名古屋芸術大学研究紀要第35巻　277～295頁（2014）

Nominalization in the Japanese and English Languages Vol. 2

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日本語要旨

本稿は、'Nominalization in the Japanese and English Languages Vol. 1'（『名古屋芸術大学研究紀要』第34巻: 249-267）の後編にあたる。前編に引き続き、同じトピックを扱った英語と日本語のテクストを比較分析することで、日本語は英語に比べ「名詞化（nominalization）」の使用頻度が極めて低いことを示す。

こうした傾向は、日本語の語彙 - 文法システムがもっている選択肢の違いからくるのではなく、各選択肢の使われる頻度の違いにある。すなわち、日本語であまり名詞化表現が用いられないのは、日本語がそもそも名詞化ができない言語であるとか、名詞化とともに用いられる文法資源をもっていないということを意味するものではない。少なくとも英語との比較においては、日本語は同等にそれらの選択肢を文法システムの中に備えているが、単にそれを用いることを好まず、代わりに、名詞化と同じはたらきをする別の文法的資源（本稿はこれをcondensing device（意味圧縮資源）と呼ぶ）を多用する。

本稿の分析を通し、いかなる言語も、テクストの目的に適った適切な論理展開、情報の組織立てをするための文法資源を備えているが、そのために頻繁に用いる手法が異なること、その頻度の違いが総体的に、「英語らしさ」「日本語らしさ」として知覚される言語パターンを生み出すことを示す。

The aim of this paper is to develop a linguistic description of the Japanese language, focusing on the use of nominalization, basing on the perception that the Japanese scientific discourse uses far less nominalization than the English one.

In the first volume of this paper, I analyzed introductory level biology textbooks in Japanese and investigated how they construct logical connections, especially causality, between events through language. The analysis shows that academic text in Japanese provides a wide range of linguistic resources for constructing and conveying causality, for which the English language often utilizes nominalization to 'package' information and uses it as the starting point of the next piece of information.

The first section of this volume, that is Section 4 (the numbers for sections, tables, figures and examples, all follow those in the first volume), summarizes the date in the first volume quantitatively to demonstrate that the Japanese language uses little

nominalization. Section 5 introduces linguistic devices other than nominalization to package information to see how the Japanese language organizes information without nominalization. This paper will call them 'condensing devices'. Section 6 presents the grammatical analysis of the Japanese discourse and shows how it constructs the flow of information effectively using condensing devises.

The analyses in the first and second volumes correctively show that academic text in both English and Japanese provides a wide range of linguistic resources for constructing and conveying logical connections, but that they deploy these resources in their own specific ways which result in their distinctive linguistic patterns.

4. Grammatical Tendency on the Continuum of 'Thingness'

In order to detect patterns in the choices for constructing causality, I summarize the lexicogrammatical options found in the first volume and tabulate the quantitative data as Tables 3 and 4. These tables show the clear difference between English and Japanese patterns in the selection of resources for constructing causality : while the English data shows a tendency towards more metaphorical expressions, the Japanese data tends towards more congruent ones.

Table 3 : English Grammatical Tendency for Constructing Causality

		CAUSE	CONDITION	total
between clause complexes		33 【17.6%】	3 【9.1%】	36 【16.3%】
within a clause complex	Parataxis	5 【2.7%】	5 【15.2%】	61 【27.6%】
	Hypotaxis	27 【14.4%】	24 【72.7%】	
within a clause	as Circumstance (preposition)	16 【8.5%】	1 【3.0%】	17 【7.7%】
	as Process (verbal group)	79 【42.0%】	0 【0.0%】	79 【35.7%】
	as Participant (nominal group)	25 【13.3%】	0 【0.0%】	25 【11.3%】
within a nominal group		3 【1.6%】	0 【0.0%】	3 【1.4%】
total		188 【100%】	33 【100%】	221 【100%】

Table 4 : Japanese Grammatical Tendency for Constructing Causality

		CAUSE	CONDITION	total
between clause complexes		17 【13.7%】	1 【2.8%】	18 【11.3%】
within a clause complex	explicit (as conjunctions)	21 【16.9%】	34 【94.4%】	84 【52.5%】
	implicit (by chaining verbs)	29 【23.4%】	0 【0.0%】	
within a clause	as Circumstance (postposition)	32 【25.8%】	1 【2.8%】	33 【20.6%】
	as Process (verbal group)	18 【14.5%】	0 【0.0%】	18 【11.3%】
	as Participant (nominal group)	5 【4.0%】	0 【0.0%】	5 【3.1%】
within a nominal group		2 【1.6%】	0 【0.0%】	2 【1.3%】
total		124 【100%】	36 【100%】	160 【100%】

In the Japanese data, more than 60 percent of causality is realized by a conjunctive element between clause complexes or by clauses within a clause complex. It has few metaphorical realizations of causality : only 11.3% is realized as Process, and 3.1% as Participant. On the other hand, the English data contains more metaphorical expressions : 35.7% is realized as Process, 11.3% as Participant. Both figures are more than three times greater than those for the Japanese data.

