

Studying English Anticausative Constructions with the Help of LLMs

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What are Anticausatives?

He broke the window.

The window broke.



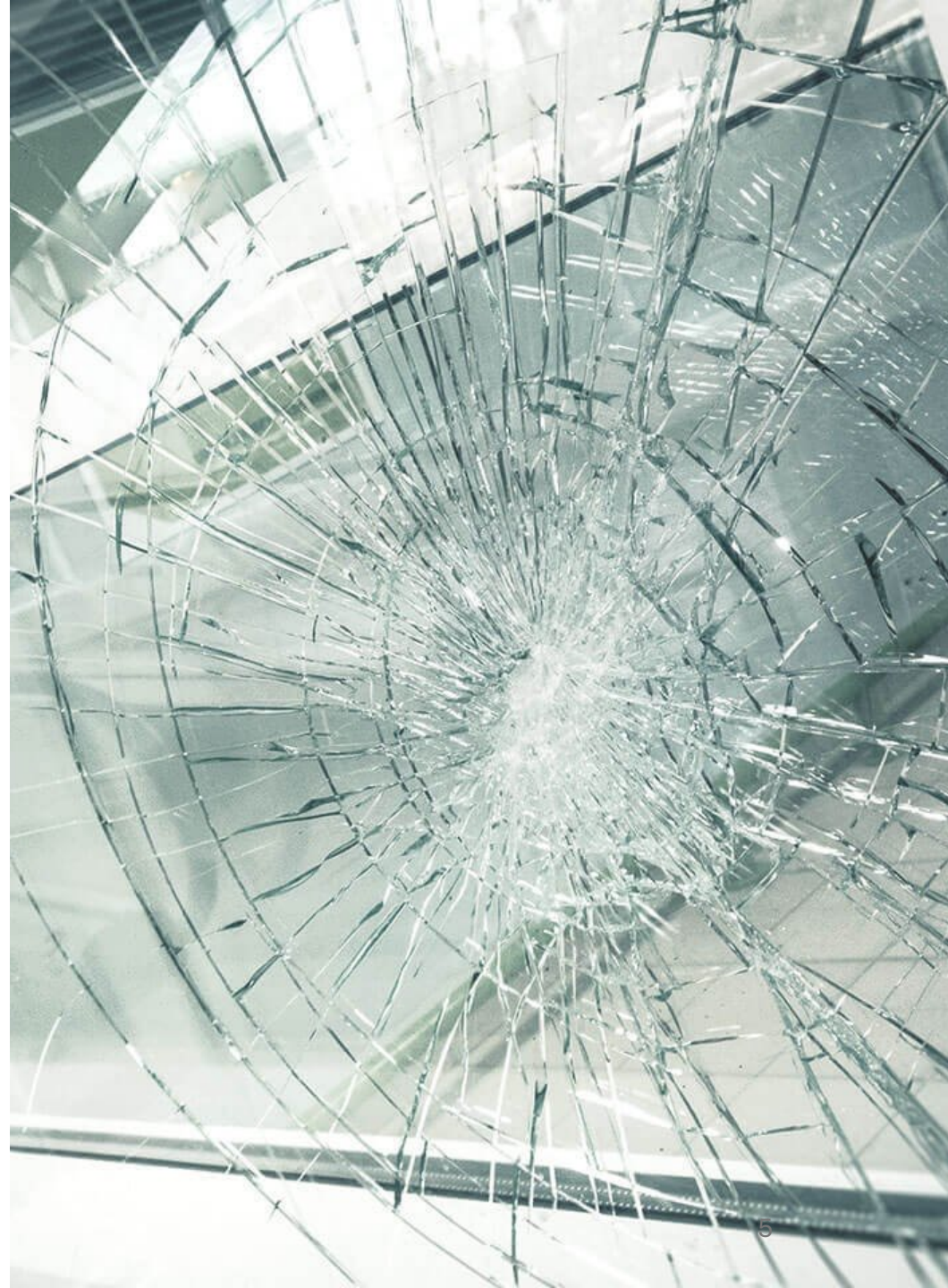
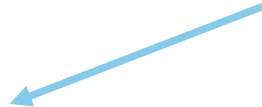
He broke the window.


The window broke.



⊘ broke the window.

