The Semantics of Corrections

Deniz Rudin, Karl DeVries, Karen Duek, Kelsey Kraus, Adrian Brasoveanu – UC Santa Cruz
{drudin,kadevrie,kduek,knkraus,abrsvn}@ucsc.edu

WoLLIC 2016
18 August 18 in Puebla

1 Introduction

Consider the sentences in (1):

(1) a. Andrew, *uh, sorry*, $[\text{Anders}]_F$ ate a taco. (full correction)
b. Anders made, *uh, sorry*, $[\text{ate}]_F$ a taco. (elliptical correction)
c. Anders made, *uh, sorry*, he $[\text{ate}]_F$ a taco. (anaphoric correction)

In each sentence:

- the speaker makes a mistake,
- signals that they've made a mistake (*uh, sorry*), and finally
- corrects their mistake.[1]

We will refer to:

- the underlined material as the ANCHOR (a.k.a. *reparandum*; see Shriberg 1994)
- the italicized material as the TRIGGER (a.k.a. editing term)
- all subsequent material as the CORRECTION (a.k.a. alteration + continuation)
- the anchor-correction pair as the (ERROR) CORRECTION STRUCTURE

We will abstain from explicitly annotating subsequent examples.

- 'repair' / 'revision' cases comparable to the above have been given significant attention in psychology (e.g. Levelt 1983), psycholinguistics (e.g. Clark & Fox Tree 2002, Ferreira et al. 2004), conversation analysis (e.g. Schegloff et al. 1977) and computational linguistics (e.g. Heeman & Allen 1999, Hough & Purver 2012)
- but these phenomena have not been given much attention in formal compositional semantics, with the recent exception of Ginzburg et al. (2014)
- Ginzburg et al. (2014): this is an unwarranted oversight; data from corrections can provide an important window into various phenomena of interest to linguistic theory

Ginzburg et al. 2014 analyze corrections within an incremental dialogue-understanding framework, and seek to unify them with other forms of disfluency. We will pursue a novel empirical investigation focusing specifically on correction structures from a grammatical perspective, though what we unearth will be of interest to theories of incremental interpretation. We will be particularly concerned with interactions between correction structures and:

i. contrastive focus
ii. propositional anaphora
iii. anaphora to quantificational dependencies

Roadmap

§2 We begin by considering (and casting doubt on) the intuitive analysis that error correction structures are a form of revision that creates a single proposition out of (parts of) the anchor and correction.

§3 We then look at the data in closer detail and argue that the anchor and correction are parsed as separate clauses, based on facts involving contrastive focus, telescoping, and propositional anaphora.

§4 We follow up with a brief proposal for a formal semantics and formal pragmatics of corrections.

[1] We expect that many of the generalizations we propose about self-corrections will extend to cross-speaker corrections, but we will not be discussing such data here.

2 The Snip & Glue Approach

Previous analyses (notably Asher & Gillies 2003, Asher & Lascarides 2009, Ferreira et al. 2004, Heeman & Allen 1999, Ginzburg et al. 2014, van Leusen 1994, 2004), though couched in very different frameworks, all pursue versions of a 'snip & glue' approach:

- the interpretation of correction structures proceeds by removing mistaken material and replacing it with corrected material
  - the mistaken portion of the anchor is deleted (snip)
  - and the correction is attached to what remains of the anchor (glue)
- the result of the interpretational process is a single meaning assigned to a single sentence

We have three empirical arguments that any snip & glue treatment of corrections (on its own) is inadequate:

i. Error correction structures are a kind of contrastive structure

ii. Anaphora in error correction structures behaves like anaphora between sentences

iii. Propositional anaphora to either half of the correction structure is possible

In the next section, we elaborate on each of these claims in turn.

3 The Empirical Ground

Three Types of Corrections

I ELLIPTICAL CORRECTIONS: error correction structures in which the correction is missing otherwise obligatory syntactic material.

(2) a. Anders made, uh, sorry, [ate]$_F$ a taco.
  b. Anders made a taco, uh, sorry, [ate]$_F$.
  c. Anders made a taco, uh, sorry, a [chalupa]$_F$.
  d. Andrew made a taco, uh, sorry, [Anders]$_F$.

- These structures are the only kind examined at length by previous theorists; it's clear to see why a snip & glue approach to them is intuitively satisfying.

