SPECIFYING WHAT PEOPLE UNDERSTAND WITH MSFA

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TODAY'S TOPIC

- Introducing *MSFA, Multi-layered Semantic Frame Analysis* (Kuroda and Isahara 2005)
  - (Briefly) comparing it with *Berkeley FrameNet (BFN)* (Fillmore, et al. 2003)
  - Presenting a sample MSFA of an English sentence
- With ONE IMPORTANT CAVEAT:
  - So far, MSFA has been done for Japanese sentences: just a few sample analyses were attempted for English.
    - Note that this is kind of inevitable, because MSFA requires, *by its very design*, an annotator/analyst to specify *a lot of knowledge hard to access for non-native speakers*.

Omitted Topic

- MSFA is coupled with a theoretical framework called *FOCAL, Frame-Oriened Concept Analysis of Language* (Kuroda, et al. 2005; Nakamoto, et al. 2005).
- But we don't have enough time to talk about FOCAL today.

Outline of Talk

- Presenting sample MSFAs
  - Explain how MSFA goes
  - Explain how MSFA is related to "ontologies"
- Giving some background
  - Especially why I deviated from Berkeley FrameNet (Fillmore et al. 2003)
- Summary

How MSFA goes
—Sample Analysis—

Overview of MSFA

- MSFA is a BFN-inspired framework for *text analysis* by linguists such that
  - it combines linguistic analysis with text annotation for "deeper" semantics
  - it makes linguistic analysis "database-ready"
- MSFA's goal is NOT just a development of a language resource *usable for NLP tasks only*.
  - I'm rather a researcher in Cognitive Science, rather than being a linguist, or an NLP guy.
  - Rather, it aims at a versatile resource that enhances as many researches as possible in Cognitive Science/Psychology, as well as tasks in NLP.

MSFA Procedure (Simplified)

1. Segment a sentences S into units U_1, ..., U_n.
   - Note incidentally that it's better NOT to try to build up larger units from smaller units. This tends to lead annotators to a "false" analysis.
   - This is not independent from Step 2. So, you need to go cyclic.
2. For each U_i, find a set of frames F_1, ..., Fm so that one of their "frame elements" is *realized* by U_i.
   - This is called "evocation" in the *Frame Semantics* literature.
3. Specify relationships among all the frames.
   1. Relevant relations are: "*F* elaborates *G*" (deals with Inheritance), "*F* constitutes *G*" (deals with part-of relations), "*F* presupposes *G*" (deals with "logical implications")

GUIDING PRINCIPLES

- "Be meticulous"
  - Every word (or morphome if morphological analysis is neccesary) needs to realize at least one semantic role, i.e., "frame element" of a frame.
    - You are not allowed to ignore a minor element by saying "its meaning is *uninteresting*." If this "excuse" is allowed, your analysis will get arbitrary very soon.
- "Be greedy"
  - To every word, you need to assign as many semantic roles as possible if they are not incompatible
    - It is an open question how many frames you need specify: there is no a priori way to tell when an MSFA is "done."