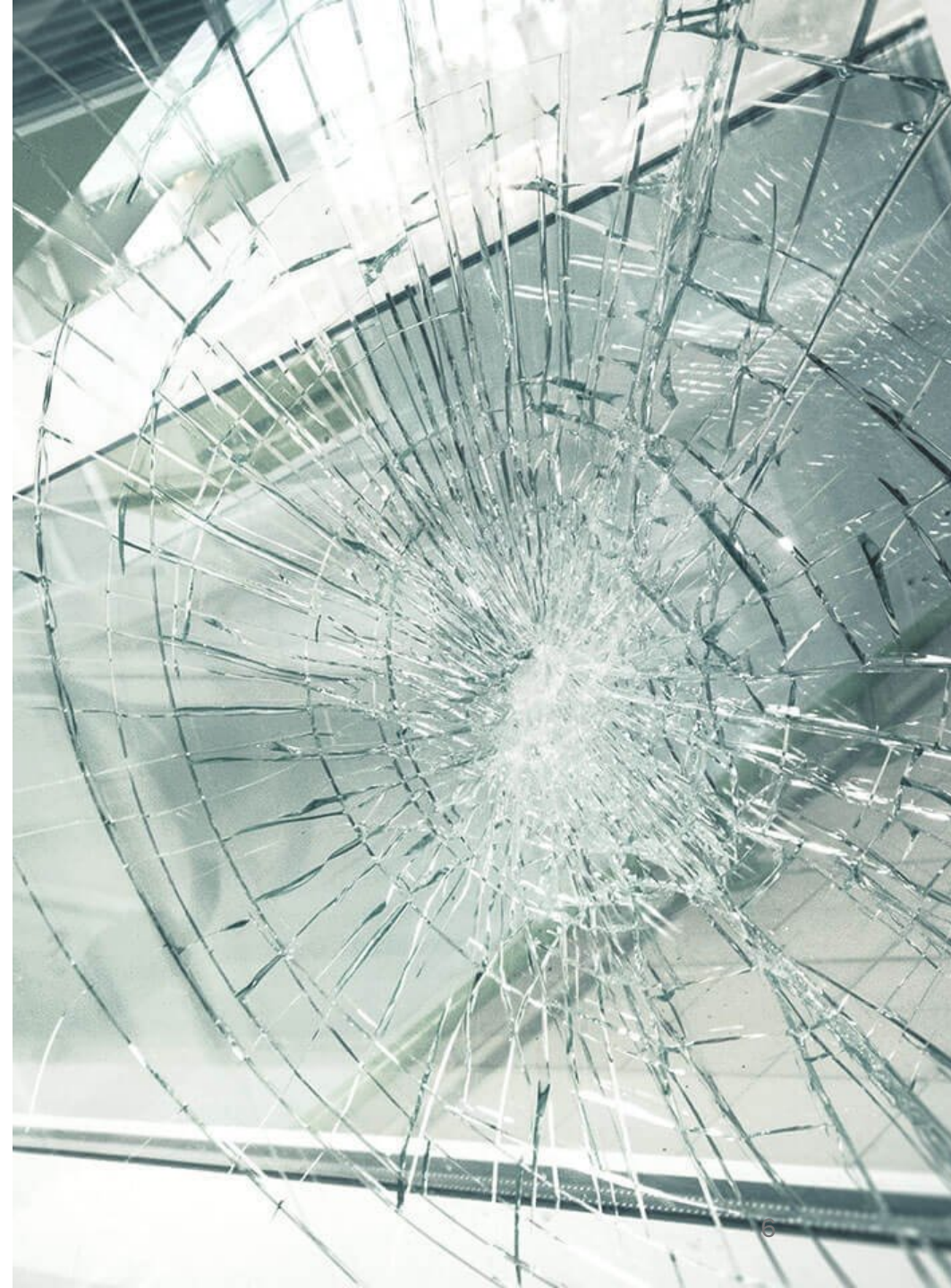
The window broke.



🚫 broke the window.


The window broke.

*The window broke by him.



Anticausatives:

- Are syntactically intransitive.
- Have patient subjects that denote the same entities as the direct objects of the corresponding transitive patterns.
- Usually have inanimate subjects.
- Do not have an external causing agent in their syntactic structure and semantic frame.
- Have a non-causative (inchoative) meaning

Relevant variable:

Syntactic transitivity

Subject role

Subject animacy

Semantic transitivity

~Causativity

Why Study Anticausatives (with LLMs)?

- Anticausatives have received considerable attention in typological as well as generative approaches to language (e.g. Alexiadou et al. 2006; Grewendorf 1989; Grimshaw 1982; Haspelmath 1987, 1993; Levin & Rappaport Hovav 1995; Schäfer 2008)
- In English, both synchronic and diachronic corpus-based investigations are rare leaving many questions unanswered (but see e.g. García García and Ruiz Narbona 2021; Ingham 2020)
- The construction has seen an increase in productivity over the past centuries and is a highly productive pattern in PDE (e.g. Halliday 1994; Keyser and Roeper 1984; McMillion 2006)

Problems with studying anticausatives in corpora:

- English uses the same verb form in the transitive and intransitive pattern
- Frequency of the anticausative construction compared to other uses of the same verb
- Polysemy of verbs that show the alternation

How to Study Anticausatives with LLMs?

A first, naive human prompt

I want to do a corpuslinguistic project on anticausatives.

Please provide a definition of anticausatives.

Then analyse the following sentences according to whether they contain an anticausative verb.

1. SNL's Tom Hanks episode, which aired October 22, had two such sketches back-to-back.
2. Iranian TV has also begun airing Japanese movies showing unveiled women.
3. NBC airs its special from 11 p.m. to 1 a.m., ABC and CBS from 11:30 p.m. to midnight.
4. Shahi portrays L.A.'s hottest lesbian DJ on The L Word, now airing on Showtime.

A first, naive LLM answer



Definition of Anticausatives

Anticausative verbs describe events that happen without an external cause or agent. They typically involve an action or change of state where the subject undergoes the action without an explicit agent causing it. These verbs are intransitive and often have a causative counterpart. For example, in the pair "break" (causative: "The boy breaks the vase") and "break" (anticausative: "The vase breaks"), the latter shows the anticausative use where the event occurs without an external cause.