The English inclination for 'thingness' is the most salient in the subclass 'cause' ; 42.0 percent of the 'cause' relations is realized as Process, and 13.3 percent as Participant. When combined, these figures account for more than half of the total instances of realization of 'cause'. Thus, we can say that the typical causal expression in English is : **A causes/proves B or A is the cause/proof of B.**

What is important here is that these metaphorical realizations require events (represented above as *A* and *B*) to be realized as nouns. The English corpus often utilizes nominalization for that purpose. Below are some examples, with the nominalized expressions in boxes :

"A causes/proves B" type

- [DNA replication] results in [the formation of new reproductive cells].
- [Different combinations of any two of these four possible alleles] produce [different coat colors].
- [This [=changes in genes themselves]] also causes [changes in inherited traits].
- ... [the geometry of the base pairs in DNA] allows only [certain kinds of bindings]

"A is the cause/proof of B" type

- The discovery of the distinctive double-helix structure of this molecule provided the key to unlocking the genetic code.
- Another source of selective change is an increase in the normal number of chromosomes.
- It [=incomplete dominance] is a result of the combined effects of gene products.

Japanese textbooks, on the other hand, use considerably fewer metaphorical realizations for constructing causality, and thus contain little nominalization. The predominant pattern in the Japanese data is the most congruent realization along the continuum, wherein events are realized by clauses and the causal relation between them is realized by a conjunctive element. Causality is less likely to be realized as a clause component in Japanese. Causal verbs, which are heavily utilized in the English corpus, such as *A causes B* and *A proves B*, account for only 14 percent of the realizational means of 'cause' relations in the Japanese corpus and 0 percent of the 'condition' relations. Thus, the typical causal expression in Japanese is : ***A ga okoru. Yotte B ga okoru*** (A happens. So B happens).

5. Condensing Devices other than Nominalization

Even when options near the metaphorical end are chosen, the Japanese language tends to construct causality without nominalization. This is possible because, apart from nominalization, the packaging function can also be attained by other lexicogrammatical devices. This paper refers to these resources as "condensing devices," because they condense, or package information into nominal groups so that the message can be reused as part of another message. Below is a definition of condensing devices followed by a list of possible devices.

Definition. A condensing device is the resource of a language that packages a phenomenon or a sequence of phenomena, which may have been congruently realized as a clause or a clause complex, into a thing, which is realized by a nominal group, so that the phenomena can be referred to throughout the text.

List. Lexicogrammatical resources which serve as condensing devices are :

i. nominalized expression : logogenetic condensing device
ii. technical term : phylogenetic condensing device
iii. embedded clause : clause as Qualifier of a nominal group

iv. discourse label : meta-semiotic thing

The details of each of these categories from ii to iv will be elaborated in the next sections with examples taken from the data.

5. 1 Technical Term : Phylogenetic Condensing Device

Technical terms, which are the technical labels for certain phenomena, are also used to condense information. Unlike nominalization, which is a logogenetic condensing device to package information in the process of text writing, technical terms can be referred to as phylogenetic devices in that they are established expressions in the language system of a specific field, and carry the same meaning in any text.

In high school level textbooks, technical terms are almost always introduced together with their definitions, so that students know what the terms condense. Once introduced, the technical term can be reusable as part of the definition of another technical term, or as the starting point of another message as Example 14 shows.

Example 14 : Technical Term as Theme

definitions (in cluase complexes)	*konoyooni ichido kakatta byooki ni nidoto kakaranai koto wa, hoka no iroirona byookiya uirusu nituite mo shirareteite,* This phenomenon wherein, in this way, people don't catch for a second time a disease that they have already had is also known to occur for other diseases caused by various other microbes and viruses, and
introduction of the technical term	*kore o men'eki to yobu.* this is called immunity.
giving more information using the shared technicalg term as the Theme of a cluase	*men'eki genshoo wa tatoe onaji shu deattemo, kotai to iu mono ga hitotsu hitotsu ta no kotai to wa kotonaru kakegaenonai mono dearu koto mo shimeshiteiru* Immune response also shows that even within the same species each individual organism is unique and different from other organisms.