SAMPLE MSFA

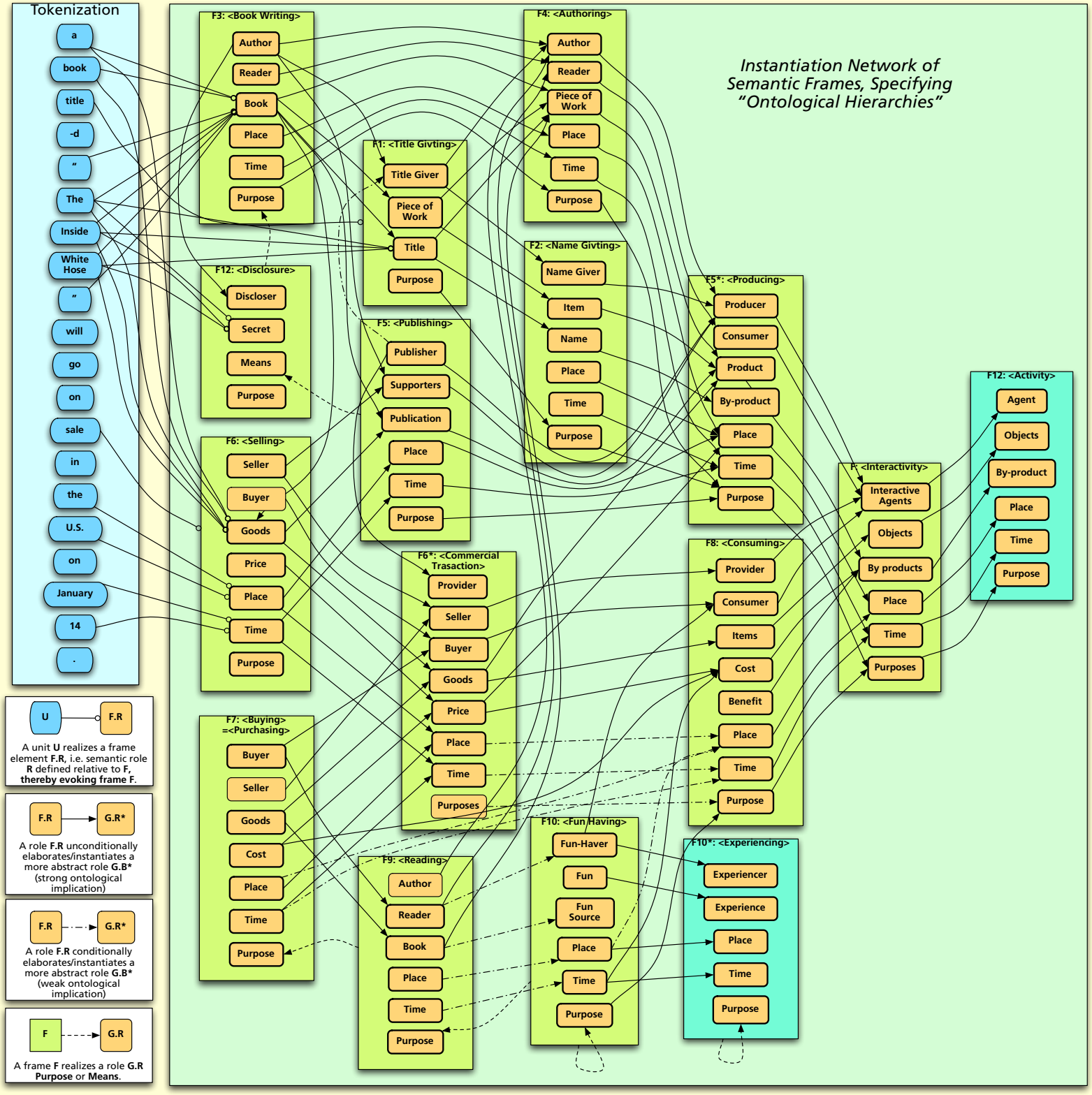
- An English translation of a Japanese Newspaper article taken from *Kyodai Corpus* (Kurohashi and Nagao 1994):
  1. *A book titled "Inside the White House" will go on sale in the U.S. on January 14.*
  2. *The book will definitely be a much-talked-about, severely criticizing the past U.S. Presidents and their aides.*
  3. *The title came as latest work of Ronald Kesler, an expert reporter and investigator at the "Washington Post" and other media.*
  4. *The book, for instance, reveals the following episodes.*
  5. *...*

SAMPLE MSFA

- The following is the original Japanese text:
  1. 「ホワイトハウスの内側」という本が十四日，米国で発売される.
  2. 歴代大統領と関係者をこきおろしており，話題になるのは間違いない.
  3. 「ワシントン・ポスト」紙などで長年，調査報道をしてきたロナルド・ケストラー氏の新著.
  4. 例えば次のような内容だ.
  5. ...

