

Dynamics of Reflexivity and Reciprocity

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1 Introduction

- Syntactic theories generally treat English reflexive and reciprocal anaphors as a natural class (Lees and Klima 1963; Pollard and Sag 1992, a.o.)
- (1) Some students helped themselves
- (2) Some students helped each other
- Their semantic connection has received little attention in formal semantics, with most studies focusing on reciprocals (Heim et al. 1991; Schwarzschild 1996; Dalrymple et al. 1998, a.o.)
- many languages express with a single proform (Maslova *to appear*)
- e.g., Cheyenne, with the verbal affix *-ahte*
 - Cheyenne (3i) has several construals: reflexive, reciprocal, and mixed
 - the mixed construal of (3i) is compatible with (3ii).
- (3) i. *ka'éskone-ho é-axeen-**ahtse**-o'o*
child-PL.AN 3-scratch.AN-*ahte*-3PL.AN
- ii. *hetané-ka'éskone é-axeen-**ahtse***
man-child 3-scratch.AN-*ahte*
*naa hé-ka'éškóne-ho noná-métó'e é-axeen-**ahtse**-o'o*
CNJ woman-child-PL.AN noná-NON.ID 3-scratch.AN-*ahte*-3PL.AN
- conjunction (3ii) is a *mixed elaboration* of (3i)
 - specifies a reflexive relation for the subgroup of the boy
 - a reciprocal relation for the subgroup of the girls

- It is difficult to translate the Cheyenne discourse (3) into English. The least awkward translation is (4), where Cheyenne (3i) is rendered as (4i), without any object:
- (4)
 - i. The children *were scratching*.
 - ii. The boy scratched *himself* and the girls scratched *each other*.
- (5)
 - i. The children scratched {*themselves, each other*}
 - # ii. The boy scratched *himself* and the girls scratched *each other*.
- The English anaphors are not compatible with mixed elaboration
- But, there are cross-sentential dependencies in English as well
- (6)
 - i. Some girls dressed up like each other (for Halloween).
 - ii. They borrowed outfits from each other.
- I propose an analysis in Dynamic Plural Logic (van den Berg 1996, henceforth DPIL) that makes the semantic parallel explicit both within and across languages

Overview of the presentation

- Section Two
 - analyze transitive verbs in DPIL
 - collective, cumulative, and distributive relations; various scope options
 - analyzed in terms of the DPIL distinction between the *global value* and the *dependent value* assigned to a variable by a *plural information state* (set of assignment functions).
- Section Three
 - reflexives and reciprocals are analyzed as anaphors that elaborate on the relations introduced by the verb
 - The global/dependent value distinction used to analyze transitive verbs also makes it possible to draw a semantic parallel between reflexives and reciprocals: they share a requirement on global values but have differing requirements on dependent values.
- Section Four
 - this parallel is extended to languages which express reflexivity and reciprocity with a single proform
 - such proforms are underspecified, not ambiguous
 - accounts for their variety of construals as well as *mixed elaboration*
- Section Five is the conclusion.

2 Collectivity, Cumulativity, and Distributivity

- Sentences with plural subjects and objects can be read collectively, cumulatively, or distributively (Scha 1981, a.o.)
- On a distributive reading the distributive operator can take either wide or narrow scope with respect to the object
- (7) allows four readings, which can be disambiguated as in (8)

(7) Sandy and Kathy lifted four boxes.

(8) Sandy and Kathy ...

- ... *together* lifted (a stack of) four boxes. (collective)
- ... *between* them lifted (a total of) four boxes. (cumulative)
- ... *each* lifted *the same* (stack of) four boxes. (narrow dist.)
- ... *each* lifted a *possibly different* (stack of) four boxes. (wide dist.)

- These can be accounted for in DPIL, assuming:
 - optional operator that distributes over the subject (δ_x)
 - that the scope of this operator may vary, as in (9).¹

(9) Four translations of *lift*^{2,3}

- $lift_x^y \rightsquigarrow \epsilon_y \wedge Lxy$ (collective)
- $lift_{\delta_x}^y \rightsquigarrow \delta_x(\epsilon_y) \wedge Lxy$ (cumulative)
- $\delta_x(lift)^y \rightsquigarrow \epsilon_y \wedge \delta_x(Lxy)$ (narrow distributive)
- $\delta_x(lift^y) \rightsquigarrow \delta_x(\epsilon_y \wedge Lxy)$ (wide distributive)

- the input to semantic composition is an indexed string of morphemes
 - interpreted left to right
 - combined by dynamic conjunction (adapting Bittner (2007)).

