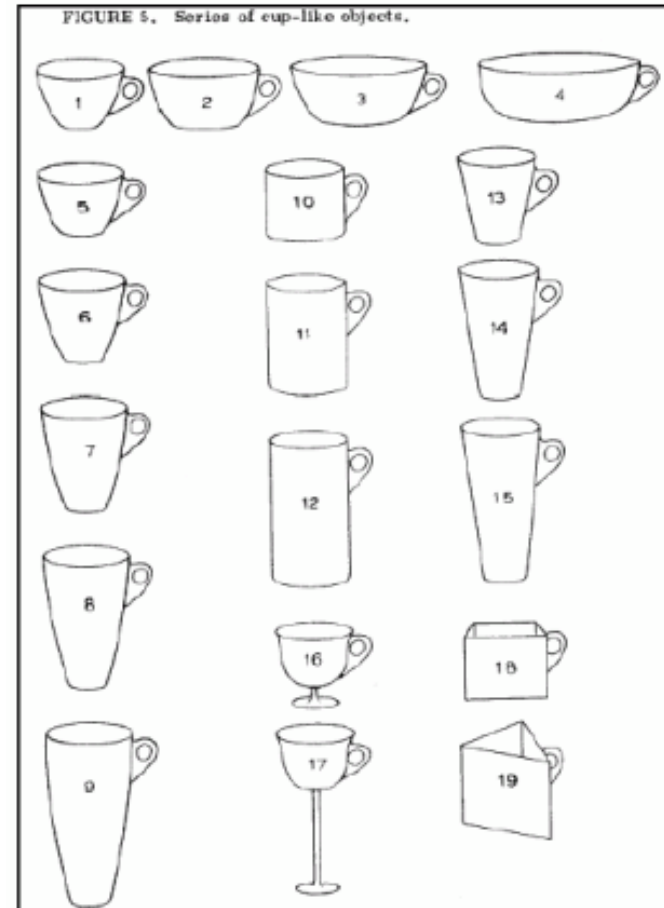
Generating Folk Tales

- Gervás (2013): Propp's ontology & combinatory rules

hero 296	lack 74 75	test 284 296	disguised 296
captive 295	*	donor 284	artisan 613
asks 295 296 297	dispatches 261 296	*	apprentice 296 613
*	seeker_hero 296	finds 296 453	unrecognised 296
not_perform_service 296	banished 261	follows 296 453	*
negative_result 296	victimised_hero 261	at_target_location 296	false_hero 616
*	transported_to 261 296	*	claims 616 617
villain 73	*	arrives 296 612	unfounded 617
maims 73 74	sets_out 296	location 612	*
victim 74	*	home 612	returns 296

