Conditionals

- **Conditionals are sentences that propose a scenario, then go on to say something about what would happen in that scenario.**
    - The scenario might be actual, or merely possible.
- Usually expressed as "if… then…" statements.
- I'll use "A → B" to symbolize an arbitrary conditional "if A, then B," regardless of that conditional's truth conditions or logic.

Example Conditionals

1. If the Axiom of Choice is true, then every set can be well ordered.
2. You will probably get lung cancer if you smoke.
3. If the syrup forms a soft ball when you drop it into cold water, then it is between 112 and 115 degrees Celsuis.
4. If kangaroos had no tails, they would topple over.[1]
5. When I rule this land, you will be sorry.

Vocabulary: Parts of Conditionals

- The *antecedent* is the "if" part of the conditional: it proposes the scenario.
- The *consequent* is the "then" part of the conditional: it says something about what would happen in the scenario.

Why Study Conditionals?

- **decision-making**: to figure out what to do, you should consider, for each action you might choose, what would happen if you chose it.
- **science and philosophy of science**: when deciding which theory to believe, you should consider, for each theory, what evidence you should expect if it is true.
- **make-believe and imagination**: what if you could talk to dolphins…
- **philosophy**: conditionals are used to formulate the concept of *counterfactual dependence*. B counterfactually depends on A iff:
    - If A had occurred, B would have occurred.
    - If A had not occurred, B would not have occurred.

  conditionals and counterfactual dependence show up in philosophical analyses of causation, dispositions, laws of nature, knowledge, and freedom.

More Vocabulary: Indicative vs. Counterfactual

This distinction is usually introduced using a pair of examples from Ernest Adams.[2] (We're supposed to generalize.)

6. If Oswald didn't kill Kennedy, then someone else did.
7. If Oswald hadn't killed Kennedy, then someone else would have.

6 is called *indicative*. 7 is called *counterfactual*. We can get the knack of creating new pairs that are similar to 6 and 7.

8. If Stephanie Kwolek didn't invent kevlar, then we can't use it in superconductors.
9. If Stephanie Kwolek hadn't invented kevlar, then we wouldn't be able to use it in superconductors.

10. If Tupac is still alive, then every radio station in the country is playing his music.
11. If Tupac was still alive, then every radio station in the country would be playing his music.

Being able to create pairs *doesn't* tell us:

- How to sort arbitrary conditionals into indicative vs. counterfactual.
- Whether every conditional falls into exactly one of these categories.
- Whether we should reason about indicatives and conterfactuals using the same underlying theory (with a few settings changed), or different theories.

Question for tutorial: what do you say about future-directed conditionals? For example:

12. If you eat that mushroom, you will get sick.

Features to Investigate

- **Truth conditions**: what does it take for a conditional to be true?
- **Logic**: which ways of reasoning with conditionals are valid?
- **Pragmatics**: what happens when you assert a conditional in a conversation?

Some Common Logical Inferences With Conditionals

Modus Ponens

$A \rightarrow B, A \vdash B$

If it's not broken, you shouldn't fix it.
It's not broken.

Therefore, you shouldn't fix it.

Psuedo Modus Ponens

$A \rightarrow B \vdash \neg A \vee B$

If it's worth proving, it's worth proving with relevant logic.

Either it's not worth proving, or it's worth proving with relevant logic.

Modus Tollens

$A \rightarrow B, \neg B \vdash \neg A$

If that were arsenic, the indicator would have turned blue.
The indicator didn't turn blue.

Therefore, it's not arsenic.

Conditional Proof

If $A \vdash B$, then $\vdash A \rightarrow B$

Nine is an odd prime number.

There is at least one odd prime number.

So by Conditional Proof, we also have:

If nine is an odd prime number, then there is at least one prime number.

Deduction Theorem

If $A_1, A_2, \dots, A_n, B \vdash C$, then $A_1, A_2, \dots, A_n \vdash B \rightarrow C$

The Liar Sentence is true.
Every instance of the T-Schema is true.

The Liar sentence is false.

So by the Deduction Theorem, we also have:

Every instance of the T-Schema is true.

If the Liar sentence is true, then the Liar sentence is false.

Import-Export

Import: $A \rightarrow (B \rightarrow C) \vdash (A \wedge B) \rightarrow C$

If there's singing, then if there's dancing, I'll go.

