Towards the identification of Bias by Word Choice and Labeling through Systematizing Annotation Schemes of Coreference

Qumeng Sun
University of Göttingen
37073, Germany
sun.qumeng@stud.uni-goettingen.de

ABSTRACT

This paper briefly introduces Coreference Resolution(CR) and Media Bias(MB). This paper disambiguates some terms that need to be clarified, lists the categories of CR and MB, and tries to construct a systematic new classification scheme with a few new definitions; then, we review recently used databases, including CoNLL and NewsWCL50, and analyze their features. The main contribution of this paper is to update the notion of near-coreference and reduce the class of coreference while accommodating the vast majority of loose coreference to reduce the pressure on annotators. Another contribution is that this paper also suggests directions for future improvements, including Strength Bar in the annotation scheme.

Keywords

Coreference Resolution, Anaphora Resolution, Media Bias, Coreference Dataset.

1. INTRODUCTION

In English texts, a great deal of referential behavior occurs. An entity may have more than one identity anaphora in a text. Loosen anaphora like bridging referents are even more. In particular, these phenomena are often used in media reports by word choice and labeling(WCL) to create bias and influence readers' opinions [8, 18].

The preference for a gambling problem can be changed simply by changing the description of the problem from a "gain" perspective to a "lose" perspective[10]. Through several well-designed experiments, Kahneman and Tversky have demonstrated the invariance and dominance invalidity of the rational decision-maker assumption in real life. Different framing of the same choice can make people issue an entirely different decision.

Coreference resolution detects co-referential relations[2] and helps to uncover and potentially eliminate the political or ideological perspectives previously imposed on articles.

This paper will focus on cross-document coreference applied to news articles reporting the same event, a typical task in cross-document coreference resolution(CDCR).

The impact caused by WCL can be described by vocabulary. We form 23 properties into the Strength Bar and introduce them into the annotation scheme to make the annotating semantic richer and the annotating method simpler. This paper also discusses and suggests the possible advantages of this annotating scheme.

The problems that this paper hopes to solve are as follows.

- The ambiguous terms used in Coreference studies need to be strictly defined.

- Media bias is becoming increasingly prevalent, and we need robust methods to detect it to reduce the harm it causes our readers.[30]

- Annotating requires the involvement of knowledgeable personnel.

First, the significant problem is that the terms used must be sufficiently clear. Since this is an interdisciplinary field, many scholars from various fields, such as linguistics, psychology, biology, computer science, and cognitive science, have studied coreference resolution. The current situation is that some literature contains vague and contradictory definitions of the same terminologies, which makes the meanings of terms ambiguous[4]. Through literature reviews, studies have been conducted to diminish the uncertainties associated with researchers' personal preferences and scientific backgrounds. In this paper, we want to analyze the definitions and systemize them into the system that identifies the relations' influence on the readers. So, a clear and straightforward definition guideline handbook is needed.

Second, detecting highly dynamic media bias[95] caused by framing is still an open question since it is more subtle than traditional agenda-setting [8]. Two common ways to influence readers' preferences in the news are the traditional *agenda setting* and the more difficult-to-detect *second-order agenda setting*, also known as *framing*.[8] Word choice and labeling(WCL) is a commonly used framing method that strongly influences readers' perceptions[62]. If models can be used to expose this framed information hidden in the news, it will be essential and helpful in many aspects [8, 28]. For example, we can avoid having our opinions baited by different media agencies if we can prevent bias caused by some implicit wording.

Third, manual annotation of corpus requires experienced annotators with advanced knowledge of linguistics. Crowdsourcing must perform better on news bias annotation tasks, with complete misjudgment[51]. The CDCR-related works focused on simple relations like pronouns using Wikipedia as a method were annotated without experts[59,60,61]. The rest were annotated mainly using undergraduate students or researchers with professional backgrounds[30,52]. The difficulty of achieving efficient, low error rate and high consistency annotating are the significant problems linguists face today. The view widely accepted by the academic community is that a consistent and well-defined annotation scheme is essential [52]. So, we must create an easy-to-follow and implement coding guidelines to annotate and detect different mention types.

To overcome those gaps and meet the finalized goal, we need to systemize existing classifications of coreference and determine how they impact readers. First, this paper will introduce and

distinguish the various coreference and near-coreference. Then, this paper will systematically relate the refined coreference to some typical bias triggers. Also, this paper will propose an optimized coreference annotation scheme based on analyzing the relationship between diverse coreference and types of influence on the reader's views and existing methods.

2. COREFERENCE RESOLUTION AND MEDIA BIAS

In this section, this paper will have a brief introduction to the definition and status of research on coreference resolution and media bias. Moreover, this paper will define essential coreference resolution and media bias terms. In the part of coreference resolution, we will introduce the types of coreference, which is a primary content in coreference resolution. In part about media bias, we will show different types of bias with examples. Some contradictory statements will emerge and ideally be resolved, which will help us further analyze.

2.1 Coreference Resolution

Coreference Resolution is an attempt to uncover the coreference. It is always…. [add some details here, e.g., where we deal with it, why it is essential, what problem it can solve, how long it has been studied]

2.1.1 Terms in Coreference Resolution
[16, 17]

In this section, you will see some terms used by multiple disciplines, and some misunderstandings occur. This section is dedicated to making research easier by clarifying the definitions of these terms within the field.

