BASHI: A Corpus of Wall Street Journal Articles Annotated with Bridging Links

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Abstract

This paper presents a corpus resource for the anaphoric phenomenon of bridging, named BASHI. The corpus consisting of 50 Wall Street Journal (WSJ) articles adds bridging anaphors and their antecedents to the other gold annotations that have been created as part of the OntoNotes project (Weischedel et al., 2011). Bridging anaphors are context-dependent expressions that do not refer to the same entity as their antecedent, but to a related entity. Bridging resolution is an under-researched area of NLP, where the lack of annotated training data makes the application of statistical models difficult. Thus, we believe that the corpus is a valuable resource for researchers interested in anaphoric phenomena going beyond coreference, as it can be combined with other corpora to create a larger corpus resource. The corpus contains 57,709 tokens and 459 bridging pairs and is available for download in an offset-based format and a CoNLL-12 style bridging column that can be merged with the other annotation layers in OntoNotes. The paper also reviews previous annotation efforts and different definitions of bridging and reports challenges with respect to the bridging annotation.

Keywords: Corpus Resource, Bridging, Anaphora, Wall Street Journal, OntoNotes, English

1. Introduction

Bridging is an anaphoric phenomenon where the interpretation of a bridging anaphor, sometimes also called associative anaphor (Hawkins, 1978), is based on the non-identical associated antecedent.

The associated NLP task of bridging resolution is about linking these anaphoric noun phrases and their antecedents, where both do not refer to the same referent, but are related in a way that is not explicitly stated. Bridging anaphors are thus discourse-new, but dependent on previous context.

(1) I went to a wedding last weekend. **The bride** was a friend of mine.[1].

(2) What is the book about? **The answer** isn't trivial.

One can think about bridging anaphors as expressions with an implicit argument, e.g. *the bride* (at a wedding) or *the answer* (to this question).

1.1. Motivation

Compared to coreference resolution, which has become one of the standard NLP tasks, with its own track at most NLP conferences, the progress in bridging resolution is much slower. The main issue for most researchers aiming to apply statistical algorithms to this task is the lack of training data. While coreference resolution has about 35,000 coreferent pairs in their standard benchmark dataset OntoNotes (taking into account the transitivity of coreference chains), most datasets for bridging commonly comprise around 400 - 600 pairs (of course, bridging anaphors are also much rarer than coreference anaphors). Note that a benchmark dataset for bridging has not yet been established. In order to tackle the lack of available training data, several smaller corpora could be combined to create a larger corpus resource, including the corpus presented in this paper. The ISNotes corpus (Markert et al., 2012) contains bridging annotations, with 633 bridging pairs. Grishina (2016) recently described a parallel corpus of German, English and Russian texts with 432 German bridging pairs that have been transferred to their English and Russian counterparts. The corpus has, to the best of our knowledge, not yet been made publicly available. One of the newest corpora is the GUM corpus (Zeldes, 2017), a corpus of 64,000 tokens annotated with bridging links and coarse-grained information status.

During the preparation of the camera-ready version of this paper, the first shared task on bridging resolution was announced[2]. As a data basis, the second release of the ARRAU corpus (first released in Poesio and Artstein (2008)) was used, which contains 5512 bridging pairs in three different domains: news text, dialogue and narrative text. This is, as far as we know, currently the biggest corpus resource containing bridging pairs. However, only a small subset of the annotated pairs contains truly anaphoric bridging anaphors, which is why annotated corpus resources like the one presented in our paper are still beneficial (c.f. Section 1.2. for the distinction between referential and lexical bridging).

The resolution of bridging links is important because it can help in tasks which use the concept of textual coherence, for example Barzilay and Lapata (2008)'s entity grid or Hearst (1994)'s text segmentation. They might also be of use in higher-level text understanding tasks such as textual entailment (Mirkin et al., 2010) or summarisation based on argument overlap (Kintsch and van Dijk, 1978; Fang and Teufel, 2014).

