

Ossetic, an Iranian language spoken in the North Caucasus, uses correlatives as the main strategy of relative clause formation:

- (1) [didinž-ət3 sə čəžg-3n ba-l3var kod-t-aj], fed-t-on wəj fəd-ə
flower-PL what girl-DAT PV-present do-TR-PST.2SG see.PFV-TR-PST.1SG DemDist[GEN] father-GEN

‘I saw the father of the girl that you gave flowers to.’

This example illustrates the main features of Ossetic correlatives: the subordinate clause is located at the left periphery; NP_{rel} (in the terminology of (Andrews 2007)) is preverbal, which is the standard position for wh-movement (Lyutikova and Tatevosov 2009). NP_{rel} may contain an internal head; NP_{mat} (the correlate) is in most cases obligatorily represented by a demonstrative correlate that does not form a constituent with the subordinate clause. Demonstrative pronouns in Ossetic are typically used as pronominals, while demonstrative determiners typically operate like definite articles; hence correlatives are morphologically indistinguishable from ordinary anaphoric expressions.

In (2) we illustrate an alternative position of the subordinate clause, where it is embedded into the main clause and immediately precedes the correlate; there is ample evidence that in this case the clause and the correlate form a constituent.

- (2) fedton, [didinžət3 sə čəžg3n bal3var kodtaj], wəj fədə

‘I saw the father of the girl that you gave flowers to.’

There are two main approaches to correlatives in the existing literature, mostly based on the data of Indo-Aryan languages. One is to consider the subordinate clause base-generated in the left peripheral position and anaphorically linked with the correlate (Srivastav 1991; Dayal 1995; Davison 2009). The other is to derive the subordinate clause’s left-peripheral position by movement from a DP-adjoined position like in (2) (Bhatt 2003); in this case, no anaphoric linking is usually assumed, as the subordinate clause is locally attached.

However, while the semantic derivation of correlatives is different in these analyses, the resulting meaning representations are generally considered to be identical to those assumed in standard analyses of relative clauses, i.e. set intersection (Partee 1975, 229; Larson and Segal 1995, 256; Zwart 2000, 378). For example, (Srivastav 1991) provides the meaning in (3):

- (3) $\lambda P.P(\iota x(\text{girl}'(x)\&\text{stand}'(x)))$

The relative clause denotes the unique element in the intersection of the relative clause predicate and its (internal) head, lifted to a generalized quantifier type which can apply to the main clause (the main clause is of type $\langle e, t \rangle$ because the correlate is interpreted as a trace, a lambda bound gap.) Set intersection is, however, unsuitable for Ossetic correlatives. Consider the following examples:

- (4) [sard-3j sə konflikt-t3, išt-a], [sə xarakter-t3, 3vdəšt-a], wədon_{i+j} wəd-əštə kad3ž-ə
life-ABL what conflict-PL take-PST.TR.3SG what character-PL demonstrate-PST.TR.3SG DemDist.PL be-PST.INTR.3PL legend-GEN
3rm3g.
material

‘What conflicts_i he took from life, what characters_j he demonstrated, they_{i+j} were legendary material.’ (Ossetic National Corpus, <http://corpus.ossetic-studies.org/en>)

- (5) danel, [f3štəg-m3 j3= x0-t-3m sə k'am_i a-rvəšt-a], wə-sə kost'um-ə_{j-i}, urš x3don 3m3 tar galstuč-ə
Danel last-ALL 3SgPoss sister-PL-ALL what photo PV-send-PST.TR.3SG DemDist-ATTR suit-IN white shirt and dark tie-IN
l3wwəd.
stand[PST.INTR.3SG]

‘Danel stood in the suit that he was in on the photo he sent to his sisters last time, white shirt and dark tie.’

(lit. ‘Danel, what photo he sent to his sisters last time, he stood in that suit, white shirt and dark tie.’) (Ossetic National Corpus)

Example (4) involves split antecedence, while (5) involves bridging. Both are features of ordinary pronominal anaphora (i.e. coreference), but do not occur in constructions that involve bound variables, such as reflexivization and relativization.

To the best of our knowledge, relative or relative-like constructions which involve this kind of obligatory, but possibly indirect coreference have not been attested in the literature. The closest analogy are resumptives, which are widely considered to involve ordinary pronouns anaphorically bound to the head of the relative clause (McCloskey 2002; Asudeh 2012). Just like with resumptives, we are not aware of a single language where correlatives are expressed using a specialized series of pronouns, which implies that an analysis that derives the semantics of correlatives from that of pronominals is to be strongly preferred to any alternatives.

