



LECTURE FOUR | MICHAELMAS 2017

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# Causation

# These lectures

- Lecture 1: ~~The very idea of a cause~~
- Lecture 2: ~~Regularity theories~~
- Lecture 3: ~~Counterfactual theories~~
- Lecture 4: The problem of redundant causation

# Today

1. Recapitulation:  
counterfactual and  
causal dependence
2. Causation defined:  
transitivity and  
ancestral relations
3. The problem of  
redundant causation:  
overdetermination and  
pre-emption





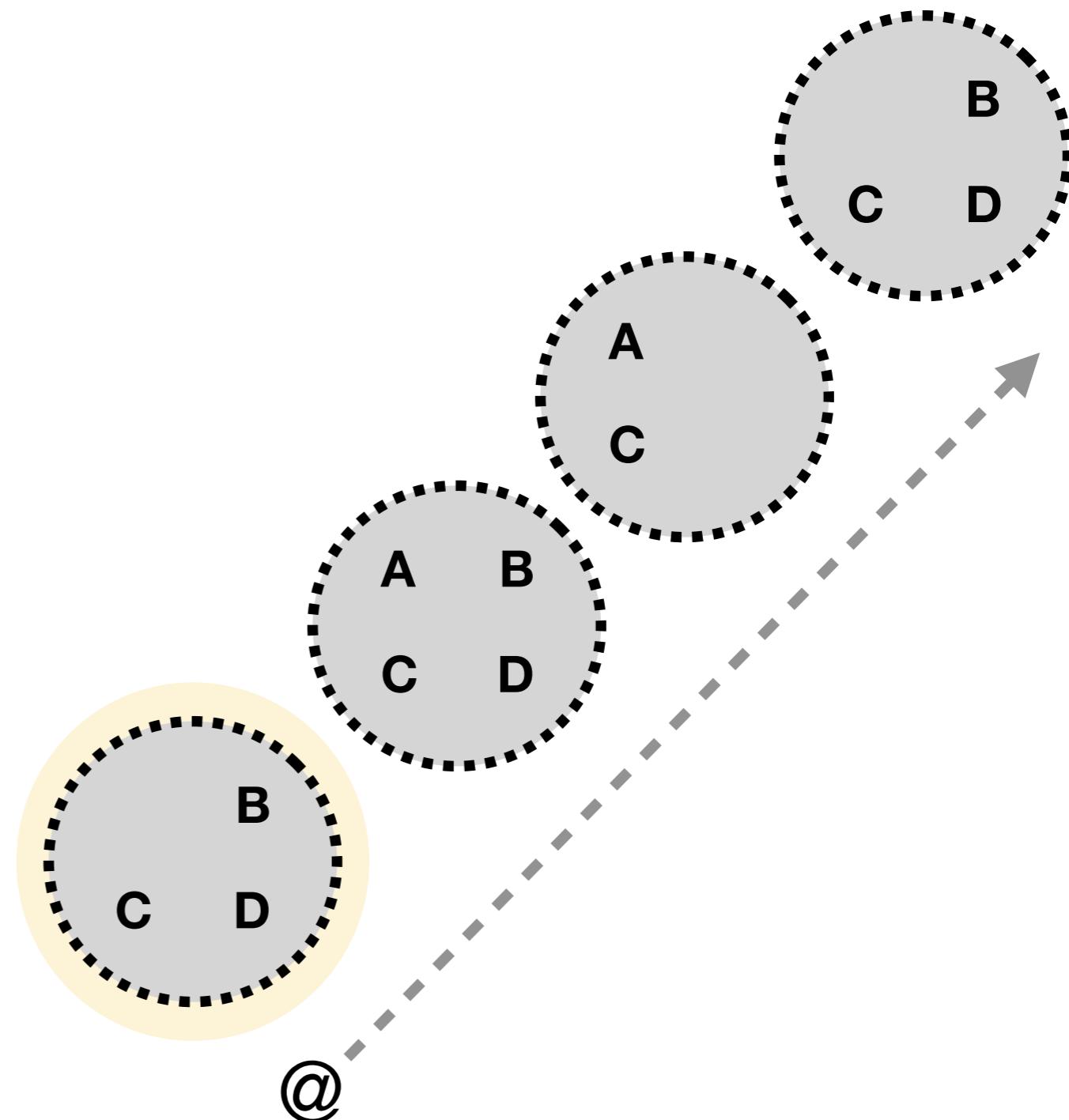
*Recap:*

**Counterfactual  
dependence**

**Causal  
dependence**

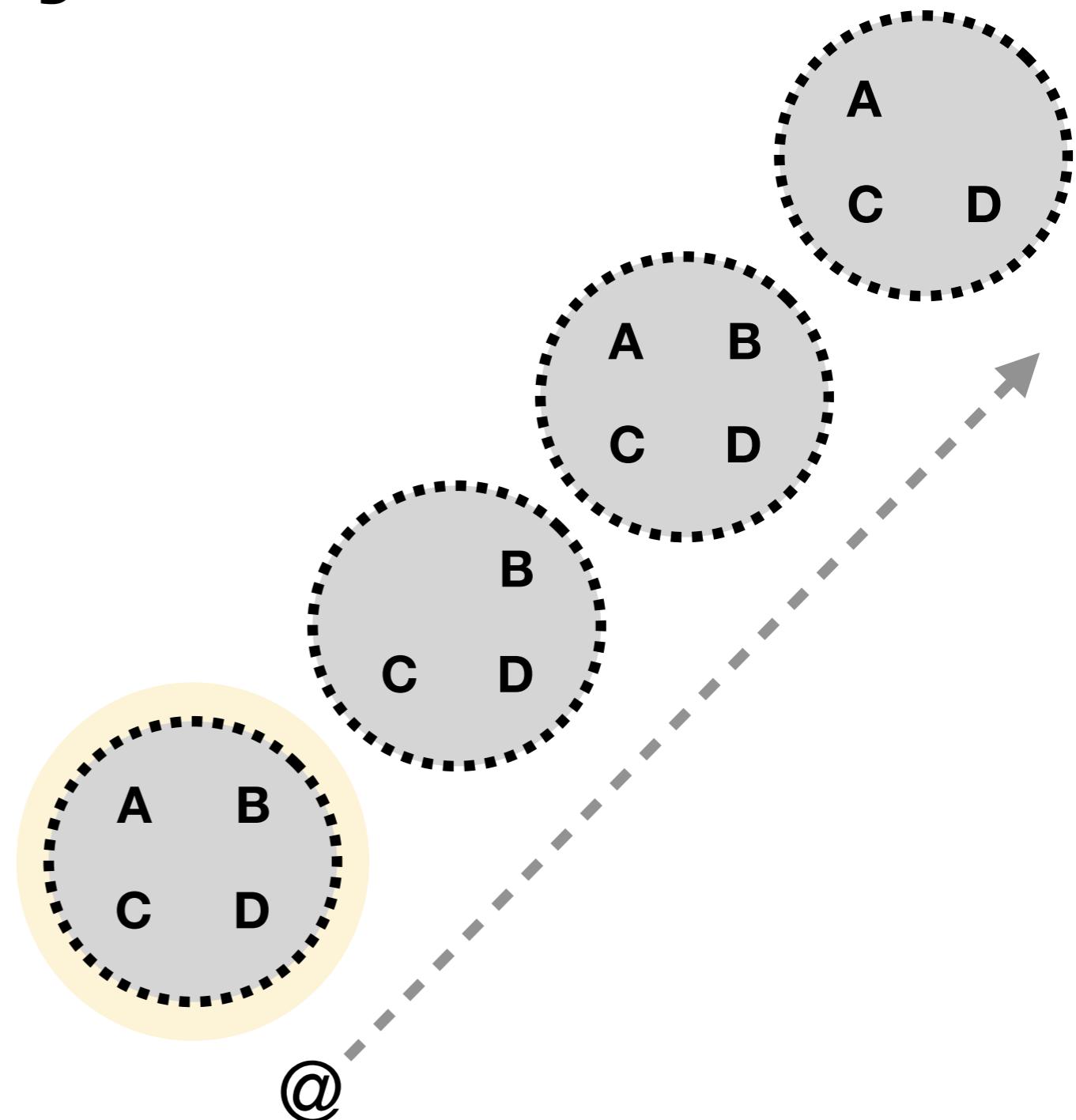
# Counterfactual dependence

- $A \Box\rightarrow B$  is true iff either
  - I. there are no possible A-worlds
  - II. some A-world which is also a B-world is closer to the actual world (actuality) than any A-world which is not also a B-world
- When ' $A \Box\rightarrow B$ ' is true we can say that B counterfactually depends on A. (Note, this is a relation between propositions)



# Is counterfactual dependence symmetrical?

- If ‘ $A \Box \rightarrow B$ ’ is true, then does it follow that ‘ $B \Box \rightarrow A$ ’ true (i.e. is counterfactual dependence a symmetric relation?)
- If A and B are true in  $\textcircled{a}$ , then  $A \Box \rightarrow B$  implies  $B \Box \rightarrow A$
- But what if the antecedent isn’t actually true?