(from *Kaitei Seibutsu*. p.152)

5. 2 Embedded Clause : Clause as Qualifier of a Nominal Group

This category of condensing device condenses phenomena by embedding a whole clause or clause complex into a nominal group. In English, this devise takes the form of what Halliday (1994 : 264-269) refers to as "(projected) fact" (*e.g. The fact that all living*

organisms, from single-celled yeast to human beings, use precisely the same biochemical apparatus...is one of the unifying ideas in the science of biology.) or what he refers to as "(elaborated) act" (*the act of threatening people* (ibid : 248). Sometimes a clause is embedded into a nominal group with no head noun. So examples like *that all living organisms...the same biological apparatus is one of the unifying ideas* can also be treated as embedded clauses.

Halliday (1994) distinguishes between embedded clauses with head nouns and those without head nouns. He treats the former as Qualifier and the latter as nominalization by saying :

> Consider *That Caesar was dead was obvious to all.* Here *that Caesar was dead* is certainly a projection ; [...] and it can indeed function as Qualifier to the noun *fact*, e.g. *the fact that Caesar was dead was obvious to all.* In either case, it is embedded [...] either as Qualifier to a 'fact' noun, or as a nominalization on its own. (p.266)

Japanese embedded clauses are almost always accompanied by head nouns such as ... *koto* (fact) or ...*no* (act)[1], so I treat these devices under the category of "embedded clause" to differentiate them from nominalized expressions. Examples are :

・ *[[[[kono yoo ni ichi do kaka-tta]] byooki ni ni do to kakar-anai]]*
this way NI one CNT get-SUSP disease NI two CNT TO get-NEG

koto wa hoka no iroiro na saikin ya uirusu ni yoru
KOTO WA other NO various NA bacterium CONJ virus NI YORU

byooki ni tsuite mo shir-are-te i-te...
disease NI TSUITE MO know-PSV-SUSP ASP-SUSP

(The fact that, in this manner, people do not catch for a second time a disease that they have already had is also known to be true with other diseases caused by various other microbes and viruses, and...)

・ *soredewa [[DNA no enki hairetsu ni shitaga-tte tokutei no*
then DNA NO base sequence NI accord-SUSP specific NO

tampakushitsu ga kooseis-areru]] no wa, [[dono yoo na shikumi ni
protein GA structure-PSV NO* WA what state NA mechanism NI

yoru]] no [C] *de a-roo ka.*
depend NO* be-CJT INT

(Then, on what kind of mechanism does (the fact) that certain kinds of proteins are produced according to the base pairs of DNA depend?)

What distinguishes these embedded clauses from nominalized expressions is that (i) phenomena are realized as (embedded) clauses with their own Participants and Processes like ranking clauses, so there is little loss or abstraction of meaning typical of nominalized expressions (Halliday 1998 : 200-201) and that (ii) events are realized as

verbal groups so they are open to the systems of POLARITY, VOICE and TENSE (e.g. verbs can be in negative, passive, and in any tense) which is impossible for nominalized expressions such as *Mary's jog in the park* in which the event itself is realized as a noun. To sum, these embedded clauses do not lose their 'eventness', and are very similar to ranking clauses except that they can function in other clauses with the aid of the head nouns *koto* and *no*.

The only case in which Japanese embedded clauses appear with no head noun is the form ...*ka*. It signals an embedded question which by itself functions as the head of the nominal group. However, the characteristics of embedded clauses argued above (phenomena are realized as clauses and events by verbal groups) are shared by this form, so I treat ...*ka* form also as an embedded clause, not as nominalization. An example is :

- *tampakushitsu no bunshi no katachi (rittai koozoo) ya*
  protein NO particle NO shape three : dimentional structure CONJ
  seishitsu, hataraki nado wa, [[donna aminosan ga dono yoo na
  trait function etc. WA what amino : acid GA what state NA
  junjo de nara-nde iru ka]] ni yotte kimaru kara...
  sequence DE line : up-SUSP ASP KA NI YOTTE be : decided CONJ
  (The shape [a three-dimensional structure], traits, and function of a protein depend on [what kinds of amino acids are aligned, and in what way.])

