Truthmakers for Generics

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Workshop on Hyperintensional Logics and Truthmaker Semantics
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Truthmaking: explanatory

- Truthmakers: for explanatory purposes

- e.g. for Metaphysical grounding

- $X$ holds in virtue of $Y$

- In linguistics increasingly popular (because of hyperintensionality)
  1. intensionality
  2. disjunction (counterfactuals, free choice, implicatures)
  3. vagueness

- Now for generics (though not hyperintensional)
Generic sentences

- Birds fly, Dogs bark, Gs are f
- Intuitively, they express useful generalizations
- If I observe that x is a bird/dog, or that x flies or barks, it is useful for me to learn/know that the generic is true.
- It allows me to make more useful inferences.
- What should meaning of the generic be to make this possible?
Standard approaches

- Bird fly, but Pinguins don’t fly $\leadsto$ Non-monotonic analysis

- Normality approach (Asher & Pelletier, Morreau & Asher, · · ·)
  - ’Gs are $f$’ is true iff all normal $Gs$ are $f$
  - for all $d$ it holds that if it were a normal $G$, it would be $f$
  - What is normal determined by selection-function (like counterfactuals)

- Probabilistic approach (Pearl, Cohen, · · ·)
  - ’Gs are $f$’ is true iff almost all $Gs$ are $f$
  - ’Gs are $f$’ is true iff most $Gs$ are $f$
Problems for standard analyses

- Problems for standard probabilistic analysis:
  1. High probability not necessary
     Ducks lay eggs
  2. High probability not sufficient
     *Belgians are right-handed.

- Problems for normality analysis
  1. What is meaning of ’normal’, if not highly probable?
     (compare criticism of ‘similarity’ for analysis of counterfactuals)
  2. What is normal should be inconsistent
     Ducks lay eggs
     Elephants live in Africa
     Ducks have beautiful feathers
     Elephants live in Asia
Problems for all

- Dutchmen wear wooden shoes
- Dutchmen are good sailors
- Frenchmen eat horsemeat
- Ticks carry the lyme disease

Solution: Relatively many Gs are f

\[ P(f/G) > P(f/\bigcup \text{Alt}(G)) \]

Cohen: generics are ambiguous

Relative reading comes through learning

But should be last option
Pavlov (1920ties): conditioning i.t.o. co-occurrence
Conditioning and contingency

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- Rescorla (1968): Rats learn a Tone $\rightarrow$ Shock association so long as the frequency of shocks following the tone is higher than the frequency of shocks experienced otherwise

Contingency $\Delta P_{\text{tone}}^{sh}$

$\Delta P_t^{sh} = P(sh/t) - P(sh/\neg t)$
Conditioning and contingency

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  $\Delta P_G^{f} = P(f/G) - P(f/\neg G)$

Note: $\Delta P_{fG} > 0$ iff 'G's are f' true on relative reading
Conditioning and contingency

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  Note: $\Delta P_G^f > 0$ iff ‘Gs are f’ true on relative reading
Accounting for examples

- Birds fly: Most do, others don't.
- Ducks lay eggs: Indeed, non-birds don't lay eggs.
- Ducks have colorful feathers.
- Belgians are right-handed: Nothing special.

The analysis correctly predicts the conjunction fallacy for generics:

\[ P(\text{manes}/\text{lion}) < P(\text{male}/\text{lion}) \]

1. Lions have manes is true.
2. Lions are male is false.
Accounting for examples

√ Birds fly

Most do, others don’t
Accounting for examples

√ Birds fly

√ Ducks lay eggs

√ Ducks have colorfull feathers

Most do, others don’t

indeed, non-birds don’t lay eggs
Accounting for examples

√ Birds fly

√ Ducks lay eggs

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*Belgians are righthanded

Most do, others don’t

indeed, non-birds don’t lay eggs

nothing special
Accounting for examples

√ Birds fly
Most do, others don’t

√ Ducks lay eggs
indeed, non-birds don’t lay eggs

√ Ducks have colorful feathers

*Belgians are righthanded
nothing special

- The analysis correctly predicts conjunction fallacy for generics:
  Only male lions have manes: \( P(\text{manes/lion}) < P(\text{male/lion}) \)
  1. Lions have manes is true
  2. Lions are male is false
Generics with hardly distinctive properties

- $\Delta^f_G$ small (but positive), still the following are good
- Dogs are 4-legged     Humans are mortal
Generics with hardly distinctive properties

