Word order and interpretation order in Japanese scrambling

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Workshop on Altaic Formal Linguistics (WAFL) 19, July 2026[1]

1 Introduction

Japanese is one of a number of languages with quite free word order, previously described as "nonconfigurational" (see e.g. Farmer 1980; Hale 1980).

(1) a. Gombei-ga fooku-de raamen-o kutteiru. (Whitman 1979: 343)
Gombei-NOM fork-INST ramen-ACC eat.PROG.PRES
'Gombei is eating ramen with a fork.'

b. Gombei-ga raamen-o fooku-de kutteiru.

c. Raamen-o G-ga fooku-de kutteiru.

d. Raamen-o fooku-de G-ga kutteiru.

e. Fooku-de G-ga raamen-o kutteiru.

f. Fooku-de raamen-o G-ga kutteiru.

Since Hoji 1985 and Saito 1985, such word order alternations have predominantly been analyzed as reflecting a hierarchical structure that derives a basic word order (SOV) together with optional **"scrambling"** movements (a term from Ross 1967).

In some cases, scrambling can affect scope and binding relationships:

(2) a. [Dareka-ga] [mittsu-ijyoo-no kaisha-o] choosa-shita. ($\checkmark\exists > 3^+$, $\boxed{*3^+ > \exists}$)
someone-NOM 3.CL-at.least-GEN company-ACC investigate-do.PAST
'Someone investigated at least 3 companies.'

b. [Mittsu-ijyoo-no kaisha-o] [dareka-ga] choosa-shita. ($\checkmark\exists > 3^+$, $\boxed{\checkmark 3^+ > \exists}$)
3.CL-at.least-GEN company-ACC someone-NOM investigate-do.PAST
≈ 'At least 3 companies, someone investigated.' (exx based on Takano 2014: 169)

The differences in word order and interpretation in (2a,b) appear to neatly parallel the "shape" of corresponding denotations in (3a,b) — setting aside the $\exists > 3^+$ reading of (2b) for now.

(3) a. $[\exists y : \text{human}(y)]\Big([3^+ x : \text{company}(x)]\big(\text{investigate}(y, x)\big)\Big)$

b. $[3^+ x : \text{company}(x)]\Big([\exists y : \text{human}(y)]\big(\text{investigate}(y, x)\big)\Big)$

Note that I write quantificational statements in the form $[Qv : \ldots\text{restrictor}\ldots](\ldots\text{scope}\ldots)$ today.[2]

[1] I thank colleagues at Nantes University and Isaac Gould for helpful discussion and comments on earlier versions of this work, and apologize for having subjected them to it.

[2] This notation goes back to at least Higginbotham and May 1981 and is adopted in Altshuler, Parsons, and Schwarzschild 2019; see Altshuler et al p. 219 for additional references. In relation to more common unary operator notation, $[\forall x : \ldots](\ldots) \equiv \forall x(\ldots \rightarrow \ldots)$ and $[\exists x : \ldots](\ldots) \equiv \exists x(\ldots \wedge \ldots)$. The case of 3^+ 'at least 3' is more complicated, but this notation lets us abstract away from these details.

The same form of scrambling can also feed variable binding:

(4) a. *[Soko$_x$-no shain-ga] [mittsu-ijyoo-no kaisha^x-o] choosa-shita.
DEM-GEN employee-NOM 3.CL-at.least-GEN company-ACC investigate-do.PAST

b. [Mittsu-ijyoo-no kaisha^x-o] [soko$_x$-no shain-ga] choosa-shita.
3.CL-at.least-GEN company-ACC DEM-GEN employee-NOM investigate-do.PAST
≈ 'At least 3 companies^x, their$_x$ own employee(s) investigated.' (Takano 2010: 84–85)

The intended reading in (4) — with the object 'at least 3 companies' binding the demonstrative *soko* 'there' in the subject — is only possible when the binder precedes the pronoun as in (4b).

Again, the contrast in (4) appears to nicely parallel how a variable must be within the scope of a quantifier to be bound by it, also reflected in the failure of variable binding in formula (5a):

(5) a. *$[\exists y : \text{employee}(y, \boxed{x})]\underbrace{\Big([3^+ x : \text{company}(x)]\big(\text{investigate}(y, x)\big)\Big)}_{\text{where } x \text{ is bound by } 3^+}$

$\boxed{x}$ cannot be bound as intended!

b. $[3^+ x : \text{company}(x)]\Big([\exists y : \text{employee}(y, x)]\big(\text{investigate}(y, x)\big)\Big)$

► The simple contrasts as in (2) and (4) appear to suggest that **surface word order directly reflects interpretation order (scope).**

But there are also cases where scope and binding do *not* simply track word order:[3]

(6) a. [Mittsu-ijyoo-no daigaku^x-ga] [soko$_x$-no sotsugyoosei-o] saiyoo-shita.
3.CL-at.least-GEN university-NOM DEM-GEN graduate-ACC hire-do.PAST
'At least 3 universities^x hired their$_x$ own graduate(s).'

b. [Soko$_x$-no sotsugyoosei-o] [mittsu-ijyoo-no daigaku^x-ga] saiyoo-shita.
DEM-GEN graduate-ACC 3.CL-at.least-GEN university-NOM hire-do.PAST
≈ 'Their$_x$ own graduate(s), at least 3 universities^x hired.' ((a): Takano 2010: 84)

► In (6a), the subject quantifier binds into the object. The grammaticality of (6b) appears to reflect **"reconstruction"** of the object.