These embedded clauses also function as condensing devices, as they enable a clause or a sequence of clauses to function as a nominal group. They sometimes function as a kind of reference to the previous parts of the text and serve as the starting point for the next piece of message, as shown in Example 15.

Example 15 : Embedded Clause as Theme

definition (in clause complexes)	*hito wa kodomo no toki ichi do hashika ni kakaruto, ni do to hashika ni kakaranai ka, kakatte mo karukute sumu.* If people catch measles in their childhood they won't get measles again, or even if they do, it will only be mild.
embedding in a nominal clause and using it as the Theme of a clause	*kono yoo ni [[[[ichido kakatta]] byooki ni ni do to kakaranai]] koto wa hoka no iroiro na saikin ya uirusu ni yoru byooki ni tsuite mo shirareteite...* This phenomenon wherein, in this way, people don't catch for a second time a disease that they have already had is also known to occur for other diseases caused by various other microbes and viruses, and (form *Kaitei Seibutsu*. p.152)

5．3 Discourse Label : Resource to Produce a Meta-Semiotic Thing

A discourse label is a category I developed based on the notion, *labeling*, proposed by Francis (1994). According to Francis, a label means "an inherently unspecific nominal element whose specific meaning in the discourse needs to be precisely spelled out" (p.83), and "there is no single nominal group to which it refers" (p.85). Below is the example he used :

> ...the patients' immune system recognized the mouse antibodies and rejected them. This meant they did not remain in the system long enough to be fully effective. The second generation antibody now under development is an attempt to get around this problem by 'humanizing' the mouse antibodies, using a technique developed by...

This problem in this example refers back to a whole stretch of discourse, *the patients' ... effective*. Francis explains such phenomenon by saying that items like *problem*, which are unspecific in their meanings, are connected to other parts of the discourse for specification. That is, if we just hear the word, *problems*, it is so unspecific in meaning that we have to refer to a previous part of the text to figure out what it means. This inherently unspecific nature of a label produces a cohesive tie between two pieces of discourse and thus it works as a condensing device.

In fact, any noun can serve as a label if it is unspecific enough to require lexical realization in its immediate context. The examples of such general nouns listed by Francis (ibid. : 88) are : *approach, area, aspect, case, matter, move, problem, stuff, thing, way*, etc.. The list can be expanded almost infinitely. Such expandability of the class member indicates that a label is a lexical item, as opposed to a grammatical item.

Labels, however, are similar to reference items (i.e. grammatical items) such as *this* and *that* in terms of their functions in discourse. Labels are almost always preceded by specific Deictics such as *this, that, the,* and *such*. For example, the label *problem* appears in the above extract in the form of *this problem*. Francis (1994) argues that "from a grammatical view, the combination of general noun plus specific determiner...is very similar to a reference item" (p.86). To capture the functional similarity between labels and references, this paper expands the scope of the category of label to include reference items, and defines label as 'an inherently unspecific item whose meaning must be reconstructed by referring back and forth to other parts of the discourse'.

Extending the notion of label in this way also has a practical purpose. In the Japanese data, the use of reference items such as *kore* (this) and *sore* (that) and labels preceded by Deictics such as *kono koto* (this fact) and *kooshita genshoo* (such phenomenon) predominate as condensing devices, and they can always be substituted

by one another without changing their referential function. Example 16 illustrates this substitutability.

Example 16 : Reference and Deictic plus Label as Discourse Label

kono yoo ni [[[[ichi do kakatta]] byooki ni ni do to kakaranai]] koto wa, hoka no iroiro na saikin ya uirusu ni yoru byooki ni tuite mo shirareteite,

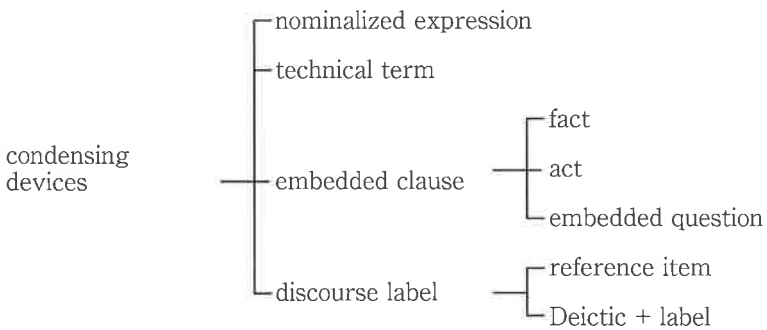
This phenomenon wherein, in this way, people don't catch for a second time a disease that they have already had is also known to occur for other diseases caused by various other microbes and viruses, and

kore o	*men'eki to yobu*	【reference】
(this	is called immunity)	
kono genshoo/ kono koto o	*men'eki to yobu*	【deictic + label】
(this phenomenon / this fact	is called immunity)	