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- New measure: $\Delta^* P^f_G = \frac{\Delta P^f_G}{1 - P(f|\bigcup \text{Alt}(G))}$ or $\Delta^* P^f_G \times \text{Impact}(f)$
Generics with hardly distinctive properties

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- Effects
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- Effects
  - Mostly similar to $\Delta^f_G$  Distinctiveness

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Generics with hardly distinctive properties

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Effects
1. Mostly similar to $\Delta^f_G$
   - Distinctiveness
2. But $\Delta^* P^f_G$ increases, if $P(f \mid \bigcup \text{Alt}(G))$ increases
   - E.g. if $P(f \mid \bigcup \text{Alt}(G)) = 0.9$, $\Delta^* P^f_G = 10 \times \Delta P^f_G$
Generics with hardly distinctive properties

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     e.g. if $P(f | \bigcup \text{Alt}(G)) = 0.9$, $\Delta^* P^f_G = 10 \times \Delta P^f_G$

    $\sim P(f | G)$ counts for more than $P(f | \bigcup \text{Alt}G)$
Causation
Problem for frequency analysis II

- Analysis i.t.o. \( \Delta^* P^f_G = \frac{P(f/G) - P(f/\neg G)}{1 - P(f/\neg G)} \)

- Problems
  1. In the end, this is just association. On what is it based?
  2. No difference between good generics and accidental generalizations
  3. Cannot account for intensional feature of generics:
     Mail from Antarctica is handled by Maria
  4. What about generics embedded in other sentences? Truth conditions
  5. How come that many believe it is about conditional probability?
Towards an Explanatory analysis

- We will explain why $\Delta^* P^f_G (\Delta^* P^e_i)$ is the correct analysis.
- Correlation should be explained in terms of causality.
- Analysis in terms of **Causal powers**: of $g$ to produce $f$, $p_{gf}$ ($p_{ie}$).
- Old idea: Aristotle, Leibniz, Kant, Harré & Madsen, Cartwright.
- Assume (with Leibniz): Principle of Sufficient Reason. Every event/object has a causal explanation/ground.
- Assume: causal structure $i \rightarrow e \leftarrow a \quad a = \bigcup Alt(i)$.
- Causal powers, $p_{ie}$ and $p_{ae}$ are independent of $P(i)$ and $P(a)$.  

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Derivation of $\Delta^* P^e_i$ 1

recall that

$P(A \lor B) = P(A) + P(B) - P(A \land B)$, thus

$P(e) = P(i) \times p_{ie} + P(a) \times p_{ae} - P(i) \times P(a) \times p_{ie} \times p_{ae}$

$P(e/i, \neg a) = p_{ie}$

Assume that $i$ is independent of $a$
Derivation of $\Delta^* P^e_i$

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Derivation of $\Delta^* P_i^e$

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  $$\Delta P_{i}^e = P(e/i) - P(e/\neg i)$$
Derivation of $\Delta^* P_i^e$ 

2

$\Delta P_i^e = p_{ie} + (P(a/i) \times p_{ae}) - (p_{ie} \times P(a/i) \times p_{ae}) - (P(a/\neg i) \times p_{ae})$

Assuming $P(i) = 0$
Derivation of $\Delta^* P^e_i$

- $P(e) = P(i) \times p_{ie} + P(a) \times p_{ae} - P(i) \times P(a) \times p_{ie} \times p_{ae}$
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- $p_{ie} = \frac{\Delta P^e_i - [P(a/i) - P(a/\neg i)] \times p_{ae}}{1 - P(a/i) \times p_{ae}}$. 
Derivation of $\Delta^* P^e_i$
Derivation of $\Delta^* P_i^e$

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- $p_{ie} = \frac{\Delta P_i^e - [P(a/i) - P(a/\neg i)] \times p_{ae}}{1 - P(a/i) \times p_{ae}}$.

- $a$ is independent of $i$: $P(a/i) = P(a) = P(a/\neg i)$
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\[ a \text{ is independent of } i: P(a/i) = P(a) = P(a/\neg i) \]

\[ p_{ie} = \frac{\Delta P_i^e}{1 - P(a) \times p_{ae}}. \]

\[ P(a) \times p_{ae} = P(e/\neg i), \text{ thus} \]
Derivation of $\Delta^* P^e_i$

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- Causal explanation of $\Delta^* P_i^e$. 
Pearl’s derivation

- Probability of Sufficiency: \( P(e_i/\neg e, \neg i) \) i.t.o. intervention

- Exogeneity: The way \( E \) would potentially respond to conditions \( i \) and \( \neg i \) is independent of the actual value of \( I \)

- Result: \( P(e_i) = P(e_i/i) = P(e/i) \) similarly \( P(e_{\neg i}) = P(e/\neg i) \)

- Monotonicity: a change from \( \neg i \) to \( i \) cannot change \( e \) into \( \neg e \).

