Varieties of Distributivity: *One by One* vs. *Each*

I. The Problem: The main goal of the paper is to argue that distributive quantificational dependencies in natural language can be established in two different ways: (*i*) by encapsulating quantification into functions storing quantificational dependencies *as a whole* – needed to account for *one by one*-based distributive sentences like (1,2,3) below, and (*ii*) by decomposing quantification in such a way that each *n*-tuple of quantificationally dependent entities is *individually* stored in a variable assignment and quantifiers are interpreted relative to the entire set of variables assignments that stores quantificational dependencies in this pointwise, assignment-wise manner – needed to account for *each*-based distributive sentences like (4).

The proposal contrasts with the previous literature, which countenances either encapsulation (Stone 1999, Bittner & Trondhjem 2008, Dekker 2008 among others) or decomposition (van den Berg 1996, Nouwen 2003, Brasoveanu 2008 among others), but not both.

(1) The boys recited 'The Raven' one by one. **(2)** Linus recited the poems one by one.

(3) The boys recited the poems one by one.

(4) The boys each recited a different poem. (sentence-internal OR sentence-external)

(5) The boys recited a different poem one by one. (sentence-external ONLY)

The main argument for the proposal that both ways of representing distributive quantification are needed is provided by the previously unnoticed contrast between *one by one* and *each* exemplified by sentences (4) and (5) above. In (4), the indefinite *a different poem* can have either a sentence-external or a sentence-internal reading, as Carlson (1987) first observed. The sentence-internal reading is: for any two boys *a* and *b*, *a*'s poem is different from *b*'s poem. The sentence-external reading is salient if (4) occurs after the sentence *Mary recited 'The Raven'*: in this case, (4) has a reading according to which each boy recited a poem different from 'The Raven' – but there might be boys that recited the same poem, as long as that poem is not 'The Raven'. However, (5) can only have a sentence-external reading: one at a time, the boys recited a poem that was different from 'The Raven'. Thus, distributive *one by one*, unlike distributive *each*, does not license sentence-internal readings of singular *different*, although distributivity has been taken to license such readings since Carlson (1987) (see Barker 2007 for a recent discussion).

Sentence-internal readings of singular *different* are licensed exclusively by an overt *each* or an overt distributive quantifier like *every boy*. They are licensed neither by *one by one* nor by the covert distributivity operator usually assumed to derive the distributive interpretation of the second VP-conjunct in examples like *The girls met and had an espresso*: a sentence like *The boys recited a different poem*, which has no overt distributor, can only have a sentence-external reading.

II. Outline of the Account: The main proposal is that *each* licenses sentence-internal singular *different* because it encodes quantificational distributivity by decomposition, while *one by one* does not license such readings because it encodes distributivity by encapsulation. We assume that decompositional distributivity should be analyzed along the lines of Brasoveanu (2008), which takes quantifiers to be evaluated relative to sets of assignments (following van den Berg 1996) and each assignment to store one of the quantificationally correlated *n*-tuples. In contrast, *one by one* encapsulates quantification in the sense that all the *n*-tuples of quantificationally correlated entities are *collected* into a function, which is stored in a single variable assignment. Sentence-internal singular *different* is not licensed because the distributive quantification does not, in this case, introduce multiple assignments that can be compared in a pair-wise fashion. The quantificational dependency contributed by *one by one* correlates the atoms in a plural event and the atoms in a plural individual that is a participant in that plural event. For example, in (1), *one by one* correlates each atomic event of reciting 'The Raven' and the single boy that is the agent of that event.

We briefly outline the formal analysis of *one by one*, which is couched in classical (many-sorted) type logic with plural events and plural entities (both domains have the familiar lattice structure). As Jackendoff (2008) observes, *one by one* is a verbal adjunct – and the system in Krifka (1989) is well suited for a compositional analysis of *one by one* along these lines. To avoid introducing the specifics of that system, we assume instead that LF syntax contains covert functional heads that introduce theta-roles. For example, the LF of sentence (1) is provided in (6) below: the functional head F_1 introduces the theme role **th** and F_2 introduces the agent role **ag**. These theta-roles are functions of type εe from events (type ε) to individuals (type e). Given its meaning in (14) below, *one by one* can be adjoined immediately below any theta-role-introducing functional head as long as the individual in the specifier of that functional head is plural. Therefore, sentence (1) allows only for adjunction immediately below F_2, sentence (2) allows only for adjunction immediately below F_1 and sentence (3) allows for both adjunction sites, hence its ambiguity.

(6) $[_{TP}$ PAST $[_{F_2P}$ [the boys] [F_2 $[_{F_1P}$ one-by-one $[_{F_1P}$ 'The Raven' [F_1 recite]]]]]]

The basic translations are provided in (7)-(14) (variables over events $\mathbf{e}, \mathbf{e}', \ldots$ are boldfaced; $|x|$ is the cardinality of x; subscripts indicate types). Sentence (1) is translated as in (15).