Therefore, this paper expands the notion of label to include both labels (lexical items ; members of an open system) and references (grammatical items ; members of a closed system). They are together referred to as *discourse labels* so that we can distinguish them from the original concept of *label* proposed by Francis.

These four types of resources—nominalization, technical term, embedded clause and discourse label—can be summarized in the form of a system, as shown in Figure 4. One important point the figure aims to show is that all of these four types of condensing devices fulfill the function of packaging information, and they contribute to the flow of information in the overall organization of text.

Figure 4 : The System of Condensing Devises



The English and Japanese languages share these four options in their systems. The frequency of selection among the options, however, differs between the two languages ; the Japanese data, as we saw in Table 1 (in Volume 1), uses fewer nominalizing expressions. In Japanese textbooks, even when 'cause' is realized as Circumstance, Process, or Participant, most events are realized as nominal groups through embedding such as ...*koto* and ...*ka*, and do not lose their 'eventness'. That is, the event is realized as a clause and, in the guise of a 'thing' with the aid of *koto*, is able to take part in another event. The whole clause takes the form of ...*koto ni yotte* ...*koto ga akiraka ni naru* (by the fact that... the fact that... becomes clear) or ...*koto ga* ...*koto o hikiokosu* (that... causes that...). Examples are :

- *shokubutsu de wa, [[koruhichin de shorisuru]] koto ni yotte, [[jin'iteki ni*
  plant DE WA colchicines DE treat KOTO NI YOTTE artificial NI

  baisuutai o tsukuru]] koto ga dekiru.
  polyploidy O produce KOTO GA can : do

  (With plants, by treating (them) with colchicines, that (we) produce polyploidy artificially is made possible [=With plants..., we can produce polyploidy artificially].)
- *1927 nen, maraa wa, [[shoojoobae no seishi ni Xsen o*
  1927 year Muller WA fruit : fly NO sperm NI X : ray O

  shooshasuru]] koto ni yotte, [[totsuzenhen'i no hasseiritsu o
  irradiate KOTO NI YOTTE mutation NO occurance : rate O

  takameru]] koto ni seikoos-hita.
  raise KOTO NI succeed-PST

  (In 1927, Muller succeeded in raising the rate of incidence of mutation by irradiating the sperm of fruit flies with X-rays.)

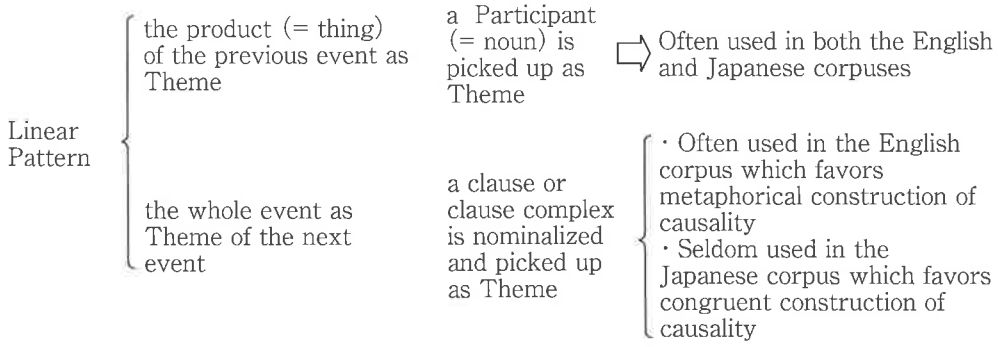
To sum up, then, another typical construction of causality in the Japanese data, other than ***A ga okoru. Yotte B ga okoru*** type, is ***A suru koto ga B suru koto o hikiokosu*** (Doing A causes doing B). In other words, most events are realized congruently by clauses or clause-like constructions in Japanese.