- The conditions under which scrambling can feed scope and binding, and where it cannot, have been a significant area of research. I introduce some key observations in §2 below.

Today, I explore **a new approach to Japanese word order and its effects on interpretation**.

- I develop **a model of left-to-right parsing**, which presents a new perspective on the relationship of surface structure and interpretation (spiritually similar to Kempson 2003). It is intended as a *supplement* to a derivational syntax, not as a replacement.
- The approach allows for a parsimonious description [although not yet explanation] of the distribution of **scrambling that feeds scope and binding ("A-scrambling")**.
- The formal proposal builds on work on **left-to-right interpretation** (e.g. Shan and Barker 2006, Bott and Sternefeld 2017) and also Shimamura and Tanaka's (WAFL 16; to appear) discussion of scrambling and **neo-Davidsonian event semantics**.

[3] For further discussion of variable binding of *soko* under reconstruction, see Yoshimura 1992 and Ueyama 1998, 2003.

2 Observations on the behavior of scrambling

As seen in the introduction, scrambling may or may not feed scope and binding.[4] Thinking of scrambling as movement, the two forms may be described as:

- **"A-scrambling":** feeds scope and binding
- **"Ā-scrambling":** reconstructs for scope and binding

I will use these as descriptive terms here.

Scrambling in Japanese can be local / clause-internal or long-distance (LD) / cross-clausal.[5]

(7) **LD scrambling that cannot feed variable binding:** (based on Takano 2010: 85)

*[Mittsu-ijyoo-no kaisha^x-o] soko$_x$-no shain-ga
3.CL-at.least-GEN company-ACC DEM-GEN employee-NOM
[$_{CP}$ Ken-ga ____ choosa-shita -to] itta.
Ken-NOM investigate-do.PAST COMP say.PAST
≈ '[At least 3 companies^x], their$_x$ own employee(s) said [that Ken investigated ___$_x$].'

Observations of the form in (7) led to (8), also echoing Mahajan (1990) on Hindi:

(8) **Traditional generalization on Japanese scrambling:** (Saito 1992; Tada 1993; a.o.)

a. Local scrambling can be A-scrambling or Ā-scrambling.

b. Long-distance scrambling is Ā-scrambling.

► **But subsequent work has shown that the facts are more complicated!** And intriguing...

(9) **LD A-scrambling out of a finite clause with null subject:**[6] (Funakoshi 2015: 329)

[Mittsu-ijyoo-no daigaku^x-o] soko$_x$-no sotsugyoosei-ga
3.CL-at.least-GEN university-ACC DEM-GEN graduate-NOM
[$_{CP}$ (izure) ____ choosa-suru-tsumori-da -to] itta.
someday investigate-do-plan-COP COMP say.PAST
≈ '[At least 3 universities^x], their$_x$ own graduate(s) said [that *pro* plans to investigate ___$_x$].'

Building on Nemoto (1993) and Takano (2010) on A-scrambling out of control clauses (not shown here), Goto-Funakoshi suggests the following:

(10) **Goto-Funakoshi's generalization:** (Goto 2014: 27, Funakoshi 2015: 332)

"...scrambling out of a clause with a null subject can produce a new binding relation, while scrambling out of a clause with an overt subject cannot."

[4] Scrambling is generally thought to not affect case marking. There are a limited set of exceptions, where it has been argued that scrambling feeds case realization, such as with so-called nominative/genitive conversion (Fukui and Nishigauchi 1992) and certain nominative objects (Kasai 2018).

[5] Following Takano (2010: note 1) (see also Hoji 2003), Arano (2025), and others, here I will continue to concentrate on variable binding between *mittsu-ijyoo* 'at least 3' and *soko* (locative demonstrative) in possessor position.

[6] Here, I follow Branan (2018) in reporting relatively acceptable examples of long-distance A-scrambling simply with no judgment mark (or with ✓ in (13) below), and the relatively ungrammatical ones with *. What is important here is the clear contrast between the two classes of configurations.

But crossing a null subject is not a sufficient condition for A-scrambling. The presence or absence of other, *linearly intervening* arguments matters too:

(11) **Addition of pre-CP intervener disrupts A-scrambling:** (Funakoshi 2015: 379)

*[Mittsu-ijyoo-no daigaku$_x$-o] soko$_x$-no sotsugyoosei-ga **Ken-ni**
3.CL-at.least-GEN university-ACC DEM-GEN graduate-NOM Ken-DAT
[(izure) ____ choosa-suru-tsumori-da] -to itta
someday investigate-do-plan-COP COMP say.PAST
≈ '[At least 3 uni's^x], their$_x$ own graduate(s) told Ken [that *pro* plans to investigate ___$_x$].'