If there's singing and there's dancing, I'll go.

Export: $(A \wedge B) \rightarrow C \vdash A \rightarrow (B \rightarrow C)$
If there's singing and there's dancing, I'll go.

If there's singing, then if there's dancing I'll go.

The Material Conditional

$A \rightarrow B$ is true whenever *at least one* of the following conditions holds:

- A is false
- B is true.

Arguments for:

- Explains the validity of Pseudo Modus Ponens, Modus Ponens, Modus Tollens, Conditional Proof, and Import-Export.
- The direct inference
  - you can infer $\neg A \vee B$ from $A \rightarrow B$ (by Pseudo Modus Ponens)
  - it's reasonable to infer $A \rightarrow B$ from $\neg A \vee B$
  - so $A \rightarrow B$ is logically equivalent to $\neg A \vee B$
- Given Pseudo Modus Ponens, Conditional Proof, and Import-Export, you can validly infer infer $A \rightarrow B$ from $\neg A \vee B$.[3]
  - Exercise for tutorial: figure out how.

Arguments against:

- Sentences that come out true *as a matter of logic*, but shouldn't come out true *at all*.

13. Either the unburied dead will walk the Earth if I bury a chicken head in my backyard, or the unburied dead will walk the Earth if I fail to bury a chicken head in my backyard.
14. Either you are virtuous if you are rich, or you are rich if you are virtuous.
15. One of these three things holds: if you grant marriage rights to same-sex couples, you will grant them to siblings; if you marriage rights to siblings, you will grant them to box turtles; or if you grant marriage rights to box turtles, you will take them away from opposite couples.

- Arguments that come out valid, but shouldn't.

16. I will not do my chores today.
    ____
    Therefore, if I do my chores today, then the world will implode.

17. Dinner will be delicious.
    ____
    Therefore, if I burn the veggie burgers and pour sand into the sweet potatoes, then dinner will be delicious.

18. I If God does not exist, then it's not the case that if I pray, my prayers will be answered.
    I do not pray.
    ____
    Therefore, God exists.[4]

- The material conditional seems to get bad results about probability. Suppose you roll a fair die.
    - The probability that *if you roll an even number, then you roll a two* is intuitively 1/3.
    - The probability of the material conditional "you roll an even number → you roll a two" is 2/3.
    - This problem will return later to exact its revenge on other theories…

The Strict Conditional

Let a model be a triple (W, R, V), with W a set of worlds, R an accessibility relation, and V a valuation function.

A → B is true ***(at a possible world w in a model)*** whenever ***for every possible world x such that Rwx***, *at least one* of the following conditions holds:

- A is false ***at x***
- B is true ***at x***.

Advantages

- Captures some of the close connections between A → B and ¬A ∨ B
- Avoids the fallacies of material implication.

Disadvantages

- Still seems to mis-classify some invalid arguments as valid.

19. ______________________________
    Therefore, if the Law of Excluded Middle is invalid, either snow is white or snow is not white.

20. It is impossible to prove the famous conjecture that P = NP.
    ____
    Therefore, if I prove that P = NP, nobody in the world of Computer Science will care.

- Gets the wrong results about the truth conditions of *counterpossible* conditionals—that is, conditionals with impossible antecedents.

21. If Hobbes had (secretly) squared the circle, sick children in the mountains of South America at the time would not have cared.[5]
22. If Hobbes had (secretly) squared the circle, sick children in the mountains of South America at the time would have taken notice.
23. If I were a horse, then I would have hooves.[6]
24. If I were a horse, then I would have scales.
25. If wishes were horses, beggars would ride.
26. If wishes were horses, no one would own any horses.

27. If LP were the correct logic, then the Law of Non-Contradiction would no longer be a logical truth.
28. If LP were were the correct logic, then the Law of Excluded middle would no longer be a logical truth.

- See Al's lecture for more criticisms!

The Relevant Conditional

For the material conditional, a model was a triple (W, R, V).