II FULL CORRECTIONS: error correction structures in which the correction does not rely on the anchor for its interpretation.

(3) a. Andrew, uh, sorry, [Anders]$_F$ ate a taco.
  b. Andrew ate, uh, sorry, [Anders]$_F$ ate a taco.
  c. Andrew ate a taco. Uh, sorry, [Anders]$_F$ ate a taco.

- These structures are less obviously addressed by the snip & glue approach, but an intuitive approach might be to simply discard the anchor entirely.

III ANAPHORIC CORRECTIONS: the correction contains pronominal elements that rely on material from the anchor for their interpretation.

(4) a. Anders made, uh, sorry, he [ate]$_F$ a taco.
  b. Anders made a taco, uh, sorry, he [ate]$_F$ it.
  c. Anders made a taco, uh, sorry, [ate]$_F$ it.
  d. Every boy made, uh, sorry, he [ate]$_F$ a taco.
  e. Every boy made some tacos, uh, sorry, they [ate]$_F$ them.

- These structures are problematic for snip & glue; the anaphoric dependencies suggest that anchor and correction are not interpretationally merged.

We argue that all three types of corrections deserve a unified account, and that the snip & glue family of approaches on its own cannot provide such an account.

3.1 Corrections and Contrast

Corrections must contain at least one focus-marked element:

(5) FOCUS PLACEMENT GOES ON LOCUS OF CORRECTION
  a. Andrew, uh, sorry, [Anders]$_F$ ate a taco.
  b. ? Andrew, uh, sorry, Anders ate a [taco]$_F$.

(6) MULTIPLE LOCI = MULTIPLE FOCI
  a. Anders made a taco, uh, sorry, [ate]$_F$ a [chalupa]$_F$.
  b. ? Anders made a taco, uh, sorry, [ate]$_F$ a chalupa.
  c. ? Anders made a taco, uh, sorry, ate a [chalupa]$_F$.

- this is contrastive focus: focus placement in the correction must correspond to the location of mistakes in the anchor, because those are the only places where the anchor and correction differ

- Asher & Gillies (2003), Asher & Lascarides (2009), van Leusen (1994, 2004) already notice that the focus/background partition of the correction should be matched in the anchor; they ultimately propose a version of the snip & glue approach involving non-monotonic logics for Common Ground (CG) update

We assume Rooth (1992)'s definition of contrast:

(7) Contrasting Phrases (Rooth 1992):
Construe a phrase α as contrasting with a phrase β iff $[\![\beta]\!]^{o} \in [\![\alpha]\!]^{f}$.
Where $[\![\alpha]\!]^{o}$ is the ordinary semantic value of α, and $[\![\alpha]\!]^{f}$ is the set of ordinary semantic values derived by replacing each focused element in α with an element of the same semantic type.

- in order for the anchor and correction to be viewed as contrastive, each needs to have an independently calculable semantic value
- a snip & glue account where the result is one semantic value built by combining the correction with cannibalized parts from the anchor will need to do something fairly complex to account for the focus facts
- for example, the SDRT approach has multiple layers of representation and multiple logics associated with these layers; focus/background information is represented in a 'lower' layer and CG update is performed in a 'higher'-level logic that non-monotonically reasons over and integrates the lower-level representations

3.2 Corrections and Telescoping

The set of quantifiers that participate in telescoping is quite small (examples from/based on Roberts 1987):

(8) a. {Every, Each} boy walked to the stage. He shook the President's hand and returned to his seat.[2]
b. * {No, Most, Half of the, Twenty} boys walked to the stage. He shook the President's hand and returned to his seat.

The set of quantifiers that can be picked up cross-sententially by a plural pronoun is larger:

[2]Generally a plural pronoun strategy is preferred to the telescoping strategy, but telescoping is at least marginally grammatical. We've found in our own experimental work that the same is true for telescoping in corrections.

(9) a. {Every, Each} boy walked to the stage. They shook the President's hand and returned to their seats.
b. {Most, Half of the, Twenty} boys walked to the stage. They shook the President's hand and returned to their seats.
c. * No boy(s) walked to the stage. They shook the President's hand and returned to their seats.

Strikingly, we see the exact same restrictions applying to relations between quantifiers and pronouns in error correction structures:

(10) a. {Every, Each} boy made, uh, sorry, he $[\text{ate}]_F$ three tacos.[3]
b. * {No, Most, Half of the, Twenty} boys made, uh, sorry, he $[\text{ate}]_F$ three tacos.

