So a few lectures ago, I had you rate a bunch of sentences under the guise of collecting training data for a classifier to detect anti-vaccine language. But as Chris has been hinting at, that’s just one part of the story. I’m ultimately interested in studying how certain linguistic strategies—specifically, factive and non-factive verbs of opinion attribution—can bias people’s perceptions of reported opinions and beliefs. (So that’s the first part of the lecture title.)

And I’m looking at data taken from the media coverage of scientific debates to study this question, since this a domain that’s really rich in reported opinions: journalists are constantly quoting from entities like scientists, organizations, parents and the like to sample from the range of differing opinions that compose a given debate.

And so today I’ll debrief the results of the in-class experiment, and then if there’s time I’ll also talk about my own work on the media coverage of one particular debate, which is vaccines.
So I had you guys rate a bunch of sentences, which I sampled from real new data. I also applied some minimal editing for the purpose of doing a more controlled experiment.
So I had you guys rate a bunch of sentences, which I sampled from real new data. I also applied some minimal editing for the purpose of doing a more controlled experiment.
And you can see that excluding the first three that were used as distractor sentences, all the other sentences fall into one of 3 “text types” in terms of the general gist of the opinion that’s being reported.
So for example, the sentences in the red block all report the general opinion that vaccines are risky.
The green block contains opinions on the general theme that vaccines cause autism.
For the purple block, the reported opinions are all some form of the belief that vaccines are effective at containing epidemics.

The first two types of reported opinions are negative toward vaccines; the third is positive toward vaccines.
And what I’ve manipulated is that, within each category, I’ve varied the identity of the verb used to report on that opinion—or in syntactic terms, the verb that’s used to embed the opinion as its complement clause.
So for example, for the “vaccines are risky” opinion, there was “acknowledge that...vaccines raise safety issues”, then “denies [that] there are risks”, “reports that ... there are risks”, and so forth. And I also included a final one without any kind of embedding, the speaker of the sentence isn’t reporting from an external source. And you can already start to see how a verb like “denies” signals something very different about the embedded opinion relative to a verb like “says”, and both are different from the bare, non-embedded opinion.
The categories I’ll focus on in the debriefing of this experiment are factive vs. non-factive verbs. As you guys have already seen, the hallmark feature of factive verbs is related to presupposition, namely that they presuppose the truth of the complement. And let’s just review quickly how this works with an example:
The categories I’ll focus on in the debriefing of this experiment are factive vs. non-factive verbs. As you guys have already seen, the hallmark feature of factive verbs is related to presupposition, namely that they presuppose the truth of the complement. And let’s just review quickly how this works with an example:

Take the sentence, “It’s raining outside”.

Reference: “Fact” (Kiparsky & Kiparsky, 1968)
Verbs and factivity (and presupposition)

S: It’s raining outside.

(1)   a. Anna {thinks, believes, says} that [it’s raining outside].

Reference: “Fact” (Kiparsky & Kiparsky, 1968)

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Take the sentence, “It’s raining outside”.

When we embed this sentence as a complement clause to verbs like thinks, believes, or says in (1a), the presupposition does not project outside of the embedded clause, “Anna thinks that it’s raining outside” no longer presupposes that it’s raining outside.
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But when we embed this sentence using a factive verb like *realizes, regrets*, or *points out*, the resulting sentence does now presuppose that it’s raining outside.

**Verbs and factivity (and presupposition)**

_S: It’s raining outside._

(1)  
   a. Anna *{thinks, believes, says}* that [it’s raining outside]$_s$.
   b. Anna *{realizes, regrets, points out}* that [it’s raining outside]$_s$.

Reference: “Fact!” (Kiparsky & Kiparsky, 1968)
Verbs and factivity (and presupposition)

S: It’s raining outside.

(1)  a. Anna {thinks, believes, says} that [it’s raining outside]s.
    b. Anna {realizes, regrets, points out} that [it’s raining outside]s.

Claim: “It’s raining outside” is a presupposition of (1b) but not (1a).

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Take the sentence, “It’s raining outside”.

When we embed this sentence as a complement clause to verbs like thinks, believes, or says in (1a), the presupposition does not project outside of the embedded clause, “Anna thinks that it’s raining outside” no longer presupposes that it’s raining outside.