(12) **Post-CP intervener does not disrupt A-scrambling!** (Branan 2018: 136)

[Mittsu-ijyoo-no daigaku^x-o] soko$_x$-no sotsugyoosei-ga
3.CL-at.least-GEN university-ACC DEM-GEN graduate-NOM
[(izure) ____ choosa-suru-tsumori-da] -to **Ken-ni** itta
someday investigate-do-plan-COP COMP Ken-DAT say.PAST
≈ '[At least 3 uni's^x], their$_x$ own graduate(s) told Ken [that *pro* plans to investigate ___$_x$].'

(13) **Summary of variable binding fed by LD scrambling out of finite clauses:**

[obj] is "at least three..." and scrambled from ___. Grammatical bound pronouns in bold.

a.	*	[obj]^x subj$_x$		[subj	___ V]	V	(7)	
b.	*	[obj]^x subj$_x$	goal	[subj	___ V]	V	(38a)	[App]
c.	*	[obj]^x subj	goal$_x$	[subj	___ V]	V	(38b)	[App]
d.	✓	[obj]^x subj		[**subj**$_x$	___ V]	V	(39)	[App]
e.	✓	[obj]^x **subj**$_x$		[*pro*	___ V]	V	(9)	
f.	*	[obj]^x subj$_x$	goal	[*pro*	___ V]	V	(11)	
g.	✓	[obj]^x subj	**goal**$_x$	[*pro*	___ V]	V	(40)	[App]
h.	✓	[obj]^x **subj**$_x$		[*pro*	___ V] goal	V	(12)	

► Across these and other examples (see Arano 2025), in grammatical cases of LD A-scrambling, the bound pronoun is contained in *the last nominal before the corresponding gap*.

(14) **Arano's generalization:** (Arano 2022a: 2; 2025: 9)

"XP can undergo A-scrambling above its next higher overt argument but no further."

- Arano (2025: 78ff) offers a highly complex derivational account for these effects.[7]

► Instead, I would like to pursue an approach where **all scrambling is the result of the same movement operation**, but the result may have different interpretational properties in different cases, in a similar spirit to Saito 2003.

Specifically, perhaps we can account for Arano's generalization in terms of **the process of left-to-right parsing** of complex sentences.

[7] In brief, this involves a [scr$_A$] probe feature specifically for A-scrambling, distinct from the trigger for Ā-scrambling, very particular assumptions about phase heads, argument-introducing heads, and feature inheritance, and the *-mark-deletion view of "salvation by deletion" effects.

3 And now for something completely different...

(15) Jiro-DAT | Taro-NOM | new book-ACC | gave
'Taro gave Jiro a new book.'

(16) new book-ACC | Jiro-DAT | gave
'*pro* gave Jiro a new book.'

(17) Jiro-DAT | Taro-NOM | Hanako-NOM | new book-ACC | bought | COMP | said
'Taro told Jiro that Hanako bought a new book.'

(18) Jiro-DAT | Taro-NOM | Hanako-NOM | new book-ACC | gave | COMP | thinks
'Taro thinks that Hanako gave a new book to Jiro.'[8]

When parsing a sentence in Japanese...

- We receive information in fragments, which I will call *tokens*. A token could be a case-marked NP, PP, adverbial, verbal complex, etc.
- We *memorize* the tokens as we go, which eventually must all be linked to some predicate(s) and thereby contribute to some *event(s)*.
- One utterance can describe multiple events. We make (informed) incremental guesses to assign information to events. Adjacent phrases often but not always describe the same event. We have to be able to *revise* earlier assumptions about event assignment.

Experimental evidence suggests that Japanese speakers do incrementally parse preverbal material into different events, subject to later reanalysis. See Miyamoto 2008 for an overview.

4 Proposal

- ▶ I explore **a model of incremental parsing**, which formalizes some of the features of parsing that we have just observed.[9]
  - A non-deterministic procedure that maps strings to their semantic representation.
  - Not a replacement for syntax, but of the mapping from structure to interpretation.
- *Surface strings* (SS) are parsed *token by token*. Tokens get assigned *event indices* (subscripts) and are placed in "*memory*," which is not totally ordered.
- A *semantic representation* (SR) is a totally ordered sequence of the tokens in memory. If A precedes B, A scopes over B and can bind into B, but not vice versa. (Formalized below.)
- Restrictions on A-scrambling (§2) will be the result of rules governing how surface order (of SS) can impact interpretation order (in SR) and how event indices can be revised.

[8] Also 'Hanako thought that Taro gave Jiro a new book' via multiple scrambling.