6. Overall Organization of Text

As we saw in Section 1.2 (in Volume 1), nominalization plays an important role in organizing information in academic discourse by constructing previous events as starting points for subsequent ones. Taking up the Rheme of a clause as the Theme of the following clause effectively realizes such a sequential relation. This linear pattern can be constructed in one of the following two ways : (i) by choosing the product (= thing) of an event as the Theme of the next event, or (ii) by choosing the whole event as the

starting point of the next event. Type (ii) involves the deployment of some kind of condensing devices to condense an event into a metaphorical 'thing' because, grammatically, only nominal groups, not whole clauses, can function as Themes. As a corollary of the difference between the English and Japanese languages in the degree of 'thingness' employed in constructing causality, it can be presumed that these two languages favor different ways to construct linear patterns of development. A likely difference is summarized in Figure 5.

Figure 5 : Hypothesis English and Japanese 'thingness' and their macro-scale structures



The following part analyzes typical explanations taken from the English and Japanese data, and examines how these two languages actually organize text to explain phenomena.

The English data, which favors the metaphorical construction of phenomena, can choose both things and events as departure points for messages. The discussion may lead to the argument that the Japanese corpus, which favors congruent realization of phenomena, seldom uses events as the starting points of messages. Actually, comparing English and Japanese text on the same topic shows that these two languages tend to focus on different aspects of the same phenomena. That is, to explain the same phenomenon, while the English text focuses on events and uses them as the points of departure for subsequent messages by nominalizing them, the Japanese text centers on products, or things, and selects them as Themes. Figures 6 and 7 show the thematic development, in both English and Japanese, of text that explains how DNA duplicates.

Figure 6 shows that English text logogenetically creates and introduces new semiotic 'things', such as *this splitting, the binding process*, and *these preferential bindings along a single strand of exposed DNA*, to construct a sequence of causal

relations where a preceding event causes the subsequent event.

Figure 6：Thematic Development in English Text：events as points of departure
(condensing devices are marked with boxes, and a small capital attached to each box indicates the kind of the device：N for a nominalized expression, T for a technical term, C for an embedded clause, and D for a discourse label.)

When a cell is about to divide,	special enzymes move along the DNA double helix, breaking the hydrogen bonds that link the bases—in effect, breaking the "rungs of the ladder".
↓	
The result of this splitting [N]	is that the two arms of the DNA ladder have exposed bases on them.
Consider, just for the sake of argument,	an adenine (A) base that is no longer locked into its partner on the other side of the double helix.
↓	
In the fluid around the DNA	are many nucleotides,
↓	
and some of these nucleotides	contain an unattached thymine (T).
↓	
This thymine	will bind to the exposed adenine in the original strand of DNA.
↓	
The binding process [N]	is aided by a special group of enzymes called DNA polymerases.
In the same way [D],	an exposed cytosine (C) will bind to a molecule of guanine (G) in the fluid around the nucleus.
↓	
No other type of nucleotide	can bind to that particular site.
↓	
The net result of these preferential bindings along a single strand of exposed DNA [N]	is that the missing strand is reconstructed, base by base [C].
↓	
The same thing [D]	happens in mirror image to the other half of the exposed DNA strand.

(from *The Sciences*. p.542)

Figure 7 shows that Japanese text focuses not on whole events, but on the products of events, to construct the same sequence of causal relations：it employs a product of a

previous event as the agent of a subsequent event. For example, the product of the event described in T-unit[2] 4, *nukureochido no kusari* (a chain of nucleotides), is rephrased as *kono atarashii kusari* (this new chain) and taken up as the starting point of the subsequent event. The cohesive bonds between two successive events are strengthened by Deictic elements such as *korera no* (these) or *kono* (this), which explicitly indicate that these are products which underwent the processes described in previous pieces of the text.

Figure 7 : Thematic development in Japanese Text : things as points of departure

[[saiboo ga bunretsusuru]] sai ni wa, When a cell is about to devide,	*sore ni sakidatte kaku no DNA ga fukusei sareru.* previous to that, the DNA has already duplicated.
sono sai kooso no hataraki ni yori At that time, by the function of enzymes,	*nijuu no rasen ga bubunteki ni hodokete ((nijuu no rasen ga)) ippon zutsu no kusari ni naru.* the double helix comes partially loose, and becomes (two) untwined chains.
sorezore no kusari ga igata no yoo na sayoo o shite, By each of the two chains acting like a mold,	*[[enki no hairetsu ga choodo soohoteki ni naru]] yoo ni [[sozai to naru]] nukureochido ga narabu.* nucleotides, the material (of DNA), are sequenced in a way that the paired bases become mutually complementary.
korera no nukureochido wa These nucleotides	*mae to wa betsu no kooso no hataraki ni yotte tagai ni ketsugooshite ((korera no nukureochido wa)) nukureochido no kusari o tsukuru.* by the function of other enzymes, are connected with each other, and form a chain of nucleotides.
kono atarashii kusari to [[igata to natta]] kusari to kara From this new chain and the chain which functioned as the mold,	*nijuu rasen ga tsukurareru.* a (new) double helix is formed.