But when we embed this sentence using a factive verb like realizes, regrets, or points out, the resulting sentence does now presuppose that it’s raining outside.

And let’s support this claim with some evidence.

Reference: “Fact!” (Kiparsky & Kiparsky, 1968)
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspensible?
- Yes → Conversational implicature
- No → Entailment
  - Is the meaning a speaker commitment of the negated version of the sentence?
    - Yes → Not at-issue
    - No → At-issue entailment
  - Can the meaning be backgrounded without creating a redundancy?
    - Yes → Presupposition
    - No → Conventional implicature

This flowchart is borrowed from last week’s hand-out, there are up to 3 questions that we ask to determine what kind of a meaning something is.
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspendible?

Meaning: It’s raining outside.
(1b) Anna realizes that it’s raining outside.

(2) Anna realizes that it’s raining outside #but it’s not raining outside.

- The first: Is the meaning cancellable or suspendible?
- So the meaning is that it’s raining outside, and the sentence is “Anna realizes that it’s raining outside”.
- And as we see in (2), it sounds weird when we try to cancel the meaning—"Anna realizes that it’s raining outside but it’s not raining outside".
So we choose the "No" arrow.
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspensible?
- Yes → Conversational implicature
- No → Entailment
  - Yes → Not at-issue
  - No → At-issue entailment

Is the meaning a speaker commitment of the negated version of the sentence?
- Yes → Can the meaning be backgrounded without creating a redundancy?
  - Yes → Presupposition
  - No → Conventional implicature
- No → At-issue entailment
Which leads us to determine that the meaning is an entailment.
Verbs and factivity (and presupposition)

Is the meaning a speaker commitment of the negated version of the sentence?

Meaning: It’s raining outside.
(1b) Anna realizes that it’s raining outside.

(3) Anna doesn’t realize that it’s raining outside #but it’s not raining outside.

- Next question: Is the meaning a speaker commitment of the negated version of the sentence?
- Well, when we negate (1b), “Anna doesn’t realize that it’s raining outside”, it still sounds odd to follow that up with “but it’s not raining outside”—so the answer is yes, the meaning is a speaker commitment.
Verbs and factivity (and presupposition)

- **Is the meaning cancellable or at least suspensible?**
  - Yes → **Conversational implicature**
  - No → **Entailment**
    - **Is the meaning a speaker commitment of the negated version of the sentence?**
      - Yes → **Not at-issue**
      - No → **At-issue entailment**

- From **Entailment**:
  - **Can the meaning be backgrounded without creating a redundancy?**
    - No → **Conventional implicature**
    - Yes → **Presupposition**
The categories I’ll focus on in debriefing this experiment are factive vs. non-factive verbs. And as you guys have already seen, the hallmark feature of factive verbs is closely related to presupposition. Let’s just review quickly how this works with an example:

Let’s take the sentence like, “It’s raining outside”. One obvious presupposition of this sentence is that it is, in fact, raining outside, and we can see that this is a presupposition because it’s impossible to cancel it.
So now we’re left to determine whether the not at-issue meaning is a conventional implicature or a presupposition.
Verbs and factivity (and presupposition)

Can the meaning be backgrounded without creating a redundancy?

Meaning: It’s raining outside.
(1b) Anna realizes that it’s raining outside.

(4) It’s raining outside, and Anna realizes it.

• And so we ask, can the meaning be backgrounded without creating a redundancy?
• We see in (4) that this is possible to do.
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspendible?
Yes → **Conversational implicature**
No → **Entailment**

Is the meaning a speaker commitment of the negated version of the sentence?
Yes → **Not at-issue**
No → **At-issue entailment**

Can the meaning be backgrounded without creating a redundancy?
Yes → **Presupposition**
No → **Conventional implicature**
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspensible?  
[Yes]  
Conversational implicature

No

Entailment

Is the meaning a speaker commitment of the negated version of the sentence?  
[Yes]
Not at-issue

No

At-issue entailment

Can the meaning be backgrounded without creating a redundancy?  
[Yes]  
Presupposition

No

Conventional implicature
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspensible?  Yes \rightarrow \text{Conversational implicature}

No \rightarrow \text{Entailment}

Is the meaning a speaker commitment of the negated version of the sentence?  Yes \rightarrow \text{Not at-issue}

No \rightarrow \text{At-issue entailment}

Can the meaning be backgrounded without creating a redundancy?  Yes \rightarrow \text{Presupposition}

No \rightarrow \text{Conventional implicature}
So that’s great, we have proven one of two parts to our claim about factive verbs.
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspendible?

