

Why study explanations?

Causal Models and Meanings – Class I

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1 Motivations

- Causation and explanation

2 Causation in philosophy

- Causation in the law
- Moral responsibility

3 Methods

- Formal semantics
- There's more to causality than language

4 Causation in the history of philosophy

- Aristotle's four causes
- Hume on Causation

5 Causation in Linguistics

- Causation in lexical semantics
- Contrastivity in causation

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Franz Kafka's *The Trial* (1915)



Figure: Wolfgang Letti, *The Trial* (1981)

Franz Kafka's *The Trial* (1915)

Someone must have been telling lies about Josef K., he knew he had done nothing wrong but, one morning, he was arrested.

[...] "And why am I under arrest?" he then asked. "That's something we're not allowed to tell you. Go into your room and wait there."

[...] "But how can I be under arrest? And how come it's like this?" "Now you're starting again," said the policeman, dipping a piece of buttered bread in the honeypot. "We don't answer questions like that." "You will have to answer them," said K.

The right to explanation

GDPR Article 13.2(f) affords a right to information about

“the existence of automated decision making and ... meaningful information about the logic involved”.

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Kate Vredenburg (2022) argues for a right to explanation.



Figure: Kate Vredenburg

Explanation across domains

Philosophy. Schaffer (2005, 2010) proposes that causation is a contrastive relation:

c rather than c' caused e rather than e' .

Linguistics. Dretske (1972) and Beaver and Clark (2008).

Artificial intelligence.

Mittelstadt, Russell, and Wachter (2019).

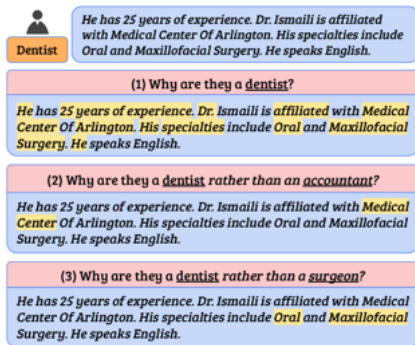


Figure: From Jacovi et al. (2021)

The world is eternal, because it exists in the eternal God as providence.

— Grigor Tatevatsi; see Zakaryan (2017)



Figure: Grigor Tatevatsi (1346–1409), an Armenian philosopher educated at the monasteries of Tatev and Metzop.

T4: Chapter 8 from the *Questions Addressed to the Heretical Dyophysites* by David the Invincible and Movsēs of Xoren (Questions 72–77)¹⁰²

«Ասա՛ զի՛նչ է մարդ»:

«Կապակցութիւն չորից տարերց հանդերձ
բանականաւն, եւ ըստ բանականին ասի
պատկեր Աստուծոյ»:

M: Tell me what is man? (1)

D: It is a bundle of four elements with the
rational (faculty), and because of the latter it is
said to be the image of God.

Figure: From David the Invincible; see Contin (2020)



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Causal theories of knowledge

Goldman (1967), 'A causal theory of knowing'.

a knows that p

just in case

what makes p true caused a to believe p .

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Gettier case (Gettier 1963):

Across the street, Madonna is hiding behind a cardboard cutout of Madonna. Alice sees the cardboard cutout and concludes that Madonna is across the street.

Causal theories of reference

Geach (1969), Donnellan (1970), and Kripke (1972):

- An initial baptism takes place
- Beginning with this baptism, the name is passed 'from link to link'.

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Case from Kripke (1972, p. 96):

"I hear the name 'Napoleon' and decide it would be a nice name for my pet aardvark."

"Napoleon is hungry today."



Figure: Napoleon

For criticism of causal theories of reference see Evans (1973) and Dickie (2015).

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*It shall be an unlawful employment practice for an employer to fail or refuse to hire or to discharge any individual, or otherwise to discriminate against any individual with respect to his compensation, terms, conditions, or privileges of employment, **because** of such individual's race, color, religion, sex, or national origin.*

— Civil Rights Act (1964), section 703(a)(1) [link]

See Murray and Eastwood (1965) for a good analysis of the relationship between sex discrimination and the Civil Rights Act.