(7) *recite* $\rightsquigarrow \lambda \mathbf{e}_\varepsilon.\, \text{RECITE}(\mathbf{e})$ **(8)** *'The Raven'* $\rightsquigarrow \text{RAVEN}_e$ **(9)** *boys* $\rightsquigarrow \lambda x_e.\, {}^*\text{BOY}(x)$

(10) $F_1 \rightsquigarrow \lambda P_{\varepsilon t}.\lambda x_e.\lambda \mathbf{e}_\varepsilon.\, P(\mathbf{e}) \wedge \mathbf{th}(\mathbf{e}) = x$ **(11)** $F_2 \rightsquigarrow \lambda P_{\varepsilon t}.\lambda x_e.\lambda \mathbf{e}_\varepsilon.\, P(\mathbf{e}) \wedge \mathbf{ag}(\mathbf{e}) = x$

(12) *the* $\rightsquigarrow \lambda P_{et}.\lambda R_{e(\varepsilon t)}.\lambda \mathbf{e}_\varepsilon.\, R(\sigma x.P(x))(\mathbf{e}))$ **(13)** *PAST* $\rightsquigarrow \lambda P_{\varepsilon t}.\, \exists \mathbf{e}_\varepsilon(P(\mathbf{e}) \wedge \mathbf{runtime}(\mathbf{e}) < \mathbf{now})$

(14) *one by one* $\rightsquigarrow \lambda P_{\varepsilon t}.\lambda R_{(\varepsilon t)(e(\varepsilon t))}.\lambda x_e.\lambda \mathbf{e}_\varepsilon.\, R(P)(x)(\mathbf{e}) \wedge \mathbf{linear\_order}(\{\mathbf{e}' \leq \mathbf{e} : \mathbf{atom}(\mathbf{e}')\}) \wedge$
$|x| > 1 \wedge \forall \mathbf{e}' \leq \mathbf{e}(\mathbf{atom}(\mathbf{e}') \rightarrow \exists x' \leq x(R(D_\varepsilon)(x')(\mathbf{e}') \wedge |x'| = 1))$ (for *two by two*, let $|x'| = 2$)

(15) $\exists \mathbf{e}_\varepsilon(\text{RECITE}(\mathbf{e}) \wedge \mathbf{th}(\mathbf{e}) = \text{RAVEN} \wedge \mathbf{ag}(\mathbf{e}) = \sigma x.\, {}^*\text{BOY}(x) \wedge \mathbf{runtime}(\mathbf{e}) < \mathbf{now} \wedge$
$\mathbf{linear\_order}(\{\mathbf{e}' \leq \mathbf{e} : \mathbf{atom}(\mathbf{e}')\}) \wedge |\sigma x.\, {}^*\text{BOY}(x)| > 1 \wedge$
$\forall \mathbf{e}' \leq \mathbf{e}(\mathbf{atom}(\mathbf{e}') \rightarrow \exists x' \leq \sigma x.\, {}^*\text{BOY}(x)(\mathbf{ag}(\mathbf{e}') = x' \wedge |x'| = 1))$

The last three conjuncts of (15) give the contribution of *one by one*: the first enforces the requirement that the atomic subevents of the event **e** under discussion are temporally ordered one after the other; the second ensures that *one by one* targets only plural individuals; the third ensures that there is a one-to-one correspondence between each atomic recitation event and each individual boy. Thus, *one by one* contributes part of the dependency encapsulated in the theta-role function **ag**: the part that relates the atoms of the plural event **e** and of the plural individual $\sigma x.\, {}^*\text{BOY}(x)$.

III. Collective Predicates, Stative Predicates, and Varieties of Distributivity: There are at least two welcome consequences of the analysis. First, we correctly predict that, unlike decomposed quantificational distributivity, encapsulated distributivity under *one by one* is compatible with collective predicates like *gather*, e.g., *The students gathered in the square one by one*. The reason is that *one by one* does not require the atomic subevents of the targeted plural event to satisfy the verbal predicate (e.g., RECITE in (15) above). Thus, a plural gathering event could be the sum of a set of atomic arrival events, each of which has a singular agent. Second, since *one by one* needs to have access to atomic subparts of an event, the analysis also accounts for the fact that stative predicates are incompatible with encapsulated (but not decomposed) distributivity, e.g., **The students knew a poem one by one*. The reason is that states are dense, having no atomic subparts.

[1] Barker, C. (2007). Parasitic Scope. *L&P* 30, 407-444. **[2]** van den Berg (1996). *Some Aspects of the Internal Structure of Discourse*. PhD diss., Univ. of Amsterdam. **[3]** Bittner, M. & Trondhjem, N. (2008). Quantification as Reference. *Quantification ...*, L. Matthewson (ed.). **[4]** Brasoveanu, A. (2008). Sentence-Internal Readings of *Same*/*Different* .... Proc. of WCCFL 27, 72-80. **[5]** Carlson, G. (1987). *Same* and *Different*. *L&P* 10, 531-565. **[6]** Dekker, P. (2008). A Multi-Dimensional Treatment of Quantification .... *L&P* 31, 101-127. **[7]** Jackendoff, R. (2008). Construction after Construction .... *Language* 84, 8-28. **[8]** Krifka, M. (1989). Nominal Reference, Temporal Constitution .... *Semantics and Contextual Expressions*, R. Bartsch et al (eds.). **[9]** Nouwen, R. (2003). *Plural Pronominal Anaphora in Context*. PhD diss., Univ. of Utrecht. **[10]** Stone, M. (1999). Reference to Possible Worlds, RuCCS 49.