In order to capture the similarities between such a coreference relation and pronominal anaphora, we have to use a dynamic semantic framework, thereby relating to such work as (Bittner 2001), which emphasises the use of dynamic mechanisms also for subclausal composition. In order to integrate the semantic analysis with LFG, such a framework also has to be based on functional application in order to be compatible with Glue Semantics (*Semantics and syntax in Lexical Functional Grammar* 1999). Accordingly, we use Partial Compositional Discourse Representation Theory, PCDRT (Haug 2013). Like CDRT (Muskens 1996), PCDRT is a compositional variant of DRT (Kamp and Reyle 1993), but employs a partial logic to allow for a more sophisticated account of anaphora. In this theory, anaphoric resolution is provided by a function \mathcal{A} taking anaphoric drefs to antecedent (but not necessarily fully coreferential) drefs. By default \mathcal{A} results from pragmatic reasoning, but it can also be (partially) specified by the grammar.

All nominals in PCDRT, regardless of whether they are pronouns, have type $\langle\langle e, t \rangle, t \rangle$, e.g., the meaning of *John* will be $\lambda P.[x_1|\text{John}(x_1)];P(x_1)$, while for *he* it will be $\lambda P.[x_1|\partial(\text{male}(x_1)),\text{ant}(x_1)];P(x_1)$. This type lifting of nominals is basically unavoidable in PCDRT insofar as nominals have to introduce drefs.

Coreference in PCDRT is generally established after semantic composition takes place, to allow for a more realistic theory of anaphoric resolution and achieve a unified account of bound pronouns and pronouns with a discourse antecedent. This is incompatible with the traditional LFG approach to binding where the pronoun’s lexical entry makes direct reference to an s-structure ANTECEDENT feature, since pronouns with discourse antecedents do not have such a feature. Instead, we use an additional binder meaning constructor that, in a sense, modifies the lexical entries of both the binder and the bindee by adducing an additional semantic relation that explicitly identifies one as the antecedent of the other:

$$(6) \quad @\text{BIND}(ant^s, pro^s) := \begin{array}{l} \%^\sigma \text{ANT}^s = ant^s \\ \%^\sigma \text{PRO} = pro^s \\ \lambda P. \lambda x. \lambda y. P(x)(y); [|x \in \mathcal{A}(y)| : \forall \alpha_{\langle t \rangle}. (\%^\sigma \text{ANT}_{\langle e \rangle} \multimap \%^\sigma \text{PRO}_{\langle e \rangle} \multimap \alpha_{\langle t \rangle}) \multimap \\ \%^\sigma \text{ANT}_{\langle e \rangle} \multimap \%^\sigma \text{PRO}_{\langle e \rangle} \multimap \alpha_{\langle t \rangle} \end{array}$$

We analyze Ossetic correlatives as akin to adverbial clauses, in that they are of type t and the properties they denote are attached to the main clause as presuppositions. Based on the fact that there can only be one correlate, we situate the subordinate clause in SpecCP:

$$(7) \quad \text{CORREL}(main^f, corr^f) := \begin{array}{l} (\downarrow \text{STYPE}) =_c \text{CORREL} \\ \% \text{MAIN} = main^f \\ \lambda P. \lambda Q. [| \partial(P) |]; Q : \downarrow_{\sigma \langle t \rangle} \multimap \% \text{MAIN}_{\sigma \langle t \rangle} \multimap \% \text{MAIN}_{\sigma \langle t \rangle} \\ (\downarrow_{\sigma} \text{CORR}) = corr^f_{\sigma} \\ (\downarrow_{\sigma} \text{CORR DET}) =_c \text{DIST} \end{array}$$

$$(8) \quad \text{CP} \rightarrow \begin{array}{ccc} \text{CP} & & \text{C}' \\ (\uparrow \text{TOPIC}) = \downarrow & & \uparrow = \downarrow \\ @\text{CORREL}(\uparrow, (\uparrow \text{GF POSS}^* \uparrow)) & & \end{array}$$

This rule introduces a meaning constructor that links the two clauses. A separate annotation assigns the correlate to the CORR s-structure feature of the subordinate clause, in order to ensure that, even if several clauses coordinated in the left periphery, like in (4), the correlate is unique and correctly identified. For DP-level correlatives, which display the same anaphoric effects as CP-level ones, the main clause is identified via inside-out functional uncertainty:

$$(9) \quad \text{DP} \rightarrow \begin{array}{ccc} \text{CP} & & \text{DP} \\ \downarrow \in (\uparrow \text{ADJ}) & & \uparrow = \downarrow \\ @\text{CORREL}((\text{GF POSS}^* \uparrow), \uparrow) & & \end{array}$$

