Post

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We often use “epistemic must” in sentences like “Sue must have been sick”. By itself, “must” seems to mean something like “necessarily” but this meaning feels too strong. Why? We (w/ @raryskin @LanguageMIT) assess this issue experimentally in tedlab.mit.edu/tedlab_website...

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We found 3 possible meanings of “must” from previous literature: vonFintel & Gillies 2021 argue epistemic “must” = “necessarily” but people use it hyperbolically to refer to probable events as certain (hyperbolical logical hypothesis). This predicts “must p” = “it is certain p”.

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Lassiter 2016 suggests that epistemic “must” is actually used literally when people use it to refer to probable events (probabilistic hypothesis). This predicts “must p” = “it is probable p”.

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Semanticists starting with Lyons (1977) proposed that epistemic “must” is an inferential evidential used to refer to events that the speaker is prompted to believe based on an act of inference (evidential hypothesis). This predicts “must p” = “I conclude p”.

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Lassiter 2016 assessed these hypotheses experimentally by having English speakers read a context where a conclusion “p” is probabilistically supported and then decide whether they agree with “must p”, “it is certain p”, and “we know p” in the context.

Context:
Yesterday, Bill bought a single ticket in a raffle with 1000 total tickets. There were also 999 other people who bought one ticket each. That is, the tickets were distributed like this: People holding one ticket: Bill, Mary, Jane, ... [997 more]. The drawing was held last night, and the winner will be announced this evening.

Sentences:

Bill must not have won the raffle	*(must)*
It is certain that Bill did not win the raffle	*(certain)*
We know that Bill did not win the raffle	*(know)*

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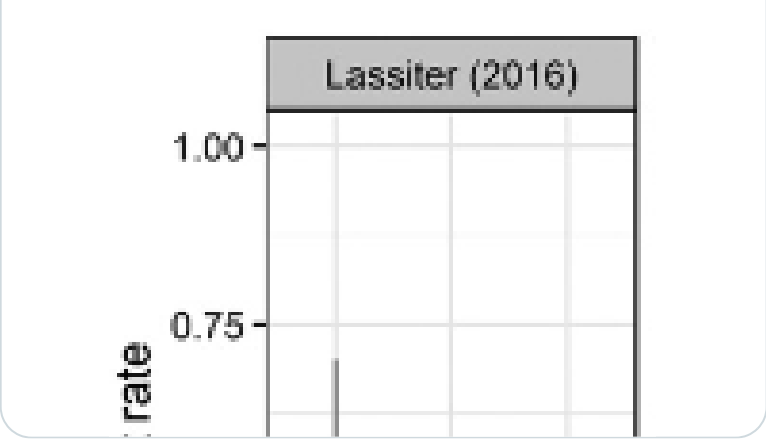
Lassiter 2016 found that “must” was agreed with at a significantly higher rate than “certain” and “know”, which he took as supporting the probabilistic hypothesis over the other two hypotheses.



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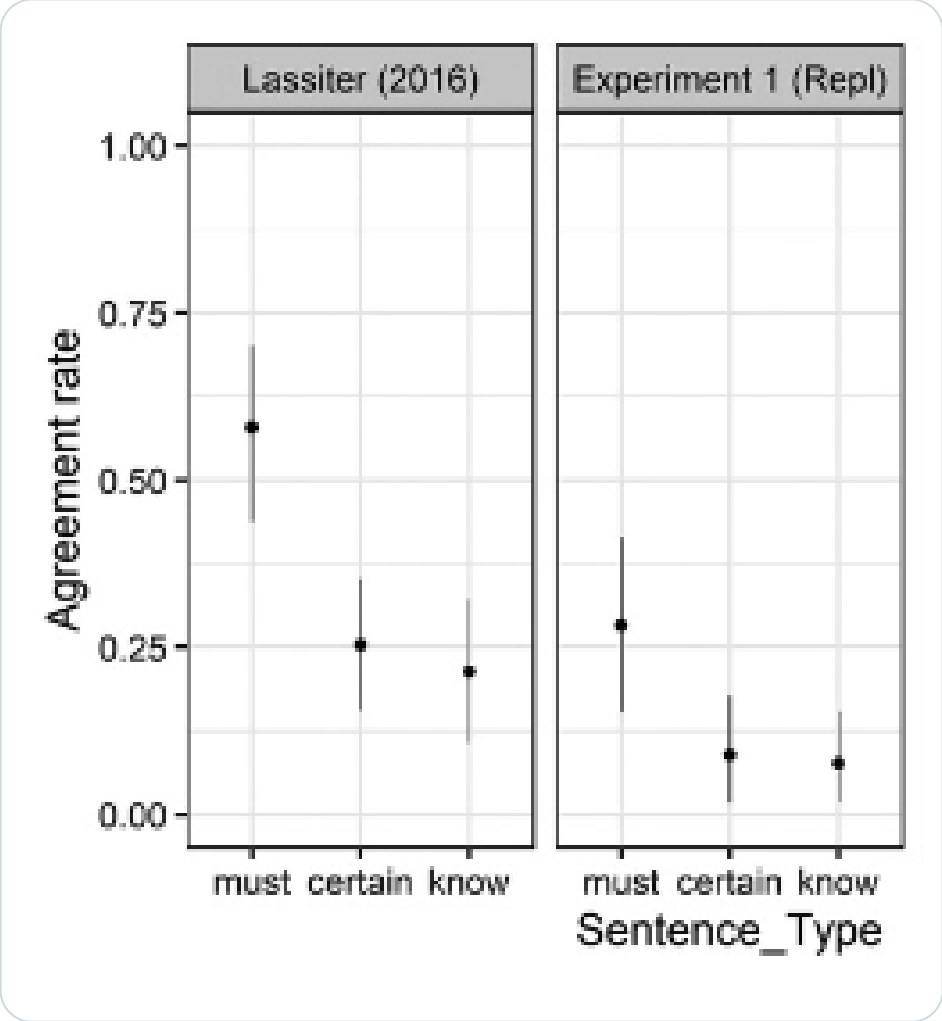
We replicated this finding but with an overall lower agreement rate across the three sentences (Exp 1). In any case, we take this finding as compatible with all three hypotheses.



