Pregnant Questions: The Importance of Pragmatic Awareness in Maternal Health Question Answering

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Humans embed assumptions in questions all the time.

When should I give my baby fever reducing meds for shots?

Which Harry Potter movie featured Tom Cruise?

Why did President Franklin D. Roosevelt get a third term?

Why can tenants be evicted without any notice if the landlord decides to sell the property?

What year did Billy Joel's 15th studio album release?

When dividing a number by zero, why is the result always infinity?

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What do we want from a QA system?

When should I give my baby fever reducing meds for shots?

Receiving shots can cause a fever in a baby.

I should give my baby some fever reducing medication when they are taking vaccines.

There is a certain amount of time that needs to pass before giving fever reducing meds after a shot.

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What do we want from a QA system?

When should I give my baby fever reducing meds for shots?

Often, fevers are associated with illness, and, **so it is understandable if you worry if your child develops a fever post-vaccination.** But, **fevers are a normal part of immune responses! Giving medication prior to a vaccine visit is not recommended because they may decrease your child's immune response to the vaccine. In most cases a child doesn't need to be medicated for a fever unless they are extremely uncomfortable.** For low grade fevers of 100-102° F (37.8 to 39° C), do not give fever medicines, since hey may reduce your child's normal immune response. For fevers above 102° F (39° C), medicine may be given for discomfort. If needed, use acetaminophen.

You should give your baby fever reducing medication after shots if they are experiencing discomfort or extreme discomfort due to the fever. However, it is important to note that in most cases, a child does not need to be medicated for a fever unless they are extremely uncomfortable. The most important thing to do when a child has a fever is to make sure they stay hydrated by drinking plenty of fluids.
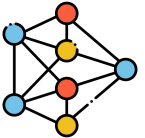
Our contributions

We explore these research questions about false assumptions in maternal health QA:

RQ 1

How do humans embed assumptions and implications in questions?

RQ 2

How do public health experts address assumptions and implications in user questions?

RQ 3

How well-equipped are current QA pipelines to answer these questions as thoroughly as humans do?

Our contributions

Question Collection

reddit

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Health Expert Annotation

OB/GYNs, Lactation Specialists, Public Health Experts

1. Answer Writing
2. Assumption Identification
3. Veracity and Supporting Document

Our contributions

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Presupposition

Implicature

Human Behavior Analysis

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Linguistic Grounding
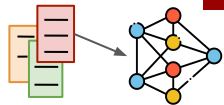
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How do humans embed assumptions in questions?

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QA Experiments: Inducing Pragmatic Behavior + Evaluation

How do we augment a classic QA pipeline to account for false pragmatic inferences?

What do expert humans think of the augmented model answers?

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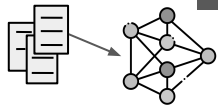### Linguistic Grounding

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Our Dataset: Questions

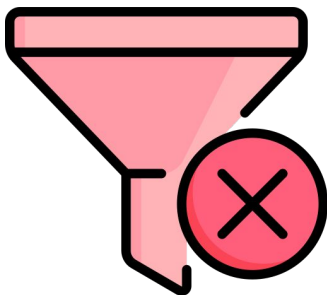Is it okay for me to color my hair after giving birth?

Is it bad to use different bottles/nipples during feedings?

When does the fetus begin to develop memory?

Our Dataset: Reddit

r/BabyBumps
r/breastfeeding
r/NewParents
r/Mommit
r/beyondthebump

Is it okay for me to color my hair after giving birth?

Filtering Heuristics

Assumption-Correcting Behavior in Upvoted Comment

Post begins with a wh word

Question is information-seeking vs. participation seeking

Edit the titular question to include post details

Our Dataset: Custom QA System

Rosie: A Maternal Health QA System

Document Corpus (Governmental + Hospital Web Documents)

Passage Retriever + Reranker delivers answers through mobile application

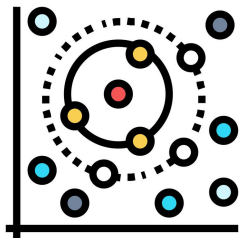Questions come from pregnant and postpartum clinical trial participants

Is it bad to use different bottles/nipples during feedings?