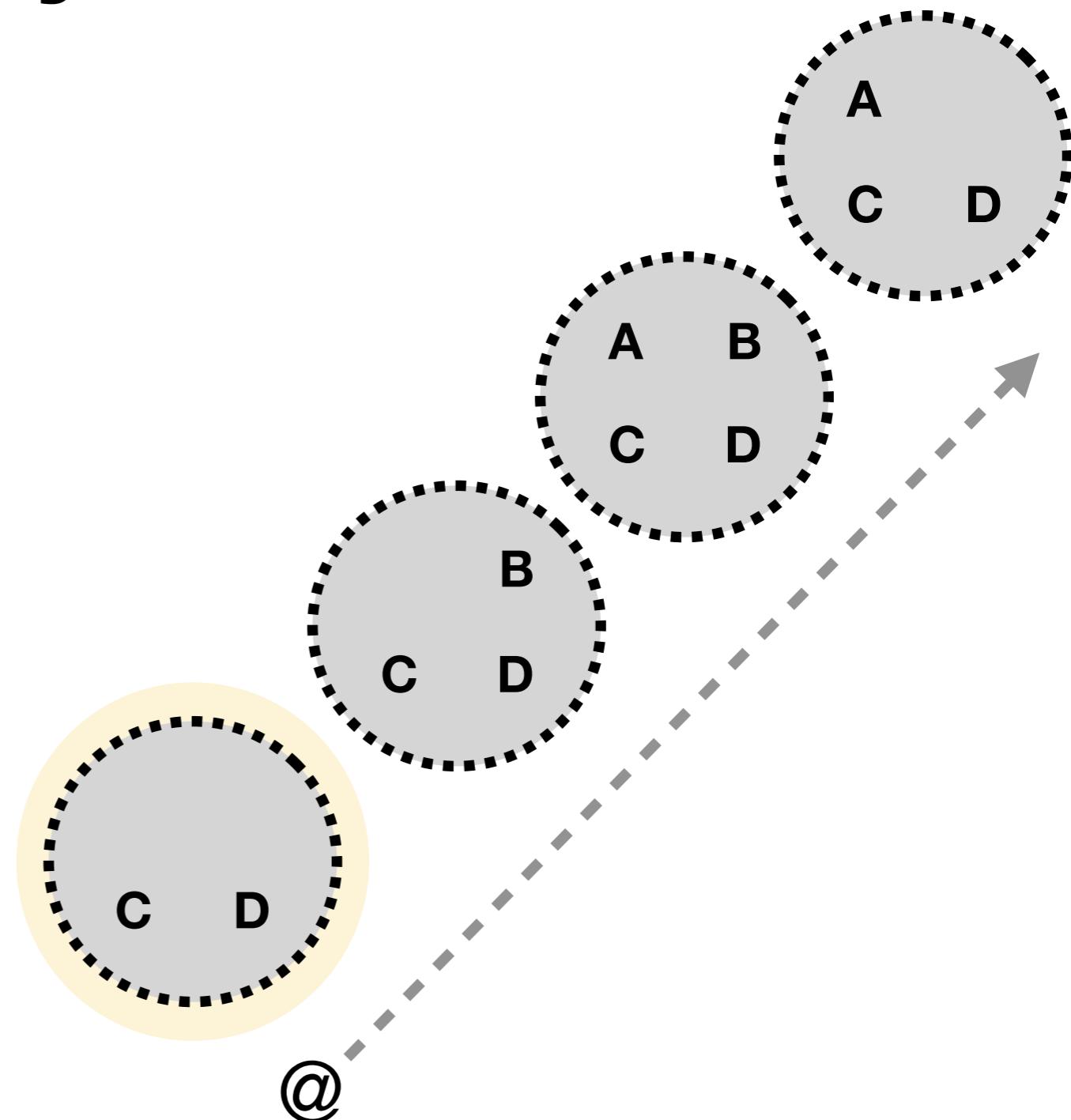
# Is counterfactual dependence symmetrical?

- Consider: If I were to throw coffee on this computer, the machine would shut down.

Plausibly, yes.

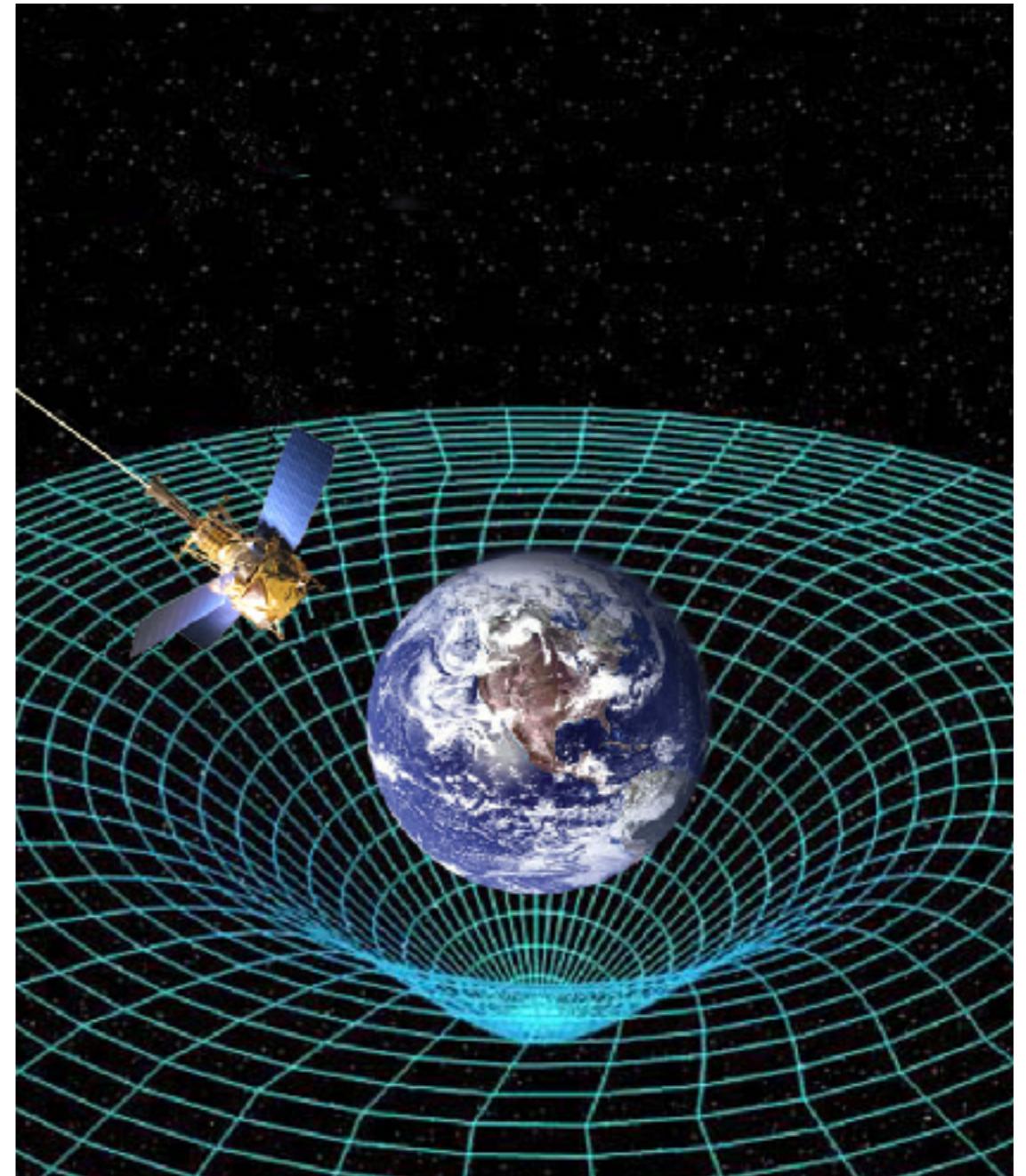
- But does it follow that, if the machine were to shut down, I would have thrown coffee on the computer?