(11) a. {Every, Each} boy made, uh, sorry, they $[\text{ate}]_F$ some tacos.
b. {Most, Half of the, Twenty} boys made, uh, sorry, they $[\text{ate}]_F$ some tacos.
c. * No boy(s) made, uh, sorry, they $[\text{ate}]_F$ some tacos.[4]

- anaphora between anchors and corrections behaves like anaphora between *separate sentences*, not like within-sentence binding
- the telescoping facts are unexpected for snip & glue accounts, which merge anchor and correction into a single sentence

3.3 Corrections and Propositional Anaphora

Error correction structures allow propositional anaphora with *that* to either the interpretation of the anchor or the interpretation of the correction:

(12) a. **A:** Anders ate fifty, uh, sorry, he ate $[\text{five}]_F$ tacos.
B: That would've been crazy!
b. **A:** Anders ate fifty, uh, sorry, he ate $[\text{five}]_F$ tacos.
B: That's much easier to believe!

[3]We were first made aware of examples of this kind by Milward & Cooper (1994), though those authors do not note their theoretical significance.
[4]Cases like this are better with polarity reversal:

(1) No boy made, uh, sorry, they $[\text{did}]_F$ make some tacos.

- unclear how this would be explained from the perspective of a snip & glue account
- but this is what we expect given the hypothesis in (14) below.

4 Proposal

- we argued that error correction structures are contrastive structures (in 3.1)
- it is easy to see how the correction can be construed as contrasting with the anchor if both anchor and correction are complete—as in (13a)
- however, assessing the contrast relation is trickier if the anchor or the correction (or both) are incomplete—as in (13b)

(13) a. Anders ate a taco. Uh, sorry, Anders ate a $[\text{chalupa}]_F$.
b. Anders ate, uh, sorry, $[\text{made}]_F$ a taco.

4.1 Basic proposal

We discussed the contrastive nature of error corrections in Roothian terms:

- basically we need to identify a suitable part of the anchor that can provide the antecedent for the focus anaphor contributed by the correction
- this is closely related the SDRT proposal that the focus-background partitions of the correction and anchor should match (van Leusen 1994, 2004, Asher & Gillies 2003, Asher & Lascarides 2009)

(14) a. Contrast-Driven Theory of Correction Interpretation (Broad Strokes):
Fill in missing material in the anchor and correction in whatever way will result in the ordinary semantic value of the anchor being a member of the focus semantic value of the correction.
b. Contrast-Driven Theory of Correction Interpretation (Thinner Strokes):
Formalization in Compositional DRT (CDRT; Muskens 1996) – see next section.

We propose the following additional semantic/pragmatic component associated with the interpretation of error correction structures (closely following the proposal in Ginzburg et al. 2014):

(15) The Discourse Effect of Error Correction Structures:
Upon calculation of the relation of contrast between the correction and the anchor:

- the speaker's commitment to the anchor is cancelled
- the speaker's commitment to the correction is asserted
- the only commitment placed on the table (in the sense Bruce & Farkas 2008) as a CG update proposal is the one contributed by the correction

4.2 Formalization in CDRT

- we build on CDRT and add:
  - discourse referents (drefs) for propositions
  - logical forms of the kind needed for focus semantics or parasitic scope
- basic types: e (entities), t (truth values), s (variable assignments) and $\mathbf{w}$ (possible worlds)

(16) Abbreviations:
a. $\mathbf{e} \coloneqq se$; 'individuals' are drefs for individuals, basically individual concepts
b. $\mathbf{s} \coloneqq s(\mathbf{w}t)$; intensionality: sentences are interpreted relative to the current assignment and the current proposition/set of worlds that are live candidates for the actual world
c. $\mathbf{t} \coloneqq s(st)$; the interpretation of a sentence is a Discourse Representation Structure (DRS), i.e., a binary relation between an input and an output assignment – see also DPL formulas, Groenendijk & Stokhof (1991)

- a dref for individuals $u_{\mathbf{e}}$ is of type $\mathbf{e} \coloneqq se$
- a dref for propositions $p_{\mathbf{s}}$ is of type $\mathbf{s} \coloneqq s(\mathbf{w}t)$