¹For definitions, see the appendix. I adopt the definitions in van den Berg (1996), except for distributivity, where I assume the modified definition of Nouwen (2003).

²C.f. van den Berg (1996) (§5.4.2), who analyzes these using a ‘pseudo-distributivity’ operator which, for both the distributive and cumulative readings, scopes over both the variable introduction and the verb.

³The verb may also distribute over the object (δ_y), e.g. $\delta_y(lift_x)^y \rightsquigarrow \epsilon_y \wedge \delta_y(Lxy)$ yields a reading where Sandy and Kathy together lifted four boxes *one at a time*. (Including optional object-distributivity, there are eight translations for *lift*.)

- superscripts introduce new values for variables
- subscripts indicate anaphora to the input values
- the indices x and y stand for the subject set and the object set, respectively.
- DPIL, *information states* are *plural* (sets of assignment functions)
 - they encode the values for variables as well as the relations (*dependencies*) between these values.
 - a *global value* is the set of values assigned to a variable by a plural info state
 - a *dependent value* is a subset of the global value, restricted to a particular value for another variable.
- Object introduced in the scope of distributivity ($\delta_x(\epsilon_y)$, as in (9b,d))
 - different y values can be introduced for each x value
 - Sandy and Kathy can pick up different boxes on (8b,d).
 - possible assignment structures for the collective and wide distributive

reading, e.g.:

G	x	y	,	G	x	y
g_1	s	b_1		g_1	s	b_1
g_2	s	b_2		g_2	s	b_2
g_1	k	b_3		g_1	s	b_3
g_2	k	b_4		g_2	s	b_4
				g_1	k	b_5
			g_2	k	b_6	
			g_1	k	b_7	
			g_2	k	b_8	

cumulative wide dist.

- Object introduced outside the scope of the distributivity (as in (9a,c))
 - the y values must be the same for all x values (no dependencies)
 - Sandy and Kathy pick up the same four boxes on (8a,c)
 - the collective and the narrow distributive readings require the same

assignment structure, e.g.:

G	x	y
g_1	s	b_1
g_2	s	b_2
g_1	s	b_3
g_2	s	b_4
g_1	k	b_1
g_2	k	b_2
g_1	k	b_3
g_2	k	b_4

- Verbal relation outside the scope of distributivity (as in (9a,b))
 - the relation holds between the global value of x and the global value of y
 - on the collective and cumulative readings (8a,b), the plurality of Sandy and Kathy picks up the plurality of the boxes.
 - $\langle G(x), G(y) \rangle \in \llbracket L \rrbracket$
 - for the assignment structure at the bottom of page four, this requires $\langle \{s, k\}, \{b_1, b_2, b_3, b_4\} \rangle \in \llbracket L \rrbracket$
- Verbal relation in the scope of (subject) distributivity (as in (9c,d))
 - for each x value the relation holds between that value and its dependent y values.
 - on distributive readings (8c,d), Sandy picks up her four boxes and Kathy picks up hers.
 - for every d in $G(x)$, $\langle \{d\}, G|_{x=d}(y) \rangle \in \llbracket L \rrbracket$
 - for the wide distributive assignment structure on page four, this requires $\langle \{s\}, \{b_1, b_2, b_3, b_4\} \rangle \in \llbracket L \rrbracket$ and $\langle \{k\}, \{b_5, b_6, b_7, b_8\} \rangle \in \llbracket L \rrbracket$
- Translations of the four readings of (7):

(10) i. *Sandy and Kathy...* \rightsquigarrow
 $+ [v = s] \wedge \epsilon_x \wedge x = v \oplus w \wedge + [w = k]$

ii. *...lifted four boxes* \rightsquigarrow

$\epsilon_y \wedge Lxy \wedge 4y \wedge \delta_y(By)$	(collective)
$\delta_x(\epsilon_y) \wedge Lxy \wedge 4y \wedge \delta_y(By)$	(cumulative)
$\epsilon_y \wedge \delta_x(Lxy) \wedge 4y \wedge \delta_y(By)$	(narrow distributive)
$\delta_x(\epsilon_y \wedge Lxy \wedge 4y \wedge \delta_y(By))$	(wide distributive) ⁴
- These relations are passed on to subsequent discourse (van den Berg 1996)
 - plural anaphora respects the relations introduced in antecedent discourse
 - in the context of the wide distributive reading of (7), the sentence *They brought them upstairs* is read analogously, i.e. *Sandy and Kathy each brought her stack of four boxes upstairs*.

