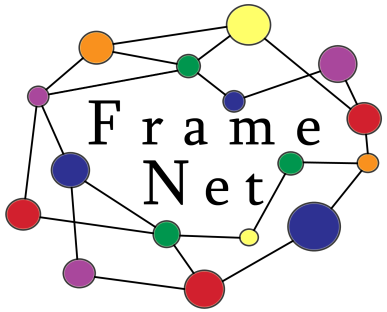
INTERNATIONAL COMPUTER SCIENCE INSTITUTE

Integrating FrameNet and MetaNet

Miriam R. L. Petruck
miriamp@icsi.berkeley.edu



MetaNet
Logo
Place Holder

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

Acknowledgements

- Gerard de Melo, Ellen K Dodge
- FrameNet
  - Chuck Fillmore, Collin Baker, Michael Ellsworth
- MetaNet
  - Oana David, Jisup Hong, Elise Stickles

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

What is FrameNet?

- A unique knowledge base with information on the mapping of meaning to form through the theory of Frame Semantics (Fillmore 1975, 1985, Fillmore and Atkins 1986, Fillmore and Baker 2010, Fillmore 2012, Fontenelle 2003, Petruck 1996)
- A resource that provides rich semantics for the core English vocabulary based on manually annotated corpus evidence, including valence descriptions for each item analyzed

What's "in" FrameNet?

- 1,215 semantic frames (including FEs)
- > 13,300 lexical units
- ~ 201,475 manually annotated examples
- ~ 1,825 frame-to-frame relations that constitute a hierarchy of semantic frames

What's a Frame?

A Semantic Frame is a script-like structure of inferences, linked by linguistic convention to the meanings of linguistic units - here, lexical items - constituting a schematic representation of a situation, object, event, or relation providing the background structure against which words are understood. Each frame identifies a set of frame elements – participants in the frame.

Semantic Frames in FrameNet

- Situation: Being_attached, Being_necessary, Being_strong, Being_wet, etc.
- Event: Apply_heat, Borrowing, Catching_fire, Cooking_creation, Hiring, Replacing, etc.
- Object: Buildings, Containers, Intoxicants, Offenses, People_by_origin, etc .
- Relations: Locative_relation, Spacial_co-location, Interior_profile_relation, Similarity, etc.

What's "in" a Frame?

- Frame Definition

  a prose description of a situation involving various participants and other conceptual roles, each of which constitutes a frame element

- Frame Elements (FEs):

  semantic roles as the basic unit of a frame, defined specifically to each frame

- Lexical Units (LUs):

  pairing of a lemma and a frame, i.e. "word" in one of its senses; LU evokes a frame

Apply_heat: Definition

A Cook applies heat to Food, where the Temperature_setting of the heat and Duration of application may be specified. A Heating_instrument, generally indicated by a locative phrase, may also be expressed. Some cooking methods involve the use of a Medium (e.g. milk or water) by which heat is transferred to the Food.

This frame focuses on the process of handling the ingredients, rather than the end result (See Cooking_creation).

Apply_heat: Frame Elements

COOK

FOOD

TEMPERATURE_SETTING

DURATION

HEATING_INSTRUMENT

MEDIUM

Lila **FRIED** the eggs in a copper pan.

Frame Elements: Coreness

- Core: uniquely defines a frame

  `Commerce`: BUYER, SELLER, MONEY, GOODS

- Peripheral: for aspects of events in general

  e.g. TIME, PLACE, MANNER

- Extrathematic: situate an event against the backdrop of another state of affairs; conceptually do not belong to the frame in which they occur
  - e.g. ITERATION, RECIPIENT

    Sue **BAKED** the cookies [twice $_{\text{ITERATION}}$].

    Sue **BAKED** the cookies [for me $_{\text{RECIPIENT}}$].