Meaning: It’s raining outside.
(1a) Anna thinks that it’s raining outside.

(5) Anna thinks that it’s raining outside, but she’s wrong—it’s sunny.

- Let’s quickly diagnose the type of meaning now for (1a)—question 1: is the meaning cancellable?
- We see in (5) that the answer is yes, we can say “Anna thinks that it’s raining outside, but she’s wrong, it’s sunny”.
So the meaning is just a conversational implicature.
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least susceptible? 
Yes → Conversational implicature

No → Entailment

Is the meaning a speaker commitment of the negated version of the sentence?
Yes → Not at-issue

No → At-issue entailment

Can the meaning be backgrounded without creating a redundancy?
Yes → Presupposition

No → Conventional implicature
Verbs and factivity (and presupposition)

Is the meaning cancellable or at least suspendible?  
Yes  
**Conversational implicature**

No  
**Entailment**

Is the meaning a speaker commitment of the negated version of the sentence?  
Yes  
**Not at-issue**

Can the meaning be backgrounded without creating a redundancy?  
No  
**At-issue entailment**

Yes  
**Presupposition**

**Conventional implicature**
From these examples, it looks like the predictions made by this basic theory about factive verbs check out.
Here are some additional examples of verbs that get categorized as factive in the literature.

<table>
<thead>
<tr>
<th>find out</th>
<th>matters</th>
<th>regret</th>
<th>ignore</th>
</tr>
</thead>
<tbody>
<tr>
<td>notice</td>
<td>counts</td>
<td>be aware (of)</td>
<td>grasp</td>
</tr>
<tr>
<td>discover</td>
<td>makes sense</td>
<td>comprehend</td>
<td>understand</td>
</tr>
</tbody>
</table>

Reference: “Fact” (Kiparsky & Kiparsky, 1968)
So returning to the sentences you guys saw, the reported opinions all correspond to clausal complements of either factive or non-factive verbs.
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And there are some that straightforwardly express one of the 3 opinions--the opinion isn't embedded as a complement clause, there's no verb of embedding. These correspond to the simple "It's raining outside" type sentence—there's no "that" complementizer.

And we predict that the stance rating of these sentences will basically correspond to the stance of the opinion itself.
So returning to the sentences you guys saw, the reported opinions all correspond to clausal complements of either factive or non-factive verbs.

And there are some that straightforwardly express one of the 3 opinions--the opinion isn't embedded as a complement clause, there's no verb of embedding. These correspond to the simple “It's raining outside” type sentence—there's no “that” complementizer.

And we predict that the stance rating of these sentences will basically correspond to the stance of the opinion itself.

So here I've transformed the ratings into numerical quantities by treating every “for” as a +1, “neutral” as a 0, and “against” as a -1, and then taking their average. So the closer to -1 the average rating, the more the sentence is perceived as being anti-vaccine, and the closer to +1, the more it’s perceived as pro-vaccine.

It looks like the “Vaccines cause autism” sentence is very close to -1, or “against”, as we'd predict, and the “vaccines are good” sentence is very close to +1, also as we'd predict. The first sentence might be a bit more complicated--it’s actually on average rated by you guys as leaning toward being “for” vaccines.
Now let’s take a look at what happened to your perceptions of the sentences when the verb of embedding changed.

So in plot a), that’s just the bare opinion again, almost all votes were that the speaker was “for” vaccines.
Now let’s take a look at what happened to your perceptions of the sentences when the verb of embedding changed.

So in plot a), that’s just the bare opinion again, almost all votes were that the speaker was “for” vaccines.