[9] The approach is thus similar in spirit to Kempson's (2003) discussion of Japanese scrambling in the framework of Dynamic Syntax, although the details and predictions are quite different. Note that this is a *competence* model of parsing, not meant to be a proposal of on-line processing behavior. Or in terms of Marr's (1982) three levels, this is a model of the algorithmic level, not an implementational level.

4.1 Interpreting semantic representations

I first introduce how semantic representations (SRs) — a totally ordered sequence of tokens with event indices, *which might be in a different order than the surface word order* — are interpreted.

- I adopt neo-Davidsonian event semantics (Davidson 1967; Parsons 1990, 1995) and will set aside the contribution of tense/aspect here.

  (19) $[\![\text{Hanako see Taro}]\!] = [\exists e]\big(\text{Ag}(e) = \text{Hanako} \wedge \text{Th}(e) = \text{Taro} \wedge \text{see}(e)\big)$

  The verb itself is a one-place predicate of events. Its participants are specified by separate *thematic functions*, Ag and Th. The event variable is then existentially bound.

- **Case markers denote thematic functions**, with some adjustment (Shimamura and Tanaka to appear, following Nomura 2016).[10]

- I adopt a **continuation-passing semantics** as in Barker & Shan's work (B&S; e.g. Shan and Barker 2006, Barker and Shan 2008, 2014) and especially Bott and Sternefeld 2017.[11]

- Every token has a semantics which I write in a version of B&S's **"tower" notation** as $\boxed{\frac{A}{B}}$. $\boxed{\frac{A}{B}}$ is interpreted as $\lambda c_{\langle t,t\rangle} \,.\, \lambda p_t \,.\, A(c(B \wedge p))$. Intuitively, quantificational parts are upstairs and corresponding non-quantificational parts are downstairs.[12]

- SR are interpreted by LOWER (↓) in (21), which "flattens" the structure with everything upstairs left-over-right and everything downstairs conjoined.

  Consider the case of example (2a) from the introduction:[13]

  (20) $\underline{\text{SR:}}$ $\boxed{\frac{\exists x : \text{anim}(x)}{\text{Ag}(e) = x}}_6$ $\boxed{\frac{3^+ k : \text{company}(k)}{\text{Th}(e) = k}}_6$ $\boxed{\frac{\exists e}{\text{investigate}(e)}}_6$ =(2a)

  someone-NOM at least 3 company-ACC investigate

  $\overset{\downarrow}{\Rightarrow} \underbrace{[\exists x : \text{anim}(x)]\Big([3^+ k : \text{company}(k)]\Big([\exists e_6]}_{\text{upstairs, left to right}}\underbrace{\Big(\text{Ag}(e_6) = x \wedge \text{Th}(e_6) = k \wedge \text{investigate}(e_6)\Big)\Big)\Big)}_{\text{downstairs, all conjoined}}$

  (21) **LOWER (↓):** $\text{SR} \Longrightarrow \big(\text{SR}(\lambda p_t \,.\, p)\big)(\top)$

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[10] Case markers are not one-to-one with theta roles. S&T dissociate the realization and semantics of case markers: for instance, nominative *-ga* may be the realization of Ag for transitives and unergatives, but of Th for intransitives.

[11] I do *not* adopt from B&S the dynamic application of LIFT which creates three- or higher-level towers, which B&S use to derive inverse scope configurations. Instead, on my account, inverse scope configurations reflect mismatches between word order (SS) and interpretation order (SR); see (20) vs (22) below. I also do not adopt their variable-free approach to binding and movement; see Leong and Erlewine 2019 for discussion of complications thereof.

[12] This echoes the treatment of quantification via "Cooper storage" (Cooper 1983), where each quantificational expression denotes the combination of a quantificational expression and a corresponding variable.

[13] Note that quantificational arguments always take scope over event closure ($\exists e$). See (i). My proposal derives this result utilizing techniques developed in Champollion 2015 and Bott and Sternefeld 2017, together with the fact that (non-clausal) arguments always precede the verb in SR.

(i) $[\![\text{John kissed every girl}]\!]$ (Champollion 2015: 36)

a. $= [\forall g : \text{girl}(g)]\Big([\exists e]\Big(\text{kiss}(e) \wedge \text{Ag}(e) = \text{John} \wedge \text{Th}(e) = g\Big)\Big)$

b. $\neq [\exists e]\Big(\text{kiss}(e) \wedge \text{Ag}(e) = \text{John} \wedge [\forall g : \text{girl}(g)]\Big(\text{Th}(e) = g\Big)\Big)$

- The "$3^{+} > \exists$" reading of example (2b) reflects a differently ordered SR:

(22) SR: $\underset{\text{at least 3 company-ACC}}{\boxed{\frac{3^{+}k : \text{company}(k)}{\text{Th}(e) = k}}_{7}}$ $\underset{\text{someone-NOM}}{\boxed{\frac{\exists x : \text{anim}(x)}{\text{Ag}(e) = x}}_{7}}$ $\underset{\text{investigate}}{\boxed{\frac{\exists e}{\text{investigate}(e)}}_{7}}$

$$\overset{\downarrow}{\Rightarrow} [3^{+}k : \text{company}(k)]\Big([\exists x : \text{anim}(x)]\Big([\exists e_7]\Big(\text{Th}(e_7) = k \wedge \text{Ag}(e_7) = x \wedge \text{investigate}(e_7)\Big)\Big)\Big)$$

- Finally, I note that I treat all individual (type e) arguments are also lifted to be quantificational, as in (23).