SAMPLE MSFA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Frame ID	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
2	F-to-F relations	elaborates F2; constitutes F3		constitutes F5; presumes F5; elaborates F4		presupposes F3	presupposes F4; constitutes F5; presumes F7	presupposes F6; elaborates F9		presupposes F5	presupposes F9		constittues F3,F5	
3	Frame	Title Giving	Name Giving	Writing	Authoring	Publishing	Selling	Purchasing	Consuming	Reading	Having Fun	Presidential Government in the U.S.	Disclosure	Reporting
4	*													Reporter
5	*					Purpose		**GOVERNOR**	**GOVERNOR**	Means				Report[start 1,end]
6	*							Purpose	Means	**GOVERNOR**	Means			
7	*								Purpose	Purpose	**GOVERNOR**			
8	*					Retailer	Seller	Seller	Provider3					
9	*					Customer	Customer	Purchaser	Consumer	Reader	Enjoyer			
10	*	Title Giver[secondary]	Name Giver[2]		Supporter	Publisher	Provider		Provider2					
11	*	Title Giver[primary]	Name Giver[1]	Writer	Author	Supporter?			Provider1				Revealer	
12	*			Purpose1							Domain=Topic		**GOVERNOR**	
13	A	Work	Object	Book	Work[+Piece]	Publication	Goods	Goods	Commodity	Book	Fun Source			Report[start 2,end]
14	book													
15	titled	**GOVERNOR**	**GOVERNOR**	Book.attribute	Work.attribute	Publication.attribute	Goods.attributes	Goods.attributes	Commodity.attribtute	Book.attribute	Fun Source.attribute			
16	"	MARKER[1,2]	MARKER[1,2]											
17	The	Title	Name										Secrets: **EVOKER**	
18	Inside													
19	White											Presidential Office: **EVOKER**	Target	
20	House													
21	"	MARKER[2,2]	MARKER[2,2]											
22	will					EXTENDER2	EXTENDER2							
23	go					EXTENDER1	EXTENDER1							
24	on			Purpose2		**GOVERNOR[+composite]**	**GOVERNOR[+composite]**						Means	
25	sale													
26	in					MARKER	MARKER							
27	the					Place	Place							
28	U.S.													
29	on					MARKER	MARKER							
30	January					Time: Date	Time: Date							
31	14													
32	.													


Tokenization
a
book
title
-d
"
The
Inside
White Hose
"
will
go
on
sale
in
the
U.S.
on
January
14
.
Instantiation Network of Semantic Frames, Specifying "Ontological Hierarchies"
F3: <Book Writing>
Author
Reader
Book
Place
Time
Purpose
F4: <Authoring>
Author
Reader
Piece of Work
Place
Time
Purpose
F1: <Title Givting>
Title Giver
Piece of Work
Title
Purpose
F2: <Name Givting>
Name Giver
Item
Name
Place
Time
Purpose
F12: <Disclosure>
Discloser
Secret
Means
Purpose
F5: <Publishing>
Publisher
Supporters
Publication
Place
Time
Purpose
F5*: <Producing>
Producer
Consumer
Product
By-product
Place
Time
Purpose
F12: <Activity>
Agent
Objects
By-product
Place
Time
Purpose
F6: <Selling>
Seller
Buyer
Goods
Price
Place
Time
Purpose
F6*: <Commercial Trasaction>
Provider
Seller
Buyer
Goods
Price
Place
Time
Purposes
F8: <Consuming>
Provider
Consumer
Items
Cost
Benefit
Place
Time
Purpose
F: <Interactivity>
Interactive Agents
Objects
By products
Place
Time
Purposes
F7: <Buying> =<Purchasing>
Buyer
Seller
Goods
Cost
Place
Time
Purpose
F9: <Reading>
Author
Reader
Book
Place
Time
Purpose
F10: <Fun Having>
Fun-Haver
Fun
Fun Source
Place
Time
Purpose
F10*: <Experiencing>
Experiencer
Experience
Place
Time
Purpose
U
F.R
A unit U realizes a frame element F.R, i.e. semantic role R defined relative to F, thereby evoking frame F.
F.R
G.R*
A role F.R unconditionally elaborates/instantiates a more abstract role G.B* (strong ontological implication)
F.R
G.R*
A role F.R conditionally elaborates/instantiates a more abstract role G.B* (weak ontological implication)
F
G.R
A frame F realizes a role G.R Purpose or Means.