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We designed 3 experiments to discriminate among the hypotheses. In Exp2, we gave English speakers the same context and asked them to rate the three sentences together with 6 baselines in a within-subject design.

The nine sentences read by participants (within-subjects) in experiment 2

Experimental items

a. Bill must not have won the raffle. (*must*)
b. It is certain that Bill did not win the raffle. (*certain*)
c. We know that Bill did not win the raffle. (*know*)

Clearly true control items

a. It is highly probable that Bill did not win the raffle. (*probable*)
b. There is a slight chance that Bill won the raffle. (*chance*)
c. Bill bought exactly one ticket in the raffle. (*one*)
d. 1000 different people bought one lottery ticket each in the raffle. (*1000*)

Clearly false control items

a. Mary bought two tickets in the raffle. (*two*)
b. The winner will be announced tomorrow. (*winner*)

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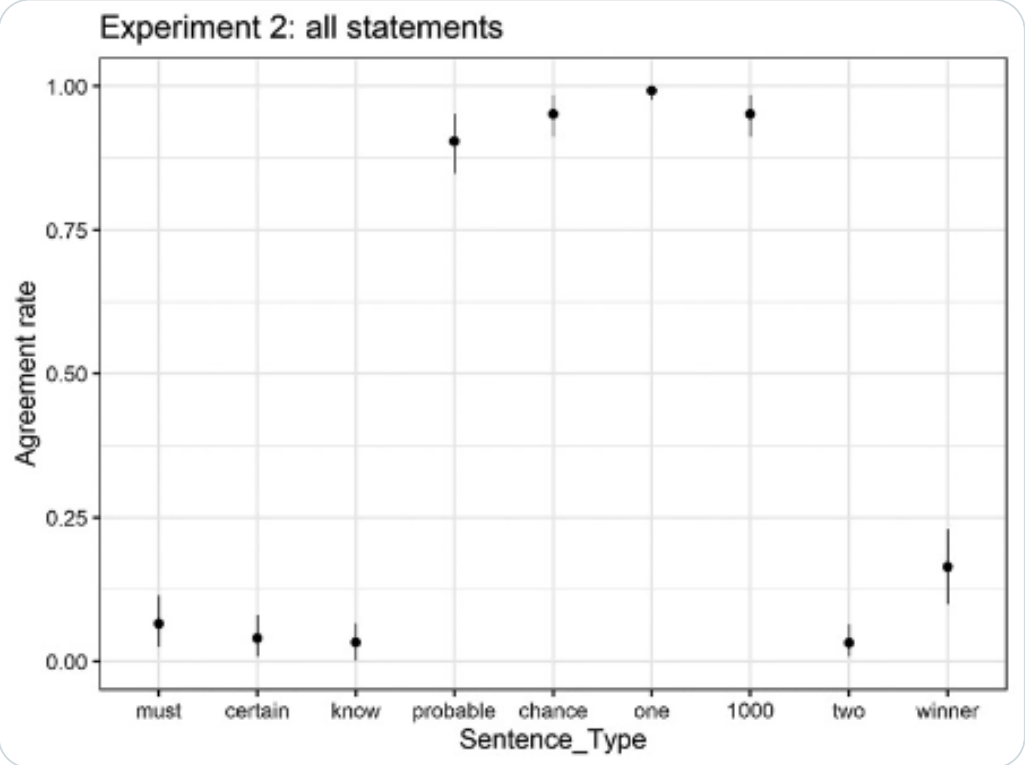
We found that “must” was agreed with at the same rate as “certain” and “know” (and false baselines) and much lower than “probable” (and true baselines). This falsifies the probabilistic hypothesis and is compatible with the other two.