Frame Elements

Triple of Information

Frame Element

- semantic role

Grammatical Function

- External, Object, Dependent

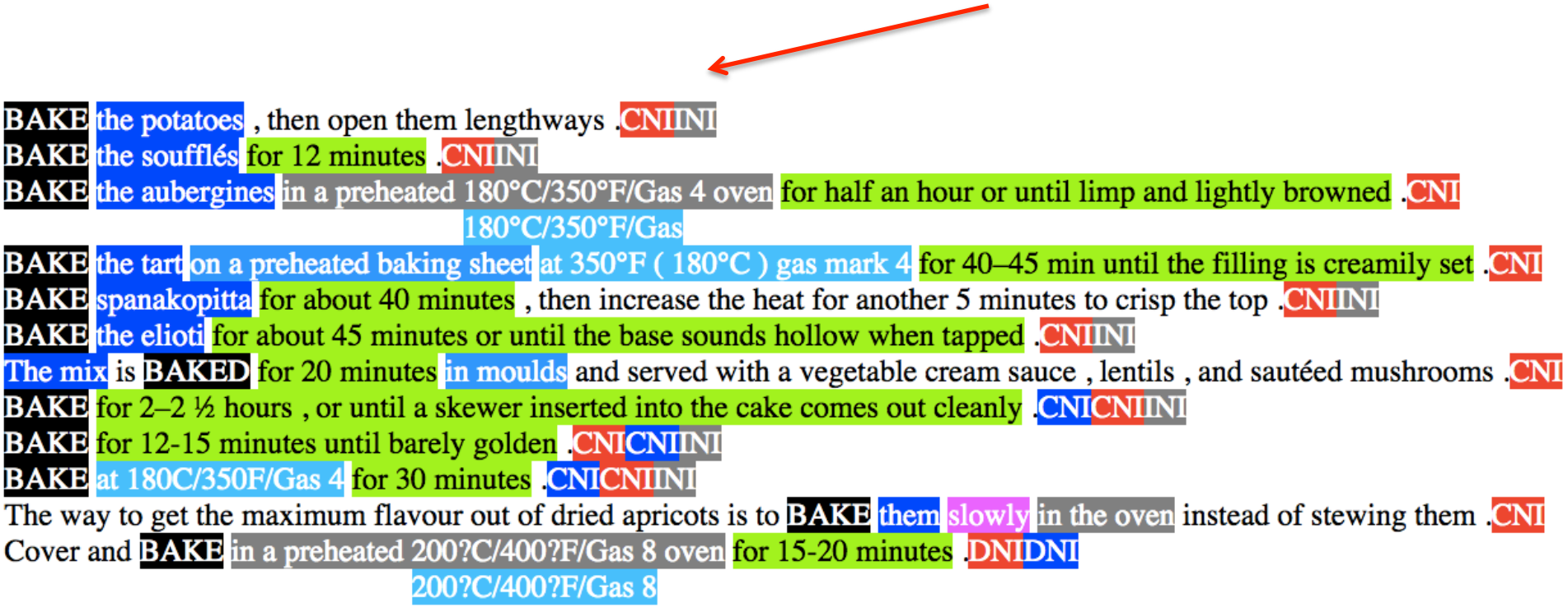
Phrase Type

- full range of PTs for language

Apply_heat: Lexical Units

bake.v, baking.n barbecue.v, blanch.v, boil.v, braise.v, braising.n, broil.v, brown.v, char.v, coddle.v, cook.v, deep fry.v, fry.v, frying.n, grill.v, microwave.v, parboil.v, plank.v, poach.v, roast.v, saute.v, scald.v, scorch.v, sear.v, searing.n, simmer.v, singe.v, steam.v, steep.v, stew.v, toast.v

Annotation: `Apply_heat`.bake.v



Annotation: `Apply_heat`.bake.v

FE:	**BAKE** [the souffle $_{\text{FOOD}}$]	[for 12 minutes $_{\text{DURATION}}$]	
GF:	Object	Dep	
PT:	NP	PP_{for}	