In plot b), the opinion is now embedded with “point out...that vaccines are effective”. And most of you still perceived the speaker as being for vaccines, which is what we’d expect based on what we’ve learned about factive verbs, since the same presuppositions of the embedded clause, which in this case is the opinion that vaccines are effective, carry over. But it’s interesting that there are a couple more votes for neutral, which I think also makes sense, because the speaker is no longer stating the opinion directly but rather relaying someone else’s.
Now let’s take a look at what happened to your perceptions of the sentences when the verb of embedding changed.

So in plot a), that’s just the bare opinion again, almost all votes were that the speaker was “for” vaccines. In plot b), the opinion is now embedded with “point out...that vaccines are effective”. And most of you still perceived the speaker as being for vaccines, which is what we’d expect based on what we’ve learned about factive verbs, since the same presuppositions of the embedded clause, which in this case is the opinion that vaccines are effective, carry over. But it’s interesting that there are a couple more votes for neutral, which I think also makes sense, because the speaker is no longer stating the opinion directly but rather relaying someone else’s.

And then we can look at plot c), which shows the condition where the embedding verb is a so-called “neg-factive” verb, because it presupposes the falsity of the embedded clause. And we see a sharp decrease in “for” ratings, and for the first time, some of you perceived the speaker to be against vaccines. And I should add that not every linguist agrees that claim presupposes the falsity of the embedded clause—but there are some who say that it does.
Now let’s take a look at what happened to your perceptions of the sentences when the verb of embedding changed.

So in plot a), that’s just the bare opinion again, almost all votes were that the speaker was “for” vaccines.
In plot b), the opinion is now embedded with “point out...that vaccines are effective”. And most of you still perceived the speaker as being for vaccines, which is what we’d expect based on what we’ve learned about factive verbs, since the same presuppositions of the embedded clause, which in this case is the opinion that vaccines are effective, carry over. But it’s interesting that there are a couple more votes for neutral, which I think also makes sense, because the speaker is no longer stating the opinion directly but rather relaying someone else’s.

And then we can look at plot c), which shows the condition where the embedding verb is a so-called “neg-factive” verb, because it actually now presupposes the falsity of the embedded clause. And we see a sharp decrease in “for” ratings, and for the first time, some of you perceived the speaker to be against vaccines.

And finally for a non-factive, pretty neutral verb of reporting like “think”, we have the most votes for a neutral speaker, almost none for against, and some for “for”.

Opinion: “Vaccines are effective”

- **a)** No embedding
- **b)** Factive (*point_out*)
- **c)** Neg-factive (*claim*)
- **d)** Non-factive (*think*)
Let’s take a look at the results for a different set of opinions: “Vaccines cause autism”. With no verb of embedding the votes were overwhelmingly for the stance “against” vaccines.
With a factive verb, in this case it was reveal, the votes are still mostly for “against”, a couple more for “neutral”. This is in keeping with the two sentence types sharing the presupposition that vaccines cause autism.
With another neg-factive verb that not everyone agrees on, *refute*, we see essentially a flip of plots a) and b)—and this is pretty compelling evidence that *refute* does behave like a neg-factive verb, in that the sentence “scientists refute that vaccines cause autism” is perceived as being strongly for vaccines by implying that the embedded clause is false.
And finally, when the embedding verb is non-factive, i.e. neutral towards the truth of the complement clause, we see that most people perceive the speaker as being neutral toward vaccines.
The results for the third opinion, “vaccines are risky”, tended to stray from the most straightforward predictions:

For starters in the no embedding condition, more than half of you actually perceived the speaker as being for vaccines.
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For starters in the no embedding condition, more than half of you actually perceived the speaker as being for vaccines.

And then in the factive condition, “acknowledge that vaccines are risky”, we do see that the “for” votes disappear, although there are also quite a few neutrals. But “acknowledge” is also what you might call “less” factive of a factive verb—as you guys may have experienced from Assignment 6. It doesn’t seem quite as strong as, say, “reveal”, but it’s clearly stronger than a non-factive verb like “thinks”. (And this kind of gradience in factivity is actually becoming a pretty developed research area and has found a lot of evidence in the form of psycholinguistic experiments similar to the one I administered to all of you.)
In the neg-factive condition, which was “deny that vaccines are risky”, we see fewer “against” and more “for”, which is what we’d expect.

And then in the non-factive condition, we see the most neutrals.
I think *deny*, and also *claim*, are not neatly “neg-factive” verbs, and your judgments show how their semantics are murkier.