Our Dataset: Natural Questions

NQ Train Set

mpnet-base-v2

Nearest Neighbors

Embed the NQ train set using a strong encoder model

Identify top 100 nearest neighbors of Reddit + Rosie

Randomly sample answerable and unanswerable questions

When does the fetus begin to develop memory?

Our Dataset

Is it okay for me to color my hair after giving birth?

Hair dye chemicals can pass through breast milk from mother to child.

False

Is it bad to use different bottles/nipples during feedings?

Using different bottles or nipples for feeding may compromise the baby's latch.

False

When does the fetus begin to develop memory?

Fetuses have the ability to form memories.

True

Our Dataset

Is it okay for me to color my hair after giving birth?

Most experts agree that hair dye is generally…
Evidence: www.mayoclinic.org/<>

Is it bad to use different bottles/nipples during feedings?

The type of nipple and bottle you choose will mainly depend…
Evidence: www.kidshealth.org/<>

When does the fetus begin to develop memory?

Studies addressing the formation of memories in utero…
Evidence: www.cdc.org/<>

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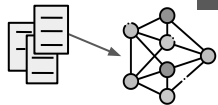
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Can we use linguistic theory to help study questions?

Presupposition

Implicit assumptions in utterances taken for granted by discourse participants. ***They are already part of an asker's world model.***

```
What vitamins should I stop taking
after becoming pregnant?
```

presupposes

```
I was taking vitamins before
becoming pregnant. (Trigger: "stop")
```

Implicature

A type of pragmatic inference suggested by an utterance instead of part of its literal meaning. These are likely beliefs that may be negated in a subsequent utterance.

```
Do most babies fit in newborn
clothes?
```

implies

```
Not all babies fit in newborn
clothes.
```

Humans making presuppositions presume that the content of the inference is true AND that their conversational partner should believe the content of the inference is true. Presuppositions are stronger, while implicatures are softer.

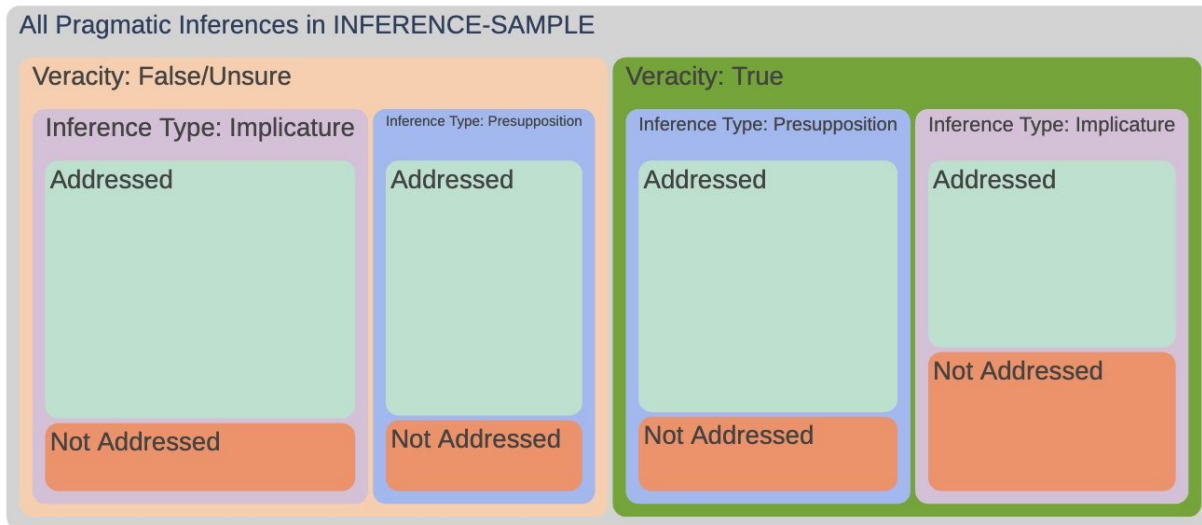`Is it sufficient if my baby takes most immunity injections?`

implies

`It is okay to pick and choose vaccines.`

`Which immunity injections can I skip for my baby?`

presupposes

We annotate a sample of inferences in our dataset and find...

