

## Explicit Discourse Connectives / Implicit Discourse Relations

Bonnie Webber   Hannah Rohde   Anna Dickinson   Annie Louis  
University of Edinburgh  
Nathan Schneider  
Georgetown University

The subject of our research is textual evidence for coherence relations between clauses (aka *discourse relations*) and what relations they provide evidence for. We call explicit indicators of coherence relations *discourse connectives*.<sup>1</sup> Coherence relations have been the object of study in semantics and psycholinguistics, including (Knott, 1996; Knott & Mellish, 1996; Knott & Sanders, 1998; Spooren, 1997), and a focus of *discourse parsing* applications in Natural Language Processing (Lin et al, 2014; Xue et al, 2015; Xue et al, 2016). In all this work, the standard assumption has been, simply put, that explicit discourse connectives signal discourse relations, and that only where they are absent or ambiguous is inference used to establish coherence.

This assumption bears questioning, however, and work we have carried out to date on *concurrent discourse relations* and on how listeners interpret *discourse connectives* shows this assumption to be false (Rohde et al, 2015; Rohde et al, 2016; Rohde et al, 2017). We believe that correcting this assumption can both improve computational modelling (say, for machine translation and relation extraction) and support deeper cross-lingual studies and more effective design and interpretation of psycholinguistic experimentation. As such, we believe that our work should be of interest to both the existing ACL and new SCiL communities.

Our work was undertaken with the computational goal of improving inter-clausal relation mining. Work on the Penn Discourse TreeBank (PDTB) (Prasad et al, 2014) had already shown that annotators sometimes chose to annotate more than one coherence relation as holding between the same discourse spans, and further annotation (Webber et al, 2016) has shown even more frequent annotation of more than one discourse relation between the same pair of spans.

But PDTB annotation has also hinted at another possible source of multiple discourse relations holding concurrently. Specifically, annotators sense-labelled some of the sentences containing the *discourse adverbial* “instead” as if the sentences started with the conjunction “but” (as in Ex. 1), annotating “instead” with a sense normally associated with “but” (CONTRAST) rather than its own more common label (CHOSEN ALTERNATIVE). Since “instead” can co-occur with conjunctions other than “but” (as in Ex. 2–4)

- (1) I planned to make lasagna. Instead I made hamburgers. ⇒ But instead I made hamburgers
- (2) I don’t know how to make lasagna. So instead I made hamburgers.
- (3) Surprisingly, they ignored the lasagna. And instead they just ate the salad.
- (4) Physical states and physical laws need not be specified in minute detail, because instead they can be summarized in the form of probabilistic relationships ... [Judea Pearl, **Causality**, 2000]

---

<sup>1</sup>This term includes lexico-syntactic constructions such as preposed modals, which we exclude. Such modals can be used to indicate a CONDITIONAL relation, as in *Should you come early, you could help set up*.

one must conclude either that “instead” is ambiguous or that the standard assumption that a discourse relation is either signalled explicitly with a discourse connective or inferred from context *but not both* is wrong. Instead, one should allow for discourse relations to be signalled explicitly (via discourse connectives), while at the same time allowing relations to be inferred from context.

This revised view has led us to try to characterize what, if any, implicit discourse connective(s) can stand proxy for discourse relations that hold concurrently with the relation(s) signalled by a wide range of explicit discourse adverbials, and to identify what licenses these implicit connectives, so as to be able to predict their distribution. That allows for both the possibility that implicit concurrent discourse relations are completely predicted by the adverbial itself, and the possibility that other features of context (including the adverbial, or independent of it) contribute to predicting the implicit relation. Our methodology to date has been primarily empirical: Using a *conjunction completion task*, we have crowdsourced data on 50 different discourse adverbials, each in 35-to-50 naturally-occurring passages, providing us with over 40K judgments. Each passage was originally either *explicit*, comprising two text spans linked by both an explicit conjunction and a discourse adverbial (where the conjunction was then excised) or *implicit*, comprising two spans linked only by a discourse adverbial (where a corresponding gap was inserted before the adverbial).

We have so far concluded: (1) It is possible for naive subjects to infer an implicit conjunction alongside an explicit discourse adverbial, and that subjects do this reliably and systematically. Even though subjects could always reject a conjunction, they consistently endorsed meaning-bearing conjunctions in a way not explainable from the adverbial alone. No adverbial was uniformly associated with a single conjunction whose meaning is linked directly to that of the adverbial itself, but adverbial-specific patterns emerge. (2) The diverse patterns we observed include cases in which more than one valid connective was endorsed by a substantial number of participants. If it weren't for the large number of participants endorsing each option, such annotation differences might be written off as annotator error or bias, or just a low level of inter-annotator agreement. But they can't be written off. Instead, we take them to reveal real differences in how people take a piece of text to relate to its context and raise new questions regarding the compatibility of certain inferences with different adverbials.

Finally, from a small trial experiment, in which we collected multiple judgments (rather than a single choice of “best” conjunction) on many of the same passages, we have acquired evidence confirming contingent substitutability of pairs of discourse connectives hypothesized by Knott (1996), but also evidence against several of his claims concerning exclusivity between connectives. Together these results highlight the need to characterize the behavior of adverbials in terms of both the explicit and implicit discourse relations that can hold.

**Acknowledgment:** Our thanks to the Nuance Foundation for funding this work.

**References** Knott & Mellish (1996). *Language and Speech*, 39(2-3):143183. Knott & Sanders (1998). *Journal of Pragmatics*, 30:135175. Knott (1996). Ph.D. thesis, Dept. of Artificial Intelligence, Univ of Edinburgh. Lin, Ng & Kan (2014). *Natural Language Engineering*, pp. 151184. Prasad, Webber & Joshi (2014). *Computational Linguistics*, 40(4):921950. Rohde et al (2015). *Proc. 1st LSDSem Workshop*, pp. 2231. Rohde et al (2016). *Proc. 10th Linguistic Annotation Workshop*, pp. 4958. Rohde et al (2017). *Proc., 12th Intl Conference on Computational Semantics*. Spooren (1997). *Discourse Processes*, 24:149168. Webber, Prasad, Lee & Joshi (2016). *Proc. 10th Linguistic Annotation Workshop*, pp. 2231. Xue et al (2015). *Proc. 19th CoNLL Shared Task*, pp. 116. Xue et al (2016). *Proc. 20th CoNLL Shared Task*, pp. 119.