(23) $\underset{\text{Taro-NOM}}{\boxed{\frac{\exists t : t = \text{Taro}}{\text{Ag}(e) = t}}}$

4.2 From surface strings (SS) to semantic representation (SR)

Now consider the process of parsing a sentence token by token:

(24) **Parsing:** On each "turn"...

i. Draw: Consider a new token T.

ii. Index: Assign an event index to T. Use the same event index as that of the previous token as long as it seems plausible to continue as such. Two special cases: Choose arbitrarily for the first token, and switch if the last token was a finite verb.

iii. Memorize: Add T to "memory." If it appears that another token already in memory, X, should take scope over or bind into T, record the ordering statement $X < T$. Otherwise, items in memory are not ordered with respect to one another.

iv. Revise: Optionally revise the event index for tokens in memory, subject to (29).

(25) **Endgame:**

Linearize the tokens in memory, obeying all ordering statements that have been recorded.

If two tokens of the same event are not already ordered in memory, order them based on a default ordering (based in part on default word order / thematic hierarchy): agent < goal < theme < V, expanded in (41) below.

The result is the semantic representation (SR).

To illustrate the effects of this procedure, I return to the simple **subject/object asymmetry** observed in the introduction:

- O cannot bind S in SOV. But binding becomes possible in its OSV variant. (4a,b)
- S can bind O in SOV. This binding is then maintained in its OSV variant. (6a,b)

Let's see what happens in each of (4a,b) and (6b) according to the proposed parsing procedure. (Here I leave off all event indices, but we will discuss them again in §4.3.)

(26) **No backwards binding with SOV:**

ss: [x's employee(s) -NOM] [at least 3 companies x -ACC] [investigated] =(4a)

No binding by a preceding token is detected, so tokens stay unordered in memory. SR reflects default [S] [O] [V] order.

sr: $\frac{\exists y : \text{employee}(y, x)}{\text{Ag}(e) = y}$ $\frac{3^{+} x : \text{company}(x)}{\text{Th}(e) = x}$ $\frac{\exists e}{\text{investigate}(e)}$

x's employee(s) -NOM | at least 3 comp's x -ACC | investigate

$$\overset{\downarrow}{\Rightarrow} [\exists y : \text{emp}(y, \boxed{x})] \Big([3^{+} x : \text{comp}(x)] \Big([\exists e] \Big(\text{Ag}(e) = y \wedge \text{Th}(e) = x \wedge \text{inv}(e) \Big) \Big) \Big)$$

☠ [x] cannot be bound as intended, just as in (5)!

(27) **Variable binding possible in OSV variant:**

ss: [at least 3 companies x -ACC] [x's employee(s) -NOM] [investigated] =(4b)

Due to the intended binding, the first two tokens are ordered in memory: [O] < [S].

sr: $\frac{3^{+} x : \text{company}(x)}{\text{Th}(e) = x}$ $\frac{\exists y : \text{employee}(y, x)}{\text{Ag}(e) = y}$ $\frac{\exists e}{\text{investigate}(e)}$

at least 3 comp's x -ACC | x's employee(s) -NOM | investigate

$$\overset{\downarrow}{\Rightarrow} [3^{+} x : \text{comp}(x)] \Big([\exists y : \text{emp}(y, x)] \Big([\exists e] \Big(\text{Th}(e) = x \wedge \text{Ag}(e) = y \wedge \text{inv}(e) \Big) \Big) \Big)$$

(28) **Backwards binding possible in OSV:**

ss: [x's graduate(s) -ACC] [at least 3 universities x -NOM] [hired] =(6b)

No binding by a preceding token is detected, so tokens stay unordered in memory. SR reflects default [S] [O] [V] order, which facilitates variable binding!

sr: $\frac{3^{+} x : \text{university}(x)}{\text{Ag}(e) = x}$ $\frac{\exists y : \text{graduate}(y, x)}{\text{Th}(e) = y}$ $\frac{\exists e}{\text{hire}(e)}$

at least 3 uni's x -NOM | x's grad(s) -ACC | hire

$$\overset{\downarrow}{\Rightarrow} [3^{+} x : \text{uni}(x)] \Big([\exists y : \text{grad}(y, x)] \Big([\exists e] \Big(\text{Ag}(e) = x \wedge \text{Th}(e) = y \wedge \text{hire}(e) \Big) \Big) \Big)$$

Note: The fact that that there's no preceding binder for x when we consider the first token [x's graduate(s) -ACC] doesn't mean it is necessarily free at SR.