⁴Since the distribution is down to singularities, this is equivalent to a formulation with iterated distributivity, or any intermediate grouping. E.g., $\delta_x(\epsilon_y \wedge Lxy) \wedge \delta_x(4y) \wedge \delta_x(\delta_y(By))$.

3 Reflexive and Reciprocal Anaphors

- Reflexivity and reciprocity are expressed by distinct proforms in English
- The proposed analysis:
 - they elaborate on the dependencies introduced by the verb
 - they share an identity requirement on global values (*global identity*)
 - they differ in their requirements on dependent values (*distributive overlap* vs. *distributive non-overlap*)
- It follows that:
 - they are only compatible with certain readings of verbs
 - reciprocals are not compatible with singular antecedents
 - relations are passed on to subsequent discourse

3.1 Plural anaphors

- The proposed translations of the plural reflexive and reciprocal anaphors:

$$(11) \textit{themselves}_{y,x} \rightsquigarrow +[PLy] \wedge +[y = x] \wedge +[\delta_y(y \circ x)]$$

$$(12) \textit{each other}_{y,x} \rightsquigarrow +[y = x] \wedge +[\delta_y(y \otimes x)]$$

- The plural reflexive presupposes plurality ($+ [PLy]$)
- Both require global identity ($+ [y = x]$)
 - requires identity of two global values (denote the same set)
 - here, the subject x and the object y
- Both have distributive requirements
 - distributive overlap ($+ [\delta_y(y \circ x)]$) for reflexives
 - distributive non-overlap ($+ [\delta_y(y \otimes x)]$) for reciprocals
- The distributive conditions impose further constraints on the dependencies between x and y that were introduced by the verb.
 - the anaphors are not compatible with all readings of the verb
- Consider a basic plural reflexive sentence:

$$(13) \text{Some students helped themselves}$$

- The proposed translation of the reflexive
 - requires only global identity and distributive overlap
 - does not specify *how many* relations hold between the individuals
 - is compatible with (subject) distributive and collective verbs
 - allows several assignment structures, e.g., for students = {a, b}:

G	x	y
g_1	a	a
g_2	b	b

G'	x	y
g_1	a	a
g_2	b	a
g_2	b	b

G''	x	y
g_1	a	a
g_1	a	b
g_2	b	a
g_1	b	b

- Consider basic plural reciprocal sentence:

(14) Some students helped each other

- The proposed translation of the reciprocal
 - requires only global identity and distributive non-overlap
 - does not specify *how many* relations hold between the individuals
 - is only compatible with (subject) distributive readings of the verb
 - allows several assignment structures, e.g., for students = {a, b, c}:

G	x	y
g_1	a	b
g_2	b	c
g_3	c	a

G'	x	y
g_1	a	b
g_2	b	c
g_2	b	a
g_3	c	a

G''	x	y
g_1	a	b
g_1	a	c
g_2	b	c
g_1	b	a
g_3	c	a
g_1	c	b

3.2 Singular anaphors

- The translation of the singular reflexive pronoun (e.g. *himself*) differs from (11) only in the number presupposition.

(15) $himself_{y,x} \rightsquigarrow +[SGy] \wedge +[y = x] \wedge +[\delta_y(y \circ x)]$

- The reciprocal is not compatible with a singular antecedent, which follows from the above analysis:
 - where the antecedent is singular, both $+[y = x]$ and $+[\delta_y(y \circ x)]$ can not be satisfied

3.3 Elaboration by subsequent discourse

- Consider discourse (16)
 - the interpretation of sentences (16ii) and (16iii) depends on the relations introduced in (16i)
 - each girl borrowed an outfit from the girl she dressed up as and returned that outfit to that girl.
- (16) i. Some girls dressed up like each other (for Halloween).
 ii. They borrowed outfits from each other.
 iii. (The next day,) they returned them.
- Crucially, both the plurality of girls and the relations between them are passed on from (16i) to the subsequent discourse.
 - If only the values were passed on, then the relations between the individual girls could be different in subsequent sentences.
 - These observations are captured by the analysis (where $D = \text{dress.up.like}$, $B = \text{borrow.from}$, and $R = \text{return}$):