Analysis of Sentences

Let's analyze the sentences to determine if they contain anticausative verbs:

1. **SNL's Tom Hanks episode, which aired October 22, had two such sketches back-to-back.**
 - **Verb:** "aired"
 - **Analysis:** "aired" here is used in a transitive sense, implying that someone (NBC or SNL) caused the episode to be broadcast. This is not an anticausative usage.
2. **Iranian TV has also begun airing Japanese movies showing unveiled women.**
 - **Verb:** "airing"
 - **Analysis:** Similar to the first sentence, "airing" is used transitively. Iranian TV is the agent that is causing the Japanese movies to be broadcast. This is not an anticausative usage.
3. **NBC airs its special from 11 p.m. to 1 a.m., ABC and CBS from 11:30 p.m. to midnight.**
 - **Verb:** "airs"
 - **Analysis:** Again, "airs" is used in a transitive sense with NBC, ABC, and CBS being the agents broadcasting the specials. This is not an anticausative usage.
4. **Shahi portrays L.A.'s hottest lesbian DJ on The L Word, now airing on Showtime.**
 - **Verb:** "airing"
 - **Analysis:** "airing" here is used to indicate the broadcast of "The L Word" on Showtime, with Showtime being the implied agent. This is not an anticausative usage.

Conclusion

None of the provided sentences contain an anticausative verb. The verbs "aired" and "airing" in these contexts are used transitively, implying an external agent (e.g., TV networks) that causes the action of broadcasting.

Can LLMs be useful for linguists?

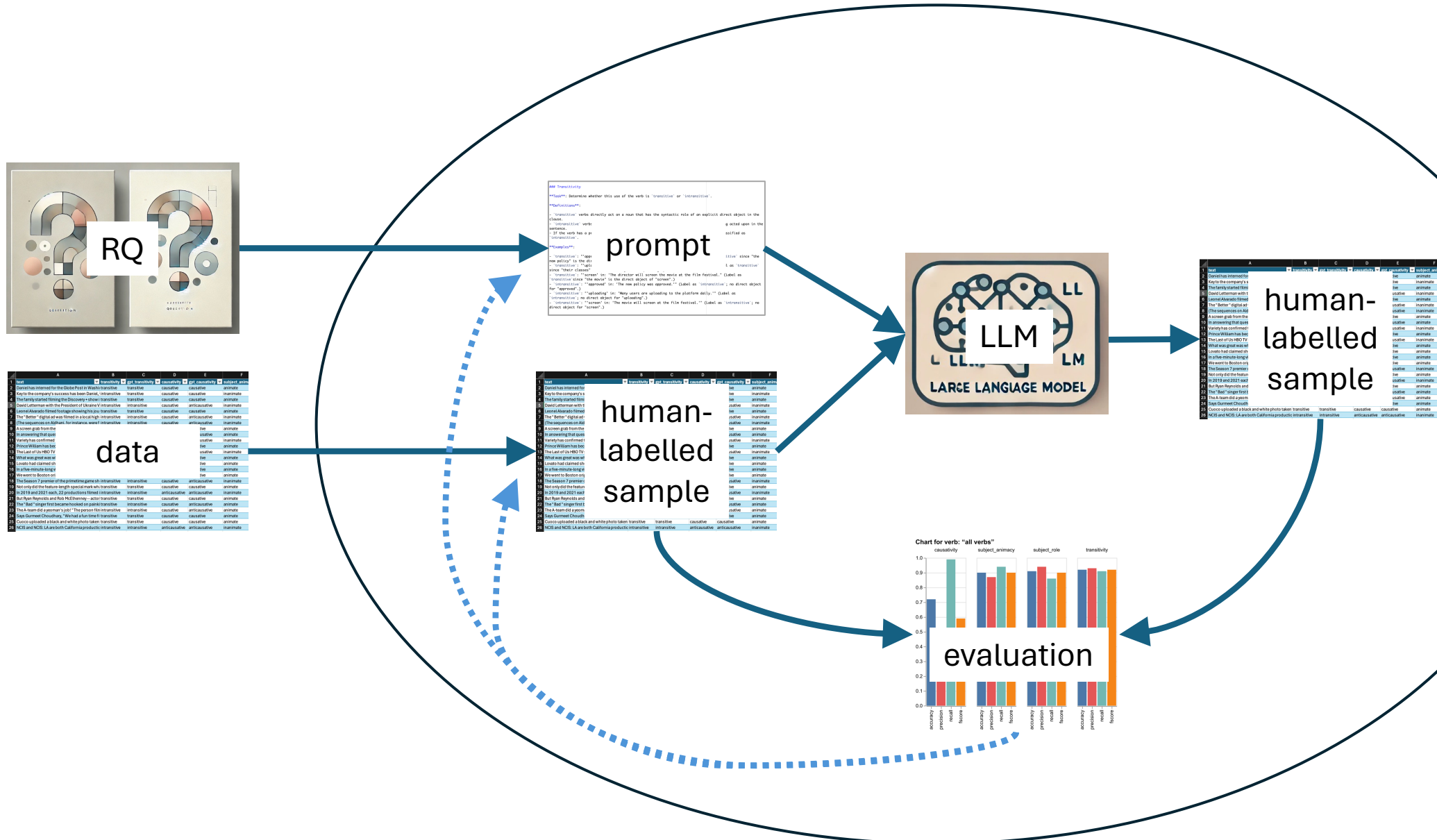
Empirical assessment

- Fonteyn (2024): successfully using BERT (precursor to GPT et al.) for **word-sense disambiguation** (metaphors) and **semantic role labelling**; also based on historical data.
- Torrent (2024): detailed book “Copilots for Linguists”; successful application in the context of **frame semantics**.
- Weissweiler (2024): identifying **argument structure constructions** with mixed success; **cost-benefit analysis**: humans vs machines.
- Yu (2023): classifying pragmatic variables related to **apology speech acts**.