1.2. Bridging: One Term, Many Phenomena

Bridging has been studied in many theoretical studies (Clark, 1975; Hawkins, 1978; Hobbs et al., 1993; Asher and Lascarides, 1998) as well as in corpus and computational studies (Fraurud, 1990; Poesio et al., 1997; Vieira

[1] Anaphors are marked in bold face, their antecedents are underlined

[2] http://anawiki.essex.ac.uk/dali/crac18/crac18_shared_task.html

and Teufel, 1997; Poesio and Vieira, 1998; Poesio et al., 2004; Nissim et al., 2004; Nedoluzhko et al., 2009; Lassalle and Denis, 2011; Baumann and Riester, 2012; Cahill and Riester, 2012; Markert et al., 2012; Hou et al., 2013b; Hou et al., 2013a; Hou, 2016; Zikánová et al., 2015; Grishina, 2016; Roitberg and Nedoluzhko, 2016; Riester and Baumann, 2017).

One big issue is that, unlike in work on coreference resolution, these studies do not follow an agreed upon definition of bridging. On the contrary, many different phenomena have been described as bridging. As a result, guidelines for bridging annotation differ in many respects so that they cannot be easily combined to create a larger bridging corpus resource. The latter would however be necessary to further research in this area, as statistical approaches to bridging resolution are limited due to the limited corpus size, cf. for example Hou (2016).

This section will present the different phenomena that have in previous research been treated as bridging and will make a suggestion for an approach that aims at a broad definition of bridging that is compatible with many previous studies.

One issue that came up in the early work on bridging and is still present in some work is the **overlap with coreferent anaphora**. Clark (1975) proposed a very broad definition, including anaphoric use of NPs that have an identity relation with their antecedent, e.g. in

(3) I met a man yesterday. **The man** stole all my money.

While it is nowadays non-controversial that these coreferent cases should not fall under the label of bridging, the more difficult cases of coreference where the anaphor and the antecedent do not share the same head but are in a synonymy, hyponymy or metonomy relation, are sometimes treated as bridging, e.g. in Poesio and Vieira (1998), among others.

(4) I met a man yesterday. **The bastard** stole all my money.

Clark (1975) and Asher and Lascarides (1998) also included **rhetorical relation or connection cases**, e.g. in

(5) John partied all night yesterday. He's going to get drunk **again** today.

While these are interesting cases of anaphoric use, most work nowadays limits the anaphor to nominal referring expressions.

Another important point of discussion is the question whether **definiteness** should be a requirement for bridging anaphors. Many studies (Poesio and Vieira, 1998; Baumann and Riester, 2012; Rösiger, 2016), among many others, have excluded indefinite expressions as potential bridging candidates as indefinite expressions introduce new information that can be processed without the context of the previous discourse. Löbner (1998) suggested that bridging anaphors can also be indefinite, as these indefinite expressions can occur in part-whole or part-of-event relations, with the consequence that many studies have linked them as bridging (e.g. in ISNotes, and others).

(6) I bought a bicycle. **A tire** was already flat.

Riester and Baumann (2017) suggested to restrict the annotation of bridging to definite expressions as part of their information status annotation of referring expressions (r-level) and to treat lexical relations (in indefinite and definite expressions) on another level (called the l-level). We agree with the opinion that definite bridging cases are different from indefinite cases and should, when both are treated as bridging, be labelled as different types of bridging.

Another common issue is **the restriction of bridging to pre-defined relations**, such as part-of, set-membership, possession or event relations, e.g. in the Switchboard corpus, (Nissim et al., 2004). Some corpora do not make such limitations (e.g. ISNotes). We believe that bridging is a versatile phenomenon that cannot be captured with pre-defined relations. Furthermore, some work (e.g. ISNotes) has excluded certain relations, e.g. comparative anaphora (Markert et al., 2012), from the bridging category arguing that they can be found by surface markers, such as *other, another*, etc., e.g. in

(7) About 200,000 East Germans marched in Leipzig and thousands more staged protests in **three other cities**.