Hierarchy of Frames and Frame Elements

- The hierarchy of frames, especially the hierarchy of frame elements, expresses conceptual hierarchies you usually find in thesauri, e.g., *WordNet* synset hierarchies.
- Why?
- A possible —and very reasonable— answer is
  - Instantiation links express "ontological hierarchies,"
  - Part —and a probably substantial body— of human conceptual system is an organization of semantic "roles" rather than one of semantic "types"

Frames and Frame Elements

- What MSFA is meant to do is to *list up all the relevant situations* in text understanding in terms of frames, assuming that:
  - Frames are organizations of frame elements, i.e., situation-specific "semantic roles"
    - *Author*, as a concept, names an Agent-class semantic role specific to the "Authoring" situation.
    - *Writer*, as a concept, names an Agent-class semantic role specific to the "Writing" situation, a subclass of "Authoring."
  - Frames are organized in principled ways.
    - So-called "thematic roles", or "deep cases" are most abstract semantic roles.

WSD needs to be frame-wise

- "Entities" in the understood content of a text may —and tend to— *realize multiple roles/frame elements simultaneously*.
  - For example, *book* realizes such roles as:
    - <Information Carrier> in <Reading> frame
    - <Good> in <Selling/Buying> frame
    - <Piece of Work> in <Writing> frame
    - <Publication> in <Publishing> frame
- This means that *Word Sense Disambiguation (WSD) needs to be done frame-wise*, explaining why WSD isn't enough for text understanding, at least for *simplex* one.

CURRENT STATUS

- MSFA was done to a tiny portion of *Kyodai Corpus* texts (3 articles, 63 sentences)
  - *Kyodai Corpus* is a collection of Japanese newspaper articles: its English translation is complete at NICT.
- Characteristics
  - No full evaluation yet
    - We need feedback from limited users, but publication is not unrestricted.
  - But, on average, a sentence has nearly 60 frames, showing that MSFA provides much deeper, ontology-based semantics than BFN.

Really need a frame database?

- Unlike BFN, frames are identified and defined in an *ad hoc* manner, which is a method based on a deliberate decision.
  - MSFA does NOT make wide-coverage a priority.
  - Basically, the way MSFA works is *exploratory*, and it MAY not assume a pre-existing database of frames.
    - So, we *may* be faced with the "standardization" issue.
- Why? — Nobody knows the *optimal* granularity in semantic description even in terms of frames.
  - This means that a large-scale development of a frame database *can* be premature (but who knows?)

MSFA and BFN analysis

- In principle, frames used in MSFA are defined independently of BFN frames.
  - We DO NOT assume that BFN frames for (U.S.) English are applicable to Japanese without modification.
    - Kanamaru, et al. (2005) examined the correspondence between the MSFA and BFN frames, showing that BFN frames are coarse-grained than MSFA frames.
  - To get a more precise assessment for compatibility, we expect much to text annotation in *Japanese FrameNet* (Ohara, et al. 2003, 2004), but nothing has come out (yet).
    - It's vital to know how it will look like when BFN frames are applied to the analysis of Japanese texts.

WHY MSFA, NOT BFN?

—A BACKGROUND—

BEYOND WSD

- Text understanding is NOT simply a task of *Word Sense Disambiguation* (WSD). Clearly, a lot more is needed.
  - (Too) many researchers in NLP, and even in Linguistics and Psychology, believe that semantic analysis reduces to the WSD problem.
- The real question is,
  - What is WSD needed *for*?
  - *Exactly what else* is needed in addition to WSD?
- To this question, *Frame Semantics* (Fillmore 1985; Fillmore and Atkins 1994) comes to rescue.