For relevant conditionals, our models are quadruples (S, g, R, V), where

- S is a set of states
  - Unlike worlds, states can be incomplete or inconsistent. They're governed not by classical logic, but by FDE.
- g is a base state in S.
  - Validity is truth preservation at all base states in all models.
- R is a *three*-place accessibility relation.
  - Extra constraint on the base state: for all $x, y \in$ S, Rgxy iff $x = y$.
- V is a valuation function.
  - Conjunction and disjunction work as in FDE. As for the conditional…

A → B is true ***(at a state s in a model)*** whenever ***for any worlds x and y such that Rsxy***, *at least one* of the following conditions holds:

- A is false ***at x***
- B is true ***at y***.

This gives us a model theory for the positive fragment of the basic relevant logic B, which is known as B+.

Rules of B+

R1. $A \rightarrow B, A \vdash B$

R2. $A, B \vdash A \wedge B$

R3. $A \rightarrow B, C \rightarrow D \vdash (B \rightarrow C) \rightarrow (A \rightarrow D)$

Axioms of B+

A1. $\vdash A \rightarrow A$

A2. $\vdash A \rightarrow (A \vee B)$
$\vdash B \rightarrow (A \vee B)$

A3. $\vdash (A \wedge B) \rightarrow A$
$\vdash (A \wedge B) \rightarrow B$

A4. $\vdash \big(A \wedge (B \vee C)\big) \rightarrow \big((A \wedge B) \vee (A \wedge C)\big)$

A5. $\vdash \big((A \rightarrow C) \wedge (A \rightarrow C)\big) \rightarrow \big(A \rightarrow (B \wedge C)\big)$

A6. $\vdash (A \rightarrow C) \wedge (B \rightarrow C) \rightarrow \big((A \vee B) \rightarrow C\big)$

What happens when we add negation?

- ¬A is true at a state *s* iff A is false at *s*.

… but wait, we didn't give falsity conditions for the conditional!

- Option 1: brute force—just stipulate, for each state, whether each conditional is false at it or not.[7]
- Option 2: add the Routley star operator.[8]
    - for any state *s*, *s** is a state
    - *s*** = *s*
    - ¬A is true at *s* iff A is *not* true at *s**
    - An example: a state and its star state in a language with four atomic sentences: A, B, C, and D. Atomic sentences and their negations are marked + in the column corresponding to a state if they are true at that state, and marked – otherwise.

s	*s**
A^+	A^-
$\neg A^+$	$\neg A^-$
B^+	B^+
$\neg B^-$	$\neg B^-$
C^-	C^+
$\neg C^-$	$\neg C^+$
D^-	D^-
$\neg D^+$	$\neg D^+$

- Option 3: Introduce a second three-place R relation to model falsity.[9]
- Option 4: Say that A → B is false at *s* iff there are states *x* and *y* such that
    - R*sxy*,
    - A is true at *x*, and
    - B is false at *y*.[10]

  (note: this works for some weak extensions of B, but it doesn't work for stronger relevant logics that a lot of people are interested in.)
- Option 5: neighborhood semantics.[11]
    - We replace the one base state *g* with a set of base states (which has to be a subset of W). We say that a proposition is true in a model iff it's true in all the base states.

- Where A is a proposition, A^F is A's falsity condition. We require F to be nicely behaved, in that it obeys the following rules:
    - $A^{F^F} = A$
    - $(A \wedge B)^F = A^F \vee B^F$
    - $(A \rightarrow B)^F = A \circ B^F$

    (where $A \circ B$ is true at s iff there exist states x and y such that A is true at x, B is true at y, and $Rxys$)

Extensions of B+

Some abbreviations:

- $R^2abcd = \exists x\ Rabx \wedge Rxcd$
- $R^2a(bc)d = \exists x\ Rbcx \wedge Raxd$
- $R^3ab(cd)e = \exists x\ Rabxe \wedge Rcdx$