Discrimination law

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See Murray and Eastwood (1965) for a good analysis of the relationship between sex discrimination and the Civil Rights Act.

For example, some countries outlaw sex discrimination but don't have any laws concerning pregnancy discrimination.

Does firing someone because they are pregnant imply firing them because of their sex?

(see Dekker v. VJV-Centrum at the European Court of Justice)

Examples

- one commits simple battery only if one “intentionally causes bodily contact” with another;
- trespasses only if one “intentionally enters or causes tangible entry upon the land in possession of another”
- is liable for negligence only if one “causes personal injury or property damage” to another.

(Harvard Law Review 2017)

- Hart and Honoré (1959) distinguish *causation in fact* and *legal causation*
- Two tests for causation in fact:
 - ① but for test
 - ② substantive factor test

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Financing for oil, fossil fuels from 2016-2018 (million USD)

\$25,555

FOSSIL FUEL EXCLUSION POLICIES



COAL

- ✗ Coal mining
- ✗ Coal power



OIL

- Tar sands
- Arctic oil
- Ultra deepwater oil
- Other oil



GAS

- LNG export
- Arctic gas
- Fracked gas
- Ultra deepwater gas
- Other gas

● No exclusion

— Partial exclusion

✗ Full exclusion

This overview lists the subsectors of the fossil fuel industry and shows for which ones ING has a finance exclusion policy. ● shows they have no exclusion policy in place, — shows they have a policy excluding some types of financing, and ✗ shows they have excluded all financing, including for projects and companies responsible for the extraction, transportation, and/or combustion of the fossil in that subsector.

\$25,555,000,000 fossil fuel investment


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Six-figure salary + bonuses

\$25,555,000,000 fossil fuel investment



Would it not be better for ABP to get out of fossil fuels altogether?

Some people believe that selling all of our fossil fuel investments would send a powerful signal that we were taking climate change seriously. In practice, however, the effect would be minimal. Fossil energy companies would remain financially attractive investments and other investors would simply take our place. We might give a powerful signal but we would lose our influence at the same time. We believe we can do more on the climate change front by continuing to invest in these companies and encouraging them to become more sustainable.

Moral responsibility

Braham and van Hees (2012): being morally responsible for an event requires causally contributing to it.

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Example (Counting votes)

- A committee with two members: Chair and CEO
- New policies require both to vote Yes to pass
- The CEO's envelope is opened first: it says 'No'.
- The proposal is declared failed without ever opening the Chair's envelope.
- The proposal's failure bankrupts the company.



- 1 Did the Chair's vote causally contribute to the outcome?

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- 1 Did the Chair's vote causally contribute to the outcome?
- 2 Is the Chair morally responsible for the outcome?

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- ① Designate a language, such as
 - A (fragment of) natural language
 - A formal language
- ② Define a model
- ③ Interpret the sentences of the language in that model

Goal of formal semantics

Find a translation from natural language into a formal language such that, for every sentence S of the language, S is intuitively true at world w just in case $\llbracket S \rrbracket^M = 1$ in the model that represents w .

Why focus on language?

Natural languages are

- expressive
- compositional

The principle of compositionality

The meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined. (Partee 1984)

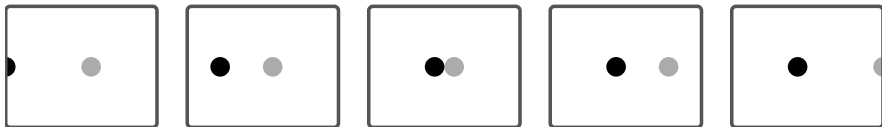


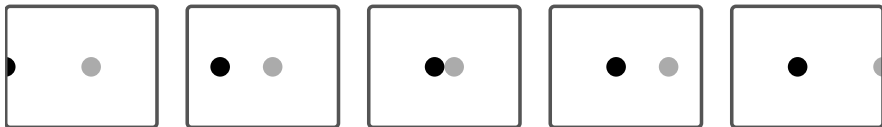
Figure: Barbara Partee

- (1) a. Socrates died because he drank poison.
- b. Socrates only died because he drank poison.