- Assume Exogeneity and Monotonicity: \( P(e_i/\neg e, \neg i) = \Delta^* P_i^e \)
Interactive causes

- Striking a match does **not by itself** cause it to light
- Need background conditions, e.g. oxygen \( j \) assume independence

\[
\Delta^* P_i^e = p_{ie} + P(j) \times p_{ij,e} - P(j) \times p_{ie} \times p_{ij,e}
\]

- If \( p_{ie} = 0 \), as for match and the oxygen, \( \Delta^* P_i^e = P(j) \times p_{ij,e} \)

- If we know \( p_{ij,e} = 1 \), then \( \Delta^* P_i^e = P(j) \)

**Proposal:** if \( P(j) \) is stable, generic is true if \( p_{ij,e} \) high
Consequences of Causal Power view

The analysis explains why $\Delta^* P_{ei} = \Delta P_{ei} - P(a/\neg i)$ is a good notion. Makes a distinction between generics and accidental generalizations. If not causal reason for generalization, then generic not true. Can account for intentional object of generics.

Objects are supposed to have causal powers/potency independent of whether right circumstances occur: $pi_{ei}$ is independent of $P(i)$. $pi_{ei}$ are stable elements of objects and truthmakers of generics $\Rightarrow$ generics express propositions.

The causal power analysis is more general, because also ok if $i$ and $a$ not statistically independent.
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- Can account for intentionality of generics. Mail from Antartica is handled by Maria.

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- $p_{ie}$ are stable elements of objects and truthmakers of generics.
  $\Rightarrow$ generics express propositions.
- The causal power analysis is more general, because also ok if $i$ and $a$ not statistically independent.
Consequences, if $i$ and $a$ not independent

\[ p_{ie} = \Delta P_e i - [P(a/i) - P(a/\neg i)] \times p_{ae} - P(a/i) \times p_{ae}. \]

What if $i$ and $a$ are not independent?

1. If $P(a/i) < P(a/\neg i)$, then $p_{ie} > \Delta P_e i$.

2. If $P(a/i) > P(a/\neg i)$, then $p_{ie} < \Delta P_e i$.

Special cases

1. $P(a/i) = 0$, because $i \perp a \Rightarrow p_{ie} = P(e/i)$.

2. $P(a/i) = 1$, because $i \parallel a \Rightarrow p_{ie} = 0$.

What counts is total causal power: $p_{tot} ie = P(e/i)$.
Consequences, if \( i \) and \( a \) not independent

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p_{ie} = \frac{\Delta P^e_i - [P(a/i) - P(a/\neg i)] \times p_{ae}}{1 - P(a/i) \times p_{ae}}.
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Consequences, if $i$ and $a$ not independent

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What if $i$ and $a$ are not independent?
Consequences, if $i$ and $a$ not independent

$$ p_{ie} = \frac{\Delta P_i^e \cdot [P(a/i) - P(a/\neg i)] \times p_{ae}}{1 - P(a/i) \times p_{ae}}. $$

What if $i$ and $a$ are not independent?

1. If $P(a/i) < P(a/\neg i)$, then $p_{ie} > \Delta^* P_i^e$
2. If $P(a/i) > P(a/\neg i)$, then $p_{ie} < \Delta^* P_i^e$
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- Special cases
  1. $P(a/i) = 0$, because $i \perp a \Rightarrow p_{ie} = P(e/i)$
  2. $P(a/i) = 1$, because $i \models a \Rightarrow p_{ie} = 0$

- $i \rightarrow a \rightarrow e$. What counts is total causal power: $p_{ie}^{tot} = P(e/i)$
i and a incompatible

- Recall $a = \bigcup Alt(i)$. The union of the alternative potential causes of $e$
Recall $a = \bigcup Alt(i)$. The union of the alternative potential causes of $e$.

