# STRICTA: Structured Reasoning In Critical Text Assessment for Peer Review and Beyond


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## 1 Contributions

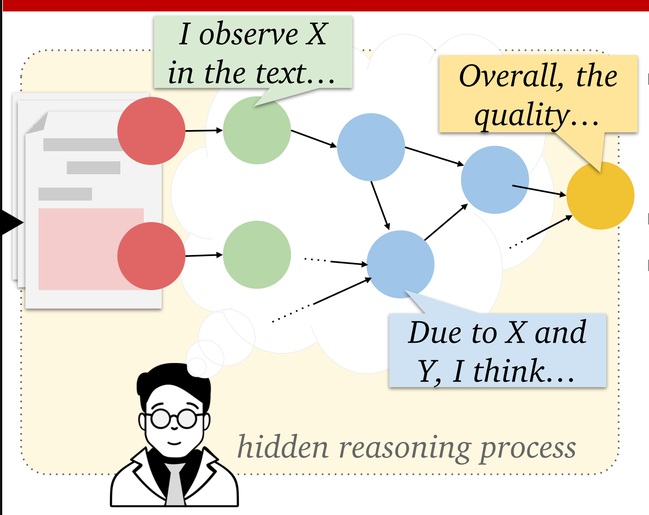
**3-step framework** *for modeling structured reasoning with uncertainty*

**Routed in causality** *using Pearl's SCMs*

**Expert multi-modal reasoning dataset** *with >4k reasoning steps on >20 biomedical papers*

**Insights in human and LLM assessment behavior** *e.g. background knowledge is a major source of variance*

## 2 Motivation

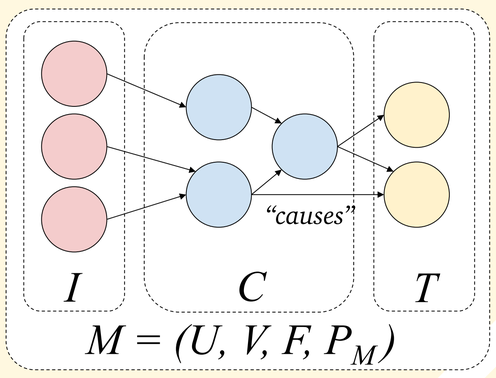



- **Critical text assessment is ubiquitous:** *peer review, essay grading, fact checking*
- **Unveiling the black box**
- **Structured reasoning** *because…*
  - ⊕ *fine-granular evaluation*
  - ⊕ *human behavior analysis*
  - ⊕ *human-LLM collaboration*