Axiom/Rule	Frame Property
$\vdash (A \wedge (A \rightarrow B)) \rightarrow B$	$Raaa$
$\vdash \big((A \rightarrow B) \wedge (B \rightarrow C)\big) \rightarrow (A \rightarrow C)$	$Rabc \rightarrow R^2a(ab)c$
$\vdash (A \rightarrow B) \rightarrow \big((B \rightarrow C) \rightarrow (A \rightarrow C)\big)$	$R^2abcd \rightarrow R^2b(ac)d$
$\vdash (B \rightarrow C) \rightarrow \big((A \rightarrow B) \rightarrow (A \rightarrow C)\big)$	$R^2abcd \rightarrow R^2a(bc)d$
$\vdash \big(A \rightarrow (A \rightarrow B)\big) \rightarrow (A \rightarrow B)$	$Rabc \rightarrow R^2abbc$
$\vdash (A \rightarrow \big((A \rightarrow B) \rightarrow B\big)$	$Rabc \rightarrow Rbac$
$\vdash \big(A \rightarrow (B \rightarrow C)\big) \rightarrow \big(B \rightarrow (A \rightarrow C)\big)$	$R^2abcd \rightarrow R^2acbd$
$\vdash \big(A \rightarrow (B \rightarrow C)\big) \rightarrow \big((A \rightarrow B) \rightarrow (A \rightarrow C)\big)$	$R^2abcd \rightarrow R^3ac(bc)d$
$\vdash (A \rightarrow B) \rightarrow \Big(\big(A \rightarrow (B \rightarrow C)\big) \rightarrow (A \rightarrow C)\Big)$	$R^2abcd \rightarrow R^3bc(ac)d$
$A \vdash (A \rightarrow B) \rightarrow B$ $C \vee A \vdash C \vee \big((A \rightarrow B) \rightarrow B\big)$	$Raga$

Exercise: For each axiom or rule, create a countermodel in B+. Then, show that in models that satisfy the corresponding constraint on the R relation, there is no countermodel.

Triviality

<u>The Thesis</u>: Generalization from the dice example: the probability of a conditional is the conditional probability of the consequent given the antecedent. In other words, for arbitrary A and B,

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P(\mathrm{B}|\mathrm{A})$$

We saw that The Thesis was incompatible with the material conditional theory.

- Bad news: given plausible background assumptions, it's also incompatible with *every other* theory that tries to assign truth conditions to the conditional.
- We can show how bad things are by a *reductio ad absurdum*: using The Thesis + the assumption that conditionals are propositions + the probability calculus to prove…
    - *triviality*: there are at most two disjoint propositions that have probability strictly between 0 and 1.

The Lewis Triviality Theorem[12]

1. Law of Total Probability:

$$P(\mathrm{X}) = P(\mathrm{X}|\mathrm{Y}) \times P(\mathrm{Y}) + P(\mathrm{X}|\neg\mathrm{Y}) \times P(\neg\mathrm{Y})$$

2. Assume there exist propositions A and B such that $P(\mathrm{A} \wedge \mathrm{B})$ and $P(\mathrm{A} \wedge \neg\mathrm{B})$ are both greater than 0.
3. From 1, plugging in A → B for X and B for Y,

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P(\mathrm{A} \rightarrow \mathrm{B}|\mathrm{B}) \times P(\mathrm{B}) + P(\mathrm{A} \rightarrow \mathrm{B}|\neg\mathrm{B}) \times P(\neg\mathrm{B})$$

4. From 2, since conditional probabilities behave just like probabilities,

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P_{\mathrm{B}}(\mathrm{A} \rightarrow \mathrm{B}) \times P(\mathrm{B}) + P_{\neg\mathrm{B}}(\mathrm{A} \rightarrow \mathrm{B}) \times P(\neg\mathrm{B})$$

5. Given 3, The Thesis lets us substitute $P_{\mathrm{B}}(\mathrm{B}|\mathrm{A})$ for $P_{\mathrm{B}}(\mathrm{A} \rightarrow \mathrm{B})$ and $P_{\neg\mathrm{B}}(\mathrm{B}|\mathrm{A})$ for $P_{\neg\mathrm{B}}(\mathrm{A} \rightarrow \mathrm{B})$, yielding:

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P_{\mathrm{B}}(\mathrm{B}|\mathrm{A}) \times P(\mathrm{B}) + P_{\neg\mathrm{B}}(\mathrm{B}|\mathrm{A}) \times P(\neg\mathrm{B})$$

6. Since $P_{\mathrm{B}}(\mathrm{B}) = 1$ and $P_{\neg\mathrm{B}}(\mathrm{B}) = 0$, the probabability calculus lets us derive

$$P_{\mathrm{B}}(\mathrm{B}|\mathrm{A}) = 1$$

$$P_{\neg\mathrm{B}}(\mathrm{B}|\mathrm{A}) = 0$$

7. Using 6 to substitute ones and zeroes into 5:

$$P(\mathrm{A} \rightarrow \mathrm{B}) = 1 \times P(\mathrm{B}) + 0 \times P(\neg\mathrm{B})$$

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P(\mathrm{B})$$

8. By 7 and The Thesis,

$$P(\mathrm{B}|\mathrm{A}) = P(\mathrm{B})$$

Bad news: we just proved that any two arbitrary propositions A and B satisfying assumption 2 are probabilistically independent. This is only possible for trivial probability distributions.