- (17) i. $\epsilon_x \wedge \delta_x(Gx) \wedge PLx \wedge \delta_x(\epsilon_y \wedge Dxy) \wedge +[y = x] \wedge +[\delta_y(y \odot x)]$
 ii. $+ [PLx] \wedge \delta_x(\epsilon_z \wedge Bxzy) \wedge \delta_z(Oz) \wedge PLz \wedge +[y = x] \wedge +[\delta_y(y \odot x)]$
 iii. $+ [PLx] \wedge \delta_x(Rxzy) \wedge + [PLz]$

3.4 Alternate translations

- No global identity:
 - $\text{themselves}_{y,x} \rightsquigarrow + [PLy] \wedge + [\delta_y(y \circ x)]$, $\text{each other}_{y,x} \rightsquigarrow + [\delta_y(y \odot x)]$
 - incorrectly allows different members in the argument (x and y) sets.
- Reflexive with distributive identity (not distributive overlap):
 - $\text{themselves}_{y,x} \rightsquigarrow + [PLy] \wedge + [y = x] \wedge + [\delta_y(y = x)]$
 - incorrectly preclude a collective interpretation of the verb (e.g., *the students praised themselves*).
- Reciprocal with distributive non-identity (not distributive non-overlap):
 - $\text{each other}_{y,x} \rightsquigarrow + [y = x] \wedge + [\delta_y(y \neq x)]$,
 - incorrectly allows a (subject-)collective interpretation of the verb.

4 Reflexive/Reciprocal Underspecification

- many languages express reflexivity and reciprocity with a single proform
- e.g., Cheyenne’s verbal affix *-ahte*
 - compatible with both plural and singular antecedents
 - several construals with plural antecedents
 - reciprocal construal can be specified with an additional modifier
 - reflexive construal only with singular antecedents

4.1 Plural antecedents

- Cheyenne *-ahte* is compatible with plural antecedents, e.g. (18)
 - allows a reflexive construal, as in (19)
 - allows a reciprocal construal, as in (20)

(18) *ka'éskone-ho é-axeen-**ahtse**-o'o*
 child-PL.AN 3-scratch.AN-*ahte*-3PL.AN

(19) The children scratched *themselves*

(20) The children scratched *each other*

- But (18) also allows a *mixed construal*
 - partially reflexive and partially reciprocal
 - (18) can refer to a group of children, some of whom scratched each other while others scratched themselves.
 - no true English translation
- Proposal: such proforms require only a global identity presupposition

(21) *-ahte* \rightsquigarrow $+[y = x]$

- This proposed translation of *-ahte* yields the right results
 - here, *-ahte* requires an identical subject and object set
 - but, no relations between the individuals are required
 - several assignment structures are possible, e.g., for children = $\{c_1, c_2, c_3\}$:

$$\dots, \begin{array}{|c|c|c|} \hline G & x & y \\ \hline g_1 & c_1 & c_1 \\ \hline g_2 & c_2 & c_2 \\ \hline g_3 & c_3 & c_3 \\ \hline \end{array}, \begin{array}{|c|c|c|} \hline G' & x & y \\ \hline g_1 & c_1 & c_2 \\ \hline g_2 & c_2 & c_3 \\ \hline g_3 & c_3 & c_1 \\ \hline \end{array}, \begin{array}{|c|c|c|} \hline G'' & x & y \\ \hline g_1 & c_1 & c_1 \\ \hline g_2 & c_2 & c_3 \\ \hline g_3 & c_3 & c_2 \\ \hline \end{array}, \dots$$

- This corresponds with intuitions, as many differing construals are allowed
 - G corresponds to the reflexive construal
 - G' corresponds to the reciprocal construal
 - G'' corresponds to the mixed construal

4.2 Singular antecedents

- Cheyenne *-ahte* is also compatible with singular antecedents, e.g. (22)
 - (unmarked) singular agreement on the noun and verb
 - specifies a reflexive interpretation

(22) *hetané-ka'éskone é-axeen-**ahtse***
 man-child 3-scratch.AN-*ahte*
 ‘The boy scratched himself.’