No, it's much more likely the machine's shutting down would have had a different cause



# Counterfactual dependence as such is not sufficient for causation

- There are many cases of counterfactual dependence which are not cases of causation (see Kim's paper in the Sosa & Tooley volume for some examples)
- Lewis: the laws of motion in a world may counterfactually depend on the laws of gravity in that world, but the latter doesn't cause the former (better to say: laws of motion supervene on laws of gravity)



# Counterfactual dependence as such is not sufficient for causation

- If you park your car on a double yellow line, then you break the law. But parking the car there doesn't cause you to break the law (it constitutes breaking the law in this instance)
- What we have to have to add to exclude cases like this is to say that the events related as cause and effect must be *distinct* from one another



# Causal dependence

- Let
  - ‘c’ and ‘e’ as terms for events (e.g. ‘the assassination’, ‘the first world war’)
  - ‘O’ be a predicate of events, meaning ‘occurs’
  - ‘¬’ be negation
- We can now define causal dependence in terms of counterfactual dependence between distinct events

**e causally depends on c iff:**

**Oc  $\square\rightarrow$  Oe**

*and*

**¬Oc  $\square\rightarrow$  ¬Oe**



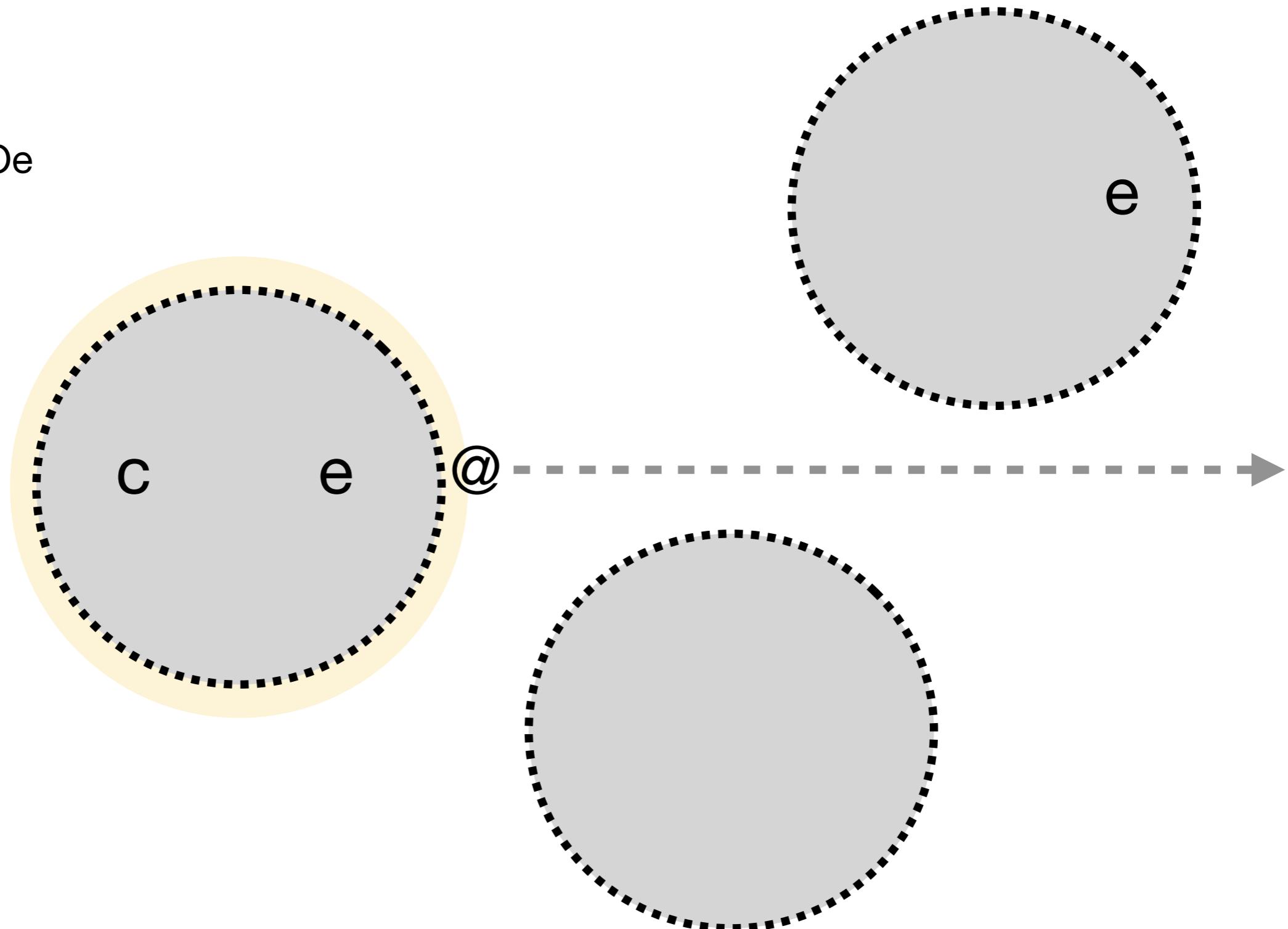
## S: The Fukushima meltdown of 2011 causally depended on an earlier tsunami