All Pragmatic Inferences in INFERENCE-SAMPLE

Veracity: False/Unsure

Inference Type: Implicature
- Addressed
- Not Addressed

Inference Type: Presupposition
- Addressed
- Not Addressed

Veracity: True

Inference Type: Presupposition
- Addressed
- Not Addressed

Inference Type: Implicature
- Addressed
- Not Addressed

When users make false or subjective inferences, they are more likely to do so via implicature.

When an inferences is false, it is more likely to be naturally addressed in an expert answer!

Our contributions

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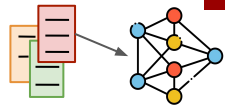
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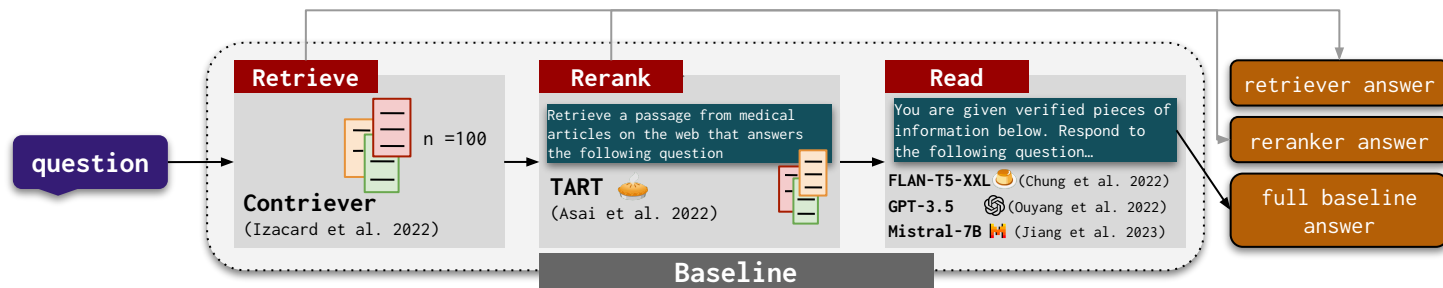**QA Experiments: Inducing Pragmatic Behavior + Evaluation**

How do we augment a classic QA pipeline to account for false pragmatic inferences?

What do expert humans think of the augmented model answers?

What does our baseline pipeline look like?

question

Retrieve

n =100

Contriever
(Izacard et al. 2022)

Rerank

Retrieve a passage from medical articles on the web that answers the following question

TART 🥧
(Asai et al. 2022)

Read

You are given verified pieces of information below. Respond to the following question…

FLAN-T5-XXL 🍩 (Chung et al. 2022)
GPT-3.5 (Ouyang et al. 2022)
Mistral-7B (Jiang et al. 2023)