And then in the non-factive condition, we see the most neutrals.
Summary

- Perceptions of stance most uniform for non-embedded opinions

So to summarize, our results show that perceptions of stance are most uniform for non-embedded opinions.
When we look at the results binned by embedding condition, and we look at the no embedding condition, the judgments are very clear cut for the first two opinions, a bit less so for “vaccines are risky”.

**Condition: No embedding**

- **a) “Vaccines cause autism”**
- **b) “Vaccines are eff.”**
- **c) “Vaccines are risky”**
Summary

- Perceptions of stance most uniform for non-embedded opinions
- Perceptions also tended to be uniform for opinions embedded by factive verbs

We see that perceptions also tended to be uniform for opinions embedded by factive verbs, and were consistent with what we'd predict from the property that factive verbs presuppose their complement clause.
As we discussed, the factive verb of embedding condition mostly doesn’t change perceptions of stance for the first 2 opinions as we’d predict, though it does change things for “vaccines are risky”—but in ways that are also more or less consistent with expectations—the perception of “for” becomes impossible.
And we also saw that perceptions tended to be less uniform in the neg-factive and non-factive conditions.

But there are two patterns that seem to emerge: One, embedding an opinion with a neg-factive verb increased likelihood of being perceived as opposing stance.
Condition: Neg-factive verb of embedding

a) "Vaccines cause autism" b) "Vaccines are eff." c) "Vaccines are risky"
Condition: Factive verb of embedding

a) “Vaccines cause autism”  b) “Vaccines are eff.”  c) “Vaccines are risky”
Summary

- Perceptions of stance most uniform for non-embedded opinions
- Perceptions also tended to be uniform for opinions embedded by factive verbs
- Perceptions tended to be less uniform in neg-factive and non-factive conditions:
  - Embedding an opinion with a neg-factive verb increases likelihood of being perceived as opposing stance
  - Sentences with opinions embedded by a neutral verb tend to be perceived as neutral

And two, sentences with opinions embedded by a neutral verb tended to be perceived as neutral
Most of you perceived the speaker stance as being neutral toward vaccines in the non-factive condition.
So I think now there’s some time to switch gears a bit to talk about some of my own ongoing research in the media coverage of vaccines, which I’ve been doing in collaboration with Dan Jurafsky and Beth Levin in the linguistics department.

And to give you guys some sense of what the media coverage looks like, here I’ve juxtaposed a screenshot of an article from the New York Times, titled “How Anti-vaccine sentiment took hold in the US”, and an article from an anti-vaccine website, “How the media lie about why parents don’t vaccinate”. And the interesting thing is that the New York Times article quotes a doctor saying this kind of ominous quote, “Science has lost its platform, now you simply declare your own truth”—and the anti-vaccine article literally does that by saying, “The truth is that…” etc.
And in declaring one’s own truth, you don’t just relay your own opinions, but also the opinions of other entities who might hold similar ones. So in this example, the author relays the opinion of parents who also express related anti-vaccine sentiments: “that public vaccine policy poses a serious threat to our health”, “that they are being lied to about what science tells us about the safety and effectiveness of vaccines”.

The truth is that an increasing number of parents are choosing not to vaccinate because they recognize that public vaccine policy poses a serious threat to both our health and our liberty [...] They understand that they are being lied to about what science tells us about the safety and effectiveness of vaccines.
And at a high level, I was interested in analyzing these quoting patterns in terms of bias in whose opinions are being conveyed, and how those opinions are being conveyed.

So one empirical question was, “which verbs does each side (pro-vaccine and anti-vaccine) use to relay their own side’s opinions, and which verbs do they tend to use to relay the opposing side’s opinions?”
Bias in opinion attribution

“Which verbs does each side use to relay their own opinions vs. the opposing side’s?”

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Likelihood (log odds ratio) of relaying an own-side vs. opposing-side opinion (Stance Bias)

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So one empirical question was, “which verbs does each side (pro-vaccine and anti-vaccine) use to relay their own side’s opinions, and which verbs do they tend to use to relay the opposing side’s opinions?”