Comparative anaphora have different properties than "regular bridging" cases, as they indicate co-alternativity, e.g. a relationship on equal terms, between the antecedent and the anaphor, while for typical bridging cases, the relation between the anaphor and the antecedent is a hierarchical one, with the bridging anaphor being subordinate to the antecedent.

While many approaches distinguish only between coreferent anaphors that refer to the same referent as their antecedent and bridging anaphors that refer to a different referent, Recasens and Hovy (2010; Recasens et al. (2012) has introduced a third concept, the concept of **near-identity** which has been picked up by others (e.g. Grishina (2016)). Near-identity is defined to hold between an anaphor and an antecedent whose referents are almost identical, but differ in one of four respects: name metonomy, meronymy, class or spatio-temporal functions.

(8) Iran maintains diplomatic relations with 99 members of the United Nations. **Tehran** and the P5+1 came to a historic agreement to end economic sanctions.

We prefer to stay with the two-class categorisation of coreference and bridging and argue that in cases where *Iran* and *Tehran* are both used to refer to the Iranian government, they should be considered coreferent. In cases where they do not refer to the same referent, but a related entity, they can in principle be considered bridging. However, in this case, *Tehran* is not anaphoric, which leads us on to the following important distinction.

Referential vs. lexical bridging

We propose the terms referential and lexical bridging to distinguish two different phenomena which are currently both defined as bridging. **Referential bridging** describes bridging anaphors that are truly anaphoric in the sense that they need an antecedent in order to be interpretable, as in

(9) The city is planning a new townhall and **the construction** will start next week.

Referential bridging is often a subclass of (referential) information status annotation. The corpus ISNotes (Markert et al., 2012) is one example of a corpus which solely includes referential bridging.
Lexical bridging describes lexical semantic relations between certain words, i.e. *Spain* and *Europe* being in a meronymy relation. These cases are not anaphoric, as the interpretation of *Spain* does not depend on the antecedent *Europe*. Lexical bridging is often annotated when certain pre-defined relations are defined as bridging. The second release of the ARRAU corpus (first released in Poesio and Artstein (2008)), as used in the first shared task on bridging resolution, for example contains both referential and lexical bridging, with the majority of the bridging links being lexical bridging pairs.
It should be noted that lexical and referential bridging are two different phenomena with completely different properties, although, for sure, they can co-occur in one and the same expression, such as in

(10) a house ... *the door*.

In this paper, we only focus on referential bridging, as we think that these are the bridging cases which are most interesting from a discourse understanding point of view. Also, the task of lexical bridging resolution is related to work that has been done in the NLP community on detecting semantic relations between words (c.f. e.g. Shwartz and Dagan (2016).

1.3. Our Proposed Approach

Our annotation guidelines are on the one hand broad enough to cover many cases, following these principles

- Bridging anaphors have to be anaphoric, i.e. not interpretable without an antecedent (=referential bridging only)
- Bridging relations are not restricted to certain predefined relations;
- bridging anaphora can be definite or indefinite (but we use two different labels to distinguish them);
- bridging antecedents can be nominal entities or events (VP or clauses) .

On the other hand, we propose a clear separation from other tasks:

- No overlap with coreference resolution: context-dependent anaphors that refer to the same entity as their antecedent are considered "given" information (independent of their surface realisation), and thus covered by coreference resolution;
- bridging anaphors are context-dependent expressions that do not refer to the same entity as their antecedent, but to a related entity;
- we focus on referring expressions, excluding rhetorical or connection cases: anaphors are nominal, antecedents can be nominal, verbal or clauses.

The annotation guidelines are tailored to Germanic languages like English and German as they focus on the distinction between definiteness and indefiniteness. The idea of a broad, but clear definition of bridging without an overlap with the concept of coreference can of course also be applied to other languages.

