Antecedents of *Respectively*

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1 Introduction

(1) English and Dutch (Domain) are used in Guyana and Suriname (Range) *respectively*. [Gr]

- Pairwise relation established between two ordered sets of objects

Claims that *respectively* induces a syntactic dependency:

- Context Freeness: Bar-Hillel and Shamir (1960), Langendoen (1977)
- Constraints on Coordination: Moltmann (1992)

Arguments against *respectively* inducing a syntactic dependency:

- Stockwell, Schachter, and Partee (1973, page 400):

  (2) They live in New York and Chicago respectively.

  Possible context: *Where do John and Bill live?*

  > "[Such examples] can only be used in a context in which it is known to what two people (or groups of people) **they** refers, and in what order those two people (or groups) are being referred to."

- McCawley (1988, pages 536-540):

  > "[Such examples] raise the possibility that *respectively* serves as an 'anaphoric device', with the coordinate constituent that 'controls' the pairing serving as antecedent."

- Pullum and Gazdar (1982, pages 481-485):

  (3) The people you have indicated are all New York residents except for the last two. They live in Chicago and Columbus respectively.

  which is to be understood in a context where someone is attempting to pick out New York residents in a mass photo of the LSA membership.

  > "In this case, the nonlinguistic context picks out a unique ordered set of people with whom Chicago and Columbus can be appropriately associated; but the sentence that contains *respectively* does not allow for a pairing between either *Chicago* or *Columbus* and any other noun phrase, so pairing of constituents certainly cannot be part of the correct characterization of *respectively* sentences."

Proposal: characterize *respectively* as establishing a pairing not between members of two coordinate structures in the syntax, but between two ordered sets of semantic entities in the discourse.

In the remainder of the paper, we:

- Demonstrate robustness of this characterization
  - Past arguments center around adaptations of a single example
- Demonstrate the degree to which resolution of the domain and range is dependent on discourse-level factors
- Suggest problems with Kac's more recent argument for the non-context-freeness of English

2 A Corpus Study

- Collected all instances of sentences containing *respectively* in two large corpora:
  - *The New York Times*: 30,000 articles (259 examples)
  - *Grolier's Encyclopedia*: 27,000 articles. (289 examples)
- Out of a total of 548 examples, in 80 cases (15%) either the domain or range is not specified by a coordinate structure in the sentence containing *respectively*.
- Examples can be further classified into one of four categories:
  1. Domain or range is specified by a conjoined structure in a previous sentence (26 cases);
  2. Elements of the domain or range are specified from distinct places in the discourse, the ordering being determined from order of presentation (23 cases);
  3. Domain or range and its ordering need to be accommodated, perhaps requiring world and/or domain knowledge (11 cases); and
  4. Elements of the domain or range are not distinguished and their ordering is not recoverable; in these cases the ordering is inferred to be arbitrary or otherwise unimportant (20 cases).
- Examples lie on a spectrum spanning from the use exemplified by sentence (1) to cases where greater amounts of information must be inferred to both identify and order the domain or range.

2.1 Class 1: Antecedents Evoked by an Intersentential Coordinate NP

(4) Kevin Sweeney, 33, and Curtis Bristow, 32, are both former residents of San Diego. They received 20 and 14 years *respectively* for conspiracy to make methamphetamines. [NYT]

(5) Until Friday, government data showed the GNP to be growing at a healthy annual rate of 2.6 percent in last year's second quarter and 3 percent in the third period. The revised GNP numbers for these two quarters, however, were 1.6 percent and 1.7 percent, *respectively*. [NYT]

Ordering is recovered from order of mention in coordinate NP.

2.2 Class 2: Antecedents Identified from Distinct Locations in the Discourse

(6) How do you film buffaloes being shot and killed during a stampede without injuring a single beast? How do you get a buffalo to charge an actor without endangering either?