► **The parsing procedure explains the observed subject/object asymmetries!**

- Interpretation order (scope) is not the same as surface word order.
- If a token is perceived to be bound (or scoped over) by a preceding token, that order relationship is maintained for interpretation.
- For tokens which do not need to follow some particular token for interpretation, leave them unordered. Then at the end, they will be ordered by a default order (25).

4.3 Multi-event descriptions

- As we saw above, an important challenge of parsing in Japanese is that tokens associated with different events can be interleaved.
- During parsing, tokens are assigned event indices, which may be revised later.
- ► I pursue the idea that **observed restrictions on A-scrambling (§2) reflect restrictions on how event indices can be revised.** In effect, postulating a binding relationship early in parsing can lead to a sort of **"garden path effect."**

During parsing, we can also "Optionally revise the event index for tokens in memory" (24). I hypothesize that the revision of event indices is subject to the following rule:

(29) **Rule for event index revision:**

If two tokens A and B in memory are ordered and bear the same event index ($A_m < B_m$), they must still share their event index after revision (e.g. $A_n < B_n$), unless B was the most recent nominal token.

We must also flesh out our semantics to interpret SR with embedded clauses. (Note that, for technical reasons, complementizers bear the matrix event's index.) See Appendix B.

- ► Let's now return to the examples from §2 where long-distance scrambling does or does not feed variable binding. Given a SS, **what event index assignments are possible?**

(30) ss: [3+companies x -ACC] [x's employees -NOM] [Ken-NOM] [investigated] [COMP] [said]

- We detect a binding relationship between the first two tokens, so we record [3+comp's x -ACC] < [x's empl -NOM] and give them the same event index. In fact, two tokens in, this looks exactly like an OSV binding example as in (27).
- Only once we have seen the second nominative and the verb 'investigate' does it make sense to reanalyze the first two tokens as part of separate events.
- But at that point, we cannot change their indices independently, per (29)!

This explains the ungrammaticality of parse (31a), which is indeed ungrammatical; see (7). At the same time, we predict another parse in (31b) to be possible, which it indeed is.[14]

(31) a. * [3+comp's x -ACC]$_7$ [x's empl -NOM]$_6$ [Ken-NOM]$_7$ [inv]$_7$ [COMP]$_6$ [said]$_6$ =(7)

≈ '[At least 3 companies]^x, x's own employee(s) said [that Ken investigated ___$_x$].'

b. [3+comp's x -ACC]$_7$ [x's empl -NOM]$_7$ ‖ [Ken-NOM]$_6$ ‖ [inv]$_7$ [COMP]$_6$ [said]$_6$

≈ 'Ken said [that [at least 3 companies]^x, x's own employee(s) investigated ___$_x$].'

- ► More generally, I predict that if we detect a binding dependency between two tokens that plausibly describe the same event, **those two tokens could be stuck describing the same event, unless we have reason to "revise" it soon after**: before we encounter another nominal, per rule (29).

[14] The parse is facilitated by a pause ‖ following the first two tokens. See Arano 2022b on the prosody of multiple scrambling.

In the following examples, we likewise detect a binding relationship in the first two tokens.

(32) ss: [3⁺uni's *x* -ACC] [*x*'s grad -NOM] ([someday]) [investigate-plan] [COMP] [said]

- Once we encounter the complementizer, we might consider whether [*x*'s grad -NOM] is part of a higher clause. At that point, [*x*'s grad -NOM] is the most recent nominal token, so we can revise them independently! We therefore predict the following parse to be possible, explaining the grammaticality of (9) above.

(33) ✓[3⁺uni's *x* -ACC]$_1$ [*x*'s grad -NOM]$_3$ ([someday]$_1$) [inv-plan]$_1$ [COMP]$_3$ [said]$_3$ =(9)
'[At least 3 universities^x], their$_x$ own graduate(s) said [that *pro* plans to investigate ___$_x$].'

This logic that facilitates A-scrambling in (9/33) is disrupted by intervening nominals before the revision point, but not after:[15]

(34) * [3⁺uni's *x* -ACC]$_1$ [*x*'s grad -NOM]$_3$ [**Ken-ni**]$_3$([someday]$_1$) [inv-plan]$_1$ [COMP]$_3$ [said]$_3$ =(11)
≈ '[At least 3 uni's^x], their$_x$ own grad(s) told Ken [that *pro* plans to investigate ___$_x$].'

(35) ✓[3⁺uni's *x* -ACC]$_1$ [*x*'s grad -NOM]$_3$([someday]$_1$) [inv-plan]$_1$ [COMP]$_3$ [**Ken-ni**]$_3$ [said]$_3$ =(12)
≈ '[At least 3 uni's^x], their$_x$ own grad(s) told Ken [that *pro* plans to investigate ___$_x$].'