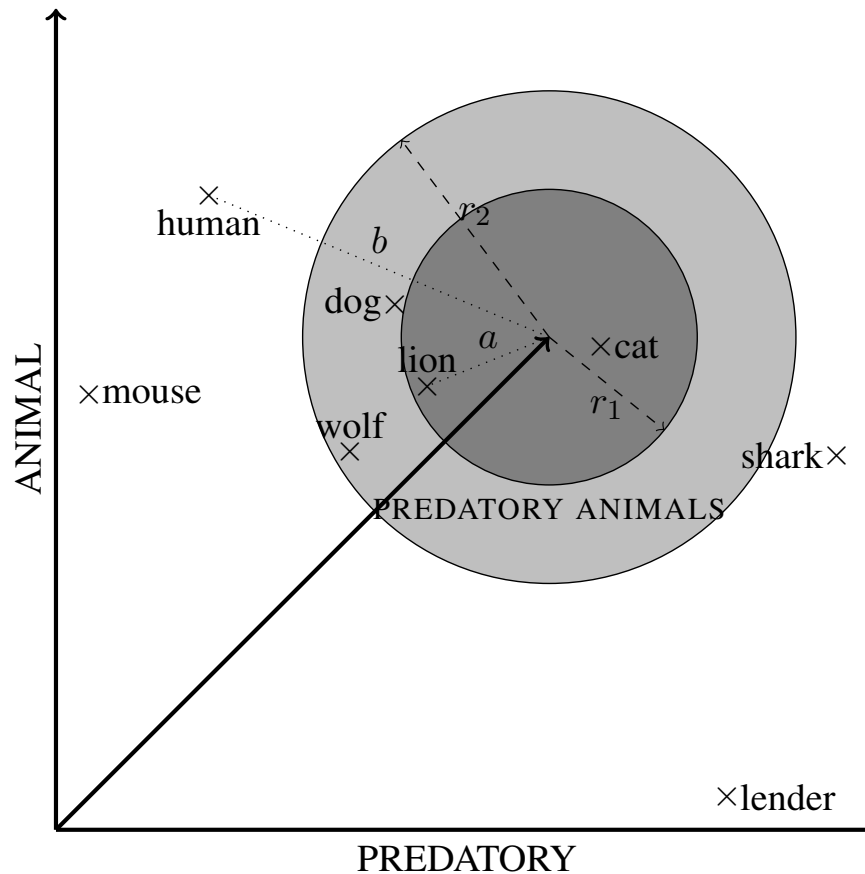
Exploration vs Transformation

- Boden (1990)
 - Exploratory creativity
 - Find new region in an existing conceptual space
 - Combinatorial creativity
 - (cf. Koestler (1964)'s bisociation)
 - Relating unrelated domains/ ideas
 - Transformational creativity
 - Redefining the conceptual space itself