e = the meltdown

c = the tsunami

S is true iff

1.  $Oc \rightarrow Oe$
2.  $\neg Oc \rightarrow \neg Oe$

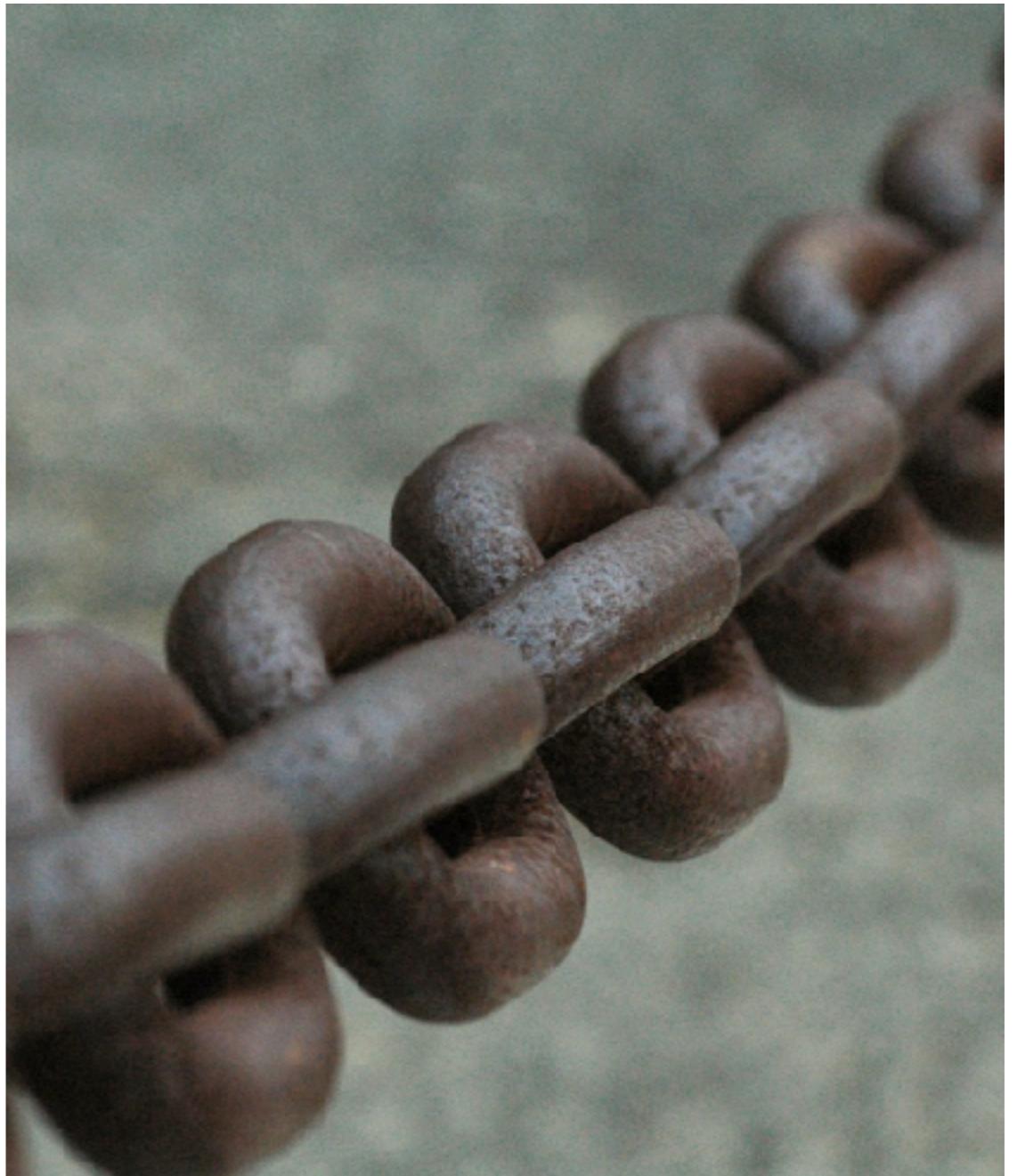


**Is causal  
dependence  
necessary and  
sufficient for  
causation?**



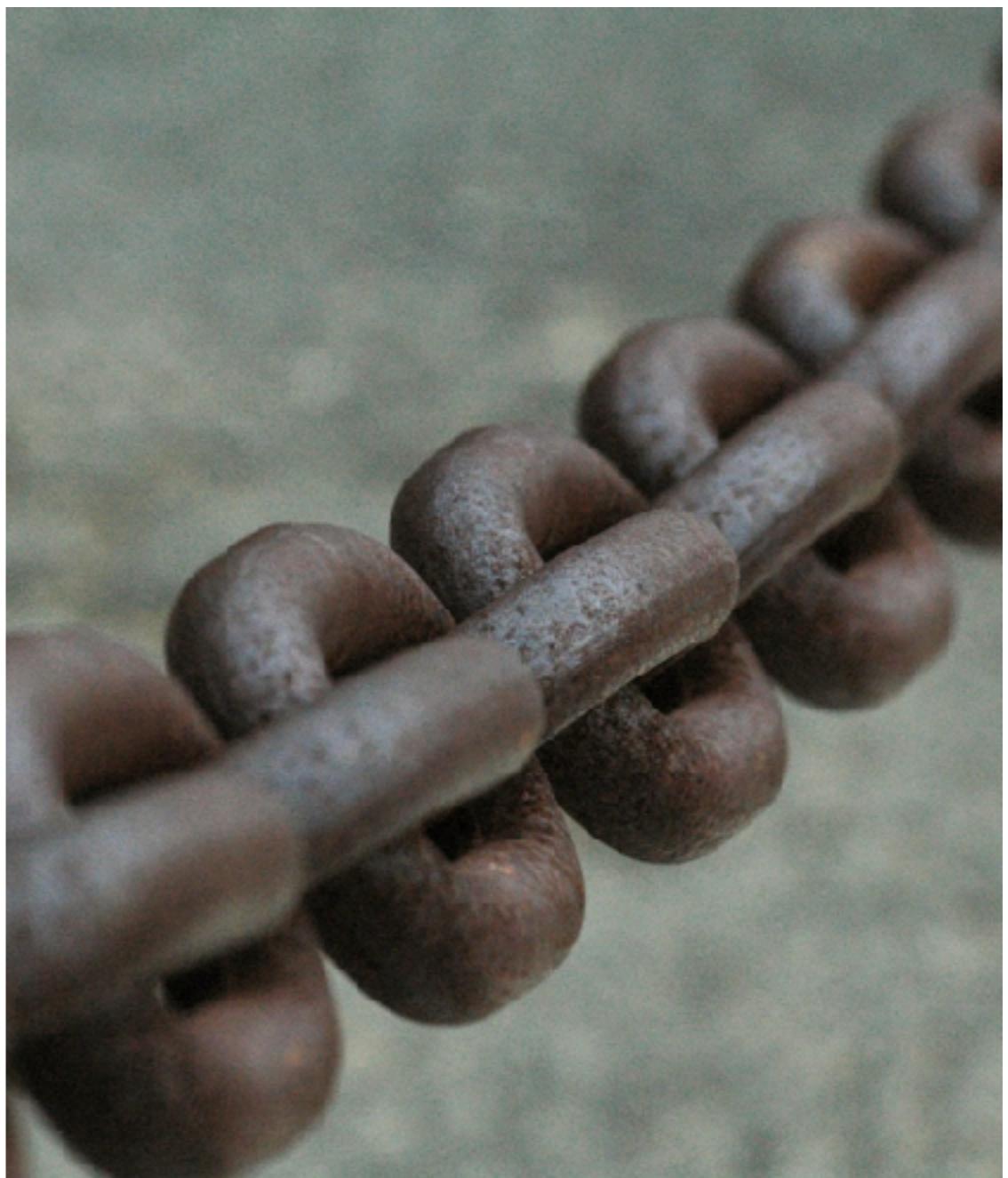
# Sufficient, not necessary

- Sufficient: Causal dependence between actual events implies causation (it is enough for an event to ‘make the difference’)
- But causal dependence is not necessary! One event can cause another even if the latter doesn’t causally depend on the former
- How? Because we think of causation as a transitive relation, and causal dependence isn’t transitive

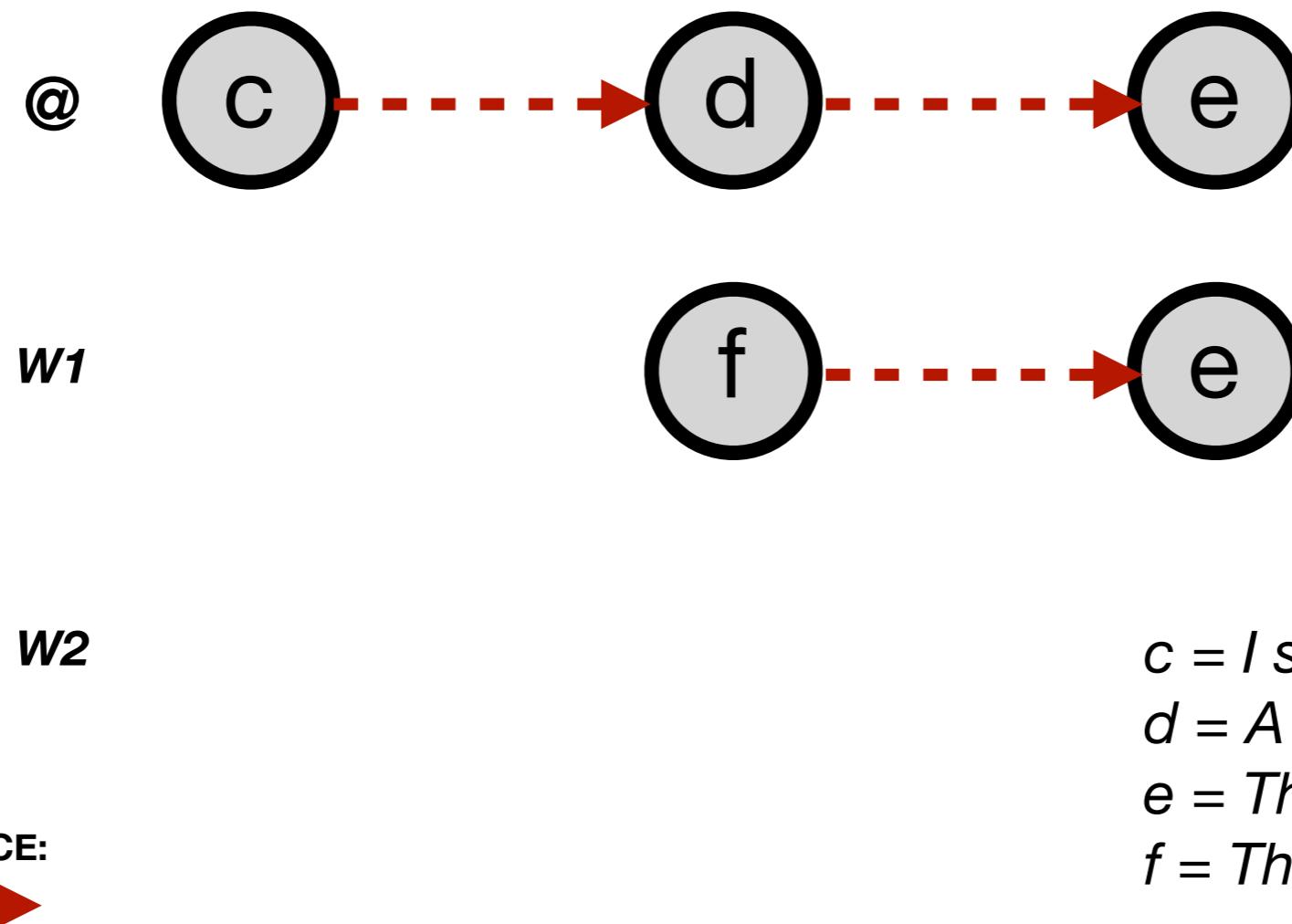


# Transitivity of causation

- For any events A, B, and C: If A causes B, and B causes C, then A causes C
- A primer on transitivity:
  - A relation R is transitive when ' $aRb$ ' and ' $bRc$ ' imply ' $aRc$ '
  - A relation R is non-transitive when ' $aRb$ ' and ' $bRc$ ' do not imply ' $aRc$ '
  - A relation R is intransitive when ' $aRb$ ' and ' $bRc$ ' imply not ' $aRc$ '