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To discriminate the remaining two, in Exp3, we compared the original story to one making the conclusion “Bill didn’t win the raffle” explanatory too; and we added the critical sentence “I conclude that Bill did not win the raffle”.

The two stories read by participants (between-subjects) in experiment 3

a. Lassiter’s 2016 context (INDUCTIVE) (suggesting a conclusion supported by a probabilistic computation)
Yesterday, Bill bought a single ticket in a raffle with 1000 total tickets. There were also 999 other people who bought one ticket each. That is, the tickets were distributed like this: People holding one ticket: Bill, Mary, Jane, … [997 more]. The drawing was held last night, and the winner will be announced this evening.

b. Modified version (EXPLANATORY) (suggesting a conclusion that is simple, coherent, and consistent with prior biases)
Yesterday, Bill bought a single ticket in a raffle with 1000 total tickets. There were also 999 other people who bought one ticket each. That is, the tickets were distributed like this: People holding one ticket: Bill, Mary, Jane, … [997 more]. The drawing was held last night. **Today, you meet Bill and he looks a little bit disappointed.**

The eight sentences read by participants (within-subjects) in experiment 3

Experimental items

a. Bill must not have won the raffle. (*must*)
b. I conclude that Bill did not win the raffle. (*conclude*)
c. It is certain that Bill did not win the raffle. (*certain*)
d. It is highly probable that Bill did not win the raffle. (*probable*)

Clearly true baselines

e. Bill bought exactly one ticket in the raffle. (*one*)
f. 1000 different people bought one lottery ticket each in the raffle. (*1000*)

Clearly false baselines

g. Mary bought two tickets in the raffle. (*two*)
h. The winner will be announced tomorrow. (*winner*)

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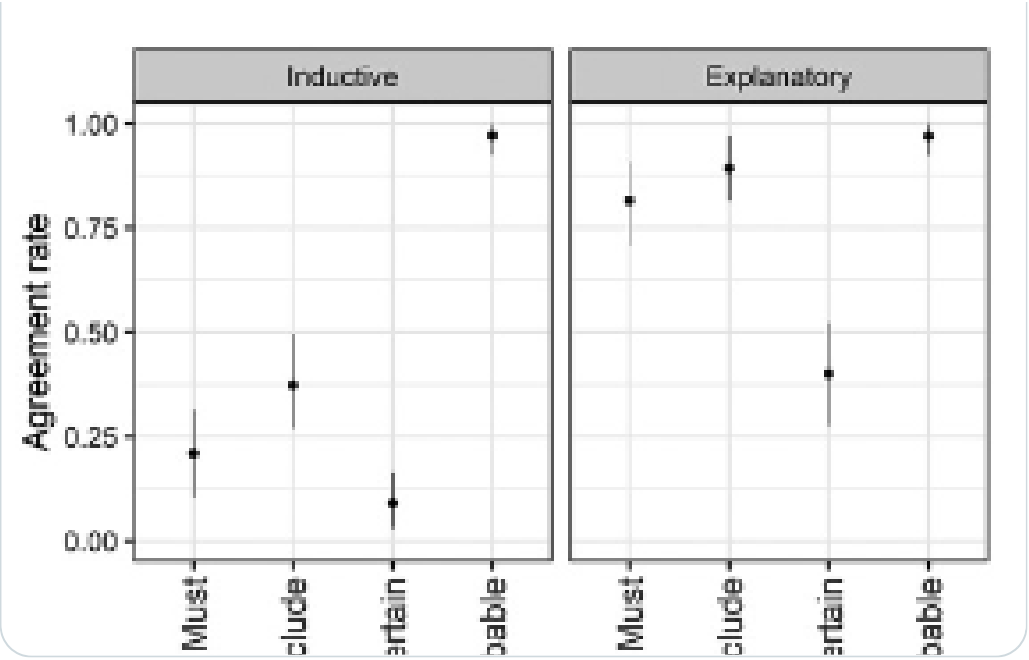
We found that the agreement rate of “must” patterned with “conclude” across both scenarios and differed from “certain” and “probable”. These results support the evidential hypothesis. We replicated this finding in Italian (Exp4).



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Conclusion:
Epistemic “must” is used like an inferential evidential to express beliefs obtained by speakers through an inference based on a subjective probability of the belief independently from its objective probability (whether it is certain or just probable).

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p.s.:
We speculate that the evidential meaning of epistemic “must” derives by extension from the original necessity meaning through inflation due to overuse of the word in daily conversation.

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