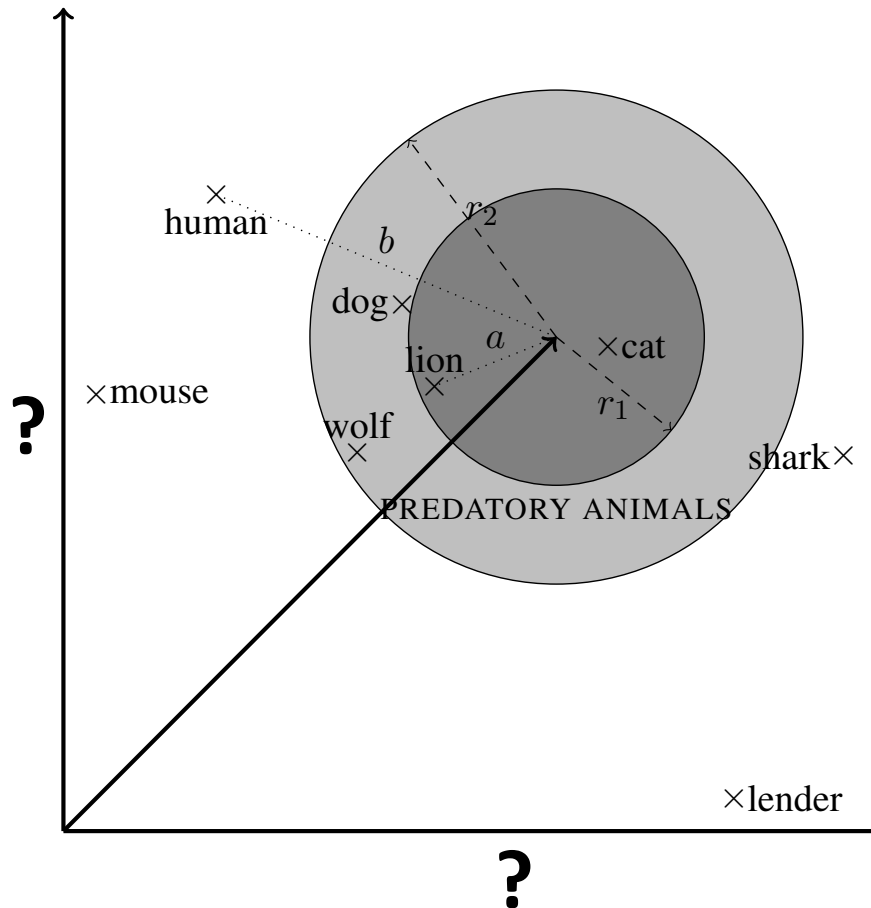
Conceptual Region Discovery

- Concept discovery: central region in defined space



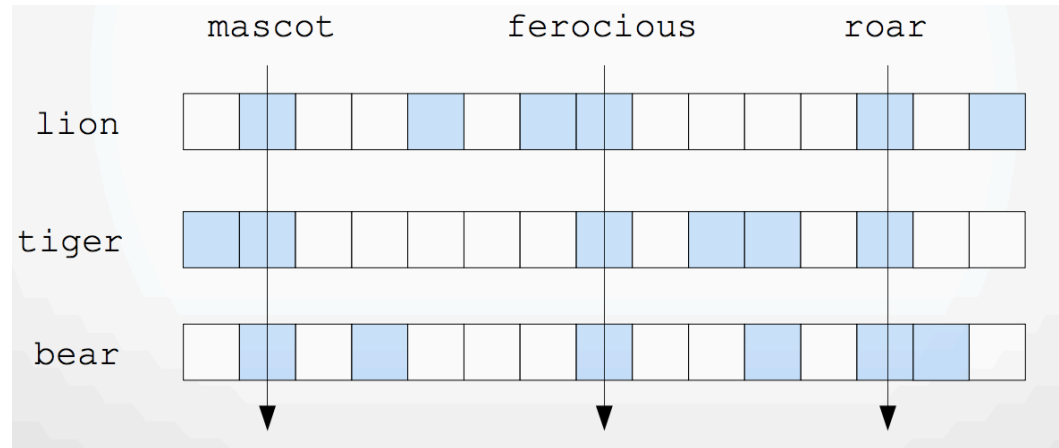
Conceptual Space Discovery?