Baseline

retriever answer

reranker answer

full baseline answer

What does our augmented pipeline look like?
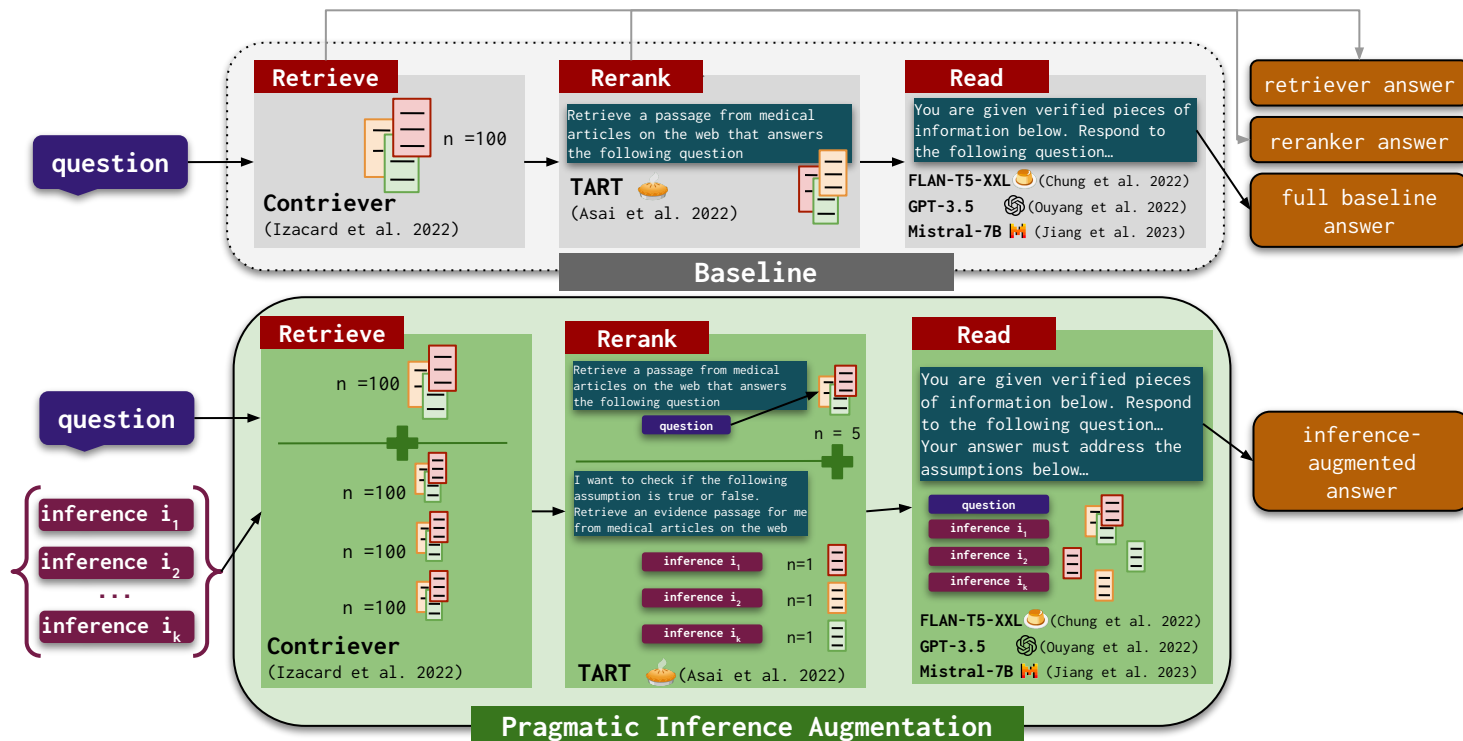
Does this work?

When should I give my baby fever reducing meds for shots?

You should give your baby fever reducing medication after shots if they are experiencing discomfort or extreme discomfort due to the fever. However, it is important to note that in most cases, a child does not need to be medicated for a fever unless they are extremely uncomfortable. The most important thing to do when a child has a fever is to make sure they stay hydrated by drinking plenty of fluids. If you are unsure whether your child should receive medication to address the fever or other symptoms, it is recommended to consult with your child's healthcare provider.

Baseline

It is not recommended to give your baby fever reducing medication before or immediately after receiving shots. Studies have shown that giving medication prior to a vaccine visit may decrease the child's immune response to the vaccine. Fevers after vaccination are actually a sign that the immune system is responding to the vaccine. If your baby develops a fever after receiving shots, it is generally not necessary to give them medication unless they are extremely uncomfortable. The most important thing to do when a child has a fever is to make sure they stay hydrated by drinking plenty of fluids. If you are unsure it is best to consult with your child's healthcare provider.