Getting out of a "vicious circle"

- MSFA is a derivative of *Frame Semantics (FS)*, addressing the following two questions:
- For a given sentence *S*,
  A. How to specify *what people understand* when they hear or read *S*? — Call this the "Specification" Problem
  B. How to represent *what people understand* when they hear or read *S*? — Call this the "Representation" Problem
- MSFA is NOT concerned with the "truth" of *S*.
  - As FS says, knowing "what to do with *S*" is crucial. Knowing "when an *S* is true" is subsidiary.

Getting out of a "vicious circle"

- The "Representation" Problem makes sense only when the "Specification" Problem is properly treated.
- But, the question is, *Is the "Specification" Problem properly treated?*
- The answer is, *No*, obviously.
- But why? — Linguists, at least in the Post-Chomskian lingusitics, are in a "vicious circle."

Before you try to explain anything ...

- Why?
  - Linguists have always tried to "explain" why people interpret such and such things, in such and such ways, without meeting the "Specification" Problem.
    - So, Linguistics is too immature a science even now: virtually *any* explanation in linguistics is arbitrary.
- So what?
  - We need to specify what people understands in sentences *before explaining why people do so*.
  - Linguists, too, need to be checked if their "interpretations" are the same as the real hearer/reader's performances in some way.
  - FOCAL provides such opportunities.

BUT WHY DEVIATE FROM BFN?

- Important fact:
  - There is no guarantee that frames provided by BFN have an optimal semantic granularity.
- This means that you need to check the *psychological reality* of descriptive devices, i.e., frames, used to specify the meaning of sentences.
  - You can't trust on linguists too much, as you already know.
  - If you are too candid to believe BFN frames as such, your analysis will soon get arbitrary.

Test case: "Attack" frame

- (Some of) BFN frames can't account for some cases of selectional restrictions: For example, <Attack> frame with core FEs <Assailant> and <Victim> can't fully explain the following patterns:
  1. The lion attacked {a. the flock of impalas; b. ???the bank branch; c. ??innocent people on street}
  2. The robbers attacked {a. ???the flock of impalas; b. the bank branch; c. ?innocent people on street}.
  3. The random killer attacked {a. ???the flock of impalas; b. ?? the bank branch; c. innocent people on street}.
- More granularity, which differentiates the <Purpose> of an <Assailant>, is clearly needed to account for this sort of selectional restrictions.