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Albert Michotte's launching effect
from *La Perception de la Causalité* (1946)

Causal reasoning in infants

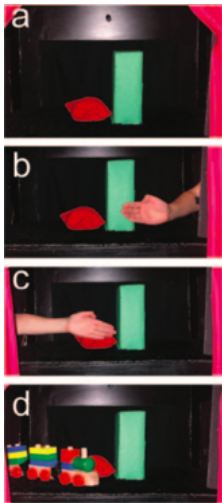


Figure: Experimental setup from Saxe, Tenenbaum, and Carey (2005)

Causal reasoning in infants

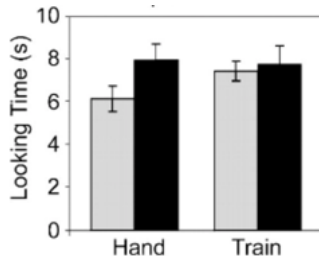
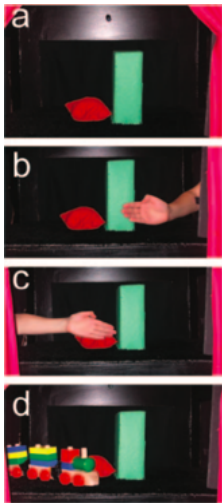


Figure: Object came from same side (gray) or opposite side (black).

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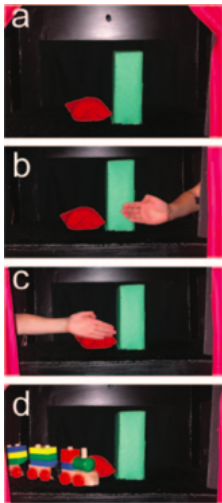


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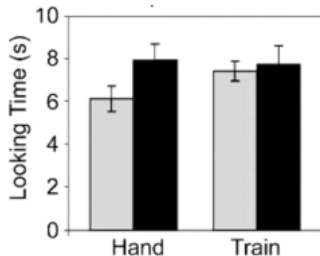


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"In the current study, infants made a distinction between causal agents and inanimate objects." (Saxe, Tenenbaum, and Carey 2005, p. 1000)

Causal reasoning without language

Causal Reasoning in Non-Human Animals

Oxford Handbooks Online

Causal Reasoning in Non-Human Animals

Christian Schloegl and Julia Fischer

The Oxford Handbook of Causal Reasoning

Edited by Michael R. Waldmann

Print Publication Date: Jun 2017 Subject: Psychology, Cognitive Psychology

Online Publication Date: May 2017 DOI: 10.1093/oxfordhb/9780199399550.013.36



Figure: Schloegl and Fischer (2017)

Figure: From Wolfgang Köhler *The Mentality of Apes* (1917)

Causal inference in non-human animals

- Causally implausible events elicit longer looking times in chimpanzees and bonobos (O'Connell and Dunbar 2005) and rooks (Bird and Emery 2010)

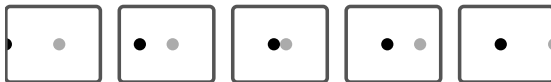


Figure: Michotte's experiment (Michotte 1963)

Causal inference in non-human animals

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- When searching for food in opaque bottles, chimpanzees learned to discriminate between lighter and heavier bottles faster than to discriminate between bottles of different colours (Hanus and Call 2011)

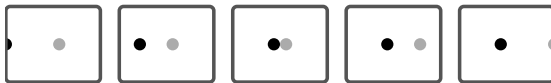


Figure: Michotte's experiment (Michotte 1963)

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- Mascalzoni, Regolin, and Vallortigara (2010) showed freshly hatched chicks a launching experiment. The chicks preferred to follow the self-propelled object over the non-self-propelled object.