Pragmatic Inference Augmented

Does this work?

How warm can my bath be while staying safe for my 4 month-old baby?

To ensure the safety of your 4-month-old baby during bath time, it is recommended to fill the basin with water that feels warm, but not hot, to the inside of your wrist or elbow. The water temperature should be comfortable for your baby and should not pose a risk of burns or scalds. It is important to check the water temperature before placing your baby in the bath to prevent any potential harm.

Baseline

The safe temperature for a baby may be different from that for an adult. It is important to ensure that the bathwater is warm, but not hot, for a 4-month-old baby. According to the provided information, the water should feel warm to the inside of your wrist or elbow. It is recommended to fill the basin with 2 inches of water at this warm temperature.This is to prevent the baby from getting burned or scalded by hot water. **It is important to note that babies are not as adaptable as adults to temperature change, and they can lose heat rapidly. Therefore, it is crucial to maintain a safe and comfortable water temperature for the baby during bath time.**

Pragmatic Inference Augmented

Does this work?

	No Reader		Baseline Reader			Inference-Augmented	
	RETRIEVE	RERANK	FLAN-T5-XXL	MISTRAL-7B	GPT-3.5	MISTRAL-7B	GPT-3.5
ROUGE-L (F1)	$15.6_{(10.3)}$	$17.5_{(10.3)}$	$15.89_{(13.7)}$	$17.4_{(5.1)}$	$18.7_{(6.0)}$	$16.2_{(4.8)}$	$18.6_{(5.9)}$
ROUGE-L (Recall)	$23.0_{(15.7)}$	$19.5_{(10.9)}$	$36.9_{(21.9)}$	$15.2_{(6.8)}$	$17.4_{(8.1)}$	$13.2_{(5.7)}$	$16.6_{(7.6)}$
BLEURT	$-0.72_{(0.34)}$	$-0.61_{(0.29)}$	$-0.79_{(0.45)}$	$-0.38_{(0.22)}$	$-0.37_{(0.22)}$	$-0.36_{(0.21)}$	$-0.38_{(0.22)}$
QAFACTEVAL	$0.69_{(1.05)}$	$0.76_{(0.80)}$	$1.16_{(1.5)}$	$1.02_{(0.65)}$	$1.15_{(0.73)}$	$0.96_{(0.62)}$	$1.17_{(0.75)}$
Human (/5)	-	-	-	-	4.43	-	4.45

We ask our expert validators to score answers from the top-performing baseline and inference-augmented pipeline. Expert validators score both model outputs simultaneously from 1–5 based on completeness.

We hypothesize that the similar ratings received by the two systems across all questions is due to shortcomings in the instruction-following capabilities of LLMs.
- Forcing the reader model to address pragmatic inferences distracts it from answering the question more completely, and does not always result in more helpful answers when the pragmatic inferences are true.

Conclusion

	No Reader		Baseline Reader			Inference-Augmented	
	RETRIEVE	RERANK	FLAN-T5-XXL	MISTRAL-7B	GPT-3.5	MISTRAL-7B	GPT-3.5
ROUGE-L (F1)	$15.6_{(10.3)}$	$17.5_{(10.3)}$	$15.89_{(13.7)}$	$17.4_{(5.1)}$	$18.7_{(6.0)}$	$16.2_{(4.8)}$	$18.6_{(5.9)}$
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BLEURT	$-0.72_{(0.34)}$	$-0.61_{(0.29)}$	$-0.79_{(0.45)}$	$-0.38_{(0.22)}$	$-0.37_{(0.22)}$	$-0.36_{(0.21)}$	$-0.38_{(0.22)}$
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Human (/5)	-	-	-	-	4.43	-	4.45

These results illustrate the promise of inducing pragmatic behavior in QA models and **represent a lower bound of their performance,** as none of the models we experiment with were trained to optimize for addressing assumptions in questions.