1. **Mentions**: A word or phrase that refers to an entity or event. The mentioned word can be a proper name(PNs) of an object, a (personal) pronoun, and adjectival nouns or phrases(APs). There are different types of mentions in articles, such as persons, organizations, locations, etc. As you can see in the example below, we can always define one mention in another mention. Every mention is individual and has one entity to refer to.

   In addition, the definition of mention in linguistics differs from that of mention in CDDR or natural language processing(NLP). Linguistic mention definitions rely on double quotation marks[66,69]. However, mention is also a reproduction of language from another source[69]. In CDCR, the definition of mention has been broadened.

   Example:

   > On *[his]* way home in the evening, *[Mike]* looked over to *[the bar]* called *[Rustic]* down the road, and he realized that *[the man in the white jersey]* was *[[his] uncle]*.

In this example, we have a total of 8 mentions. Most of them are simply pronouns: *[his, pronouns], [the bar, pronouns], [his, pronouns], [his uncle, pronouns]*.

Other mentions are PNs or adjectival nouns or phrases: *[Mike, PNs], [Rustic, PNs], [the man in the white jersey, APs]*. "The man" and the adjectival structure together form a phrase, which is the most complex mention in this example. There is a similarity between PNs and APs. They introduce an entity by describing them with names or adjectives.

2. **Entity**: An entity is an abstract concept to describe an object in the reference space[67]. Each entity corresponds to a thing in the real world called a referent. Each mention corresponds to one entity, which can have many mentions[16].

   It is important to emphasize that linguistic entity is a different concept. A linguistic entity can be a letter, a tone, a word, a phrase, or a whole sentence[66,68].

   Also, referent and entity are sometimes confused, but they usually appear in different contexts. "Entity" usually involves discussions with words like "event." This situation will be explicitly discussed in this paper in the later part.

   Example:

   > We use the previous example where there were three entities here.

   1. Mike, the subject of this sentence, has three mentions in this example: **[his]**, **[Mike]**, and **[his]**.

   2. The roadside bar called Rustic has two mentions in this example: **[the bar]** and **[Rustic].**

   3. Mike's uncle is mentioned twice in this example: **[the man in the white jersey]** and **[his uncle]**.
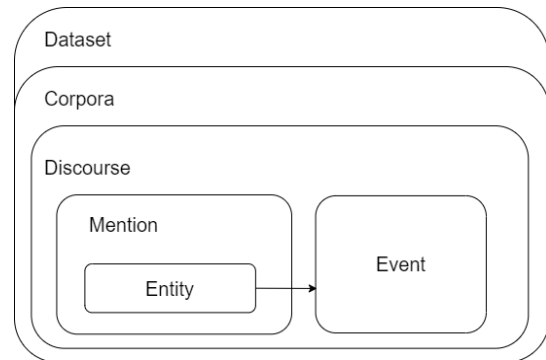

Figure 1 Relationships between linguistic terms

3. **Event**

   In linguistics, an event is a specific occurrence involving participants in discourse[19]. Events usually require the participation of at least one entity, either the entity executing the event or the entity affected by the event[64].

   In event extraction, we can consider event-related entities as **event arguments**, which is the reason why these two concepts are linked[16,63,64,65]. Familiar entities associated with events are participants (human or non-human) and attributes (location, event, etc.)[64].

   Events can always be found by searching verbs in sentences. These verbs are often summarized as **event triggers**[64]. We can use "Negative" to describe an event if it is clearly stated that it did not occur [63].

   Example:

   > More than 100,000 people's apartments were *[damaged](Positive)* in the earthquake.

   > According to the latest reports, **no** civilians were *[injured](Negative)* in the military exercise.

4. **Discourse**

Discourse is a concept used for describing a type of communication that can be written or spoken, and it is made up of many related sentences[4]. Discourse is often used to describe a form of language use that public speakers always use called utterances with a stricter definition[20].

5. **Corpora and Dataset**

Both corpus and dataset are data collections for research and analysis. A corpus can be considered a specific type of dataset that focuses on transcribing natural languages into audio, video, and picture[21,22]. A dataset, on the other hand, is a broader concept covering a variety of data types and structures.

The corpus is usually a dataset component in natural language processing(NLP) tasks. For example, the dataset may contain text (from a corpus) and category labels associated with each text in a text classification task.

6. **Coreference Resolution and Anaphora Resolution**

   a) Coreference

Coreference is a relationship between two mentions. The key idea is that they refer to the same entity[4].

As shown in **Figure 4**, there are notable distinctions between Coreference and Anaphora. Coreference emphasizes the relationship's two-way nature, i.e., the two mentions are independent. On the contrary, pronouns depend on the discourse's antecedent to express completely [42].

We can easily define coreference with our proposed naming scheme in **9. b)**. When two mentions form referencing relations, they can be each other's referred and referring words, and the relationship between them is coreference.

This paper does not recommend adding the word "relation" after coreference, as this repeats its definition.

Example[72]:

"[Microsoft Corp.] plans to incorporate artificial intelligence tools like ChatGPT into all of [its] products and make them available as platforms for other businesses to build on."

In this example, we say that *Microsoft Corp.* and *its* are coreferential. The relation between them is coreference.

   b) Coreference Resolution

For the definition of coreference resolution(CR), some papers consider it as the task of identifying mentions in linguistic expressions that point to the same entity [9]. Others define it as identifying mentions pointing to the same real-world entity, referent[76]. It makes more sense to use the first definition. This way, we can unify it with the description of coreference and define CR as the task of finding coreference.