- Subspace discovery: dimensions defining region

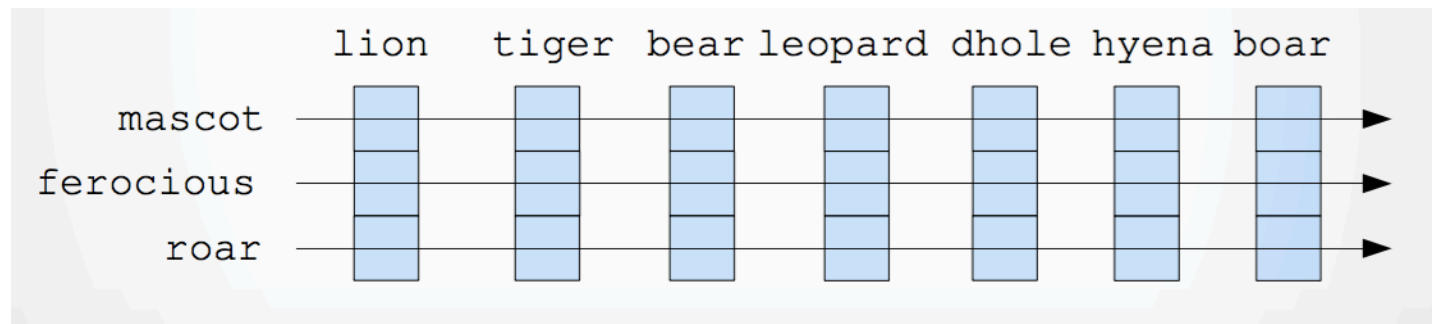


Subspace selection

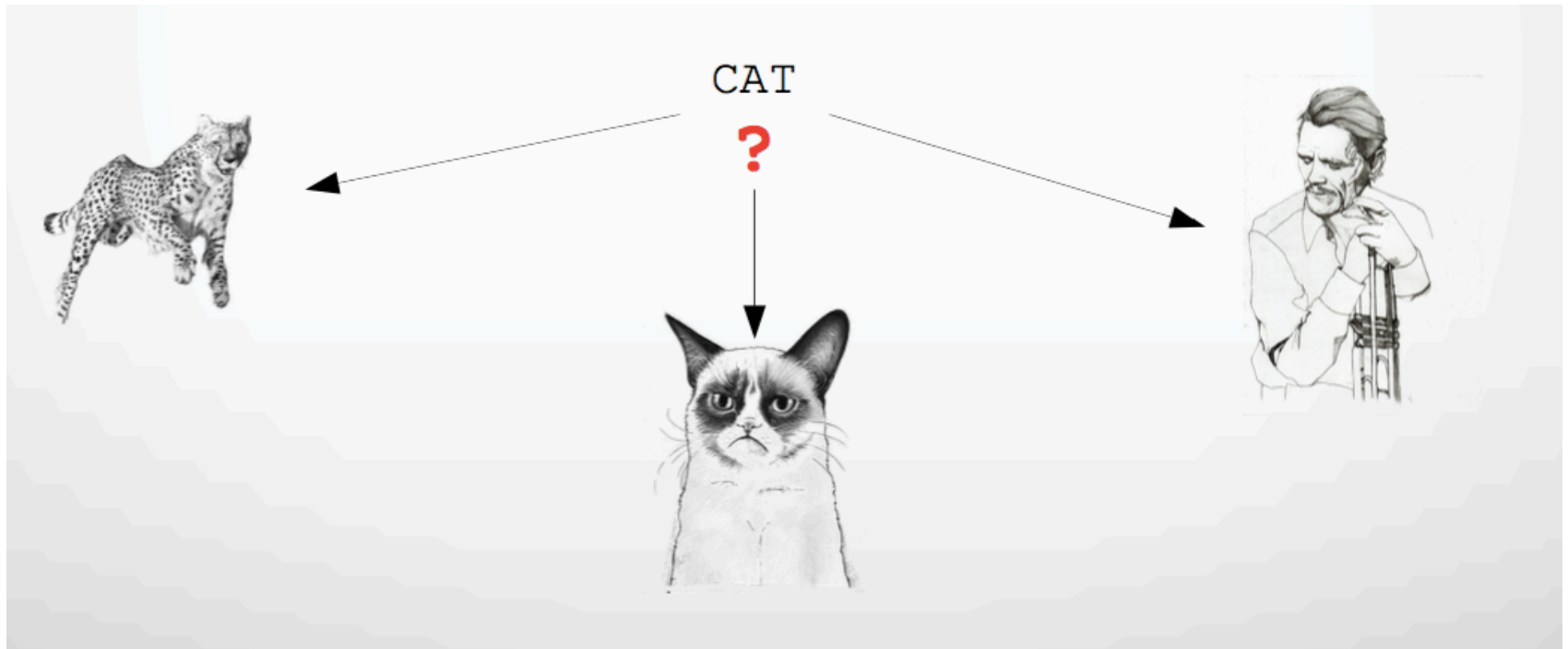
- Find characteristic shared dimensions:



- Then use them to find new examples:

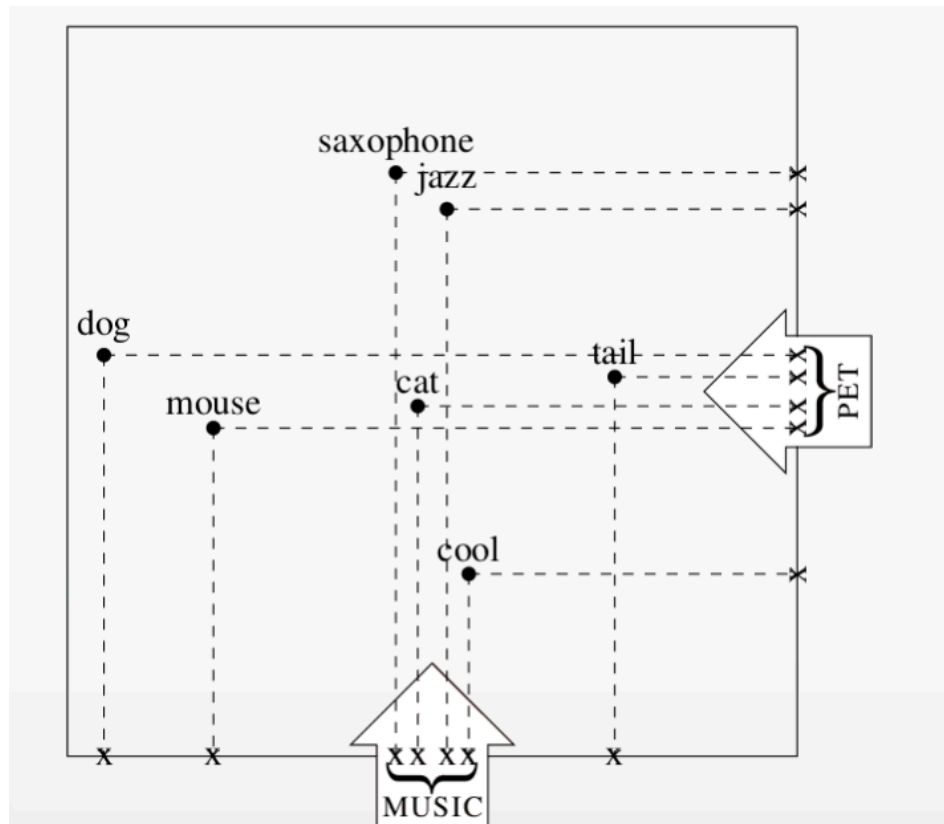


Context-dependent associations



Dynamic Concept Formation

- Sub-space within sparse space, via dimension selection
 - Discovering context-dependent, “ad hoc” concepts



McGregor et al,
JAGI 2015

Evaluation vs Humans

- Overlap against human-suggested terms:

	norm	anchor	w2v
WILD ANIMAL	0.10	0.20	0.14
BRIGHT COLOR	0.04	0.22	0.10
CULINARY CREATIVITY	0.23	0.17	0.14
INFECTIOUS DISEASE	0.17	0.20	0.09
POSITIVE EMOTION	0.09	0.11	0.13
POLITICAL IDEOLOGIES	0.21	0.23	0.16
PROFESSIONAL OCCUPATIONS	0.19	0.35	0.11
THEATRICAL CREATIVITY	0.16	0.29	0.22
<i>overall</i>	0.16	0.23	0.14

Surgery vs Butchery

- **Input:**
surgeon, scalpel, patient
- **Characteristic dimensions:**
orthopedic incision surgical anesthesia ophthalmic ...
- **Conceptual output:**
incision surgical endoscopic biopsy surgery chemotherapy
incisions laparoscopic lesion forceps grafts abdominal
psychotherapy ...
- **Input:**
butcher, meat
- **Characteristic dimensions:**
kosher pork halal minced meat butcher sausage poultry ...
- **Conceptual output:**
meats pork beef sausages grilled mutton compared sausage
cooked barbecued roasted steak veal ...

Surgery & Butchery

- **Input:**

surgeon, scalpel, patient, butcher, meat

- **Characteristic dimensions:**

knife throat plastic patient nurse bone doctor cuts ...
blood kills harm fatally accidentally murdered ...

- **Conceptual output:**

stabs knife stabbing syringe throat grabs impales
scalpel patient butcher corpse dog removes dies slashes
injures slicing lunges chest bandage strangle bruises ...

A Surgery/Butchery Poem

- Add some sequence & rhyme constraints:

*Who have throat soothe knife frozen lathe catheter
that stabs broken into another irritation
stabbing sore bite cough headache or stab
defibrillator
either grabs will surgically keep amputation*

A Surgery/Butchery Poem

- Add some sequence & rhyme constraints:

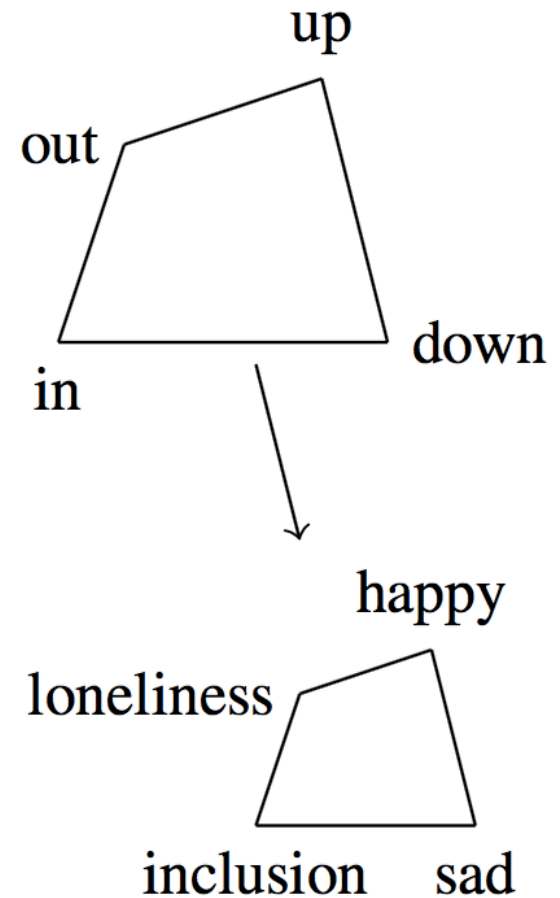
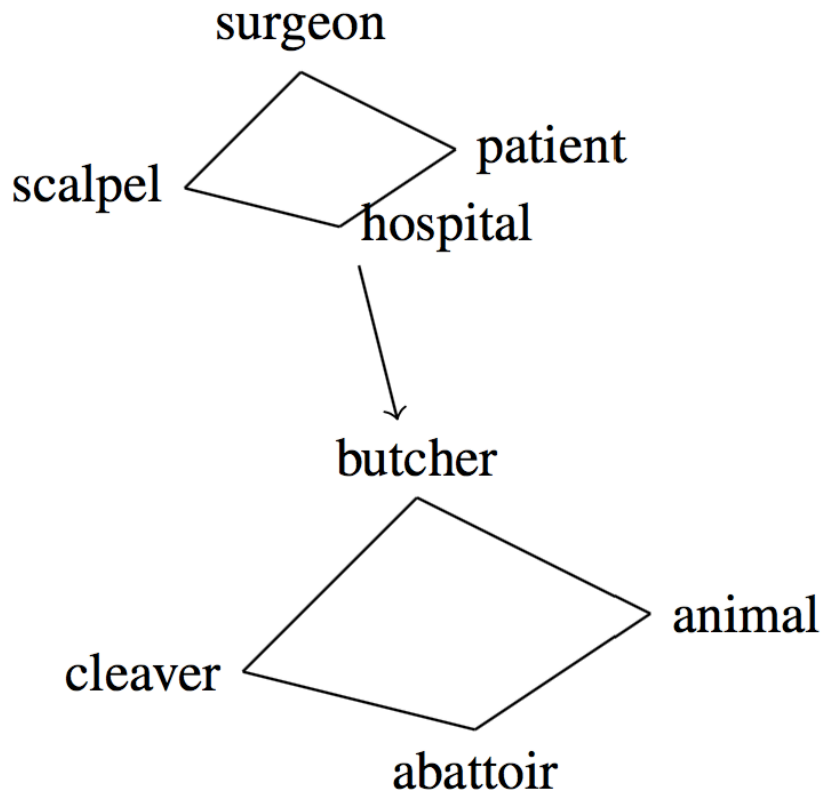
*Valerie impaled throat stabbing knife to keep
into which headache have unknowingly
or solar sore soothe slitting syringe screwdriver
but bite extinguisher accidentally*

A Surgery/Butchery Poem

- Add some sequence & rhyme constraints:

*Or need extinguisher to make but syringe
soothe many delivery speech into either
that stabs nor another surgical stab
sore headache have nor original hand another*

Metaphors



Evaluation

- Intrinsic evaluation of a single process
- Value: output artefact appropriateness
 - Domain expert judgements
 - e.g. melody ratings
 - Comparison with existing resources
 - e.g. concept discovery vs WordNet
- Novelty: output and process novelty (in context)
 - e.g. rate originality, innovation, emotion, skill, ...
 - word association tests (van der Velde et al, 2015)

Evaluation

- Extrinsic evaluation relative to end use
- Task-based evaluation
 - HCI methods: observation & ratings
 - usability, utility, user engagement
 - e.g. The Poetry Machine (Kantosalo et al 2015)
 - Co-creative writing between human & computer
 - e.g. SoundCloud music use
 - Network & sharing analysis (Jordanous et al 2015)
- Overall cultural/aesthetic value
 - (but rather a blunt instrument)

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