► The parsing-based approach here — where event indices are assigned and revised subject to (29) — offers an alternative understanding for Arano's generalization (14):

(29) **Rule for event index revision:**
If two tokens A and B in memory are ordered and bear the same event index ($A_m < B_m$), they must still share their event index after revision (e.g. $A_n < B_n$), unless B was the most recent nominal token.

(14) **Arano's generalization:** (Arano 2022a: 2; 2025: 9)
"XP can undergo A-scrambling above its next higher overt argument but no further."

- Admittedly, the rule in (29) and especially its "most recent nominal token" clause is a stipulation that *describes* the shape of these effects, rather than truly explaining it.

The parsing-based perspective leads us to new predictions worth investigating:

► Long-distance A-scrambling may be possible, even beyond what is predicted by Arano's generalization (14) if, **at the point where we detect two tokens in a binding relationship, there is already good reason to believe that they do *not* belong to different events.**

[15] As in (31) above, the SS in (11/34) allows for an alternative parse where the first two tokens keep describing the same event, facilitated by a pause:
(i) ✓[3⁺uni's *x* -ACC]$_1$ [*x*'s grad -NOM]$_1$ ‖ [Ken-ni]$_3$ ([someday]$_1$) [inv-plan]$_1$ [COMP]$_3$ [said]$_3$
≈ '*pro* told Ken [that [at least 3 universities]^x, their$_x$ own graduate(s) plan to investigate ___$_x$].'

- Recall that a sequence of nominatives can lead us to switch event indices / postulate a clause boundary. (See e.g. Uehara and Bradley 2002 for experimental support.) I will use this to construct a test case.
- As background, long-distance scrambling of subjects is often degraded (Saito 1985, a.o.), but is possible in certain situations, for instance facilitated by prosodic breaks:

  (36) ?[LGB-ga] ‖ Sanseido-no hito-ga ‖ [$_{CP}$ ____ Forisu-no hon-no
  LGB-NOM Sanseido-GEN person-NOM Foris-GEN book-GEN
  nakadewa yahari dantotsu-no besuto-seraa da to] itteita-yo.
  among indeed by.far-GEN best-seller COP COMP say.PROG.PAST-SFP
  ≈ '[*LGB*], a person from Sanseido was saying [___ is indeed by far the best-seller among the books by Foris].' (Mihara 1994: 100)

  (See Yamashita 2013 and citations there for factors that support LD subject scrambling.)

► I believe the following long-distance A-scrambling is indeed acceptable, **in line with the predictions of the parsing-based account but contrary to Arano's generalization.**

  (37) [Mittsu-ijyoo-no kaisha^x-ga] ‖ soko$_x$-no shain-ga kisha-ni ‖
  3.CL-at.least-GEN company-NOM DEM-GEN employee-NOM reporter-DAT
  [$_{CP}$ ____ hasan-sunzen da to] itta.
  bankrupt-just.before COP COMP say.PAST
  ≈ '[At least 3 companies^x], their$_x$ own employee(s) told reporters [___ is just about to go bankrupt].'

5 Conclusion

- Today, I explored **a formal model of left-to-right parsing** and its utility for understanding flexible word order in Japanese Kempson spiritually as in 2003.
- My model **dissociates surface word order from interpretation order (scope),** offering a new approach to "reconstruction" facts. Interpretation itself is also left-to-right, building on Barker and Shan 2014, Bott and Sternefeld 2017, a.o.
- Detailed rules for the parsing procedure — especially, assigning and revising event indices — allows for a new mode of description for **the distribution of scrambling that feeds scope and binding**. Future work may further refine this description.
  - Such an approach, if maintained, would allow us to think of **"scrambling" as a single derivational operation** yielding different interpretational reflexes in different contexts (echoing Saito 1992), rather than A- vs Ā-scrambling subject to very complex restrictions on their application (e.g. Arano 2025).

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Appendix A: Further data on the locality of A-scrambling

(38) **LD scrambling that cannot feed variable binding:** (Takano 2010: 85–86)

a. *[Mittsu-ijyoo-no kaisha^x-o] soko$_x$-no shain-ga Aya-ni
3.CL-at.least-GEN company-ACC DEM-GEN employee-NOM Aya-DAT
[$_{CP}$ Ken-ga ____ choosa-shita -to] itta.
Ken-NOM investigate-do.PAST COMP say.PAST
≈ '[At least 3 comp's^x], their$_x$ own employee(s) told Aya [that Ken investigated ___$_x$].'

b. *[Mittsu-ijyoo-no kaisha^x-o] Aya-ga soko$_x$-no shain-ni
3.CL-at.least-GEN company-ACC Aya-NOM DEM-GEN employee-DAT
[$_{CP}$ Ken-ga ____ choosa-shita -to] itta.
Ken-NOM investigate-do.PAST COMP say.PAST
≈ '[At least 3 comp's^x], Aya told their$_x$ own employee(s) [that Ken investigated ___$_x$].'