Anaphora resolution(AR) and CR are two very similar concepts. Anaphora resolution usually deals with intra-linguistic relations[4] with a narrower scope. This means the link in AR is confined to the text. It can be solved without the intervention of knowledge from the outside world[4,78]. AR always requires that the entities referred to be identical[4, 33]. On the contrary, coreference requires a loose form of the

antecedent, which can be NPs, verb phrases, and subordinate clauses. The significant difference between anaphora and coreference is that anaphor relies on the antecedent to interpret it[79].

For Example, "Joe Biden" and "Biden" is coreference because both words refer to Joe Biden, the current president of the United States; "Biden" and "He" are anaphora because the personal pronoun "He" must first be referred to "Biden," and the personal pronoun "He" cannot determine its referent when it occurs independently.

Anaphora resolution and coreference resolution are subsets of entity resolution with many intersections, but neither is a subset of the other [4, 35]. Also, we believe it's fair to say AR is a subset of CR, excluding some exceptional cases[78]. When a part-whole relationship precedes two words, they hardly constitute a strict coreference[4], but still, it can be subsumed by a near co-reference.
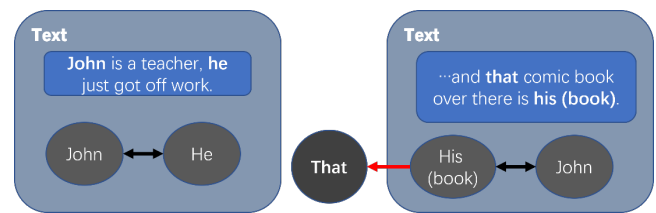

Figure 2 Example of exophora

7. **Anaphora, cataphora, and endophora**

Anaphora has different meanings in literature and NLP, respectively.

In literary writing, anaphora is a rhetorical device. Its most prominent feature is the intentional use of repeated words or phrases in consecutive sentences[73].

Perhaps the most famous example is from Dickens' A Tale of Two Cities: "It was the best of times, it was the worst of times, it was the age of wisdom…."[70]

When we refer to anaphora in CDCR, we usually refer to a relationship in an expression that needs to be interpreted by the separated mentions called anaphor and antecedent.

Anaphor is a component needed for the formation of a coreference. Antecedents provide necessary information for interpreting an expression [3, 5, 6, 32].

In a narrower definition, people only call the anaphora after the antecedent anaphora. In other cases, we call it cataphora. Cataphor and postcedent form a pair of terms whose relationship is called cataphora. Both relationships are referred to as endophora. Endophora is synonymous with anaphora broadly [6, 41, 77].

Therefore, endophora is often used to describe the relationship between pronouns and antecedents in text. Correspondingly, exophora describes the relationship outside the text, as shown in **Fig. 2**. This is the case with the pleonastic pronouns mentioned later in this paper.

Example[71]:

"Should **[that person]** stay in their job? Well, I raised the issue …," McCarthy told CNN, adding it

could "rise to that occasion" of impeachment if [**Mayorkas**] is found to be "derelict" in [**his**] duties.

In this example, we focus on Homeland Security Secretary Alejandro Mayorkas. There are two relationships in this example. The first one is anaphora, which is the relationship of the pronoun "**that person**"(anaphor) to the proper name "**Mayorkas**"(antecedent). The second one is cataphora, which is the relationship of the pronoun "**his**"(cataphor) to the proper name "**Mayorkas**"(postcedent).

8. **Head**

The head is the only necessary component of an endocentric construction[32, 40], while other parts can be removed properly without harming the grammaticality in some cases[6]. The whole phrase will lose semantic content after omitting the optional elements. The typical endocentric constructions are noun phrases(NPs) and verb phrases. The following example explains the position of the head in the sentence[40].
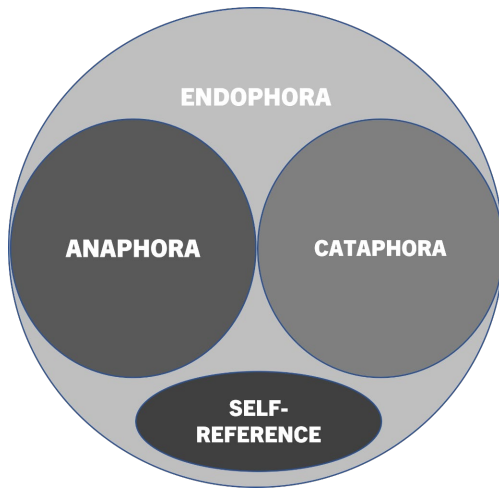

Figure 3 Relationships within endophora. Self-reference, together with anaphora and cataphora, constitutes the concept of endophora. [77]

Example:

[The young **man**] [will have been **studying**] French for ten months.

In this example, we have two endocentric constructions. In the first one, it is an NP, and the noun "**man**" is the head of the endocentric construction. It can replace the entire NP; the sentence will remain correct. The second one is a verb phrase, the verb "**studying**" is the head of it.