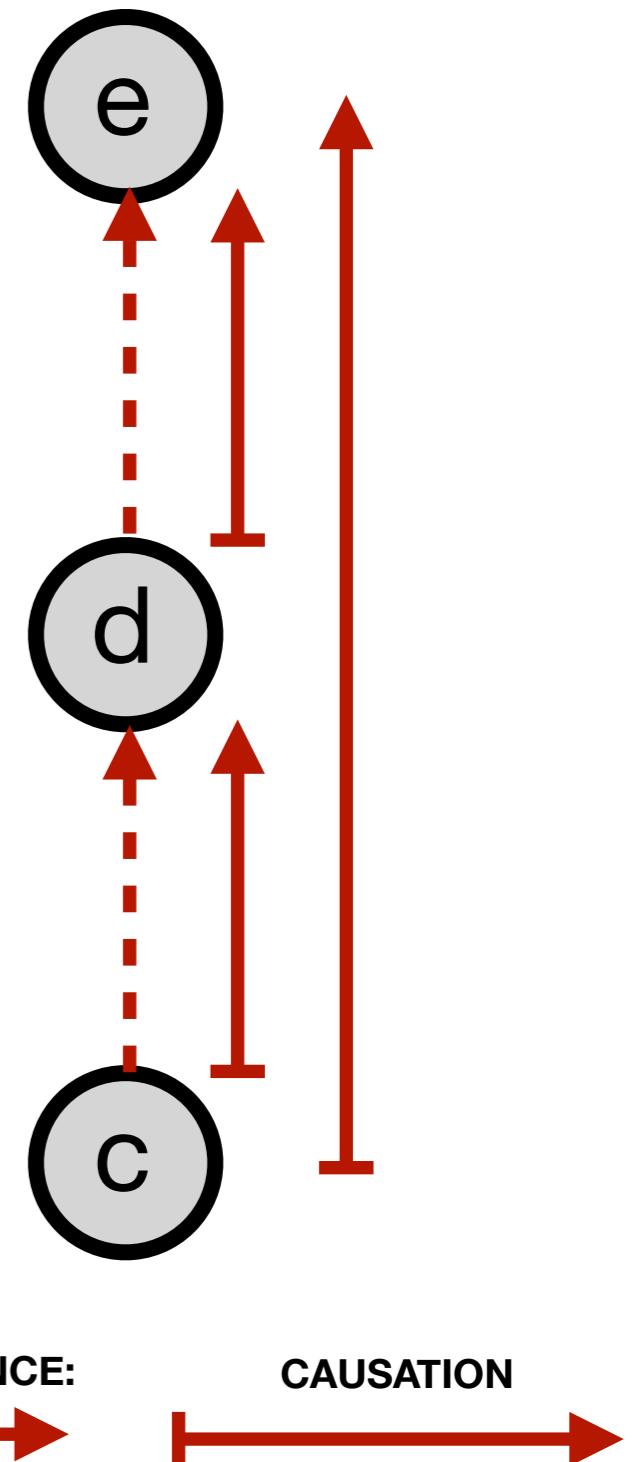
Causal dependence among actual events implies causation. If  $c$  and  $e$  are two actual events such that  $e$  would not have occurred without  $c$ , then  $c$  is a cause of  $e$ . But I reject the converse. Causation must always be transitive; causal dependence may not be; so there can be causation without causal dependence. Let  $c$ ,  $d$ , and  $e$  be three actual events such that  $d$  would not have occurred without  $c$  and  $e$  would not have occurred without  $d$ . Then  $c$  is a cause of  $e$  even if  $e$  would still have occurred (otherwise caused) without  $c$ .



$c = I$  shoot the president  
 $d = A$  revolution breaks out  
 $e = The$  government falls  
 $f = The$  stock markets collapse

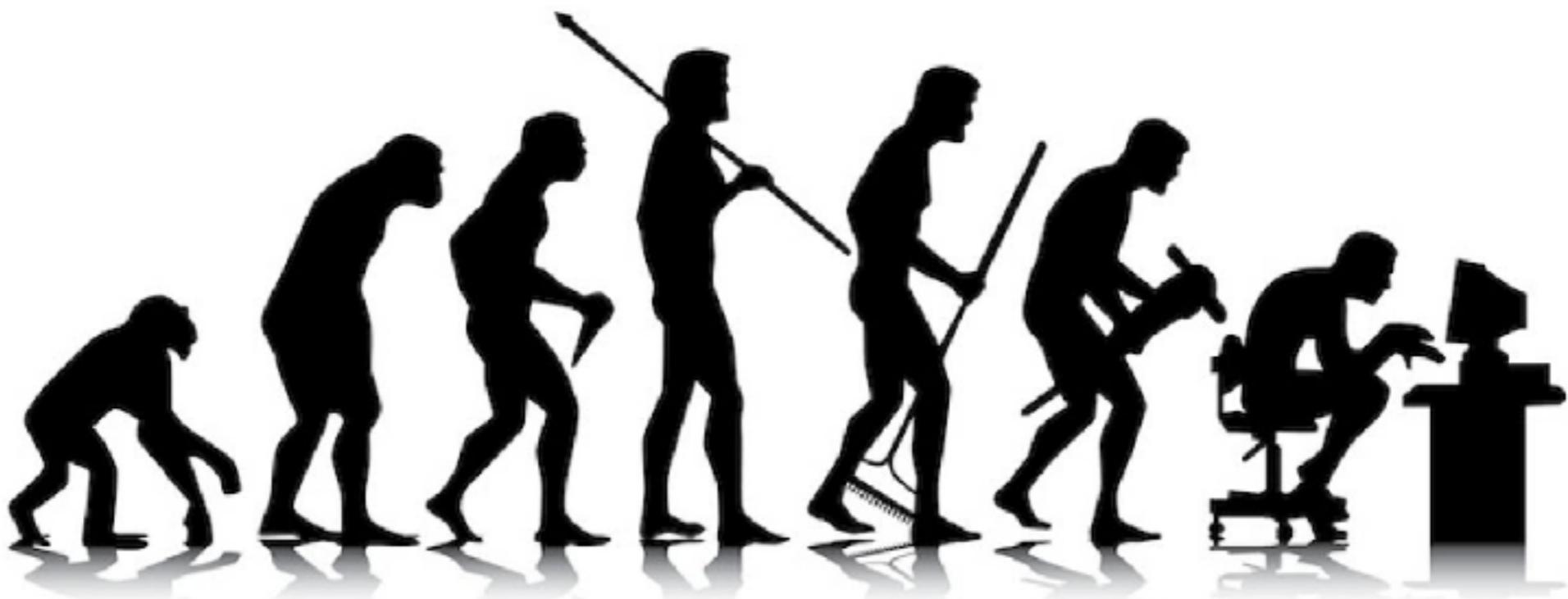
# Building causation from causal dependence

1. If  $e$  causally depends on  $d$ , then  $d$  causes  $e$ ; if  $d$  causally depends on  $c$ , then  $c$  causes  $d$
2. Causation is transitive
3. So, if  $c$  causes  $d$  and  $d$  causes  $e$ , then  $c$  causes  $e$
4. We have a causal relation between  $c$  and  $e$  that is not a relation of causal dependence



# Ancestral relations

- Causation is not causal dependence, but it does depend on causal dependence. Can we define this dependence?
- **Causation is the *ancestral* of the relation of causal dependence**



# Ancestral relations

- The ancestral of a relation R is that relation which stands to R as the relation of *being an ancestor* stands to the relation of *being a parent*
- All parents of x are ancestors of x, but not all ancestors of x are parents of x; instead, all ancestors of x are either parents of x, or parents of parents, or parents of parents of parents,...etc.
- Is ‘x is a parent of y’ transitive? No. Is ‘x is an ancestor of y’ transitive? Yes.
- Is ‘y causally depends on x’ transitive? No. Is ‘y is caused by x’ transitive? Yes.