(17) **Lexical relations**. When an intensional n-ary static lexical relation R of type $\mathbf{w}(e(e(\ldots t)))$ is interpreted relative to a propositional dref $p_{\mathbf{s}}$, it is interpreted distributively relative to the worlds in p:
$R_p(u_1, \ldots, u_n) \coloneqq \lambda i_s.\ \forall w_{\mathbf{w}} \in pi\ (R(w)(u_1 i) \ldots (u_n i))$

(18) **Basic DRSs**.

a. We abbreviate introducing drefs $\nu_1, \ldots, \nu_n$ as: $[\nu_1, \ldots, \nu_n]$

b. We abbreviate a DRS that contains only conditions $C_1, \ldots, C_n$ as: $[C_1, \ldots, C_n]$

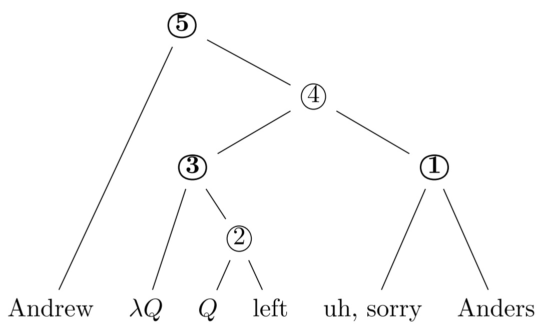
c. Dynamic conjunction is symbolized as ';'; for two DRSs D, D' of type $\mathbf{t}$, we have that: $D; D' := \lambda i_s.\lambda j_s.\ \exists k_s(Dik \wedge D'kj)$, where '$\wedge$' is classical static conjunction

d. A DRS $[\nu_1, \ldots, \nu_n|\ C_1, \ldots, C_n]$ introducing some drefs and contributing some conditions is just the abbreviation of the dynamic conjunction $[\nu_1, \ldots, \nu_n];\ [C_1, \ldots, C_n]$.

A simple error correction structure like (19) is interpreted as in (20):

(19) Andrew left, uh, sorry, Anders.

(20) a. *uh, sorry* $\rightsquigarrow \lambda A_\alpha.\lambda B_{\alpha(\mathbf{st})}.\lambda A'_\alpha.$
$[p_1, p_2];\ B(A')(p_1);\ B(A)(p_2);\ CG \mathrel{+}= p_2$

b. 

c. ① $\rightsquigarrow \lambda B_{((\mathbf{est})\mathbf{st})\mathbf{st}}.\lambda A'_{(\mathbf{est})\mathbf{st}}.\ [p_1, p_2];\ B(A')(p_1);$
$B(\lambda P_{\mathbf{est}}.\lambda p_{\mathbf{s}}.\ [u_2|\ u_2 = \text{ANDERS}];\ P(u_2)(p))(p_2);\ CG \mathrel{+}= p_2$

③ $\rightsquigarrow \lambda Q_{(\mathbf{est})\mathbf{st}}.\lambda p_{\mathbf{s}}.\ Q(\lambda x_{\mathbf{e}}.\lambda p_{\mathbf{s}}.\ [\text{LEAVE}_p(x)])(p)$

⑤ $\rightsquigarrow [p_1, p_2, u_1, u_2|\ u_1 = \text{ANDREW},\ \text{LEAVE}_{p_1}(u_1),$
$u_2 = \text{ANDERS},\ \text{LEAVE}_{p_2}(u_2)];\ CG \mathrel{+}= p_2$

- (20a): the trigger contributes the crucial operator relating the correction to the anchor; the operator takes three arguments:
  - the correction A_α (the type α is underspecified and is dictated by the correction itself)—this is *Anders* in our case;
  - the mistaken part of the anchor A'_α that must have the same type as the correction—this is *Andrew* in our case;
  - the remaining part of the anchor $B_{\alpha(\mathbf{st})}$ that can be predicated of both A and A'—this is a type-lifted version of *left* in our case.

