

RESULT, PURPOSE and REASON – so what?

The connective *so* in English can mark RESULT, PURPOSE and REASON relations, so how do hearers distinguish between these three? We address this question by a combination of empirical methods, corpus study and a psycholinguistic experiment. Our results tell us more about how ambiguous connectives manage to unambiguously map to coherence relations and also supports the conclusion that explicit coherence relations are qualitatively different from implicit ones (e.g. Sporleder & Lascarides, 2008).

The connective *so* (and the related *so that*) are generally assumed to mark RESULT and PURPOSE relations. Traditionally, a *so* marked PURPOSE relation is distinguishable from a RESULT relation in that (1) a PURPOSE relation is intentional, and must have an agent who does an activity for a REASON and (2) the 'so' marked argument can be fronted, a RESULT relation cannot be.

- (1) RESULT: John's car broke down, so he can't come to the party.
- (2) PURPOSE: John bought a new suit so he would look good at the interview.
- (3) ?? So he can't come to the party, John's car broke down.
- (4) PURPOSE: So he would look good at the interview, John bought a new suit.

There are also tendencies for the *so* marked PURPOSE clause to describe a future event or situation, whereas a *so* marked RESULT clause is often about the past. PURPOSE is also special because it is one of only two relations of standard Rhetorical Structure Theory (RST), where relation nuclearity doesn't necessarily coincide with the so-called 'locus-of-effect'. In RST, the 'so'-marked argument of a PURPOSE relation is the satellite. But it is this satellite that sometimes links back to the greater discourse structure (see e.g. Stede 2008).

In order to understand more about the relationship between *so* on the one hand, and RESULT and PURPOSE on the other, we first conducted a corpus study.

Corpus study: We classified 500 randomly extracted examples from the British National Corpus (BNC) of *so* and 100 randomly extracted examples of *so that*. We also classified the first 11 files of the Penn Discourse Treebank (PDTB 2.0; 347 examples of 'so'). The PDTB is a connective-based annotation of the Penn Treebank (1 ml words, newswire). In the PDTB2.0, textual units without an explicit connective were annotated with the most appropriate connective, identifying implicit relations. Finally, explicit and implicit connectives were classified for their coherence relation. By using this corpus, we can study implicit (i.e. non-marked) *so* relations and their interpretations. We found that:

- PURPOSE relations are quite infrequent with 'so': BNC: 10% - 51 instances in 500 sample; PDTB2.0: 4% - 14 cases in 347 examples. This may be a difference in genre.
- We did not find Implicit PURPOSE relations. In the PDTB2.0 unmarked *so* relations were always RESULT relations
- With *so that*, PURPOSE relations dominate (BNC: 63 vs. 36 RESULT and 1 unclear in 100 sample), but RESULT relations are certainly present, contrary claims by e.g. Knott (1996) that 'so that' marks PURPOSE only.
- Among the RESULT relations in the PDTB2.0, 80% were implicit (266 out of 333).

Based on our manual examination of the corpus examples we have developed a number of hypotheses. First, PURPOSE Relations must be explicitly marked. Removing a *so* from a PURPOSE relation changes its interpretation to a RESULT relation, e.g.

- (5) John bought a new suit. He would look good at the interview. (cf. (2))

Second, many RESULT relations seem to be more accurately characterized as REASON relations, where the first argument (the non-*so* marked argument) is actually an Explanation, e.g. (6). We believe that this more specific category seems to be accurately

distinguishable from RESULT relations. Similar to PURPOSE, removing *so* seems to change the more specific REASON interpretation to a straightforward RESULT relation, e.g.

(6) Maria just turned 12 so she has to buy an adult ticket.

(7) Maria just turned 12. She has to buy an adult ticket.

This suggests that the same two events will get a different interpretation depending on whether or not they are explicitly marked with an otherwise ambiguous connective (!). Also, Implicit *so* relations in the PDTB2.0 were only RESULT relations. But if we remove *so* from RESULT relation examples, do people still interpret them as RESULT? These questions can be further investigated psycholinguistically.

Experimental study: As a first step, we presented 20 native English speakers via Amazon's Mechanical Turk service with 12 sentence (plus 4 fillers) based loosely on BNC examples, balanced by PURPOSE, REASON, or RESULT relations. For each coherence type, subjects saw two explicit and two implicit versions (implicit = no connective, e.g. (4)):

(8) PURPOSE-explicit: Thomas sent Daniel his account number so he can pay him immediately.

(9) REASON-explicit: Jacquie is always working out so she's very fit.

(10) RESULT-explicit: Harry didn't have much time between lectures so he just grabbed a cup of coffee.

(11) RESULT-implicit: Harry didn't have much time between lectures. He just grabbed a cup of coffee.

Subjects were asked to choose the best paraphrase for the target sentence. The paraphrases were constructed with the target sentence, with *so* or a full stop, replaced by *as a result*, *in order to*, and *that's why*, to indicate PURPOSE, REASON and RESULT making any small changes necessary for naturalness.

Experimental Results: Briefly, for our stimuli, all *so* marked PURPOSE relations were recognized. Unexpectedly, the same stimuli sentences without *so* were recognized as PURPOSE 76% of the time, suggesting when the relation between the events is clear, implicit PURPOSE relations are possible. Still, when *so* is left out, the same two events seem to lose their PURPOSE interpretation for some speakers. However, only 15% of the remaining relations were RESULT, contradicting our prediction that implicit PURPOSE relations would tend to default to RESULT relations.

60% of *so* marked REASON relations were recognized, and 65% of implicit marked REASON relations were recognized, with PURPOSE and RESULT responses about equal. Only 47% of *so* marked RESULT relations were classified as such, however 66% of implicitly marked RESULT relations were identified. This is consistent with the hypothesis that using *so* indicates a PURPOSE or REASON relation and that for RESULT relations without additional meaning, explicit marking should be less necessary. It looks like there is a perceivable difference between a RESULT and a REASON relation, but it may be strongly emphasized by the particular example. Finally, our corpus work showed that PURPOSE is infrequent, and likely to only be explicitly marked. Based on these findings, we might have concluded that PURPOSE relations are not inferable without an explicit connective like *so*. However, our experiment showed that subjects frequently do recognize a PURPOSE relation even without a connective. This result emphasizes the value of doing both corpus and experimental work.

Selected References: Sporleder & Lascarides (2008). Using Automatically Labeled Examples to Classify Rhetorical Relations; Stede (2008). Connective-based Local Coherence; Knott (1996). *A data-driven methodology for motivating a set of coherence relations*. PhD Thesis