# The problem of redundant causation

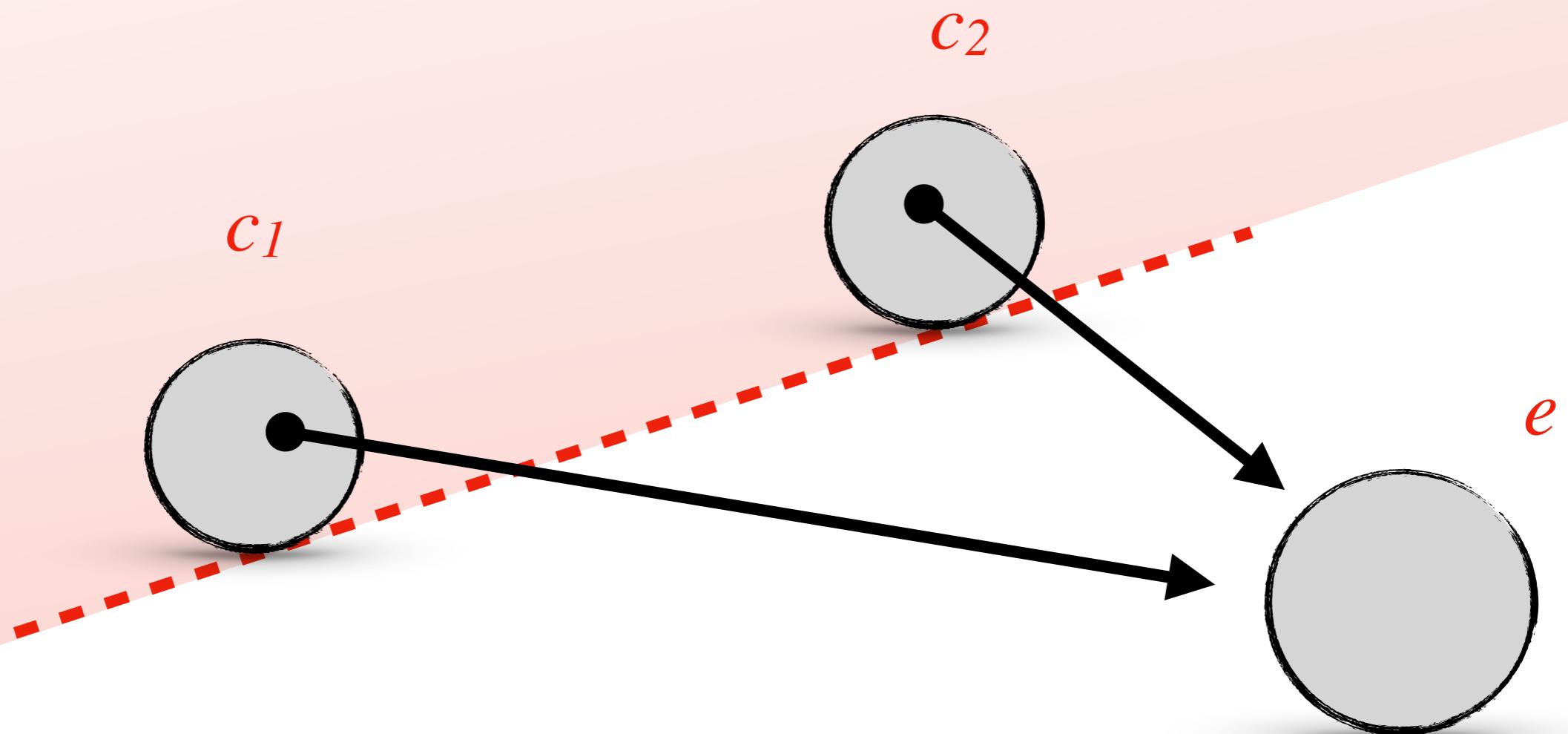


# Redundant causes

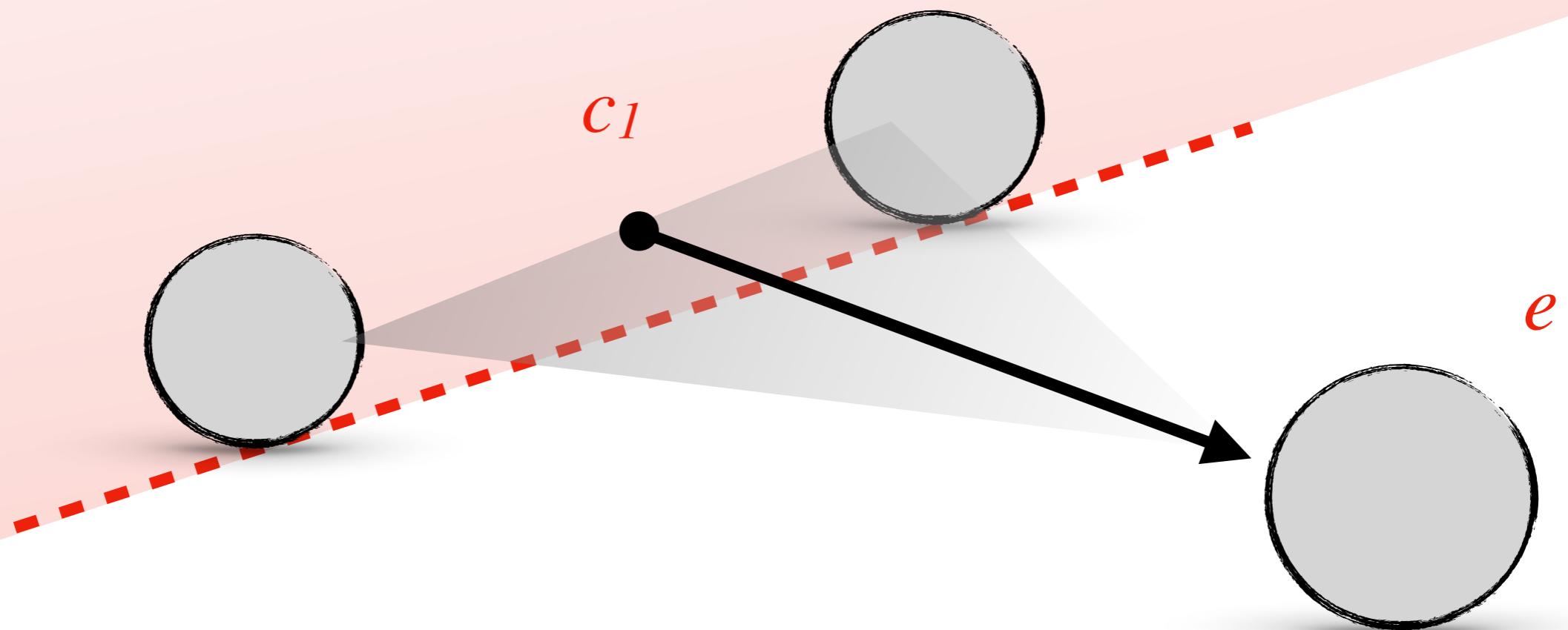
- Redundant causation: c causes e, but it is not true that if c had not occurred, e would not have occurred
- Two kinds of case are typically discussed:
  1. Overdetermination
  2. Pre-emption