2. Corpus Creation

We annotate 50 articles from the WSJ that are already part of OntoNotes. The articles were selected blindly, but we exluded articles that were already annotated as part of the ISNotes corpus (Markert et al., 2012) and those articles that give an overview of what happened in a certain time frame, thus containing several separate discourses in one document. The corpus is named BASHI, bridging anaphors hand-annotated inventory[3]. It is a relatively small corpus, but because of its categorised bridging links it can be combined with many other corpus resources (e.g. ISNotes), in order to create a larger corpus resource.

3. Annotation Scheme

3.1. Markables

Markables (and thus candidates for bridging anaphors) are all NPs that have been gold annotated in the OntoNotes corpus (Weischedel et al., 2011). Pre-marked NPs in OntoNotes include

- nominal phrases: *the president*
- proper names: *Mr. Bush*
- quantifier phrases: *all the products*
- pronouns: personal, possessive, demonstrative, reflexive

If the annotator thinks that an NP has not been pre-marked, he or she added a markable to the set of markables (this is rarely the case).

3.2. Non-markables

The pre-marked NPs do not include

- nominal premodification: the *US* president
- interrogative or relative pronouns

The annotators are told to mark the longest span of the NP that refers to the entity, including determiners and adjectives, dependent PPs and relative clauses.

[3]Bashi can mean "bridge" in Japanese.

(11) There have been concerns that the Big Board's basket could attract investors with a short term perspective who would rapidly turn over the product, thus increasing volatility.

3.3. Bridging Anaphors

We only annotate referential bridging. This means that bridging anaphors are discourse-new, anaphoric expressions which are dependent on the previous context, and for which the text presents an antecedent NP which does not stand in the relation of identity, but in some other form of relation to the associative phrase. The antecedent may be an associate in a typical relation such as part-of, part-of-event or any kind of associate as long as there is a clear relation between the two phrases.

(12) We use a classifer to distinguish between the two categories.
The training data consists of ...

(13) My sister celebrated her birthday last weekend. I offered to help her make **the cake**.

(14) Our correspondent in Egypt is reporting that **the opposition** is holding a rally against **the constitutional referendum**.

Often, the anaphor is lacking an implicit argument (the antecedent) which enables the interpretation of the expression. This is also reflected in the bridging definition of Roitberg and Nedoluzhko (2016) (called genitive bridging) where they restrict bridging cases to those that can form a genitive construction with the antecedent. While genitive constructions might be a bit too restrictive and the use of genitive constructions is very language-dependent, we agree that bridging pairs can often be seen as head-argument constructions.

(15) **the opposition** (in Egypt)

(16) **the answer** (to this question)

3.3.1. Definite Use

Most bridging anaphors are definite NPs. Note that bare singulars can sometimes also count as definite, in cases where the insertion of the definite article is more plausible than the insertion of an indefinite article. Bare plurals usually count as indefinites.

(17) I went into the room. **The windows** were broken.

(18) We performed the experiments using ... . **Evaluation** is done by means of 10-fold cross validation.

3.3.2. Indefinite Use

Some bridging anaphors are indefinite expressions. In this case, we label the NP as indefinite and link it to the preferred antecedent. Indefinite cases of bridging are typically either part-of or part-of-event relations. As a general rule, indefinite expressions always introduce new information that can be interpreted without context. Nevertheless, we annotate them as bridging in cases where we feel that the interpretation strongly benefits from an argument, i.e. the antecedent.

(19) I bought a bicycle. **A tire** was already flat.

(20) Afghanistan ... **Millions of refugees** would rush home.

3.3.3. Comparative Anaphors

Comparative anaphors have been excluded from the bridging category and treated as a separate category in the ISNotes corpus. We include them in the bridging cases, but label them as comparative and link the comparative markable to the antecedent.

(21) About 200,000 East Germans marched in Leipzig and thousands more staged protests in **three other cities**

(22) President Bush, the Canadian prime minister and **14 other members of the Committee**.