Practical advantages

- **easy** to use: “programming in English”
- **interpretable** in the form of natural language feedback (controversial)
- **versatile**
 - **variables**: formal & semantic
 - **data formats**: sentences, paragraphs, documents
- **scalable**: big data & small cost

An iterative LLM Workflow



Input data

	A	E	G	I	J	L	P
1	text	verb_realization	transitivity	semantic_transitivity	causativity	subject_animacy	subject_role2
2	Over MBS it will continue to be aired from the Cook County Marriage License Bureau.	aired	intransitive	transitive	causative	inanimate	patient
3	One other consideration dampened Congressional ardor for legislation like the Celler Bill. N. A. B.'s President Mark Foster Ethridge acutely observed that the State Department would find it easier to explain embarrassing statements on international broadcasts if private broadcasters made them than if they were aired over a Government-owned- &-operated station.	aired	intransitive	transitive	causative	inanimate	patient
4	In the course of its existence, the Radio Theatre has aired 272 different shows, ranging from Peg O' My Heart to the Life of Louis Pasteur.	aired	transitive	transitive	causative	animate	agent
5	Last week for the first time in six months CBS's short-wave listening post picked up a newscast aired by the celebrated German Freiheitsender-the secret " Freedom Station " the Nazis have repeatedly tried to suppress.	aired	intransitive	transitive	causative	inanimate	patient
6	Designed to tell inside stories about programs and radio personalities, Behind the Mike is now aired over 85 stations and short-waved to Canada and South America.	aired	intransitive	transitive	causative	inanimate	patient

LLM setup

- **model selection:** GPT-4o by OpenAI
currently best balance of cost/speed vs performance
- **prompt**
 - **task and role:** “you’re a corpuslinguistic annotator, analyse verbs!”
 - for each **variable:** definition, labels, examples
 - **instruction:** “classify the verb <VERB> in the utterance <UTTERANCE>”
- **specification for structured output** (and input): variables and values

Prompting LLMs: an art rather than a science

- **Chain of Thought** (CoT) prompting (Wei et al. 2022):
 - “think step by step”
 - encouraging reasoning over stream-of-consciousness
- clear **instructions**
 - role: “corpuslinguistic annotator in research project”
 - specification of relevant concepts, variables, and values
- few-shot **examples** with correct labels (Brown et al. 2020)
 - prototypical examples
 - borderline cases
 - previous misclassifications
- function calling for **structured output**

Prompt

Task

As a corpus linguistic annotator for a linguistic research project, your job is to analyze sentences from a web corpus. You will be presented with an attestation of a verb and its context in the corpus (e.g. "'uploading' in: 'He was uploading the files'".) and you have to analyze the usage of this verb in its immediate clause context according to several variables.

Transitivity

****Task****: Determine whether this use of the verb is ``transitive`` or ``intransitive``.

****Definitions****:

- ``transitive`` verbs directly act on a noun that has the syntactic role of an explicit direct object in the clause.
- ``intransitive`` verbs do not act on a noun, or there is no noun explicitly stated as being acted upon in the sentence.
- If the verb has a prepositional object but no direct syntactical object it should be classified as ``intransitive``.

****Examples****:

- ``transitive``: "'approved' in: 'The committee approved the new policy.'" (Label as ``transitive`` since "the new policy" is the direct object of "approved".)
- ``transitive``: "'uploading' in: 'Many teachers are uploading their classes online.'" (Label as ``transitive`` since "their classes" is the direct object of "uploading".)
- ``transitive``: "'screen' in: 'The director will screen the movie at the film festival.'" (Label as ``transitive`` since "the movie" is the direct object of "screen".)
- ``intransitive``: "'approved' in: 'The new policy was approved.'" (Label as ``intransitive``; no direct object for "approved".)
- ``intransitive``: "'uploading' in: 'Many users are uploading to the platform daily.'" (Label as ``intransitive``; no direct object for "uploading".)
- ``intransitive``: "'screen' in: 'The movie will screen at the film festival.'" (Label as ``intransitive``; no direct object for "screen".)

Causativity

****Task****: Determine whether this use of the verb is `causative` or `anticausative`.

****Definitions****:

- `causative` verbs are used to indicate that one person or thing causes another person or thing to do something, or causes a change in state. They typically have a clear, deliberate agent who instigates the action.
- `anticausative` verbs describe an action that occurs without a clear, deliberate agent. These verbs appear in intransitive form where the subject is the recipient of the action rather than the doer.