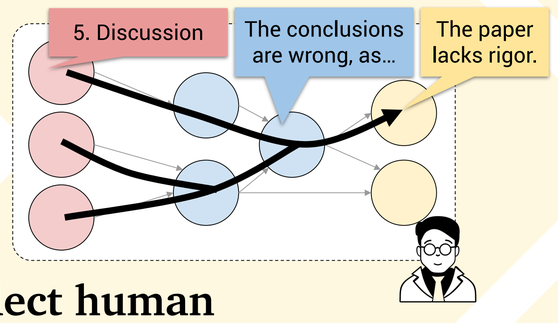
## 3 STRICTA

### I. Design Structured Causal Model

**Discover reasoning steps and links** *e.g. by expert interviews*

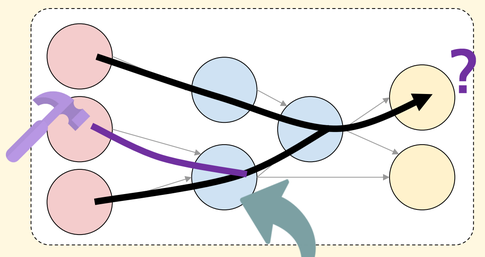



### II. Populate SCM




**Collect human reasoning** *as annotations*

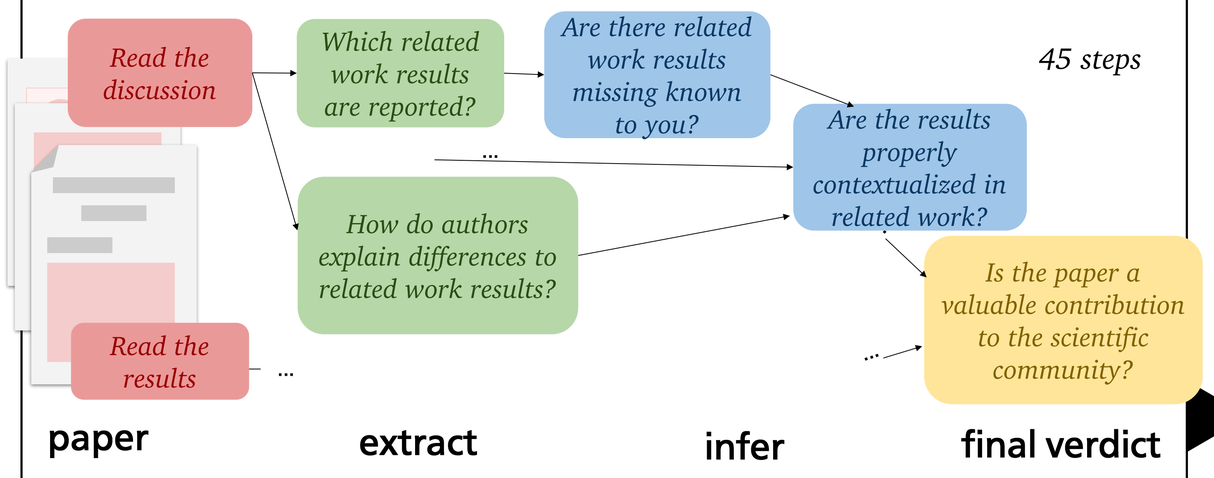
### III. Analysis + LLMs



**Study causal reasoning** **Test LLMs**

## 4 Biomedical Paper Assessment

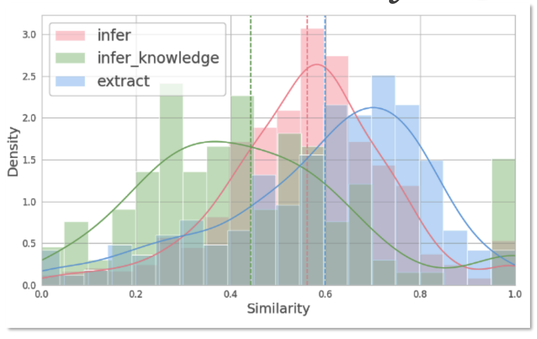
**Biomedical Assessment Workflow** *based on interviews*




### Expert-generated Dataset

| Dataset Statistics | |
|---|---|
| *# step answers* | *4371* |
| *# worklow answ.* | *93* |
| *# papers* | *22* |
| *Krippendorff's α* | *0.42* |

### Background knowledge *invokes dissimilarity*




## 5 Causal Analysis + LLM Experiments

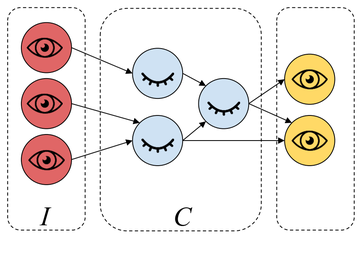
**Which factors shape the assessment most?**

| Steps' Average Causal Effect on Verdict | |
|---|---|
| *Consistency of conclusions to RQs* | *0.37* |
| *Relevance of conclusions to science* | *0.20* |
| *Clarity of the paper* | *0.20* |

› *Humans show a* **positive bias** *towards* **well-written papers.**

*… and a lot more analysis including counterfactuals etc.*

### Can LLMs explain human's final verdicts?




‹ *LLMs perform best on* **extraction** *and* **weight factors differently**

| | BERT-F1 ↑ | SummaC ↑ | TRUE ↑ | F1 ↑ |
|---|---|---|---|---|
| human*† | **0.799**$_{\pm.06}$ | −0.151$_{\pm.30}$ | 0.151$_{\pm.27}$ | **0.801** |
| Llama3 Prg† | 0.752$_{\pm.10}$ | −0.274$_{\pm.36}$ | 0.098$_{\pm.30}$ | 0.170 |
| Mixtral Prg† | 0.761$_{\pm.09}$ | **-0.149**$_{\pm.26}$ | 0.120$_{\pm.32}$ | 0.559 |
| GPT3.5t Prg† | 0.759$_{\pm.10}$ | −0.178$_{\pm.35}$ | **0.163**$_{\pm.37}$ | 0.531 |
| GPT4o Prg† | 0.780$_{\pm.07}$ | −0.186$_{\pm.30}$ | 0.139$_{\pm.35}$ | 0.720 |
| majority$^{io}$ | | | | 0.854 |
| human*$^{io}$ | 0.799$_{\pm.06}$ | −0.158$_{\pm.29}$ | 0.150$_{\pm.27}$ | 0.801 |
| Llama3$^{io}$ | 0.786$_{\pm.07}$ | −0.141$_{\pm.30}$ | 0.145$_{\pm.35}$ | 0.657 |
| Mixtral$^{io}$ | 0.794$_{\pm.07}$ | **-0.077**$_{\pm.27}$ | 0.161$_{\pm.37}$ | 0.822 |
| GPT3.5t$^{io}$ | **0.805**$_{\pm.07}$ | −0.125$_{\pm.34}$ | **0.214**$_{\pm.41}$ | 0.789 |
| GPT4o$^{io}$ | 0.795$_{\pm.07}$ | −0.094$_{\pm.28}$ | 0.194$_{\pm.40}$ | **0.876** |
| GPT4o§ | 0.776$_{\pm.07}$ | −0.154$_{\pm0.28}$ | 0.188$_{\pm.39}$ | 0.828 |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