9. **Referent, reference, antecedent, postcedent, complement, and referring word**

a) Complement and Postcedent

Due to the similarity of definitions, sometimes, complement is used as a postcedent[54]. Complement and antecedent are two different concepts. The antecedent is usually used in coreference resolution tasks, i.e., identifying the antecedent of pronouns. Conversely, complement is generally used to

analyze the structure of sentences and grammatical rules to better understand the meaning of linguistic expressions.

b) Referent and Head

In linguistics, the referent is an abstract concept that refers to an entity in the real or imagined world[6]. The object or particular discourse entity that a mention relates to is the referent of this mention[42]. They are each other's signified and signifier[74]. Due to the diversity of meanings of the same word, a word may have more than one possible referent. Also, one referent can be represented by different words[75].

Example:

"Electric Arts has a top-notch team of **lawyers**."

In this sentence, the entity that the word "lawyer" refers to, an abstract concept, is a referent, a group of human beings who study law and work in EA.

It is used in CoNLL to represent the first occurrence in a descriptive entity, similar to the concept of "head"[52]. We believe that this way of definition may be reasonable in the paper, but overall it can lead to confusion for readers with different scientific backgrounds.

c) Referred word and Referring word

To simplify the language, papers[4] sometimes omit "abstract concept from the real or imaged world" and say that a word is a referent. This simplification has led to a tendency to use the term referent to refer to antecedent and postcedent supersets.

We have received inspiration from the definition of referring expression. Instead of referent, we propose to use the **referred word** as a superset of antecedent and postcedent. So, if a referred word is before the anaphor, it is an antecedent. Correspondingly, a referred word that appears after an anaphor is called a postcedent.

We also propose defining the superset of anaphor and cataphor as **referring words** or words instead of pronouns in CDCR.
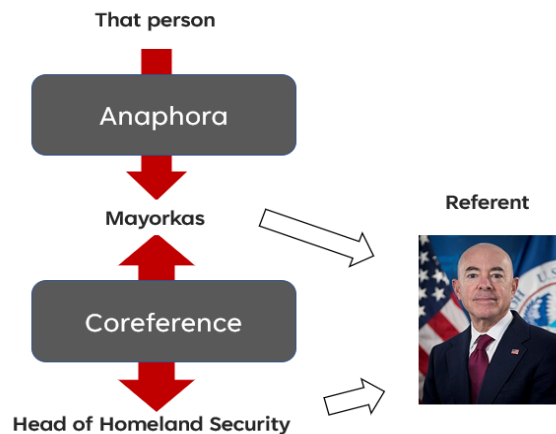
Example:

Figure 4 Example of the difference between Anaphora and Coreference

"[Mike] is 198cm tall. [He] is [[a basketball player]'s son]. [Jack], [his father], played in the NBA for three years."

[He] is anaphora, and [Mike] is referent(antecedent). [a basketball player] is cataphora, and [Jack] is postcedent since it comes later than the anaphora. In this example, the first anaphora is a pronoun; the second is an NP[31].

d) Antecedent and referential anchor

[42] use "referential anchor" to replace the term "antecedent." They have very similar definitions and are interchangeable. However, "referential anchor" emphasizes the importance of the word or phrase to the overall contextual understanding. This paper recommends using "antecedent" rather than "referential anchor" when discussing coreference. We believe this helps to reduce barriers to understanding.

e) Reference

In NLP, reference is a superset of coreference and endophora. It describes the relationship of the referring word to the referred word and contains both coreferential and endophora parts[76].

The difference between reference and mention is that "reference" emphasizes how relations are made.

2.1.2 Type of Coreference

This section divides relations into two categories: coreference and near-coreference. This idea to create a new term called near-identity coreference in the middle of the existing definition was raised by Recasens et al.[34]. They suggested that it is a middle ground relation between identity and non-identity

2.1.2.1 Coreference

- Fixed-anaphora

There are words in the language whose presence implies the appearance of anaphora. In this paper, such words are uniformly referred to as fixed anaphora. The vast majority of anaphora phenomena can be generalized by fixed anaphora.

Demonstratives are words like this, that, these, and those. They are an essential part of language and are often used with gestures or other nonverbal cues to clarify meaning[40].

Zero anaphora has a Pro-Form-like referential function. Pro-Form is a filler word always used instead of other words or sentences whose meaning can be retrieved from the contex[7]. Another concept that overlaps almost precisely with zero anaphora is that of **one anaphora**, which refers to those attempts to use "one" to refer to an entity.

Also, sometimes we use "it" to describe the weather conditions. Where no explicit antecedent exists, this situation is called a **pleonastic "it"**[81]. In this case, "it" is usually a formal subject or object but does not refer to any entity.

Example:

There are two roads next to the creek, a narrow one [GAP] and a wide one [GAP]. The word "road" is

omitted at [GAP], as well as any other possible pronoun[5, 6].

Personal pronouns are used to refer to people, including "I," "you," "he," "she," "we," "they," etc.[32].

Indefinite pronouns are used to refer to an unspecified person or thing, including "anyone," "someone," "everyone," "something," "anything," etc.[32].

Possessive pronouns are used to express ownership or affiliation, including "my," "your," "his," "her," "its," "our," "their," etc. [32].

Relative pronouns are used to guide definite clauses, including "that," "which," "who," "who," "whom," etc. [32].

Reflexive pronouns are used to indicate that the bearer of the action and the performer of the movement are the same people, including "myself," "yourself," "himself," "herself," "itself," "ourselves," "yourselves," "themselves." [32]

Fixed anaphora fall under the study of anaphora resolution, and they can be found. Identifying their antecedents is also relatively simple but can sometimes be challenging[80].