COOK	CNI
HEATING_INSTRUMENT	INI

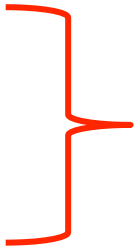
Annotation Results: `Apply_heat`.bake.v

Number Annotated	Patterns				
1 TOTAL	Container	Cook	Duration	Food	
(1)	PP[in] Dep	CNI --	PP[for] Dep	NP Ext	
1 TOTAL	Container	Cook	Duration	Food	Temperature_setting
(1)	PP[on] Dep	CNI --	PP[for] Dep	NP Obj	PP[at] Dep
5 TOTAL	Cook	Duration	Food	Heating_instrument	
(2)	CNI --	PP[for] Dep	CNI --	INI --	
(3)	CNI --	PP[for] Dep	NP Obj	INI --	
3 TOTAL	Cook	Duration	Food	Heating_instrument	Temperature_setting
(1)	CNI --	PP[for] Dep	CNI --	INI --	PP[at] Dep
(1)	CNI --	PP[for] Dep	NP Obj	PP[in] Dep	2nd --
(1)	DNI --	PP[for] Dep	DNI --	PP[in] Dep	2nd --
1 TOTAL	Cook	Food	Heating_instrument		
(1)	CNI --	NP Obj	INI --		
1 TOTAL	Cook	Food	Heating_instrument	Manner	
(1)	CNI --	NP Obj	PP[in] Dep	AVP Dep	
1 TOTAL	Duration	Heating_instrument	Temperature_setting		
(1)	PP[for] Dep	PP[in] Dep	2nd --		

Frame-to-Frame Relations in FN

- Inheritance
- Using
- Subframes
- Precedes
- Perspective_on
- See also
- Inchoative_of
- Causative_of