# Overdetermination

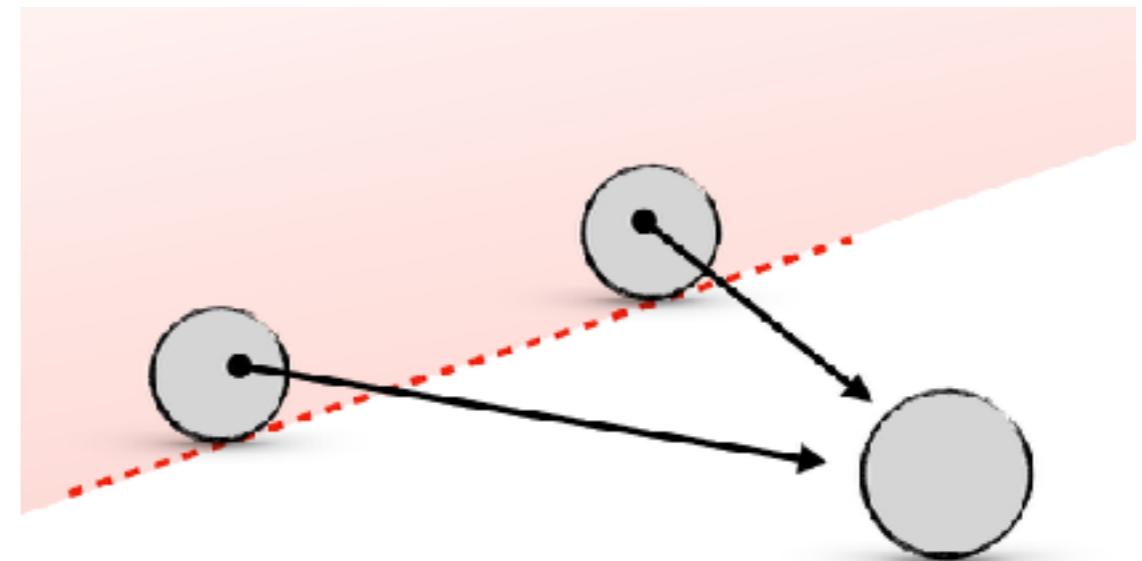


# Overdetermination

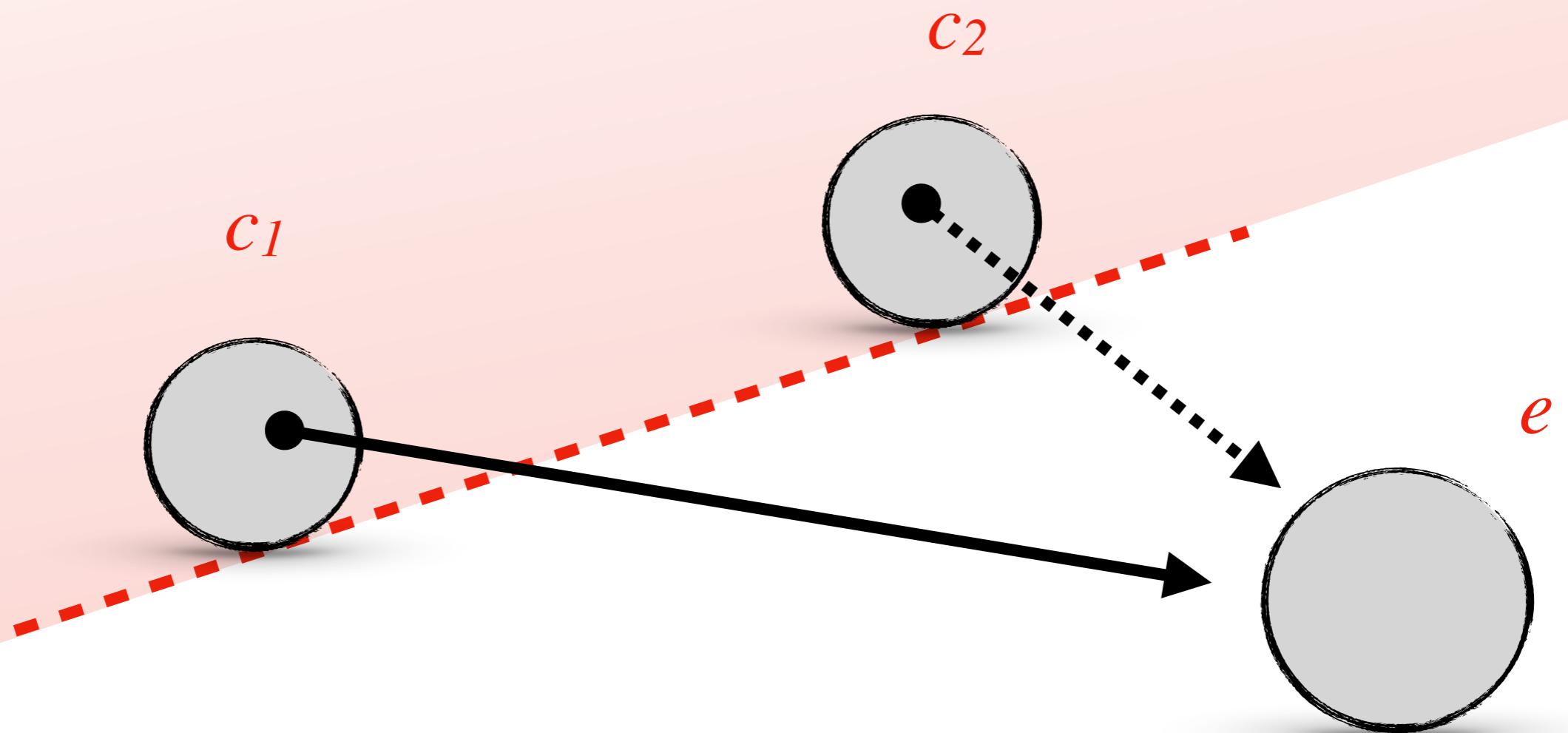


# Overdetermination

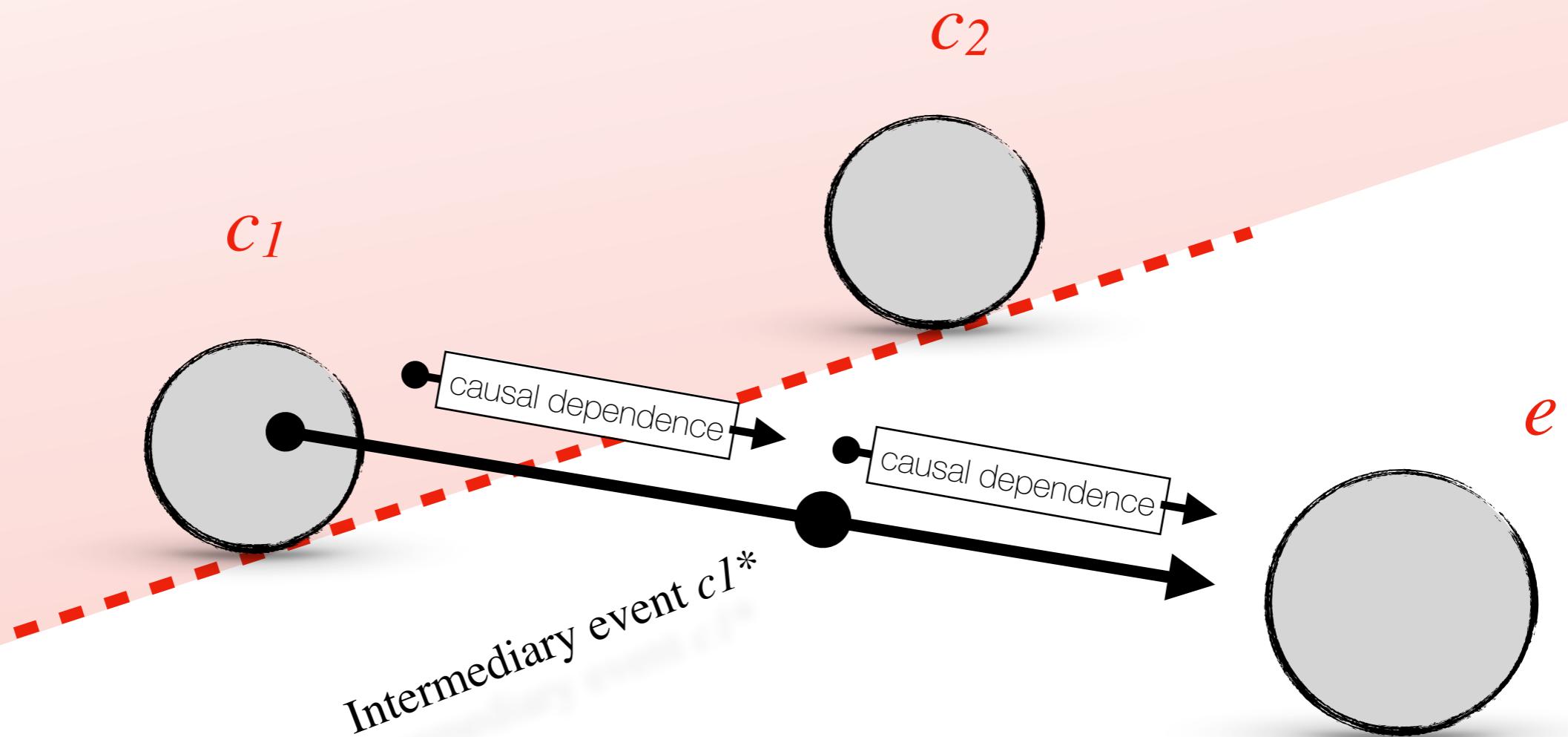
- Overdetermination (symmetrical redundancy): e has two independent causes, c<sub>1</sub> and c<sub>2</sub>. Since c<sub>1</sub> and c<sub>2</sub> are independent, either would occur without the other.
- Unclear why these causes are independent: it is just as attractive to think that this is just a single event (perhaps of joint causation)
- (See Postscript to ‘Causation’ for detailed discussion by Lewis)