- World Knowledge

We categorize coreference with world knowledge as common-sense and knowledge-based.

Common-sense world knowledge includes that some verbs can only be used with specific nouns. For example, we all know that cell phones are usually used to make phone calls, not to eat. If we see the sentence "Bob has his [smartphone] and [bread] in his hand and is gobbling [it] up," we can know that [it] is [bread], not [smartphone] if we have basic common sense.

Knowledge-based world knowledge depends not on common knowledge but extraordinary synonyms and nouns. For example, the synonym for famous basketball player Kobe Bryant is "Black Mamba."

In the following, we will distinguish and explain each kind of coreference that belongs to common sense or knowledge in more detail.

- Synonym

    The word sets exist in different languages and are so similar in meaning that they can be interchanged in any context. Words within this set are called synonyms. We must highlight this relationship by knowing the relevant language dictionary and knowledge-based world knowledge coreference.

- Context-driven synonyms

    Context-driven synonyms are synonyms that occur due to the proximity of a phrase in a narrow context.

    Typical examples are words with multiple meanings and objects to refer to in different sentences. The word scale, for example, can refer to an instrument that measures weight or to the tiny plate on the skin of a fish[47].

- Language conventions, verb collocation

    This is traditional common-sense world knowledge. A native speaker can easily make the identification and does not require the presence of an expert.

- Encyclopedic

  This is typical knowledge-based world knowledge coreference.

  Example:

  - If they had not seen the film or artwork, no one would know that Spider-Man and Peter Benjamin Parker are the same people.

  - Nor could we have known that Taylor Swift and American country music are two related words.

World knowledge is not only present in the coreference. It is also part of the near-coreference. In this paper, we argue that we can distinguish them in a way other than deliberately distinguishing them in theory in the CDCR task. We must be informed that the coreference of world knowledge types is of different similarity. The concepts in the near-coreference can better summarize some of these, and we have chosen to use terms like metonymy to describe this relationship. In the next section, we will discuss these concepts.

2.1.2.2 Near-coreference

A. Bridging

An overall perspective suggests that bridging anaphors do not share coreference with their antecedents; they are connected through near-coreference. These relations can be based on lexico-semantic, frame, world knowledge, etc. [37, 3]. The antecedents of bridging can be NPs, verb phrases, or sentences[36, 37]. Finding bridging relations through grammatical clues is difficult.

[1] suggested separating the bridging relations into referential bridging and lexical bridging to simplify the classification[38]. This paper will be reclassified on this basis. Here we will introduce the five types of bridging[4, 34].

1. Metonymy bridging

   Metonymy means using a different entity to represent another entity in literature writing.

   There are different metonymy, some of which are cultural metonymy, such as using pens to represent publishing and shears to represent military power.

   Example:

   - "The pen is mightier than the sword." [82] The word "pen" here stands for writing and words, while "sword" stands for violence and war.

   - "Hollywood churns out blockbuster movies every year" The word "Hollywood" stands for the American film industry and studios.

   Others are conventional metonymy, such as "give me a hand," "new face," "boiling," etc. A similar concept in rhetoric is Antonomasia, which is used to describe phenomena where proper names and generic terms are used to refer to each other [48], such as the use of Solomon to refer to an intelligent person [44] or the use of Golden State to refer to California.

   Example:

- "We need some new faces around here." We need new people, not just their faces.

- "Please give me a hand. "I need you here to help me do something I cannot do alone, not just your hand.

Metonymy bridging is also known as near-identity relation [34]. This is a form of coreference in which one object refers to another. There is a coreference between the two objects in the discourse, but not necessarily naturally outside the discourse.

Example:

- Use **the White House** to refer to **the U.S. government**.

- Use **the Crown** to represent **the British Royal Family**.

2. Synecdoche (Meronymy bridging)

Meronymy has also been called whole part lexical relation[45]. Here are the different forms of meronymy application[44].

A Y has an X, and an X is a part of Y.

A Y has Xs, and an X is a part of Y.

The parts of a Y include the X(s), the Z(s), etc.

The X(s) and the Z(s) are parts of a Y.

Meronymy is narrowly known as a bridging relation[34]. It uses a part of an object to refer to the whole object. A relationship of inclusion is emphasized. Here the bridging anaphora must be a minor component. For example, Biden refers to the US government, lenses refer to glasses, and floor-to-ceiling windows refer to hotel rooms.

More systematically, it can be classified as "whole and part," "object and element," "similar set," and so on. However, all these types emphasize the same focus: the inclusion relationship between them and the relationship between the minor element or part and the larger object or whole. There is a particular case in which two sets have similar composition, and this case called a "similar set," is also included in Meronymy bridging.

Examples:

"The kitchen is where the magic happens. The chef just put the finishing touches on the dish before it went out to the dining room."

In this example, the first sentence uses Metonymy to represent the "kitchen" as "the place where the magic happens," suggesting that some unique cooking process occurs here. The second sentence uses Meronymy, which describes the dish as a whole composed of several parts, such as the chef adding a final touch to the dish.

Synecdoche is always used as a figure of speech in literature writing, not CDCR. It has the same content as meronymy when people use it to refer to an entirety utilizing a part of something. But synecdoche can also use the name of the whole structure to refer to a small piece of a thing[32, 43, 46, 47].