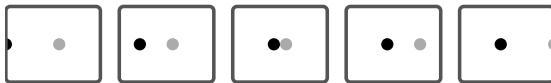


Figure: Michotte's experiment (Michotte 1963)

...but monkeys seem to have some language



Figure: A putty nose monkey

DE GRUYTER MOUTON

Theoretical Linguistics 2016; 42(1-2): 1–90

Philippe Schlenker*, Emmanuel Chemla, Anne M. Schel, James Fuller, Jean-Pierre Gautier, Jeremy Kuhn, Dunja Veselinović, Kate Arnold, Cristiane Căsar, Sumir Keenan, Alban Lemasson, Karim Ouattara, Robin Ryder and Klaus Zuberbühler

Formal monkey linguistics

DOI 10.1515/tl-2016-0001

Abstract: We argue that rich data gathered in experimental primatology in the last 40 years can benefit from analytical methods used in contemporary linguistics. Focusing on the syntactic and especially semantic side, we suggest that these

Figure: Schlenker et al. (2016)

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Figure: Schlenker et al. (2016)

If a is an alarm parameter (≥ 0):

$[[\text{krak}]]^a = \text{true}$ iff there is an alert and the alarm level is $\geq a$.

$[[\text{hok}]]^a = \text{true}$ iff there is an eagle and the alarm level is $\geq a$.

Figure: From Schlenker et al. (2016, p. 17)

Some questions

- What do we talk about when we talk about causation?
- When we call something *causal* reasoning, how do we know it is causal?
- Do we always talk about something that can be expressed in language?

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Aristotle's Four Causes

Physics II.3 (194b17-195a4), *Metaphysics* V.2

Four answers to the question 'Why?'.

"we think we do not have knowledge of a thing until we have grasped its why, that is to say, its cause [*aitia*]" (*Physics* 194 b 17-20)

Material cause (*hūlē, nature*) "that out of which" it is made. The material cause of Rodin's *The Thinker* is bronze.

Efficient Cause (*kinoûn, cause in its modern sense*) The source of change.

Formal Cause (*eîdos, form or idea*) The essence of the object, the pattern the object exemplifies.

Final Cause (*télos, goal or end*) That for the sake of which a thing is done. The goal of a seed is to become a plant.

The Greek word *aitia* is often translated as 'cause', but is better translated as 'explanation'.

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*we may define a cause to be an object, followed by another, and where all the objects, similar to the first, are followed by objects similar to the second. Or in other words, where, if the first object had not been, the second never had existed*¹

¹davidhume.org/texts/e/7

*we may define a cause to be an object, followed by another, and where all the objects, similar to the first, are followed by objects similar to the second. Or in other words, where, if the first object had not been, the second never had existed*¹

- ① The first definition gave rise to regularity theories of causation
- ② The second gave rise to counterfactual theories of causation

¹davidhume.org/texts/e/7

- ① The cause and effect must be contiguous in space and time.
- ② The cause must be prior to the effect.
- ③ There must be a constant union betwixt the cause and effect. [...]
- ④ The same cause always produces the same effect, and the same effect never arises but from the same cause.

“Of all the ideas that occur in metaphysics, none are more obscure and uncertain than those of power, force, energy or necessary connection”

“All our ideas are merely copies of our impressions, so it is impossible for us to think of anything that we haven’t previously felt through either our external or our internal senses.”

“When we look around us at external objects, and think about the operation of causes, we are *never* able to discover any power or necessary connection, any quality that ties the effect to the cause and *makes it an infallible consequence of it*.

All we find is that the one event *does in fact follow* the other. The impact of one billiard-ball is accompanied by motion in the other. This is all that appears to the outer senses.

The mind feels no sentiment or inward impression from this sequence of events: so in no single particular instance of cause and effect is there anything that can suggest the idea of power or necessary connection.”

“Summing up, then: throughout the whole of nature there seems not to be a single instance of connection that is conceivable by us. All events seem to be entirely loose and separate.”