The binding itself occurs at the level of the lexical entry of the relativizer:

$$(10) \quad \text{a. INDEF} := \lambda R. \lambda P. [x_1 | R(x_1)]; P(x_1) : \\ ((\uparrow_{\sigma} \text{VAR})_{\langle e \rangle} \multimap (\uparrow_{\sigma} \text{RESTR})_{\langle t \rangle}) \multimap \forall \alpha_{\langle t \rangle}. (\uparrow_{\sigma \langle e \rangle} \multimap \alpha_{\langle t \rangle}) \multimap \alpha_{\langle t \rangle}$$

$$\text{b. RELPRO}(clause^f, rel^s) := \begin{array}{l} \% \text{CLAUSE} = clause^f \\ \%^\sigma \text{REL} = rel^s \\ (\% \text{CLAUSESTYPE}) = \text{CORREL} \\ @\text{BIND}(\%^\sigma \text{REL}, (\% \text{CLAUSE}_{\sigma} \text{CORR})) \end{array}$$

$$(11) \quad \begin{array}{ccc} s\partial & \text{D}^0 & (\uparrow \text{DET}) = \text{REL} \\ \text{relativizer} & @\text{INDEF} & \\ & @\text{RELPRO}((\text{OPER } \uparrow), \uparrow_{\sigma}) & \end{array}$$

The marker $s\partial$ is semantically nothing more than a generalized quantifier that takes the property denoted by the internal head and produces a resource of type $\langle\langle e, t \rangle, t \rangle$; on the meaning side its contribution is identical to that of an ordinary indefinite article. The @BIND template is what is specific to correlatives: this meaning constructor connects the discourse referents introduced by the relative NP and the pronoun via the coreference relation \mathcal{A} , while keeping their lexical entries intact². This captures the idea that correlates are ordinary pronominals or definite descriptions.

Applying these rules leads to the following DRS for (5), where we have simplified the representations of *danel* and *sisters*, which are immaterial to the point.

$$(12) \quad \begin{array}{|c|} \hline x_1 \ x_2 \\ \hline \text{photo}(x_1) \\ \partial(\text{suit}(x_2)) \\ \text{ant}(x_2) \\ \partial(\text{sent}(danel, sisters, x_1)) \\ \text{stood}(danel) \\ \text{in}(danel, x_2) \\ x_1 \in \mathcal{A}(x_2) \\ \hline \end{array}$$

x_2 is correctly specified to take x_1 as its antecedent, but since the discourse referents are distinct, we predict the possibility of partial coreference and bridging, unlike the variable binding approaches to correlatives found in (Srivastav 1991; Bhatt 2003).

Andrews, A. 2007. "Relative clauses." In *Complex Constructions*, vol. 2 of *Language Typology and Syntactic Description*, 206–236. Cambridge. Asudeh, A. 2012. *The Logic of Pronominal Resumption*. Oxford. Asudeh, A., M. Dalrymple, and I. Toivonen. 2013. "Constructions with Lexical Integrity." *JLM* 1 (1). Bhatt, R. 2003. "Locality in correlatives." *NLLT* 210:485–541. Bittner, M. 2001. "Surface Composition as Bridging." *JoS* 18:127–177. Davison, A. 2009. "Adjunction, features and locality in Sanskrit and Hindi/Urdu correlatives." In *Correlatives cross-linguistically*, 223–262. Amsterdam and Philadelphia. Dayal, V. 1995. "Quantification in correlatives." In *Quantification in Natural Languages*, 2:179–205. Dordrecht, Boston, and London. Haug, D. T. T. 2013. "Partial dynamic semantics for anaphora: compositionality without syntactic coindexation." *JoS*. Kamp, H., and U. Reyle. 1993. *From Discourse to Logic*. Dordrecht. Larson, R. K., and G. M. Segal. 1995. *Knowledge of Meaning*. Cambridge, MA. Lyutikova, E., and S. Tatevosov. 2009. "The clause internal left edge: Exploring the preverbal position in Ossetian." In *International Conference on Iranian Linguistics 3*. Paris. McCloskey, J. 2002. "Resumption, Successive Cyclicity, and the Locality of Operations." In *Derivation and Explanation in the Minimalist Program*, 184–226. Muskens, R. 1996. "Combining Montague semantics and discourse representation." *L & P*, no. 19:143–186. Partee, B. H. 1975. "Montague Grammar and transformational grammar." *LI* 6:203–300. Dalrymple, M., ed. *Semantics and syntax in Lexical Functional Grammar: the resource logic approach*. 1999. Cambridge, MA. Srivastav, V. 1991. "The syntax and semantics of correlatives." *NLLT*, no. 9:637–686. Zwart, C. J.-W. 2000. "A Head Raising Analysis of Relative Clauses in Dutch." In *The Syntax of Relative Clauses*. Amsterdam and Philadelphia.

1. We use this notation for local names of s-structures; using local names is important because template arguments are simply substituted into the equations (Asudeh, Dalrymple, and Toivonen 2013), which can lead to different s-structures being referred to by ant^s and pro^s in different places.

2. The OPER is the function occupied by the relative NP, so the expression "(OPER \uparrow)" maps to the subordinate clause.