Promising ways to block the argument:

- **Step 3**: Deny that conditionals express propositions with truth conditions.
- **Step 3**: Accept that conditionals express propositions with truth conditions, but deny that the probability of a conditional is the probability of the proposition it expresses.
- **Step 4**: deny that conditionals express the same proposition in every context.
- **Steps 5 and 8**: Reject The Thesis

How Plausible is The Thesis?

Many philosophers believe that it holds for indicatives, but not for counterfactuals.

- The Oswald-Kennedy example is illustrative.
  - Let $\neg$O = "Oswald didn't kill Kennedy"
  - Let SE = "Someone else killed Kennedy"
  - $P(\text{SE}|\neg\text{O})$ is high.
  - But it seems improbable that if Oswald hadn't killed Kennedy, then someone else would have.
- Dissenting opinion from Edgington[13]: The Thesis holds for counterfactuals too, but with a different probability function.
- Dissenting opinion from Pollock[14]: not even indicatives obey The Thesis.

  > "Suppose we know of a vase which was included in a certain shipment of vases. Seventy-five percent… of the vases were ceramic and highly fragile, and the other 25% were plastic and virtually unbreakable. We know of this shipment that every ceramic vase which was dropped broke, and none of the plastic vases broke. Furthermore, we know that when the shipment reached its destination, all broken vases and all plastic vases were discarded, and of the discarded vases, 75% were plastic. This completes our initial background information regarding this shipment. On the basis of this information, we can reasonably believe that
  >
  > *If the vase was dropped, it broke.*
  >
  > Suppose we are now informed that the vase under consideration was discarded… As 75% of the discarded vases were plastic, this makes it unreasonable to believe that if the vase was dropped then it broke."

Do Conditionals Have Truth Conditions?

If they don't, how should we understand the concept of a valid inference? One proposal comes from Adams.[15]

- Ordinary propositions are assertible to the extent that they have high probability.
- We can say that a conditional is assertible to the extent that its consequent has high conditional probability given its antecedent.
- A valid argument is one whose conclusion is guaranteed to be assertible (to as high a degree as you like) whenever its premises are sufficiently assertible.
    - More formally: an argument is valid iff for every ε in the (0, 1) interval, there exists a δ in the (0, 1) interval such that any probability distribution that gives each of its premises probability greater than or equal to $1 - \delta$ must assign its conclusion probability greater than or equal to $1 - \varepsilon$.
- Problems:
    - What is assertibility?
    - Doesn't allow us to interpret nested conditionals.
    - Weird results about arguments with countably many premises (if we allow such things).

Context-Dependent Propositions?

A lot of expressions are context-dependent; which proposition they express depends on when they are uttered, and by whom.

- "I am hungry"—truth conditions depend on the speaker.
- "It's noon"—truth conditions depend on the time.
- "Ray is tall"—truth conditions depend on a standard of tallness.
- "This knife is good"—truth conditions depend on a purpose.
- "If Pete called, he won"—truth conditions depend on a probability function?

> Sly Pete and Mr. Stone are playing poker on a Mississippi riverboat. It is now up to Pete to call or fold. My henchman Zack sees Stone's hand, which is quite good, and signals its content to Pete. My henchman Jack sees both hands, and sees that Pete's hand is rather low, so that Stone's is the winning hand. At this point, the room is cleared. A few minutes later, Zack slips me a note which says "If Pete called, he won," and Jack slips me a note which says "If Pete called, he lost." [16]

Alas, context-dependent truth conditions don't help with triviality. There's another triviality theorem, due to Robert Stalnaker.[17]

- Suppose we have two arbitrary propositions A and B which satisfy The Thesis, so that

$$P(\mathrm{A} \rightarrow \mathrm{B}) = P(\mathrm{B}|\mathrm{A})$$

  Then we can find two other propositions C and D which *don't* satisfy The Thesis.
- Let $\mathrm{C} = \mathrm{A} \vee \neg(\mathrm{A} \rightarrow \mathrm{B})$
- Let $\mathrm{D} = \mathrm{A} \wedge \neg\mathrm{B}$
- If C → D, then C must be true.
  - If C is false, its first disjunct A must be false.
  - But if D is true, its first conjunct A must be true.
- If C is true, then C → D takes on the truth value of D.
- We can draw the following truth table, based on the truth values of A and B.