(from *Kaitei Seibutsu*. p.134)

The analysis above, however, does not mean that Japanese text never selects packaged events as starting points of messages. Even though Japanese text tends to focus on products, or things, to construct thematic development, the focus can sometimes

shift to events. The primary linguistic resource in charge of changing an event into a nominal group so that it can function as a Theme, however, is not nominalization like in English, but a different condensing device—discourse labels. As noted in Section 3.1, one of the characteristics of conjunctive phrases found in the Japanese data is that they often include demonstrative elements such as *kono* (this) and *sono* (that).[3] The examples are : *kono tame* (because of this), *kono kekka* (as a result of this), *sono kekka* (as a result of that), *kono yoo ni shite* (in this way), and *sore ni yotte* (by that). The demonstrative elements within these Conjuncts work as discourse labels and function to create cohesive ties by referring back to and by summarizing previous parts of the discourse. Figure 8 demonstrates their function in constructing linear types of thematic development.

Figure 8 : Thematic development in Japanese Text : events as points of departure

[[bosaiboo no kaku nai ni bunsanshite ita]] senshokutai wa, Chromosomes which have been scattered inside the nucleus of a mother cell	*bunretsu ga hajimaru to himojoo ni kawaru.* turn into thread-like shapes when the cell division starts.
kono^{D} *toki* At this time	*dookei doodai no senshokutai dooshi ga heikoo ni narabi, sorezore ga tsuigoosuru.* chromosomes with identical shapes and sizes line up side by side, and combine.
[[tsuigooshita]] soodoosenshokutai wa, Each of the combined homologous chromosomes	*sorezore tate no sakeme ni yotte 2 tsu ni wakarete iru.* is divided into two parts by a vertical cleft.
kono jiki^{D} *no owari ni wa,* At the end of this phase,	*kakumaku to kakushootai ga mienaku nari, boosuitai ga deki hajimeru.* nuclear membrane and nucleoli disappear, and a spindle begins to form.
[・・・]	

[[chuuki ni saiboo no sekidoomen ni naranda]] senshokutai wa, Chromosomes which lined up along the equatorial plane of the cell in the middle phase	*kooki ni juuretsumen de bunrishite sorezore ryookyoku e idooshi, atarashii kaku o tsukuru.* divide along the vertical cleft in the final phase, move to the poles of the cell, and form new nuclei.
kono^{D} *kekka,* As a result of this,	*1 ko no bosaiboo kara 4 ko no seishoku saiboo ga dekiru.* from one mother cell are produced four reproductive cells.

(from *Seibutsu IB*. p.105)

The figure shows that discourse labels like *kore* (this) and *kono* (this) effectively function to condense events and to place them at the starting points of subsequent events. In sum, instead of logogenetically creating 'things' and placing them at thematic positions to make the text flow, which is the typical pattern we see in English, Japanese tends to use discourse labels such as *kore* and *sore*, which are already incorporated into the language system. Another grammatical resource typical of the Japanese data also serves the same kind of cohesive purpose. It's the identifying relational process that realizes causality in a clause, such as *kore wa... kara de aru* (this is because...). (See Section 3.1 (in Volume 1) for the examples and detail of this resource.) The motivation for using this resource might be to place the discourse label at the thematic position.

The analysis in this section has shown that, contrary to the hypothesis made in Figure 5, it is possible for the Japanese language to construct both types of linear development : one focusing on products and one focusing on events. This is because the Japanese language can organize text with linguistic devices other than nominalization, such as thematized demonstrative elements.

7. Conclusion

This paper has described how the Japanese language functions to construct and transmit knowledge in science textbooks. What was found through the analysis is summarized below.

(1) Grammatical Resources for Explaining Phenomena

The Japanese language has a wide range of grammatical resources for explaining phenomena. That is, it has enough options in terms of the degree of 'thingness' to realize causality : as conjunctive elements, postpositions, verbs, and nouns. These options

are for the most part common to the systems of both Japanese and English, but they show different patterns of likelihood for selection in their actual instances of use—the Japanese text favors options near the congruent end of the 'thingness' continuum.