****Examples****:

- `anticausative`: "'opened' in: 'The door opened.'" (Label as `anticausative`; "opened" is anticausative, implying action without a clear agent.)
- `anticausative`: "'aired' in: 'The show first aired in 1993.'" (Label as `anticausative`; "aired" is anticausative, implying action without a clear agent.)
- `anticausative`: "'uploading' in: 'The images are uploading.'" (Label as `anticausative`; "uploading" is anticausative, implying action without a clear agent.)
- `causative`: "'opened' in: 'She opened the door.'" (Label as `causative`; "opened" has a clear agent, "she".)
- `causative`: "'airs' in: 'The BBC airs a weekly 15-minute political commentary.'" (Label as `causative`; "airs" has a clear agent, "the BBC".)
- `causative`: "'uploaded' in 'The images were being uploaded.'" (Label as `causative`; "uploaded" is passive and implies an agent.)

Subject Role

****Task****: Analyse the semantic role of the subject of the target verb.

****Definitions****:

- ``agent``: The subject of the verb performs the action. It is typically a doer or a causative entity in the sentence.
- ``patient``: The subject of the verb receives the action. It is usually the entity that is acted upon or affected by the action.

****Examples****:

- ``agent``: "'chased' in: 'The cat chased the mouse.'" (Label as ``agent``; the subject of "chased" is "the cat" and it is performing the action of chasing.)
- ``agent``: "'films' in: 'My husband films our dog's every move.'" (Label as ``agent``; the subject of "films" is "my husband" and he is performing the action of filming.)
- ``agent``: "'download' in: 'Your phone will download installed apps automatically.'" (Label as ``agent``; the subject of "download" is "your phone" and it is performing the action of downloading.)
- ``patient``: "'chased' in: 'The mouse was chased by the cat.'" (Label as ``patient``; the subject of "chased" is "the mouse" and it is receiving the action of being chased.)
- ``patient``: "'filming' in: 'The movie is currently filming in Prague.'" (Label as ``patient``; the subject of "filming" is "the movie" and it is undergoing the action of being filming.)
- ``patient``: "'download' in: 'The game will download automatically.'" (Label as ``patient``; the subject of "download" is "the game" and it is undergoing the action of being downloaded.)

Subject Animacy

****Task**:** Identify whether the subject of the verb is ``animate`` or ``inanimate``.

****Definitions**:**

- ``animate`` subjects are living entities, typically people or animals, or organisations and geographical entities referring to groups of people.
- ``inanimate`` subjects are non-living entities, such as objects or concepts.

****Examples**:**

- ``animate``: "'barked' in: 'The dog barked loudly.'" (Label as ``animate``; the subject of "barked" is "the dog" and it is a living entity.)
- ``animate``: "'released' in: 'Microsoft released a new software version.'" (Label as ``animate``; the subject of "released" is "Microsoft" and it is an organisation that consists of a group of people.)
- ``animate``: "'installed' in: 'The city of Munich installed new park benches.'" (Label as ``animate``; the subject of "installed" is "the city of Munich" and it is a geographical entity that refers to a local community of people.)
- ``inanimate``: "'struck' in: 'The clock struck midnight.'" (Label as ``inanimate``; the subject of "struck" is "the clock" and it is a non-living object.)
- ``inanimate``: "'left' in: 'Her vanity left her heavily in debt.'" (Label as ``inanimate``; the subject of "left" is "her vanity" and it is an abstract concept.)
- ``inanimate``: "'install' in: 'Microsoft is easy to install.'" (Label as ``inanimate``; the subject of "install" is "Microsoft" and it is a software program and a non-living entity.)

Starting the classification process

```
prompt = ChatPromptTemplate.from_messages([
    ('system', prompt_txt),
    ('human', 'Please classify the following sentence: {input}'))
])
```

```
for _, row in tqdm(df_dev.iterrows(), total=len(df_dev)):
    try:
        result = runnable.invoke({"input": row['verb_realization'] + ' in: ' + row['text']})
        row_data = {
            'text': row['text'],
            'transitivity': row['transitivity'],
            'gpt_transitivity': result.gpt_transitivity,
            'causativity': row['causativity'],
            'gpt_causativity': result.gpt_causativity,
```

Variables specification for LLM

```
class UtteranceClassification(BaseModel):
    """Classifying verbs according to several linguistic criteria."""
    gpt_transitivity: Literal['transitive', 'intransitive'] = Field(..., description="Whether this use of the verb should be labelled either `transitive` or `intransitive`.")
    gpt_causativity: Literal['causative', 'anticausative'] = Field(..., description="Whether this use of the verb should be labelled as `causative` or `anticausative`.")
    gpt_subject_role: Literal['agent', 'patient'] = Field(..., description='Whether the semantic role of the subject of the verb should be labelled as either `agent` or `patient`.')
    gpt_subject_animacy: Literal['animate', 'inanimate'] = Field(..., description='Whether the subject of the verb should be labelled as `animate` or `inanimate`.')
    gpt_subject: str = Field(..., description='The subject in this utterance that you considered for your classification.')
    gpt_verb: str = Field(..., description='The verb in this utterance that you considered for your classification.')
    gpt_object: str = Field(..., description='The object in this utterance that you considered for your classification.')
```