So for this I measured a quantity that I called “Stance Bias”, and it’s a measure of the relative likelihood that a verb relays an own-side opinion compared to an opposing-side opinion. So verbs with a high stance bias are those that are more likely to relay an own-side opinion.
Bias in opinion attribution

“Which verbs does each side use to relay their own opinions vs. the opposing side’s?”

Likelihood (log odds ratio) of relaying an own-side vs. opposing-side opinion (STANCE BIAS)

“Which verbs does each side use to relay opinions from their allies vs. opponents?”

And another empirical question was, “which verbs does each side use to relay the opinions of their allies vs. enemies?”
Bias in opinion attribution

“Which verbs does each side use to relay their own opinions vs. the opposing side’s?”

Likelihood (log odds ratio) of relaying an own-side vs. opposing-side opinion (Stance Bias)

“Which verbs does each side use to relay opinions from their allies vs. opponents?”

Likelihood (log odds ratio) of relaying opinion from an own-side vs. opposing-side entity (Entity Bias)

And I computed a similar metric for each verb, but this time it measures the relative likelihood of relaying an opinion from an own-side entity compare to an opponent entity.
Data and methods

- Scraped media articles from NYT, Fox, Breitbart, Children’s Health Defense (CHD), Physicians for Informed Consent, etc.
- Use dependency parsing to automatically extract source entity (= who’s being quoted from), predicate of quoting (= how opinion is quoted), and content of quote itself (= what opinion is quoted)
- Automatically classify stance of embedded opinions using BERT fine-tuned on labeled data collected from Amazon MTurk
A few observations:
- "Say" most common for own and opposing-side quotes in pro-vax media
- anti-vax media uses conclusive/high confidence verbs to embed own-side quotes
- anti-vax media uses argumentative verbs to embed opposing-side quotes
Going back to factive verbs, we find that factivity accounts for some of the variance in a predicate’s stance bias— at least, the broad categorization of positive and negative values is as predicted—though we see that there are many cases of non-factive verbs showing a large magnitude stance bias. And as a reminder, a positive stance bias means that a verb is more likely to embed an own-side opinion, so we expect factive verbs to have a large positive stance bias, and neg-factive verbs to have a large negative stance bias.

Once exception is “allege”, which is more likely to introduce an own-side opinion in anti-vax media, despite it presupposing the falsity of its complement.
The case of *allege*

- “The whistleblower alleged that the MMR vaccine increases the risks of these conditions.”
- “In 2014, Thompson sought federal whistleblower protection and testified to Congressman William Posey about the fraudulent omission of key autism results in the 2004 paper. Thompson alleged that he had acted at the direction of senior CDC officials, including Branch Chief and lead author Frank DeStefano, who ordered Thompson and coauthors to dump the datasets into a giant garbage can to get rid of the evidence establishing a causal vaccine-autism connection.”

- But when we looked at the larger contexts in which “allege” was used, the positive stance bias made a bit more sense—it seems that “allege” is reserved for courtroom contexts, and there are a lot of people trying to sue for vaccine injuries.
And a final figure that I wanted to share is that we find that in pro-vax media, there is a strong positive correlation between a predicate’s entity bias and stance bias, in other words, predicates that tend to quote opinions from own-side, pro-vaccine entities like the CDC, WHO, Bill Gates, also tend to express opinions that are in favor of vaccines (and these are predicates like “warn”, “report”, “announce”, “stress”, “say”), and predicates that tend to quote opinions from opposing-side entities, in this case anti-vaccine entities (like Robert Kennedy Jr., Tom Cruise), also tend to express opinions that are against vaccines. And you might think that this is just a very intuitive fact about reporting, but this is not the case in the anti-vaccine media we looked at:
So there is some positive correlation between stance and entity bias happening along the y=x line, but there’s also this cluster of verbs that tend to attribute an anti-vaccine opinion to a *pro*-vaccine source entity, and the interesting thing is that a lot of these verbs have a concessive tone: *acknowledge, admit, recognize* -- part of a conspiracy narrative.
Thank you!

https://www.youtube.com/watch?v=i-DZiHi5UD3&feature=youtu.be&t=290

And I want to close with this clip from The Late Show w/ Stephen Colbert, that bears on factivity, but also shows how really diverse the semantics of these opinion attribution verbs are.
References