(2) Overall Organization of Text

Japanese text can be seen to pattern in specific ways, reflecting the method of development most appropriate to the purpose of explaining science, the linear pattern. Japanese utilizes grammatical resources in its distinctive ways to construct linear patterned thematic development. It usually takes up products (realized by nominal groups) as the Theme of subsequent clauses. When giving thematic status to events, the Japanese language tends to utilize not nominalized expressions, but discourse labels, which refer back to the preceding events. These discourse labels are placed at the beginning of clauses as part of conjunctive elements and semantically tie them to the previous clauses.

Throughout the analysis, we have seen that the difference between English and Japanese discourses in science result from differences, not in the richness of choice provided by their respective language systems, but in the probability of selection for any particular construction in actual instances of use. This means the Japanese language system does have options that involve nominalization of phenomena, but seldom selects those options. The difference in the probability of choices creates a linguistic syndrome particular to the Japanese language that exemplifies patterns of co-occurrence among the selection of condensing devices and the choice of linguistic resources. These linguistic features and collaborative patterns together contribute to 'Japaneseness' in the ways the language constructs meaning and sets it apart from other languages, at least from English.

And even more important point deducted from the analysis is that, even though Japanese rarely uses nominalized expressions, it is as competent at constructing and conveying scientific knowledge as a language—English, in this case—that favors nominalization. Apart from nominalization, which is the central resource used in scientific discourse in English, it has its own ways of creating meaning and its own linguistic resources for serving the same function. I hope the description and analysis conducted in this paper will serve as groundwork for the argument that any language may be capable as a resource for doing science regardless of differences in superficial forms and choices.

Notes

0. This paper is a revised version of the unpublished doctoral thesis presented to the Department of Linguistic Functions, the Graduate School of International Cultural Studies, Tohoku University in 2006. This paper reconsiders the same data and examples from a new pedagogical perspective focusing on the use of nominalization.
1. The distinction between fact and act here follows Teruya (2007 : Chap.5).
2. Theme unit, as proposed by Thomson (2005), is a structural unit of Japanese having one Theme-Rheme set. Based on grammatical and semantic grounds, Thomson argues that Japanese does not map Themes onto clauses but onto Theme units, which may conflate or "map onto clause simplexes, complexes, clauses within a complex and across sentences" (p.151). Grammatically, the Japanese Theme unit is "realized by a segment of text that forms a co-referential unit in which the referent (that which is retrievable in any non-initial clauses in the unit) is the first constituent in the unit" (p.162). Further, hypotactic enhancing clauses, which precede dominant clauses, serve as Themes for Theme units. These include both a dependent clause itself and a dominant clause, because these enhancing clauses function in a manner similar to that of Circumstances (p.171).
3. The English corpus mostly uses non-demonstrative conjunctions such as *then, eventually, after time, so, therefore, thus, as a consequence*, and *consequently*. Those with demonstrative elements, such as *in this way* or *because of this*, are very few, both in variation and in number.

Interlinear notation key

ASP	aspect
ATP	attempt : [*-te*] *miru*
CJT	conjecture : V-*daroo*
CND	conditional : V-*to*
CNT	counter : [number] *ko, dai, do*
CONJ	conjunctive
COP	copula : da, aru
DE	nominal marker (Circumstance; "in")
ENU	enumerative : [*-shi*] *tari*
GA	nominal marker (Participant; nominative)
INT	interrogative : V-ka
KARA	nominal marker (Circumstance; "from")
KOTO	rankshifted nominal clause marker
MADE	nominal marker (Circumstance; "from")
MO	nominal marker
NA	adnominal marker
NEG	negative : [*-shi*] *nai*
NI	nominal marker (Circumstance "in / to", Participant)
NI*	adverbial marker
NO	nominal marker (Participant; possessive)

O	nominal marker (Participant; accusative)
PST	past
PSV	passive
SHITE	postposition ("as")
SUSP	non-finite, tactic verb form : *-shi, -shite*
TO	postpositional quotative clause marker
TO*	nominal marker (Circumstance "in / to")
TSUITE	postposition ("about")
WA	nominal marker
YOTTE YORI YORU	postposition ("by")

adapted from Teruya (1998 : xxiii-xxiv)

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