Since meronymy is originally a relatively loose coreference, continuing to give up some of the precision can improve the efficiency of the classification. This paper argues that introducing this term into CDCR can accommodate more coreference and simplify the classification.

This article consolidates multiple definitions of Synecdoche into one new definition. That is, there is a **subset** or **intersection** between two mentions.

Here are some examples marked with the traditional definition[32].

1. [Whole and Part] "The suits on Wall Street walk by my office daily." This example uses suits to represent the financial workers or the entire industry.

2. [Whole and Part] "The United States won the Olympic gold medal." Here the word "United States" represents the whole national team.

3. [Whole and Part]"I bought a new set of wheels. The "wheels" here represent the whole vehicle.

4. [Species and genus] " Humans are cruel creatures, Sara said. " The word "creatures" here refers to human beings.

5. [Species and genus] "John has studied musical instruments since childhood, and his piano standard is now at a performance level." Here the instrument and the piano composed coreference.

6. [Materials "New Blood" uses blood to represent humans.

7. [Intersection] "Mary is the oldest of his mother's family and the youngest of his father's family." This article introduces the concept of intersection and incorporates it into synecdoche. Here is a good example, a person can be the oldest descendant in one family and the youngest in another, illustrating the intersection phenomenon.

8. [Intersection/comparative bridging] "The new smartphone is faster than the previous model. " This comparative bridging can also be classified as Synecdoche. The connection between these two references is that they are cell phones linked by being compared.

B. Functional

The variable functions mentioned earlier in the discourse usually refer to functional near-coreference. They can be derived as general coreference relations in which the antecedent changes over time. This paper will classify time, place, variable numbers, and variable roles as functional near-coreference.

C. Paraphrasing

Paraphrasing refers to using different words and grammatical structures to convey the same meaning in a linguistic expression[84]. Usually, it is a separate task from coreference resolution, but papers have shown that the two tasks can be mutually beneficial[83]. So this paper is reasonable to include it in the category of near-coreference.

Above, we have introduced three types of near-coreference: Bridging, Functional, and Paraphrasing.

It can be found that in Bridging, we can mix metonymy and meronymy bridging and call them synecdoche. In this paper, a new definition of synecdoche is given. That is, two mentions have a subset relation or an intersection relation. So, this paper proposes to divide bridging into those two categories, which can reduce the time and difficulty of annotating.

In addition, we categorize the dynamic attributes often required for events, such as time and place, as functional near coreference.

Finally, we categorize other complex coreference structures as paraphrasing, a structurally more complex near coreference that a rule-based model may not easily solve.

2.2 Media Bias Causing by WCL

By definition, *framing* is a psychological concept used to implicitly describe attempts to persuade readers of their views [11]. In their original study, Tversky and Kahneman used several subtle experiments to demonstrate that framing influences people and makes entirely different decisions when faced with the same scenario [10]. Several subsequent studies have repeatedly verified this [14,15].

Within media bias, there are many types of bias and different levels [54]. Bias is usually classified into two categories. They are agenda-setting and second-order agenda-setting (known as framing) [8]. In comparison, framing is a type of bias that focuses more on the bias that arises at the time of writing rather than the selection stage of a news story. Biases due to WCL are hard to detect and sometimes rely on a large amount of context for effective detection [12]. Traditional detection methods cannot detect biases hidden in WCL[8]. This is because such biases are more subtle than the traditional emphasis on something and are more challenging for readers to realize. So, media organizations also often use this method to sway readers' opinions [8].

As a more specific example, we can see in the news the bias created by different media when describing people with depression or psychosis [24, 25]. Byung-Chul Han describes it as "narcissistic depression" or "egocentrism" [23], attempting to turn depression into an abstract rational-analytical process while underestimating its pathological features. Other articles emphasize the pathological features of this mental illness, potentially leading the reader to believe that having depression is an abnormal mental state, thus causing the patient to be surrounded by prejudice and discrimination initiated by those around them after the diagnosis [26].

More than half of Americans prefer irrelevant news stories, and if they get a strong point of view without being observed, it will cause serious misunderstandings[28].

2.2.1 Types of Media Bias

The types of bias listed here do not include biases caused by focus bias, only those that can be reached through word choice, labeling, and stereotypes. The result of different media biases is usually a degraded social image of a person or a group of people. Here are some common ways for this purpose[24]. We can be aware of the possibility of bias by detecting invisible critical framing sentences that appear in different articles' descriptions of the same event or group.

2.2.1.1 Word Choice

A. Verb choice

Media use different verbs to imply their bias, meaning an otherwise neutral action or event is implicitly praised or criticized. They use subjective verbs to describe someone's actions.

Examples:

- Admit and Acknowledge

  The word "admit" and "acknowledge" can describe the same action but give readers different feelings. "Admit" sounds like someone already did something wrong.

  In defending a right-wing academic, WSJ used the friendly word "acknowledge" to describe him as having some awareness of his mistakes[85].

  Meanwhile, in the scholar's interview with the center-left media, the interviewer Cathy Newman used the more serious word "admit" to make him look bad. [86]

B. Norn choice

People with different political positions and within other groups often use different terms to describe the same event or human individual. Using additional terms to describe the same object is the classic scope of the study of CR.