	A	B	A → B	C A ∨ ¬(A → B)	D A ∧ ¬B	C → D
x	T	T	T	T	F	F
y	T	F	F	T	T	T
	F		T	F	F	F
z	F		F	T	F	F

- Using the truth table, we can calculate:
  - $P(\mathrm{C} \rightarrow \mathrm{D}) = y$
  - $P(\mathrm{D}|\mathrm{C}) = \frac{y}{x+y+z}$

  $x + y + z$ had better not equal 1, if $P(\mathrm{A} \rightarrow \mathrm{B}) = P(\mathrm{B}|\mathrm{A})$
- So $P(\mathrm{C} \rightarrow \mathrm{D}) \neq P(\mathrm{D}|\mathrm{C})$.

Conditionals as Restrictors

Kratzer: "The textbook analysis of conditionals is based on a momentous syntactic mistake."[18]

- Consider the following sentence:

  With probability 1/3, if you roll an even number, you will roll a two.

- You may have been tempted to parse this sentence as follows:

  $P(\text{A} \rightarrow \text{B}) = 1/3$

- But that's wrong! There is not a proposition, A → B, which the sentence is assigning probability 1/3.
- Conditionals are modal restrictors. (I'll explain what this means.)
- Modals quantify over possible worlds:
  - You should eat a big breakfast.
    - [SHOULD](you eat a big breakfast)
    - [for all best worlds w](you eat a big breakfast at w)
  - You can travel by the Red Line.
    - [CAN](you travel by the Red Line)
    - [for some world w](you travel by bus at w)
  - You will roll a two with probability 1/3.
    - [PROBABILITY 1/3](you roll a two)
    - [for 1/3 of the worlds w](you roll a two at w)
- You can restrict quantifiers with conditionals.
  - Everybody loves logic.

    $\forall x(Lxl)$

  - Everybody loves logic if they're clever.

    $\forall_C x(Lxl)$

    (you might have parsed it as $\forall x(Cx \rightarrow Lxl)$. That works fine for the universal quantifier, but not so great for "most"…)

  - {Always, usually, sometimes, never} farmers feed donkeys carrots.

    $\text{QUANTIFIER}[x, y]_{Fx \wedge Dy}(Cxy)$

  - {Always, usually, sometimes, never} if a farmer takes care of a donkey, she feeds it carrots.

    $\text{QUANTIFIER}[x, y]_{Fx \wedge Dy \wedge Txy}(Cxy)$

- Conditionals also restrict quantifiers over possible worlds:
    - If you're not having lunch, you should eat a big breakfast.
        - [SHOULD: no lunch](you eat a big breakfast)
        - [for all best worlds *w*: you don't have lunch at *w*]
          (you eat a big breakfast at *w*)
    - If you're going to Boston College, you can travel by the Red Line.
        - [CAN: you're going to Boston College](you travel by bus)
        - [for some world *w*: you're going to Boston college at *w*]
          (you travel by bus at *w*)
    - If you roll an even number, you will roll a two with probability 1/3.
        - [PROBABILITY 1/3: you roll an even number](you roll a two)
        - [for 1/3 of the worlds *w*: you roll an even number at *w*]
          (you roll a two at *w*)
- This restrictor story provides a handy account of the difference between indicatives and counterfactuals: the conditional is restricting different modals. (Different sets of worlds are being quantified over.)
- What about conditionals that don't appear to have modals in them? What is the conditional restricting?
    - "If Oswald didn't kill Kennedy, then someone else did."
    - Kratzer's answer: there's a covert modal.
        - [MUST: Oswald didn't kill Kennedy]
          (someone else besides Oswald killed Kennedy)

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