(39) **LD scrambling is A-movement across its clausemates:** (Takano 2010: 93)

[Mittsu-ijyoo-no kaisha^x-o] Ken-ga Aya-ni
3.CL-at.least-GEN company-ACC Ken-NOM Aya-DAT
[$_{CP}$ soko$_x$-no shain-ga ____ choosa-shita -to] itta.
DEM-GEN employee-NOM investigate-do.PAST COMP say.PAST
≈ '[At least 3 companies^x], Ken told Aya [that their$_x$ own employee(s) investigated ___$_x$].'

(40) **LD A-scrambling out of a finite clause with null subject:** (Funakoshi 2015: 327)

[Mittsu-ijyoo-no daigaku^x-o] Ken-ga soko$_x$-no sotsugyoosei-ni
3.CL-at.least-GEN university-ACC Ken-NOM DEM-GEN graduate-DAT
[$_{CP}$ (izure) ____ choosa-suru-tsumori-da -to] itta.
someday investigate-do-plan-COP COMP say.PAST
≈ '[At least 3 uni's^x], Ken told their$_x$ own graduate(s) [that *pro* plans to investigate ___$_x$].'

Appendix B: Interpreting SR with embedded clauses

First, we must revise the "endgame" (25) to specify a default SR order for embedded clauses:

(41) **Expanded SR order defaults:**

agent < goal < theme < V < C, and C precedes the contents of its description.

The subordinating complementizer should generally precede its contents, in order to scope over it, due to its specialized semantics:[16]

(42) $\underset{\textit{-to}\ \text{COMP}}{\boxed{\frac{\text{Th}(e) =}{}}_n} = \lambda c_{\langle t,t\rangle} \,.\, \lambda p_t \,.\, \text{Th}(e_n) = {}^{\wedge}c(p)$

(43) **A simple example with an embedded clause:**

a. SS: $\boxed{\text{Hanako-NOM}}_3\ \boxed{\text{Taro-NOM}}_4\ \boxed{\text{runs}}_4\ \boxed{\text{COMP}}_3\ \boxed{\text{said}}_3$ with possible indices

'Hanako said that Taro is running.'

b. SR: $\underset{\text{Hanako-NOM}}{\boxed{\frac{\exists h : h = \text{Hanako}}{\text{Ag}(e) = h}}_3}\ \underset{\text{said}}{\boxed{\frac{\exists e}{\text{say}(e)}}_3}\ \underset{\text{COMP}}{\boxed{\frac{\text{Th}(e) =}{}}_3}\ \underset{\text{Taro-NOM}}{\boxed{\frac{\exists t : t = \text{Taro}}{\text{Ag}(e) = t}}_4}\ \underset{\text{running}}{\boxed{\frac{\exists e}{\text{run}(e)}}_4}$

$\overset{\downarrow}{\Rightarrow} [\exists h : h = \text{H}][\exists e_3]\Big(\text{Th}(e_3) = {}^{\wedge}\Big([\exists t : t = \text{T}][\exists e_4]\big(\text{Ag}(e_3) = h \wedge \text{say}(e_3) \wedge \text{Ag}(e_4) = t \wedge \text{run}(e_4)\big)\Big)\Big)$

c. Undo all of the singleton existential quantifiers by individual reference in-situ:

$= [\exists e_3]\Big(\text{Th}(e_3) = {}^{\wedge}[\exists e_4]\Big(\text{Ag}(e_3) = \text{H} \wedge \text{say}(e_3) \wedge \text{Ag}(e_4) = \text{T} \wedge \text{sleep}(e_4)\Big)\Big)$

d. Rearrange thematic statements to just be bound by their appropriate event binders:

$= [\exists e_3]\Big(\text{Ag}(e_4) = \text{H} \wedge \text{say}(e_3) \wedge \text{Th}(e_3) = {}^{\wedge}[\exists e_4]\Big(\text{Ag}(e_4) = \text{T} \wedge \text{sleep}(e_4)\Big)\Big)$

A technical but important note on step (d):

- Admittedly, moving thematic statements out of the embedded clause's proposition description seems suspicious, but I believe this is legitimate.
- I assume that logical subparts of an interpreted structure, such as the content of a complement clause, must be *contingent*: possibly true and possibly false (cf Gajewski 2002).
- For example, consider $\text{Ag}(e_3) = \text{H}$ in the scope of ${}^{\wedge}[\exists e_4]$ in (c) above. If $\text{Ag}(e_3) = \text{H}$ were false, the entire embedded proposition ${}^{\wedge}[\exists e_4]$ ... would be a contradiction (never true).
- Assuming ${}^{\wedge}[\exists e_4]$ ... to be contingent, its value must not depend on $\text{Ag}(e_3) = \text{H}$. $\text{Ag}(e_3) = \text{H}$ can hence be treated as a separate requirement outside of the scope of ${}^{\wedge}[\exists e_4]$.

[16] The tower notation in (42) reflects a slight abuse of notation.