✓ 0.0s

Python

Classification output

	A	D	E	J	K	L
1	text	causativity	gpt_causativity	gpt_subject	gpt_verb	gpt_object
2	Over MBS it will continue to be aired from the Cook County Marriage License Bureau.	causative	anticausative	it	aired	
3	In the course of its existence, the Radio Theatre has aired 272 different shows, ranging from Peg O' My Heart to the Life of Louis Pasteur.	causative	causative	the Radio Theatre	aired	272 different shows
4	Designed to tell inside stories about programs and radio personalities, Behind the Mike is now aired over 85 stations and short-waved to Canada and South America.	causative	anticausative	Behind the Mike	aired	
5	He enlisted the aid of President Jardine, of the college, who, in turn, persuaded Brinkley to air the program.	causative	causative	Brinkley	air	the program
6	Carter was broadcasting under the sponsorship of Philco at the time of the Army-Navy run-in, but Carter's constant antilabor stands in his broadcasts soon brought the picket line to stations airing his talks, the boycott to Philco products.	causative	causative	stations	airing	his talks

Types of classification error/success

	Predicted Positive	Predicted Negative
Actual Positive	True Positive <ul style="list-style-type: none"> • <i>Meanwhile, the last part of the Munich project is filming in Prague.</i> • <i>And the show hadn't even aired yet.</i> 	False Negative <ul style="list-style-type: none"> • <i>It is airing five nights a week on cable's Turner Classic Movies.</i>
Actual Negative	False Positive <ul style="list-style-type: none"> • <i>So this episode was screened for Lucas.</i> • <i>She was just filming.</i> • <i>Most Broadway actors screen well [...].</i> 	True Negative <ul style="list-style-type: none"> • <i>Airrack had only uploaded 58 videos at that point.</i> • <i>Download the mobile app.</i>

Evaluation metrics

- **Accuracy** is a measure of the model's **overall correctness**.
 - It is the ratio of correct predictions (both true positives and true negatives) to the total number of cases examined.
- **Precision** measures the “**accuracy**” for the **positive class**.
 - It is the ratio of true positive predictions to the total number of positive predictions (both true and false positives).
- **Recall** measures the **coverage of the positive class**.
 - It is the ratio of true positive predictions to the total number of actual positive instances
- **F1 score** provides a **balance of precision and recall**.
 - It is the harmonic mean of precision and recall

Variable specification

```
variables_spec = {  
    'causativity': {  
        'labels': ['causative', 'anticausative'],  
        'average': 'binary',  
        'pos_label': 'anticausative'  
    },  
    'transitivity': {  
        'labels': ['transitive', 'intransitive'],  
        'average': 'binary',  
        'pos_label': 'intransitive'  
    },  
    'subject_animacy': {  
        'labels': ['animate', 'inanimate'],  
        'average': 'binary',  
        'pos_label': 'inanimate'  
    },  
    'subject_role': {  
        'labels': ['agent', 'patient'],  
        'average': 'binary',  
        'pos_label': 'patient'  
    }
```