metarelation: pointer to user

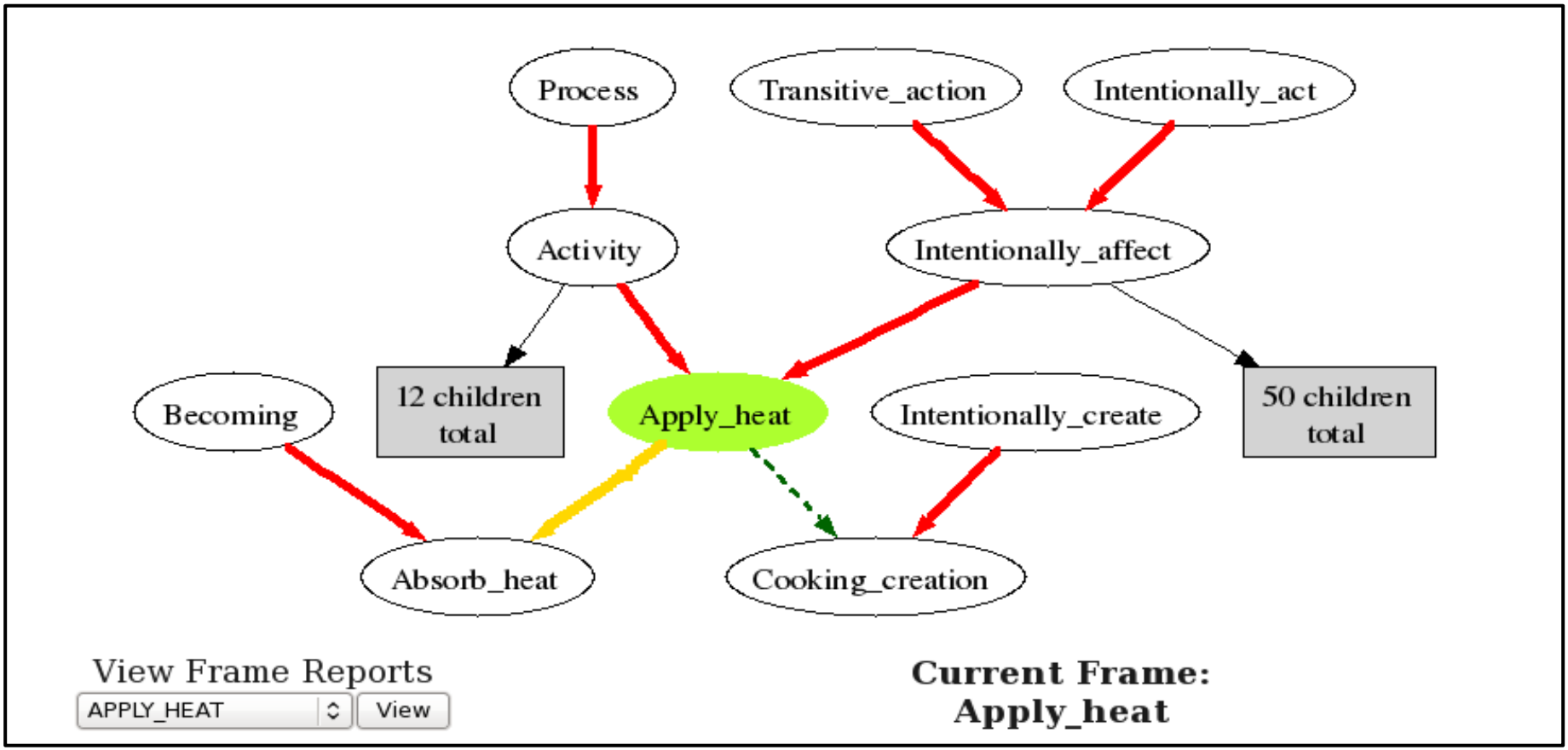


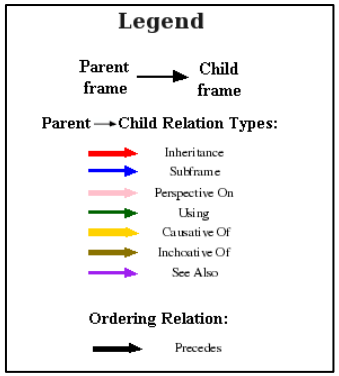
regular lexical relations

Inheritance

- Relationship between a more general frame, the parent frame, and a more specific one, the child
- Child frame elaborates parent frame
- Corresponding entities, FE, frame relation, and semantic characteristics, in both child and parent
- Child frame entity is the same as or more specific than in parent frame

`Apply_heat` ***inherits*** `Intentionally_affect`


Process
Transitive_action
Intentionally_act
Activity
Intentionally_affect
Becoming
12 children total
Apply_heat
Intentionally_create
50 children total
Absorb_heat
Cooking_creation
View Frame Reports
APPLY_HEAT
View
Current Frame:
Apply_heat


Legend
Parent frame
Child frame
Parent→Child Relation Types:
Inheritance
Subframe
Perspective On
Using
Causative Of
Inchoative Of
See Also
Ordering Relation:
Precedes