  This type lifting happens systematically as a consequence of (i) the mistake *Andrew* scoping out of the anchor and (ii) the trigger+correction *uh, sorry, Anders* taking (parasitic) scope immediately under the scoped-out mistake

- this LF is the result of establishing anchor-correction contrast, i.e., dividing the anchor in a way that matches the focus-background partition of the correction
- once the correction operator in (20a) takes its arguments, it introduces two propositional drefs p_1 and p_2 for the anchor and the correction respectively, and requires only the p_2 dref to be added to the CG
- in (20c), we assume a Lewis-style typing with the 'intensionalization' type $\mathbf{s}$ being innermost (closest to the type of sentences $\mathbf{t}$)
- we also assume Montagovian type lifts for proper names, which are of type $(\mathbf{e}(\mathbf{st}))(\mathbf{st})$, e.g.,
  Anders $\rightsquigarrow \lambda P_{\mathbf{e}(\mathbf{st})}.\lambda p_{\mathbf{s}}.\ [u_2|\ u_2 = \text{ANDERS}];\ P(u_2)(p)$

See appendices for presentations of how to extend this analysis to account for more complex correction structures, including those involving pronominal anaphora and telescoping.

5 Conclusion

We have argued in this talk that in error correction structures, the anchor and the correction are given separate interpretations, in opposition to standard accounts in which the output of an error correction structure is a single unified interpretation for the entire structure.

- on the basis of focus placement facts, we have argued that error correction structures are a species of contrast structure
- on the basis of telescoping facts, we have argued that the anchor and correction are treated as separate sentences
- on the basis of propositional anaphora facts, we have argued that the interpretation of the anchor is still accessible after the correction has been completed

In light of these facts, we conclude that snip & glue accounts of error correction are inadequate on their own.

One way to think about the present account of error corrections relative to the SDRT one or the one in Ginzburg et al. (2014) is that it tries to see how far we can get in a relatively unstructured version of dynamic semantics in which:

- we have only DPL + propositional drefs (+ the tech needed for subclausal compositionality)
- we assume a monotonic version of incremental interpretation (no non-monotonic glue logic)
- important point: simply adding propositional drefs and incorporating a separate CG update that involves only some of these propositional drefs is enough to capture the basic interpretation of corrections
- this enables us to incorporate telescoping corrections fairly easily because the basic DPL system can be generalized to a dynamic plural logic

Acknowledgments

We want to thank Pranav Anand, Donka Farkas, Andreas Walker, Paul Willis, Erik Zyman and the audiences at the UCSC S-Circle (October 2015), CUSP (Stanford, November 2015), the UCSC SPLAP Workshop (February 2016), CoCoLab (Stanford, March 2016) and three WoLLIC reviewers for discussion and comments on this work. The usual disclaimers apply.

References

Asher, N. & A. Lascarides. 2009. Agreement, disputes and commitments in dialogue. *Journal of Semantics* 26. 109–158.

Asher, Nicholas & Anthony Gillies. 2003. Common ground, corrections, and coordination. *Argumentation* 17. 481–512.

van den Berg, Martin. 1996. *Some aspects of the internal structure of discourse: The dynamics of nominal anaphora*. Amsterdam: University of Amsterdam dissertation.

Brasoveanu, Adrian. 2007. *Structured nominal and modal reference*: Rutgers Univ. dissertation.

Bruce, Kim & Donka Farkas. 2008. Context structure for dialogues. Manuscript, University of California at Santa Cruz and Pomona College.

Clark, Herbert H. & Jean E. Fox Tree. 2002. Using uh and um in spontaneous speaking. *Cognition* 84(1). 73–111. doi:10.1016/S0010-0277(02)00017-3.

Ferreira, Fernanda, Ellen Lau & Karl Bailey. 2004. Disfluencies, language comprehension, and tree adjoining grammars. *Cognitive Science* 28. 721–749.

Ginzburg, Jonathan, Raquel Fernández & David Schlangen. 2014. Disfluencies as intra-utterance dialogue moves. *Semantics and Pragmatics* 7.

Groenendijk, Jeroen & Martin Stokhof. 1991. Dynamic predicate logic. *Linguistics and Philosophy* 14(1). 39–100.

Heeman, Peter & James Allen. 1999. Speech repairs, intonational phrases and discourse markers: Modeling speaker' utterances in spoken dialogue. *Computational Linguistics* 25(4).

Hough, Julian & Matthew Purver. 2012. Processing self-repairs in an incremental type-theoretic dialogue system. In *Proceedings of the 16th SemDial Workshop on the Semantics and Pragmatics of Dialogue (SeineDial)*, 136–144. Paris, France. http://www.eecs.qmul.ac.uk/~mpurver/papers/hough-purver12semdial.pdf.

van Leusen, Noor. 1994. The interpretation of corrections. In P. Bosch & R. van der Sandt (eds.), *Proceedings of the Conference on Focus and Natural Language Processing*, vol. Vol.3, IBM Working paper 7, TR-80.94-007, 1–13. IBM Deutschland GmhB.

van Leusen, Noor. 2004. Incompatibility in context: A diagnosis of correction. *Journal of Semantics* 21. 415–441.