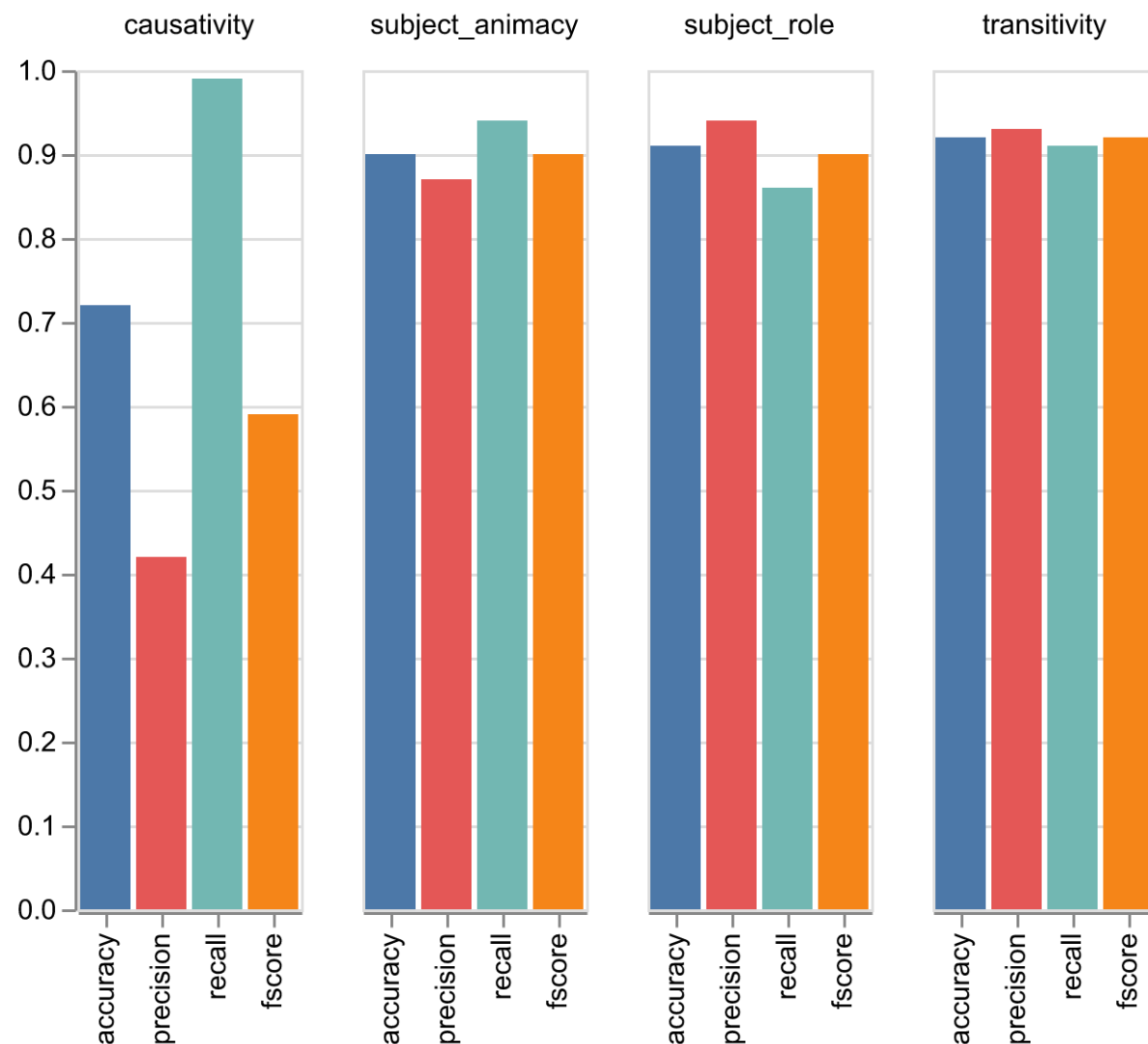
labels: the allowed values

average: binary vs multi-class classification problem

pos_label: the value of main interest

Results across all verbs

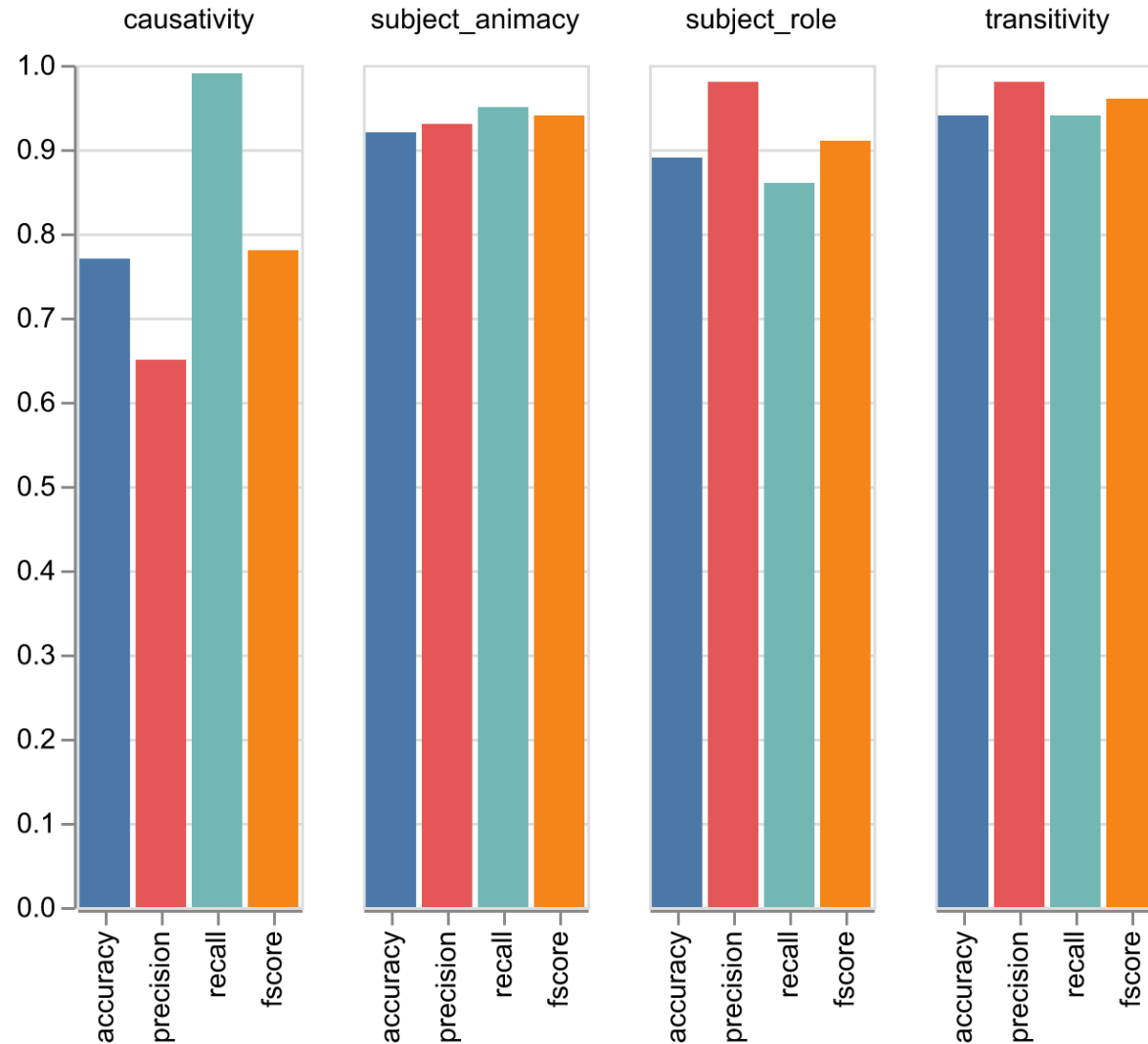
Chart for verb: “all verbs”