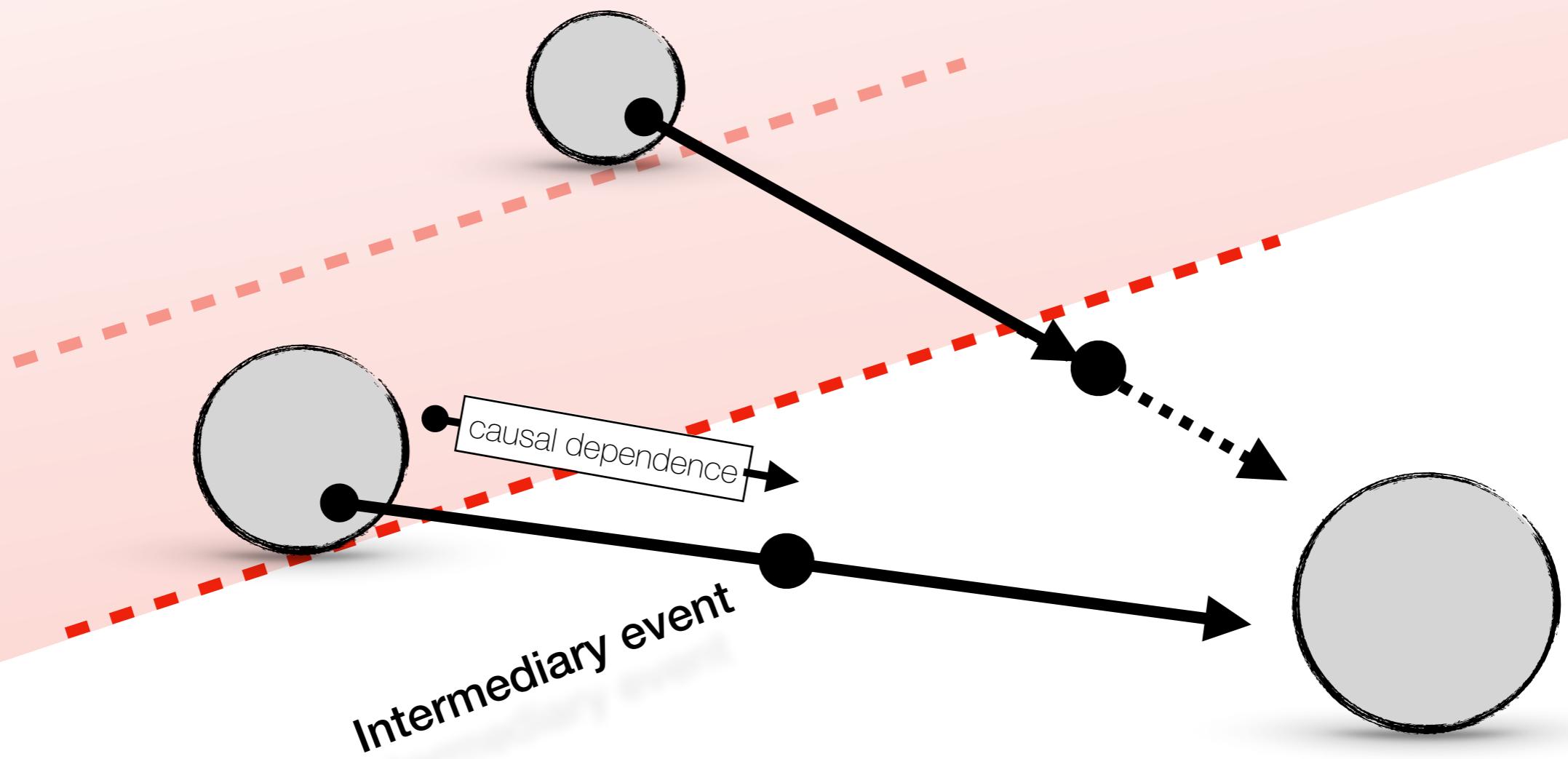
# Pre-emption



# Pre-emption

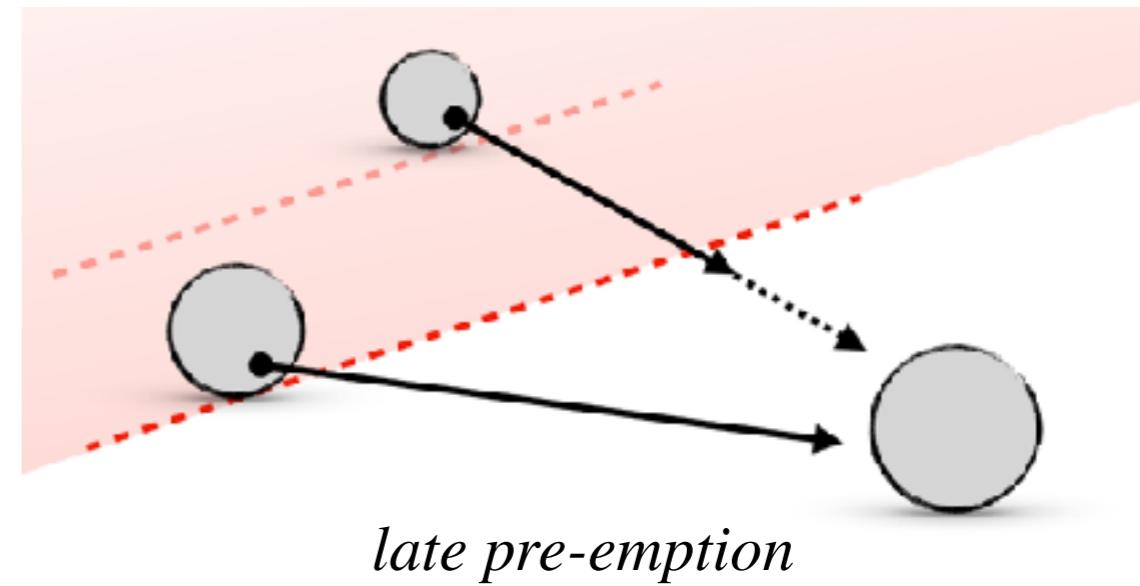
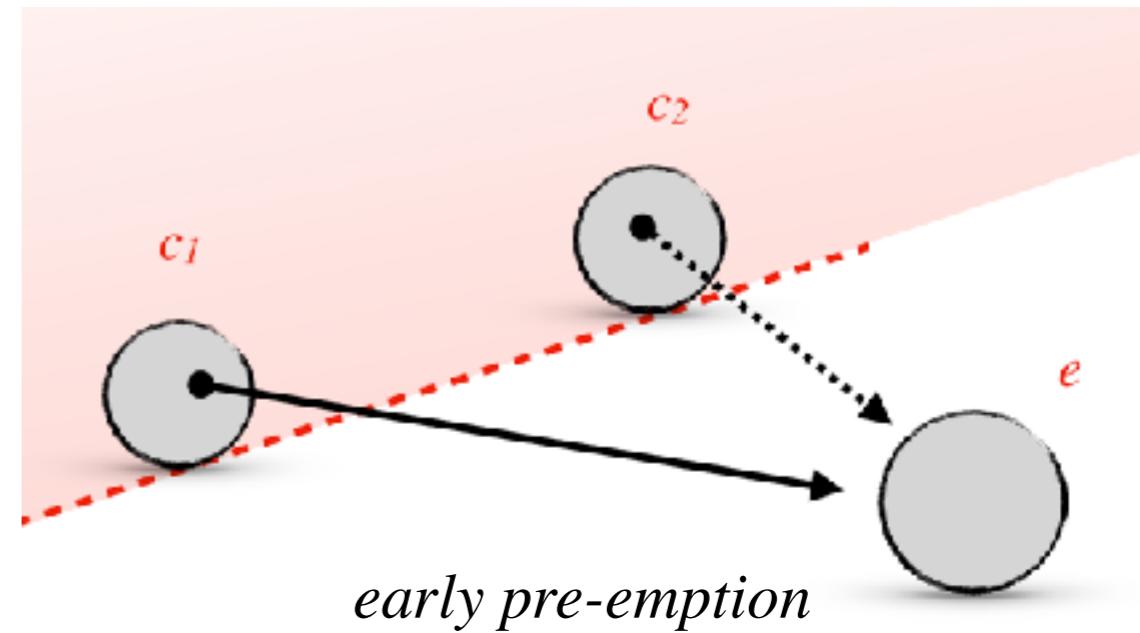


# Late pre-emption



# Pre-emption

- We should distinguish early pre-emption and late pre-emption
- **Early pre-emption:** c causes e, but there is a ‘back-up’ cause waiting to cause e if c fails. So e does not causally depend on c
- **Late pre-emption:** c causes e, but there is a second process that causes e if c or any of its intermediary effects  $c^*$ ,  $c'$ ... etc. fails
- The counterfactual theory of causation is equipped to deal with early pre-emption, but has difficulties with late pre-emption



# Summary

- **Efficient causation**  
(One of four ‘causes’ or ‘because’ Aristotle talked about; can be conceived in terms of intervention, or purely in terms of natural process)
- **Regularity theories**  
(Hume’s psychological theory, Mackie’s INUS theory)
- **Counterfactual theories**  
(David Lewis, made possible by a proper semantics for counterfactuals; asymmetry and transitivity of causation)
- **Problems for counterfactual theories**  
(Overdetermination, Early and Late Pre-Emption)

# Good luck!

- ~~Lecture 1: The very idea of a cause~~
- ~~Lecture 2: Regularity theories~~
- ~~Lecture 3: Counterfactual theories~~
- ~~Lecture 4: The problem of redundant causation~~