Levelt, Willem. 1983. Monitoring and self-repair in speech. *Cognition* 14. 41–104.

Milward, David & Robin Cooper. 1994. Incremental interpretation: Applications, theory, and relationship to dynamic semantics. In *The 15th International Conference on Computational Linguistics (COLING 94)*, 748–754. Kyoto, Japan: COLING 94 Organizing Comm.

Muskens, Reinhard. 1996. Combining Montague semantics and discourse representation. *Linguistics and philosophy* 19(2). 143–186.

Nouwen, Rick. 2003. *Plural pronominal anaphora in context: Dynamic aspects of quantification*: UIL-OTS, Utrecht University dissertation.

Purver, Matthew. 2004. *The Theory and Use of Clarification Requests in Dialogue*: King's College, University of London dissertation. http://www.dcs.qmul.ac.uk/~mpurver/papers/purver04thesis.pdf.

Roberts, Craige. 1987. *Modal subordination, anaphora, and distributivity*: University of Massachusetts Amherst dissertation.

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1. 75–116.

Schegloff, Emanuel, Gail Jefferson & Harvey Sacks. 1977. The preference for self-correction in the organization of repair in conversation. *Language* 53(2). 361–382.

Shriberg, Elizabeth. 1994. *Preliminaries to a Theory of Speech Disfluencies*: University of California at Berkeley dissertation.

Appendix A: A Generalized Account

(21) Correction LF generation algorithm:

I. Adjoin the trigger (the correction operator) to the correction.

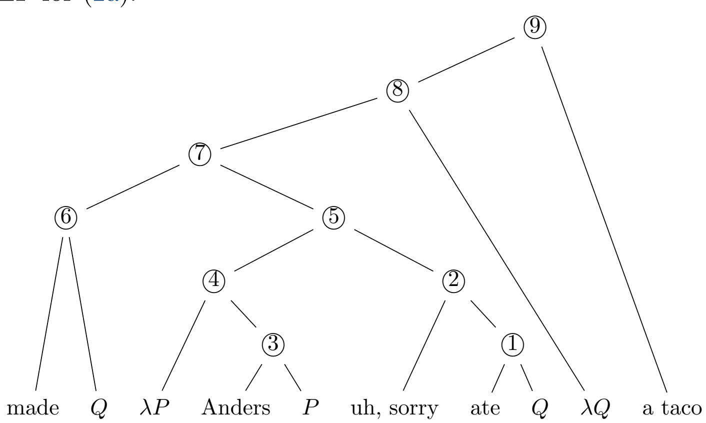
II. Adjoin the anchor to the resulting structure.

III. Insert a variable of the appropriate type to fill in missing syntactically obligatory structure.

IV. Identify that portion of the anchor that is a member of the focus semantic value of the correction, and move it to an adjoining position, leaving in place a variable and lambda-abstractor of the appropriate type.

V. Identify that portion of the correction that corresponds to an unbound variable in the anchor, and move it to an adjoining position so that it can take scope over that variable.

(22) a. LF for (2a):



b. a taco $\rightsquigarrow \lambda P_{\mathbf{e(st)}}.\lambda p_{\mathbf{s}}.\ [u_2|\ \text{TACO}_p(u_2)];\ P(u_2)(p)$

② $\rightsquigarrow \lambda Q'_{\mathbf{(est)st}}.\lambda P'_{\mathbf{est}}.\ [p_1, p_2];\ Q'(P')(p_1);$
$Q'(\lambda x_{\mathbf{e}}.\lambda p_{\mathbf{s}}.\ Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.\ [\text{EAT}_p(x, x')])(p))(p_2);\ CG \mathrel{+}= p_2$