“So the feeling or impression from which we derive our idea of power or necessary connection is a feeling of connection in the mind—a feeling that accompanies the imagination’s habitual move from observing one event to expecting another of the kind that usually follows it. That’s all there is to it”

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Scope ambiguity



$\exists x \forall y (x \text{ is a true soul mate for } y)$

$\forall y \exists x (x \text{ is a true soul mate for } y)$

Scope ambiguity



$\neg(\exists x(x \text{ is a day} \wedge \text{I regret } x))$

$\exists x(x \text{ is a day} \wedge \neg(\text{I regret } x))$

(2) I'm looking for a friend.

$\exists x(x \text{ is a friend} \wedge \text{I am looking for } x)$

I am looking for $\exists x(x \text{ is a friend})$

- (3) Ali doesn't love Sarah because she's famous.

Scope ambiguity

- (3) Ali doesn't love Sarah because she's famous.
 - a. ... He loves her because she's funny.

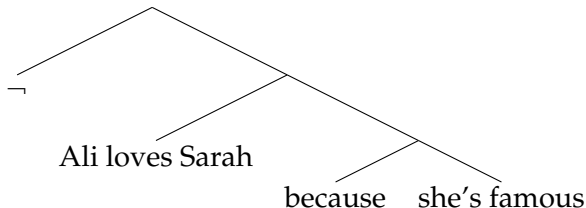
Scope ambiguity

(3) Ali doesn't love Sarah because she's famous.

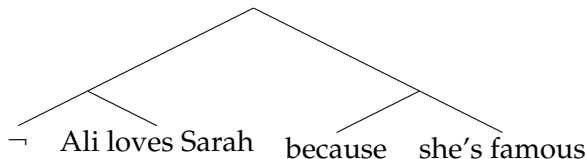
a. ... He loves her because she's funny.

b. ... He wants a quiet life.

a.



b.

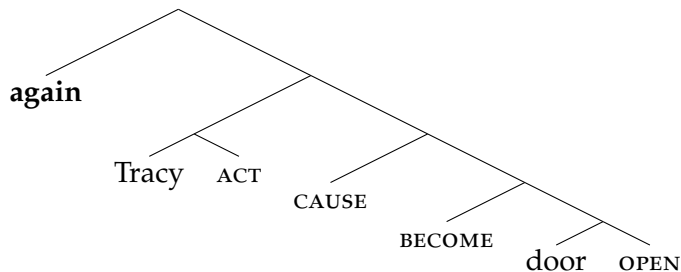


(4) Tracy opened the door again.

See Morgan (1969), McCawley (1973), Dowty (1979), and von Stechow (1995). This example is from Levin (2005)

The repetitive reading

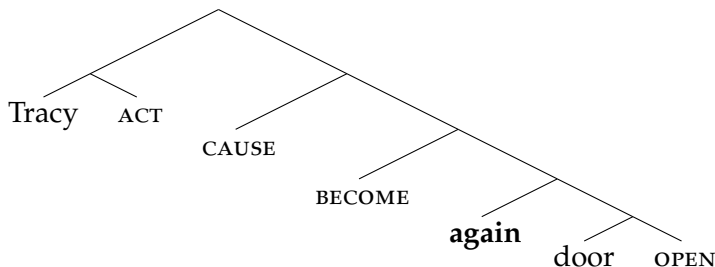
(4) Tracy opened the door again.



‘Tracy yet again performed the activity of opening the door.’

The restitutive reading

(4) Tracy opened the door again.



‘Tracy brought it about that the door was once more open (though she may not have opened the door previously).’