By using, *respectively*, fake and stunt buffaloes, says Jim Wilson, Kevin Costner's co-producer on "Dances With Wolves," a stunningly beautiful and, by all accounts, remarkably authentic portrait of American Plains Indian culture in the late 1860s. [NYT]

(7) The gain of an operational amplifier is given by the ratio of the feedback resistance to the input resistance. Thus if these two resistances are 100,000 and 1,000 ohms, *respectively*, the gain will be 100. [Gr]

(8) A springboard, with adjustable fulcrum, is 1 or 3 m (3 or 10 ft) above the water surface. The platform, inflexible, is set at 5-10 m (16-33 ft) above the surface. For Olympic and other major competition for both men and women, the 3-m and 10-m heights, *respectively*, are used. [Gr]

Ordering is recovered through order of presentation.

2.3 Class 3: Antecedents Identified by Accommodation

(9) In most carbon compounds an adjacent atom will contribute one to three electrons, which are matched by an equal number from carbon to form a single, double, or triple bond, *respectively*. [Gr]

(10) A section cut downward from the surface through the various soil horizons forms the soil profile. From the surface downward, the major soil horizons are designated A, B, and C, *respectively*. [Gr]

(11) Though the Trail Blazers won this series in six games from Phoenix, they were far from dominant. Their margins of victory were 2 points, 1 point, 6 points, and 3 points, *respectively*. [NYT]

Ordering inferred using world/domain knowledge.

2.4 Class 4: Arbitrary Ordering

(12) In the long history of the Texas oil industry, there has rarely been a gusher as powerful as either of those that burst to the surface in the aging oil patch southwest of San Antonio last month. In an area regarded as well past its oil-producing prime, the wells surged with 20,000 and 12,000 barrels a day, *respectively*, in a field where most wells produce less than 500. [NYT]

(13) Eleven isotopes of copper are known, two of which are not radioactive and occur with a natural abundance of 69.09% and 30.91%, *respectively*. [Gr]

Ordering assumed to be arbitrary or irrelevant. Meaning of *respectively* reduces to that of 'each' or 'individually'.

3 Summary of Data

- Four types of examples show that varying degrees of inference may be necessary to identify the antecedents, as well as to impose an ordering on them.
- *Respectively* does not impose an intrasentential syntactic relation between elements of two coordinate structures.

4 A More Recent Context-Freeness Argument

Kac (1987):

(14) * I like, dislike, and like this and this respectively.

which is ungrammatical because:

> no NP in the second coordinate phrase can be construed as the Object of more than one V in the first. It then follows in turn that if the Vs are all surface-transitive, there must be at least as many Ns in the second coordinate phrase as there are Vs in the first. (Kac, 1987, pp. 446-447)

Kac's argument:

- Does not require that there be a *matching* number of conjuncts in the conjoined verb constituent and the object NP constituent,
- but instead depends on the weaker assumption that the number of conjuncts in the conjoined verb constituent is *less than or equal to* the number in the NP object constituent.
- Therefore his argument is immune to Pullum and Gazdar's objection.

An example in the Pullum and Gazdar spirit:

(15) John, Bill, and Pete were invited to the party. I like, dislike, and like these three men, respectively.

Real examples where *range* is identified referentially:

(16) In 1970, Japan and China became the fourth and fifth nations to possess independent launch capability. Osumi and China 1 were launched from within these two countries, *respectively*. [Gr]

(17) Glenn Davis, b. Claremont, Calif., Dec. 26, 1924, is a former football player who starred at the U.S. Military Academy as a freshman in 1943 and during West Point's undefeated seasons of 1944, 1945, and 1946. He scored 3, 20, 18, and 13 touchdowns, *respectively*, in those seasons. [Gr]

(18) Out of three possible reasons for fighting - restoring the government of Kuwait and defending Saudi Arabia, protecting oil reserves, and stopping Saddam from developing nuclear weapons - majorities of 56 and 62 percent, respectively, rejected the first two reasons as not being good enough. [NYT]

5 Conclusion

- *Respectively* imposes the constraint that the sets of elements it establishes a pairing between have the same cardinality.
- The data presented here show that these elements are semantic entities in the discourse, not syntactic conjuncts of a coordinated constituent.

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