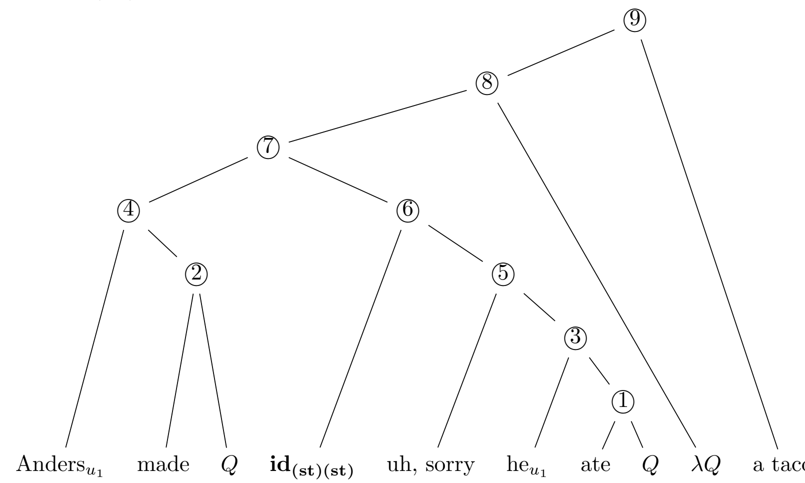
⑤ $\rightsquigarrow \lambda P'_{\mathbf{est}}.\ [p_1, p_2, u_1|\ u_1 = \text{ANDERS}];\ P'(u_1)(p_1);$
$Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.\ [\text{EAT}_p(u_1, x')])(p_2);\ CG \mathrel{+}= p_2$

⑦ $\rightsquigarrow [p_1, p_2, u_1|\ u_1 = \text{ANDERS}];\ Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.[\text{MAKE}_p(u_1, x')])(p_1);$
$Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.[\text{EAT}_p(u_1, x')])(p_2);\ CG \mathrel{+}= p_2$

⑨ $\rightsquigarrow [p_1, p_2, u_1|\ u_1 = \text{ANDERS}];\ [u_2|\ \text{TACO}_{p_1}(u_2),\ \text{MAKE}_{p_1}(u_1, u_2)];$
$[u_2|\ \text{TACO}_{p_2}(u_2),\ \text{EAT}_{p_2}(u_1, u_2)];\ CG \mathrel{+}= p_2$

Appendix B: Anaphoric Corrections

(23) a. LF for (4a):



b. $\mathbf{id}_{\mathbf{(st)(st)}} \rightsquigarrow \lambda \mathcal{D}_{\mathbf{st}}.\ \mathcal{D}$

he$_{u_1}$ $\rightsquigarrow \lambda P_{\mathbf{e(st)}}.\lambda p_{\mathbf{s}}.\ P(u_1)(p)$

⑤ $\rightsquigarrow \lambda f_{\mathbf{(st)(st)}}.\lambda \mathcal{D}_{\mathbf{st}}.\ [p_1, p_2];\ f(\mathcal{D})(p_1);$
$f(Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.\ [\text{EAT}_p(u_1, x')]))(p_2);\ CG \mathrel{+}= p_2$

⑥ $\rightsquigarrow \lambda \mathcal{D}_{\mathbf{st}}.[p_1, p_2];\mathcal{D}(p_1);Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.[\text{EAT}_p(u_1, x')])(p_2);CG \mathrel{+}= p_2$

⑦ $\rightsquigarrow [p_1, p_2, u_1|\ u_1 = \text{ANDERS}];\ Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.[\text{MAKE}_p(u_1, x')])(p_1);$
$Q(\lambda x'_{\mathbf{e}}.\lambda p_{\mathbf{s}}.[\text{EAT}_p(u_1, x')])(p_2);\ CG \mathrel{+}= p_2$

⑨ $\rightsquigarrow [p_1, p_2, u_1|\ u_1 = \text{ANDERS}];\ [u_2|\ \text{TACO}_{p_1}(u_2),\ \text{MAKE}_{p_1}(u_1, u_2)];$
$[u_2|\ \text{TACO}_{p_2}(u_2),\ \text{EAT}_{p_2}(u_1, u_2)];\ CG \mathrel{+}= p_2$

To maintain the general format for the correction operator contributed by *uh, sorry*, we assume the covert insertion of a node denoting the identity function

$\mathbf{id}_{\mathbf{(st)(st)}}$ over objects of type $\mathbf{st}$. This is for convenience only, we could also generalize the interpretation of the correction operator in a suitable way.

Appendix C: Telescoping

We build on Dynamic Plural Logic (DPlL) (van den Berg 1996, Nouwen 2003) and Plural Compositional DRT (PCDRT) (Brasoveanu 2007), which recasts DPlL in classical type logic and incorporates discourse reference to possible worlds. DPlL/PCDRT enables us to treat updates with universal quantifiers in much the same way as updates with proper names or indefinites, so our CDRT account of anaphoric corrections like (4a)/(4b) can be straightforwardly generalized to (4d) and (4e).