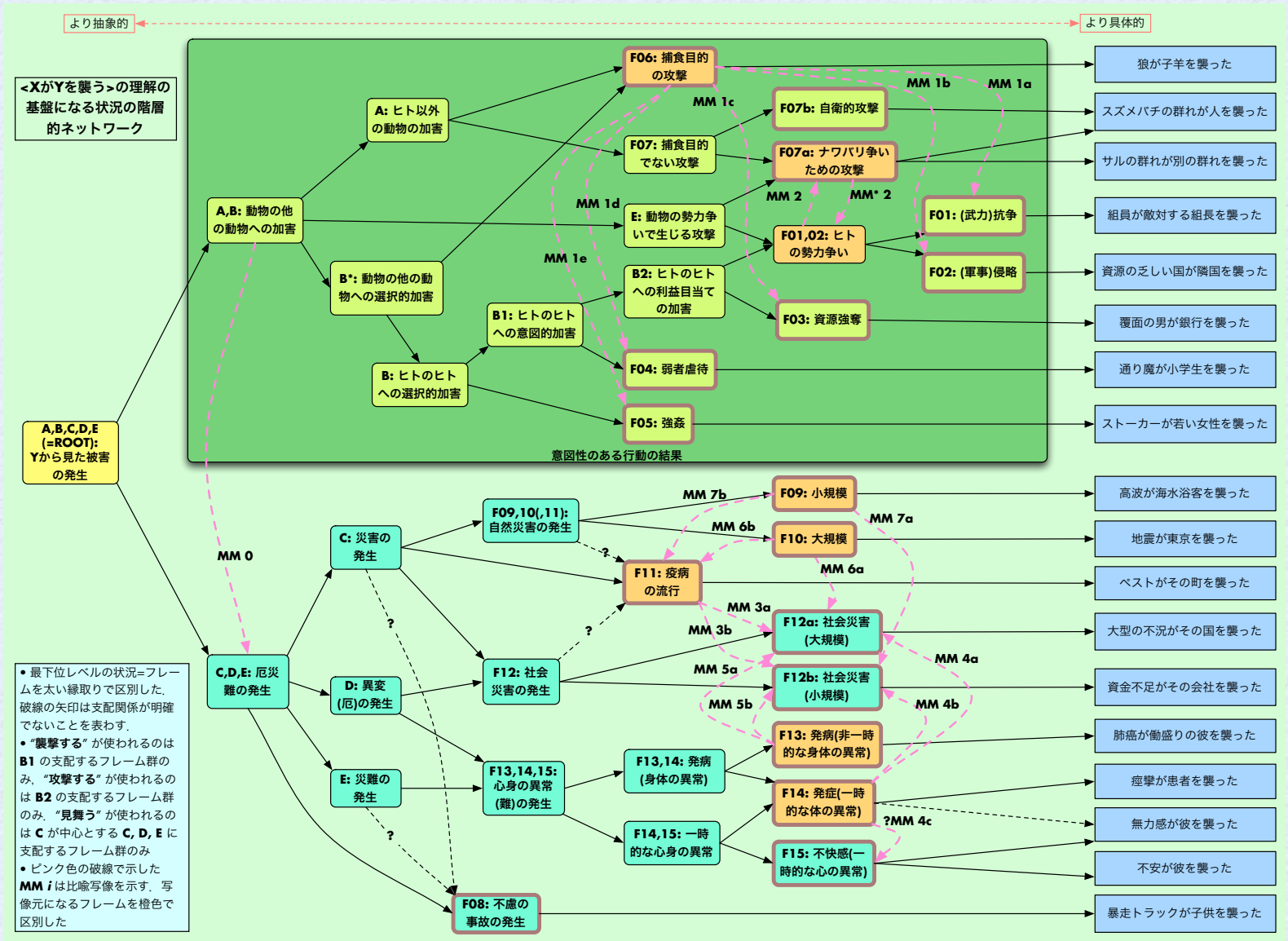
DESIDERATA

- The optimality of semantic analysis/annotation in terms of *granularity* is task-dependent.
  - There is NO optimal level for semantic analysis without specifying what you want to do with it.
- The best way is
  - NOT to disguise yourself as defining semantic frames at the optimal level of granularity.
  - to assign a granularity index to each frame, ranging from a shallow to a very deep level one.

Why finer granularity?

- Given a frame for a verb *XVY* (e.g., *X* attack *Y*), you have a set of *semantic co-variations* between *X* and *Y* in terms of finer-grained semantic types.
  - Selectional restrictions clearly correlate with units of such co-variations. For example, a <Predator> only attacks a <Prey> living in the same environment. This explains why the following contrasts:
  - The {a. tuna; b. ???wolf} attacked the sardins.
  - The {a. ???tuna; b. wolf} attacked the sheep.
- Usually, BFN frames have a number of subclasses, which serves as "units" of selectional restictions.

FOCAL ON RESCUE?



For the case of "X-ga Y-wo osou" ("X attacks Y", "X hits Y" in English), 15 different situations F01, F02, ... , F15, were identified by FOCAL and were shown to make sense to non-linguists through experiments.

SUMMARY

- MSFA tries to overcome some weaknesses of BFN by providing much finer-grained semantic analysis than BFN, to fully account for most cases of selectional restrictions.
- MSFA is not as useful as BFN for NLP: it doesn't try to provide a wide-coverage database of frames.
- My tentative evaluation:
  - MSFA would be more preferable for researches in Cognitive Science/Psychology than linguistic resource developments in NLP.
  - But NLP will require semantic descriptions at this level of finer-granularity sooner or later.

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