Examples:

- "Internet users," "Chinese social media users," "Defenders," "Chinese students," or "misplaced patriotism"

  This series of different words all describe the same group of people who posted responses to the British Museum's tweet. They accused the tweet of exacerbating cultural appropriation regarding the Chinese New Year.

  The South China Morning Post expanded on the event's impact by describing the behavior as patriotic[87]. They also expanded the scope of participants in the event to include first-generation Chinese immigrants to stigmatize this group.

  In contrast, the Chinese government-sponsored media outlet Globes called these British Museum critics "a large number of netizens," hiding that most participants were Chinese[88]. They imply that the crowd of critics may be Chinese and many Britons involved so that the situation can be described as one-sided.

2.2.1.2 Labelling

A. Physical: This is a class of ways a physical defect disadvantages the depicted person.

Example:

- Former U.S. President Donald Trump has been called a "**Delusional Psychopath**" by MSNBC[89].
- Sky News used the term '**Dementia patient**' to describe Joe Biden and criticized his political stance by describing his fragile health[90].
- When commenting on Nicolas Cage's acting, the press used the term "**laughably unhinged**" to describe him[91].

B. Character: This type of label imposes moral weaknesses on entities. The more obvious moral defects include criminal or illegal behavior.

Example:

- Describing a person who has driven over the speed limit as a "criminal" can effectively undermine the public's trust in that person and their social profile.
- Fox News used "Serial Liar" to describe Joe Biden and criticized his personality and political stance by describing his illegal behavior[92].

C. Status: This labeling consists mainly of the suppression of the social status of the subject. This includes educational background, economic status, professional level, etc.

Example:

- In a documentary critical of the U.S. presidential election, former U.S. President Obama's brother is portrayed as an African American living in the worst **ghetto**[93].
- Social media once falsely accused Bill Gates of being arrested by the U.S. military. In a Reuters article setting the record straight for him, he was described as a "**billionaire and philanthropist**." In contrast, in the disinformation article, Bill Gates was described as a "**billionaire and Microsoft founder**[94].

Scheme	CoNLL	ECB+	ISNotes	NiDENT	GUM	WikiCREM	NewsWCL50	*Ideal for WCL
Year	2012	2014	2018	2010	2017	2019	2019	-
Features	Multi-layer annotation	Event/Action Centric	Information Status	Near-coreference	Rich-annotation	Pronoun resolution	WCL	-
Annotator	Experienced	Experienced	Experienced	Experienced	Experienced	Crowdsourcing	Experienced	Semi
Entity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
Event	No	Yes	Yes	No	No	No	Yes	-
Coreference Type	2	-	8	3(17)	5	-	-	More
Entity Type	18	4(31)	-	-	11	-	5(29)	-
Near-coreference	Strict(apposition)	Strict(type)	Bridging	-	Bridging	-	Bridging	Briding & More
NPs	Yes	Head	Yes	Yes	Yes	No	Yes	Yes
VPs	No	Yes	Yes	No	No	No	Yes	Head
Pronouns	Almost	Yes	Yes	Yes	Almost	Yes	No	No
Copular verbs	No	Identity	Yes	No	No	No	-	Yes
Adverbs	Time & Date	Time & Loc	-	No	No	No	Yes	Yes
Adjectival NPs	Appositives	-	-	-	Appositives	No	Property	-
Semantic of Words	No	No	No	No	No	No	Some	Yes

Figure 5 Summary of tagging methods for different corpora.

3. METHOD: THE ANNOTATION CATEGORIZATION

First, this subsection will review previous databases and summarize the characteristics of their markup schemes. After that, this subsection will explore the complexity of media bias, the need for rich text annotation, and the impact of database size on the study. Ultimately, this section will present possible directions for the markup scheme.

3.1 Annotation Schemes Review

This paper reviewed seven databases; the results are shown in **Figure 5**. Each database has good characteristics.

CoNLL-2012 is a standard stable annotate method that is used in OntoNotes. Its highlight is that it expands the ACE category to account for most NPs, making the annotation content more varied and containing more semantic information. And it extends the definition of coreference to appositives related to entities or events but still requires coreference in a stringent definition.

ECB+ is a mature **cross-document(CD)** database, one of today's most widely used CDCR databases. Its breakdown of entity types is one of its highlights. And it integrates entities and events, further expanding the richness of data in the database. In addition, since it is an action-focused annotation scheme, it also tags verb phrases(VPs).

ISNotes introduces **Information Status(IS)**. IS has been mentioned in several articles[1,3]. In [3], they presented an idea that dividing IS into eight types based on Nissim[49] can help them to build a corpus called ISNotes. They also put the anaphoric information into three types: coreference, **bridging**, and comparative.

NiDENT expanded the types of coreference to seventeen. This is valuable for us to study the relationship between coreference and prejudice. However, the richness of coreference annotation requires more experienced annotators.

GUM is a loose annotation scheme that also uses bridging, and it is a **publicly available** database.

WikiGREM's annotation scheme is innovative but also leads to limitations. Its scope of material is relatively limited, and only those entries in Wikipedia can be used. WikiGREM is also a database for pronoun resolution tasks, which is unsuitable for studying media bias.

NewsWCL50 provides 29 different descriptive orientations, which reflect the semantic affective tendencies of certain words towards certain entities or events. In addition, NewsWCL50 does not label pronouns because they do not help study WCL Bias. Its data sources are also all news, so it is optimized for media bias research.