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

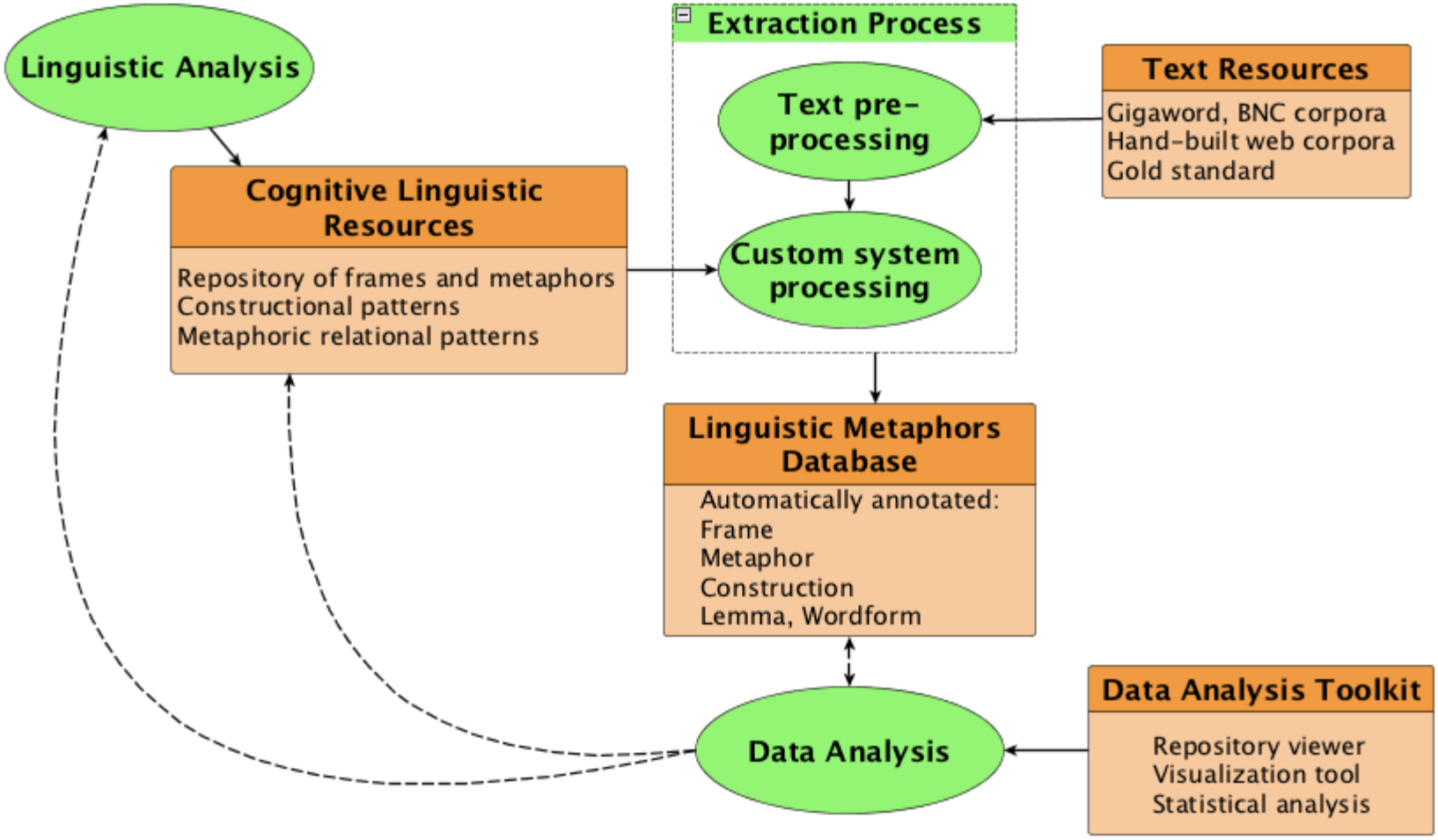
What's "in" MetaNet

- Conceptual metaphors
- Relations between source and target domains, represented as semantic frames
  - 650 frames
- Relations between metaphors
  - 785 metaphors
- Linguistic expressions of CMs in terms of CMT
- Rich annotation of linguistic expressions
  - tens of thousands (~100K?)