When are $i$ and the alternative causes incompatible?
Recall $a = \bigcup \text{Alt}(i)$. The union of the alternative potential causes of $e$

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When we take causes of features to be *essences* of kinds

Aristotle
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- When are $i$ and the alternative causes incompatible?

- When we take causes of features to be **essences** of kinds

- Different kinds have no essence in common: incompatible.
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Different kinds have no essence in common: incompatible.

This could explain why for kinds, generics are taken to be about probabilities: generic sentence good $\rightarrow$ high conditional probability
Aristotle, Moderns on essences

- What makes it that birds have wings?
- The essence of birds
- What makes that metal conducts electricity?
- Because of its atomic structure
- What is essence: its potential, its causal power something that a kind of object has by necessity, and makes what it is.
Idea: represent concepts as graphical models (Danks)

$F = \{f, f'\}$ is set of features, $b$ is (unobservable) essence of birds

Essentialism: $f \leftarrow b \rightarrow f'$

It follows that $p_{bf} = P(f/b)$

(The Theory-Theory of concepts represents them somewhat more involved)
Aristotle

- Four causes (ways of explaining)
  1. Material (what it is made of)
  2. Formal (what it is)
  3. Efficient (what produced it)
  4. Final (telos, goal-oriented)

- Final causes also in nature $\Leftrightarrow$ Modern science/philosophy

- Aristotle: Final causes of natural objects are *internal* to objects

- Now: Telos = Form (that what it can grow into = potential)

- *Crocodiles die young.
  *Bees are sterile
Causal power and Function

- Aristotle: Causal power of animals is function
- Seems true also for artifacts
- and for norms
  1. Boys don’t cry
  2. Men open doors for women

- Recall: $\Delta^* P_i^e = P(j) \times p_{ij,e}$, if $p_{ie} = 0$
- Perhaps many times we think of $j$ as ideal circumstances.

- Do not look at $P(j) \times p_{ij,e}$, but just at $p_{ij,e} \approx \frac{P(e|i,j)-P(e|\neg i,j)}{P(j)-P(e|\neg i,j)}$
Some consequences

- Causality is asymmetric generics as well.

- Suppose all and only all $G$s are $F$, then either $p_{gf} > 0$ or $p_{fg} > 0$, but not both. Thus only one of the generics can be true.

- Similarly, if $g$ and $f$ have a common cause, $p_{gf} = 0 = p_{fg}$

- To make one true $\Rightarrow$ generics ambiguous

- $P(i \rightsquigarrow e/e) = \frac{P(i) \times p_{ie}}{P(e)}$

- If this is high, it says that $i$ is a likely causal explanation of $e$.

- (Compare: not all $\models$ is explanatory, sometimes only ‘evidential’

$$\phi \models \phi \lor \psi \quad \phi \land \psi \models \phi$$)
Non-causal generics?

- **Relations:**
  1. Boys are taller than girls
  2. Women are more nurturing than men
  
  caused by boys? Haslanger: Yes!

- **Conceptual relations**
  1. Red things are colored
  
  Colored = red ∨ blue ∨ ···

- **Generics in mathematics, logic, games**
  1. Prime numbers greater than 2 are odd
  2. Disjuncts entail disjunctions
  3. Bishops move diagonally

- Not standard causality, but perhaps something like *grounding*

  Metaphysical causality
Muslims are terrorists

- Ticks carry the Lyme disease.

- True although only very few ticks do  ⇒  Impact

- But if relatively many muslims are terrorists

- Why is then ‘Muslims are terrorists’ not true?  (according to many)

- Perhaps because someone becomes a terrorists not because (s)he is Muslim, but because of other circumstances?
Dispositions

- Dispositional sentences
  1. Salt is soluble
  2. This glass is fragile

- Analyses:
  1. Goodman: *conditional*: Salt solves, if put in water
  2. Quine: *kind*: This glass is of kind glass, and ‘glasses break easily’

- but dispositional sentences seem true because of *nature of ...*

  $\Rightarrow$ causal power analysis
Habituals

1. John drinks beer
2. Mary murders children
3. Hillary Clinton is a liar

- Not just frequency, normality. Impact
- Also, have the feeling that due to character/essence of individual

⇒ Causal power analysis

Impact important
Individual-level predicates

- Goodman: many predicates should be given dispositional treatment

- ‘Red’ $\approx$ appears red under normal conditions

In linguistics distinction

1. Stage-level predicates
2. Individual-level predicates

- Carlson, Kratzer, Chierchia: generic analysis