3.2 The Complexity of Media Bias

We found a phenomenon in some of the articles: conflict of bias. We can observe this phenomenon in news reports about U.S. President Joe Biden's military assistance to Ukraine.

CNN is anti-war liberal, but based on their political stance, they support the president's right-wing actions, describe it as a "decisive action," and equate carrying out arms support with keeping the West's views in line.

Meanwhile, Fox News is very much a traditional right-wing media outlet, and they don't support Joe Biden, but they do support conducting brutal military acts. So, they think this action is "welcome" and "the right choice. They thought the tough action was the right thing to do, but it was not right-wing enough, and they condemned the action as coming too late.

With two conflicting supporting ideologies, the news media reveal their bias in their coverage. Some papers also tend to argue that bias is highly dynamic or driven by news economies[29, 95].

This paper suggests considering the complexity of the news media as commercial objects and the high degree of uncertainty surrounding bias itself.

3.3 Annotation Schemes Features

3.3.1 Strength Bar

Because of the complexity of media bias generation, more than a single binary judgment of consequences is required.

In this part, this paper will try to extend the classification from [18, 56] introduced. In[18], they describe the impact caused by bias. Some words were extracted to describe the impact of specific terms on the entity.

We could serialize these tendencies, describing them as an emotional polarity and placing them on an axis instead of dividing them into these categories. The potential influence of each category on the reader's change of opinion is judged and given scores to distinguish between strength and category.

3.1 Strength bar content for the impact of media bias.

Power	Intention	Vulnerable
Confidence	Security	Appearance
Importance	Positive	Intelligence
Difficulty	Economic	Violence
Justification	Trust	Empathy
Aggressive	Legitimacy	Betrayal
Quality	Social image	Function
Profitability	Fairness	

In this paper, we expand the 19 description directions of NewsWCL50 to 23 [18, 56] and turn them into intensity bars with four different levels. For example, the four states of the "difficulty" intensity bar are difficult, complex, not challenging, and very easy.

3.3.2 Big Data

This paper argues that the current dataset specifications need to be larger, and the models are not complex [8,18] to exploit the benefits of machine learning or deep learning.

Some literature questions that deep learning is not an optimal solution to the problem. Like the point made by [8], machines may need help to identify these framing categories because their differences are so minor that even experienced human annotators may make mistakes. This paper argues that this may be a fact until more extensive databases become available.

More complex models, as well as more extensive data, are needed. Also, reducing the level and difficulty of human intervention, even for unsupervised learning, is an important topic[51]. [8] Some articles have made a simple classification of frames, but introducing more complex codebooks and types of structures may be needed.

Whisper large uses over 680,000 hours of copyrighted content to train its models[27]. The real problem is that frames caused by WCL will not declare themselves due to their purpose. Different from translation and speech recognition, it is difficult for us to get access to a larger corpus. This is one of the reasons why some articles [18] put online news into consideration to expand the scope.

Also, if many annotators are considered, we can consider introducing different opinions of different markers into the data as probabilities. This can further reduce the requirement for the academic background of the taggers. This uncertainty will merge with the uncertainty of the near-coreference. If the data is large enough, this paper argues that we can find complex models to handle these uncertainties.

3.3.3 Schemes

This subsection evaluates the different markup schemes used by the database and indicates which features are most helpful for WCL tasks.

First, we need a semi-supervised marking method. That is, it requires the participation of a small number of professionals and a large number of native speakers in crowdsourcing. In this paper, we aim to reduce the category of near-coreference.

A more extensive range of coreference is necessary and is reflected in this paper as coreference and near-coreference. We simplified the classification of bridging coreference while ensuring that it is still huge in scope and can include very loose coreference. ARRAU uses Subset, Element, Possession, and Other to explain all bridging relations [96]. Inspired by it, this paper wishes to generalize all neural-coreference regarding Subset, Intersection, Functional, and Paraphrasing.

Since we aim to analyze media bias in news reports, pronouns are unimportant for our analysis, so we do not need to mark pronouns.

Also, it is unnecessary to introduce all verb phrases, so only the head of the verb phrase needs to be introduced to obtain complete information about the action and simplify the marking of the action.

In addition, by defining near-coreference, we also classify adverbial constituents such as an event, place, date, and event into the category of near-coreference, which does not require separate analysis.

4. DISCUSSION AND FUTURE WORK

- Let Twitter in.

  Annotation schemes must be paired with many quality sources to become a reliable corpus. Social media is rife with more pronounced and diverse biases than traditional media. With some filtering, it can be a good source of information.

- Mapping media bias and coreference to provide prior.

  In this paper, we failed to relate the consequences of media bias to the type of co-reference. Based on extensive data analysis, it may be possible to first use reference bias labels provided by predictive models based on the kind of co-reference at the time of labeling, which could reduce the probability of human labelers' errors.

- Bridging no metaphors

  We did not have time to discuss metaphors when discussing Bridging relations, and we can add to the framework here in subsequent work.

- Improve the Strength bar.

  The Strength Bar can also be defined more precisely. Currently, it has only four scales and 23 objects.

5. CONCLUSION

This paper clarifies and systemizes the concepts related to coreference resolution and WCL-induced media bias. Then, new optimization directions in cludes Strength Bar are proposed based on the currently popular methods. These attempts improve the precision of the terminology, reduce the difficulty of coreference annotation, and increase the amount of information that comes from the annotation.

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