- The proposed translation of *-ahte* in (21) yields the right results
 - here, *-ahte* requires identical subject (x) and object (y) sets
 - singular subject (antecedent), so singular (identical) object
 - allows assignment structures with identical singleton sets assigned to

x and y , e.g.:

G''	x	y
g_1	c_1	c_1

4.3 Specification of reciprocity

- An additional modifier can specify a reciprocal construal
 - morphologically complex modifier, preposed to the verb
 - plural antecedent

(23) *hé-ka'éškóne-ho noná-métóe é-axeen-**ahtse**-óo*
 woman-child-PL.AN noná-NON.ID 3-scratch.AN-*ahte*-3PL.AN
 ‘The girls scratched each other.’

(24) *noná-métóe* \rightsquigarrow $+[\delta_y(y \odot x)]$

- The proposed translations of *-ahte* + *noná-métóe* yield the right results
 - here, *-ahte* requires identical subject (x) and object (y) sets
 - *noná-métóe* contributes the non-overlap requirement
 - allows assignment structures with non-overlapping y -singular sub-states,

as with English *each other*, e.g.:

G''	x	y
g_2	c_2	c_3
g_3	c_3	c_2

4.4 Mixed Elaboration

- The underspecified sentence in (25i) (= (18)) is compatible with the continuation in (25ii)⁵ (= (22 conjoined with 23)).

- (25) i. *ka'éskone-ho é-axeen-**ahtse**-o'o*
 child-PL.AN 3-scratch.AN-*ahte*-3PL.AN
- ii. *hetané-ka'éskone é-axeen-**ahtse***
 man-child 3-scratch.AN-*ahte*
*naa hé-é-ka'éškóne-ho noná-métǽ é-axeen-**ahtse**-o'o*
 CNJ woman-child-PL.AN noná-NON.ID 3-scratch.AN-*ahte*-3PL.AN

- The conjunction (25ii) is a *mixed elaboration* of (25i), specifying
 - a reflexive relation for the (singular) subgroup of the boy ($\{c_1\}$)
 - a reciprocal relation for the subgroup of the girls ($\{c_2, c_3\}$).
 - allows only the ‘mixed’ assignment structure, one of the structures

possible for (18):

G''	x	y
g_1	c_1	c_1
g_2	c_2	c_3
g_3	c_3	c_2

- the Cheyenne discourse (25) is difficult to translate into English
 - The least awkward translation is (26), where Cheyenne (25i) is rendered as (26i), without any object:
 - If there is a reflexive or reciprocal object, as in (27i), then mixed elaboration is infelicitous (#).⁶

- (26) i. The children *were scratching*.
 ii. The boy scratched *himself* and the girls scratched *each other*.

- (27) i. The children scratched *{themselves, each other}*
 # ii. The boy scratched *himself* and the girls scratched *each other*.

- The mixed elaboration in English in (27) is infelicitous because the reflexive and reciprocal anaphors are specified for reflexivity/reciprocity.
- An ambiguity analysis cannot account for Cheyenne discourse (25)

⁵There is a typo in this example in the proceedings; this is the corrected version.

⁶A discourse like (27) might be acceptable with ‘themselves’ on a collective interpretation. The proposed analysis of reflexives is compatible with collective translation of the verb: see Sections 2 and 3.

- Discourses parallel to Cheyenne (25) are acceptable in other languages which express reflexivity and reciprocity with a single proform, regardless of morphological category.
 - Cheyenne *-ahte*
 - Polish *się* (Bittner, p.c.)
 - Romanian *se* (Brasoveanu, p.c.)
 - French *se* (Déprez, p.c.)
 - German *sich* (Tonhauser, p.c.)

5 Conclusion

- Reflexive and reciprocal anaphors are analyzed as sentence-internal elaborations of the relations introduced by the transitive verb.
- These relations, which can be collective, cumulative, or distributive, can also be elaborated on in subsequent discourse
- The DPIL distinction between global and dependent values allows a semantic parallel to be drawn between reflexive and reciprocal anaphors.
 - they share a requirement on global values
 - they differ in requirements on dependent values
- The proposed analysis generalizes to languages that express reflexivity and reciprocity with a single proform
 - such proforms underspecified, not ambiguous
 - they presuppose only global identity
- the proposal accounts for several facts
 - variety of construals with plural antecedents
 - mixed elaboration
 - only reflexivity with singular antecedents
- Mixed elaboration discourse available in many languages

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