In DPlL/PCDRT updates are binary relations over sets of assignments of type $(st)((st)t)$, rather than binary relations over single assignments of type $s(st)$. Our type $\mathbf{t}$ therefore becomes $\mathbf{t} := (st)((st)t)$. Since we work with sets of assignments, our 'intensionalization' type can simply be $\mathbf{s} := s\mathbf{w}$, i.e., the type of drefs for possible worlds. The reason is that given a set of assignments I_{st} and a dref $p_{s\mathbf{w}}$, we retrieve a set of worlds (i.e., a proposition) as shown in (24). Introducing new drefs relative to a set of assignments (25) is just the cumulative-style generalization of introducing drefs relative to single assignments. Lexical relations are still interpreted distributively (26), but relative to a set of assignments rather than a propositional dref. Similarly, dynamic conjunction is still interpreted as relation composition (27). To handle quantifiers, we introduce a maximization operator $\mathbf{M}_u(D)$ that extracts the set of entities that satisfies the update D and stores it in dref u (28).

(24) $p_{s\mathbf{w}} I_{st} = \{pi : i_s \in I\}$ (pI is the image of I under function p)

(25) $[\nu_1, \ldots, \nu_n] := \lambda I_{st}.\lambda J_{st}.\ \forall i_s \in I \exists j_s \in J(i[\nu_1, \ldots, \nu_n]j) \wedge \forall j_s \in J \exists i_s \in I(i[\nu_1, \ldots, \nu_n]j)$

(26) $R_p(u_1, \ldots, u_n) := \lambda I_{st}.\ I \neq \varnothing \wedge \forall i_s \in I\ (R(pi)(u_1 i) \ldots (u_n i))$

(27) $D; D' := \lambda I_{st}.\lambda J_s.\ \exists K_s(DIK \wedge D'KJ)$

(28) $\mathbf{M}_u(D) := \lambda I_{st}.\lambda J_{st}.\ ([u]; D)IJ \wedge \neg\exists K_{st}(([u]; D)IK \wedge uJ \subsetneq uK)$

Universal quantification contributes a maximization operator over the restrictor, and the nuclear scope further elaborates on the maximal restrictor-satisfying dref (29). Singular or plural anaphora in subsequent sentences can pick up the maximal dref introduced by the universal *every*, in much the same way that the nuclear scope of an *every* quantification can pick up that dref and further elaborate on it. To properly distinguish between singular anaphora (telescoping) and plural anaphora, we need to extend the system with a notion of distributivity and a notion of discourse plurality/singularity. But the basic system outlined here is enough to show that we can now capture telescoping corrections in the same way we capture regular anaphoric corrections, as shown in (30) (cf. (23)).

(29) every$_u$ $\rightsquigarrow \lambda P_{\mathbf{est}}.\lambda P'_{\mathbf{est}}.\lambda p_{\mathbf{s}}.\ \mathbf{M}_u(P(u)(p));\ P'(u)(p)$

(30) Every$_{u_1}$ boy made, uh sorry, he$_{u_1}$ / they$_{u_1}$ ate a taco. $\rightsquigarrow$
$[p_1, p_2];\ \mathbf{M}_{u_1}([\textsc{boy}_{p_1}(u_1)]);\ [p'_1, u_2 | p'_1 \sqsubseteq p_1, \textsc{taco}_{p'_1}(u_2), \textsc{make}_{p'_1}(u_1, u_2)];$
$[u_2 | p_2 \sqsubseteq p_1, \textsc{taco}_{p_2}(u_2), \textsc{eat}_{p_2}(u_1, u_2)];\ CG \mathrel{+}= p_2$[5]

[5]To derive the correct truth conditions, we need to introduce an additional propositional dref and suitable subset relations between propositional drefs to capture the fact that anaphora from the correction to a quantifier in the anchor builds on part of the content contributed by the anchor. The subset relations $p'_1 \sqsubseteq p_1$ and $p_2 \sqsubseteq p_1$ need to preserve the full dependency structure associated with the worlds in p_1. That is, for any p_1-world that we retain in the subsets p'_1 or p_2, we need to retain the full range of u_1-entities associated with that world.