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Fraassen (1980): explanation is contrastive on the effect side

c explains e rather than E^*

We can explain why John, rather than his brothers, contracted paresis, for he had syphilis; but not why he, among all those syphilitics, got paresis. (Fraassen 1980, p. 111)

Hitchcock (1996): causation is contrastive on the cause side

c rather than C^* causes e

The solution to this puzzle is to deny that there is any such thing as the causal relevance of moderate smoking for lung cancer. ... Relative to heavy smoking, it is a negative cause of (prevents) lung cancer; relative to abstaining, moderate smoking is a positive cause of (causes) lung cancer. ... Relations of positive or negative causal relevance only hold relative to specific alternatives. (Hitchcock 1996, p. 402)

Schaffer (2005): causation is contrastive on both sides

(5) *Sam ruined Ali's jumper while ironing it.*

- a. *Context A: the jumper is iron-safe cotton. Ali knows how to iron, Sam doesn't.*

Ali: The jumper is ruined because [Sam]_F ironed it.

- b. *Context B: the jumper is cashmere and ruined by ironing. Both know how to iron.*

Ali: The jumper is ruined because Sam [ironed]_F it.

Heim (1992): presuppositions restrict the set of worlds we consider when we evaluate modal expressions.

- (6) If Ali had stopped smoking, he would have been able to run faster.

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # The jumper is ruined because [Sam]_F ironed it.

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # The jumper is ruined because [Sam]_F ironed it.

Free association with focus (Beaver and Clark 2008)

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # The jumper is ruined because [Sam]_F ironed it.

Free association with focus (Beaver and Clark 2008)

- Focus on *Sam* signals QUD *Who ironed the jumper?*

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # The jumper is ruined because [Sam]_F ironed it.

Free association with focus (Beaver and Clark 2008)

- Focus on *Sam* signals QUD *Who ironed the jumper?*
- Presupposes: someone ironed the jumper.

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # *The jumper is ruined because [Sam]_F ironed it.*

Free association with focus (Beaver and Clark 2008)

- Focus on *Sam* signals QUD *Who ironed the jumper?*
- Presupposes: someone ironed the jumper.
- *Because* has a counterfactual semantics.

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
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Free association with focus (Beaver and Clark 2008)

- Focus on *Sam* signals QUD *Who ironed the jumper?*
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- Presuppositions restrict counterfactual modal bases (Heim 1992).

- (7) *The jumper is cashmere and ruined by ironing. Sam ironed it.*
Ali: # The jumper is ruined because [Sam]_F ironed it.

Free association with focus (Beaver and Clark 2008)

- Focus on *Sam* signals QUD *Who ironed the jumper?*
- Presupposes: someone ironed the jumper.
- *Because* has a counterfactual semantics.
- Presuppositions restrict counterfactual modal bases (Heim 1992).
- If Sam hadn't ironed the jumper, but someone still did, the jumper would not have been ruined. ✗

Pat had two daughters, one named Bertha; the other was named Aretha and was indispensable to him in his business. He had made a commitment to marry one of the daughters to one of the sons of a man who once saved his life. There were two such sons, the elder son Clyde and the younger son Derek. According to a custom of the society and period, an elder son had to marry before his younger brothers; this was known as seniority. Given the contract, seniority, and the desirability of leaving Aretha free to run his business for him, he figured out that the best thing to do was to marry Bertha to Clyde, and that is what he did.

(Dretske 1972, Rooth 1999)

- (8)
- a. He married [Bertha]F to Clyde because Aretha was indispensable in the business. (true)
 - b. He married Bertha to [Clyde]F because Aretha was indispensable in the business. (false)

- (9)
- a. The reason he married [Bertha]F to Clyde was that Aretha was indispensable in the business. (true)
 - b. The reason he married Bertha to [Clyde]F was that Aretha was indispensable in the business. (false)
 - c. The reason he married [Bertha]F to Clyde was that he wanted to obey seniority. (false)
 - d. The reason he married Bertha to [Clyde]F was that he wanted to obey seniority. (true)

- (10)
- a. If he hadn't married [Bertha]F to Clyde, Aretha couldn't have continued to run the business. (true)
 - b. If he hadn't married Bertha to [Clyde]F, Aretha couldn't have continued to run the business. (false)
 - c. If he hadn't married [Bertha]F to Clyde, seniority would have been violated. (false)
 - d. If he hadn't married Bertha to [Clyde]F, seniority would have been violated. (true)

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