3.4. Antecedents

As a general principle, one antecedent has to be chosen. In special cases, e.g. comparative cases where two antecedents are needed, the annotator may create two or several links.

(23) President Bush, the Canadian prime minister and **14 other members of the Committee**.

We include nominal and abstract antecedents, where the anaphors links back to a VP or a clause.

(24) What is the meaning of life? **The answer** cannot be expressed in one sentence.

The antecedent should be the best semantically related expression. In case of several possible antecedents, the closest should be chosen.
Bridging should not be used as a substitution category for aggregated coreference, where we need two coreference links to for example state that *all sides* involves *the media* and *the congressman* (in a context where these two expressions do not appear in a coordination).

3.5. Link Types

As there are different types of links covered under the term bridging in previous annotation efforts, we distinguish a number of bridging types, for purely pragmatic reasons. The phenomena can then be studied separately, if needed, or certain anaphor types can be excluded when merging data from different source corpora. Cases of the category bridging-contained, as described in Baumann and Riester (2012), is not annotated as bridging because it is not an anaphoric phenomenon and as such a special case where the antecedent modifies the bridging anaphor.

(25) *the windows in the room*

(26) *the mother's room* or *her room*

The annotated bridging link categories are the following: (i) definite bridging links, (ii) indefinite bridging links and

(iii) comparative bridging links. Cataphoric bridging links are not allowed.

4. Annotation Procedure

The annotation is done using the annotation tool Slate (Kaplan et al., 2012) [4]. The markables, i.e. the gold annotated NPs in OntoNotes, are presented in green. Coreferent entities shown in red are already marked and can thus not be marked as bridging anaphors. Exceptions are the first mention in a coreference chain, which can of course be of the category bridging. We refrain from annotating attributes in order not to complicate the annotation process. The annotation involves two annotators (both graduate students in computational linguistics, who have previously been involved in information status annotation) for five WSJ articles, to establish the inter-annotator agreement. The gold annotations for this subset are then merged, and differences between the two versions are resolved via discussion between the annotators. The rest of the corpus is annotated by a single annotator.

5. Difficult Annotation Decisions

Some cases of bridging are very clear, particularly for definite anaphors that occur in a well-defined relation with their antecedent, e.g. whole-part (*the house - the window*). In this case, it is obvious that the definite anaphor requires the antecedent for its interpretation.

5.1. Generic Use vs. Bridging

Other cases are less clear, and they are often a question of generic use vs. bridging. Consider the following example that is taken from the Wall Street Journal and is thus concerned with the US (which is often not explicitly stated, but obvious given the WSJ's location).

(27) **The police** would be waiting.

The question whether *the police* is a generic reference to the concept police or whether a bridging link should be placed between *the police* and *the US* is not obvious. When does such an entity need an antecedent or when does it simply add (optional) information? In cases of obvious generic use, we do not link the two entities. If we get the feeling that we are not speaking about the generic class *police*, but more specifically about the police in, say, Baltimore, we link the two entities. As a general rule, if the entity is interpretable on its own, we do not link it, e.g. in

(28) When you annotate a text, **bridging anaphors** are the most difficult issue.

Still, this distinction remains a little vague.

5.2. Unused/Mediated vs. Bridging

Another difficult choice is the distinction between the information status category unused (sometimes called mediated) and bridging, i.e. in a case like

(29) Iran ... **foreign secretary Mottaki**

where some people might consider this a bridging case, as the *foreign secretary Mottaki* is probably not interpretable alone for a typical WSJ reader without the mentioning of *Iran* first. However, others might argue that his discourse referent might already be identified by his name.
Furthermore, while we typically assume entities like *the moon* to be unique, known entities, and thus of the category unused/mediated, there might be contexts where there are several moons, and one might want to link *the moon* to the entity *the earth* via a bridging relation.