Variable	Class	Frequency
causativity	causative	1104
	anticausative	280
subject animacy	animate	680
	inanimate	704
subject role	agent	736
	patient	648
transitivity	transitive	689
	Intransitive	695

Results for the verb *air*

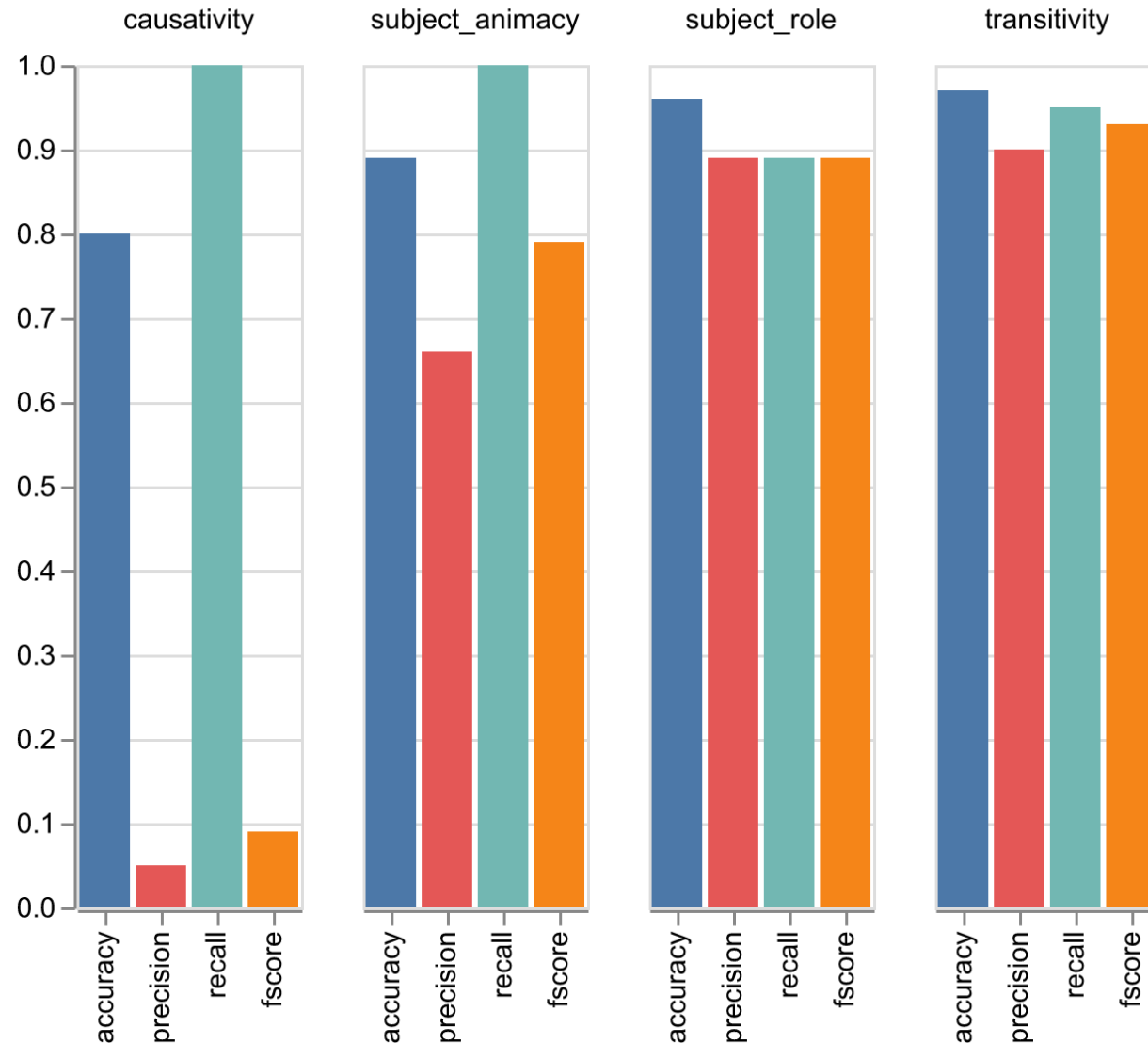
Chart for verb: “air”



Variable	Class	Frequency
causativity	causative	314
	anticausative	230
subject animacy	animate	158
	inanimate	386
subject role	agent	176
	patient	368
transitivity	transitive	370
	intransitive	174

Results for the verb *download*

Chart for verb: “download”



Variable	Class	Frequency
causativity	causative	98
	anticausative	1
subject animacy	animate	78
	inanimate	21
subject role	agent	80
	patient	19
transitivity	transitive	79
	intransitive	20

Conclusion and next steps

Overall, using LLMs for studying English anticausative shows promising initial results.

However, iterative improvement has been essential and there is still more to be done:

- improving prompt for causativity variable
- including semantic transitivity as a variable
- deploying the LLM to discover anticausatives in unlabelled dataset

Maybe: trying other LLMs (e.g. Claude Sonnet 3.5)

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Appendix

Results from February: mixed success