5.3. Determining a Single Antecedent

In some contexts, the writer/speaker introduces a topic into the discourse and then talks about aspects referring to this topic. In cases where there are several noun phrases representing this topic it is not always obvious which NP should be chosen as the antecedent.

(30) No age group is more sensitive than younger voters, like Ms. Ehman. A year ago this fall, voters under 30 favored George Bush by 56 to 39 % over Michael Dukakis, [..]. Voters in **the same age group** backed Democrat Florio 55% to 20 % over Republican Courter.

It is relatively obvious that *the same age group* is a bridging anaphor, but whether *younger voters, like Ms. Ehman*, *Ms. Ehman* or *voters under 30* should be chosen as the antecedent remains unclear (and does not really make a big difference in terms of the interpretation of the anaphor).

6. Resulting Corpus

As can be seen in Table 1, the corpus consists of 459 bridging links, 114 of which contain an indefinite anaphor, 275 a definite anaphor and 70 are comparative anaphors. Out of these 70 comparative anaphors, 12 have more than one link to an antecedent. The corpus contains 57,709 tokens.

Bridging links	459
Definite	275
Indefinite	114
Comparative	70

Table 1: Corpus statistics for the gold bridging corpus

6.1. Inter-Annotator Agreement

Five WSJ articles have been annotated by a second annotator, in order to assess the inter-annotator-agreement. Table 2 shows the agreement for the respective categories. We only report the observed agreement, as the expected agreement for linking markables is considered extremely low (as one can potentially link every NP with all preceeding NPs) and can thus be neglected.
It can be seen that the agreement is high for comparative anaphora: as these almost always occur with surface markers such as *other, another, etc.*, they can be easily spotted. The agreement for the chosen antecedent is also higher, as they are typically local antecedents in a rather narrow window. As expected, the agreement for anaphor detection as

[4] Annotation guidelines:
http://www.ims.uni-stuttgart.de/institut/mitarbeiter/roesigia/guidelines-bridging-en.pdf

Bridging anaphor type	anaphor			anaphor+antecedent		
	same	diff.	agreement	same	diff.	agreement
Definite	34	13	73.9%	30	17	63.8%
Indefinite	15	11	57.7%	11	15	42.3%
Comparative	12	2	85.2%	10	4	71.4%
Total	31	25	70.9%	51	36	59.3%

Table 2: Inter-annotator agreement on five WSJ articles

well as for full bridging resolution is higher for definites than for indefinites. This confirms our hypothesis that for definites, it is easier to decide whether they are anaphoric or not. Overall, for anaphor detection, we achieve an agreement of 70.9% and 59.3% agreement for the overall links. As the overall agreement on the bridging links is rather low (also for other corpora), one could think about evaluating the task of bridging resolution differently than with the typical precision/recall metrics, particularly for contexts such as Example (29).

6.2. Format and Download

The corpus is made available in the form of a download link[5]. The download contains the annotations in an offset-based XML format as well as CoNLL-12 style columns. For the single anaphor type categories (definite, indefinite, comparative) we have created separate columns, as well as one joint column which contains all the bridging links. As the OntoNotes data has to be obtained separately via the LDC, the download will include instructions on how to merge the annotations with the actual corpus data and the annotations in the OntoNotes release (words, part-of-speech, coreference, etc.).

7. Conclusion

We have presented BASHI, a corpus of 50 WSJ articles which adds bridging anaphors and their antecedents to the other gold annotations that have been created as part of the OntoNotes project (Weischedel et al., 2011). As the bridging links contain information about the type of the bridging anaphor (definite, indefinite, comparative), it is compatible with many other bridging corpora and can thus be used to create a bigger corpus resource, which would be required for further advances using statistical methods. The corpus contains 57,709 tokens and 459 bridging pairs and is available for download in an offset-based format and a CoNLL-12 style bridging column that can be merged with the other annotation layers in OntoNotes.

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[5] http://www.ims.uni-stuttgart.de/forschung/ressourcen/korpora/bashi.html

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