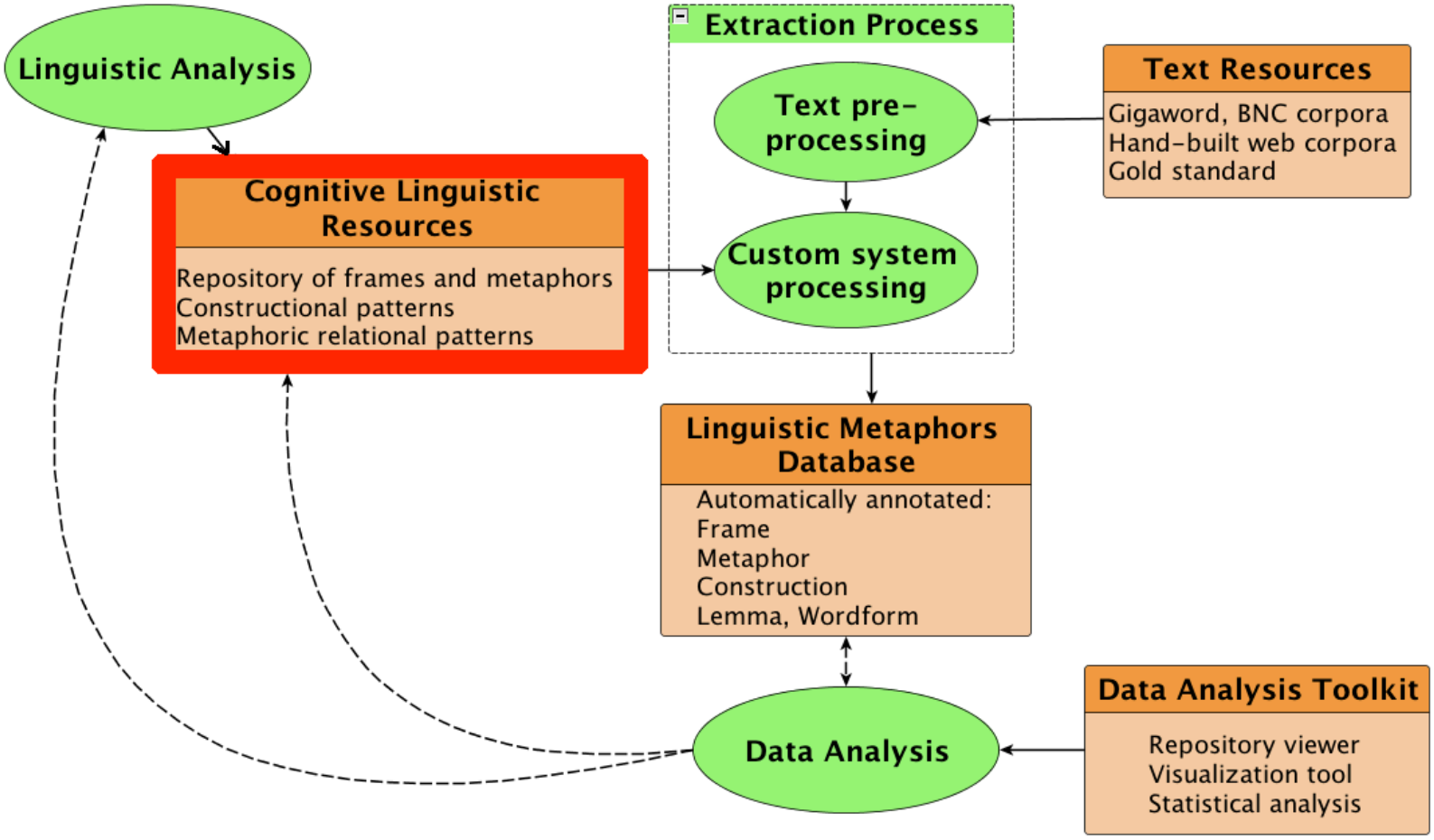
MetaNet: Objectives

- Develop repository of conceptual metaphors
- Build database of examples of linguistic expressions of conceptual metaphors
- Develop system to identify metaphors in text automatically.
- Add rich annotation to examples, facilitating various types of data analysis [thus gaining insights into domain(s) of interest, as well as further refining conceptual metaphor theory and extraction system.]
- Multilingual: American English, Mexican Spanish, Iranian Farsi, Russian.

System Overview



Metaphor Repository



Metaphor Repository

- Formalization of Conceptual Metaphor Theory (Lakoff and Johnson 1980)

- Source and Target domains: represented as semantic frames (Fillmore 1976, 1982, 1985)

- Conceptual metaphors: represented as mappings from Source frames to Target frames

- Networks of frames and conceptual metaphors
  - Structured relations between frames and metaphors

Metaphor Repository

- Initial repository focused on conceptual metaphors previously identified in literature (including, e.g. MWLB and PITF)
- Repository expanded via analysis of various domains of interest: social issues such as poverty, taxation, democracy, gun rights and gun control.
- Analysis of new domains builds on and is linked to existing networks of frames and metaphors already in repository

Category:Frame

This is the Frame category. This category uses the form Frame.

Create or edit a Frame:

Create or edit

Total number of Frame pages: 656

A

- Ability to act
- Absorption
- Access
- Access to a location
- Access to an object
- Access to education
- Access to knowledge
- Accompany
- Across
- Action
- Activity
- Addiction
- Addressing poverty
- Addressing social problems
- Adoption
- Advocacy

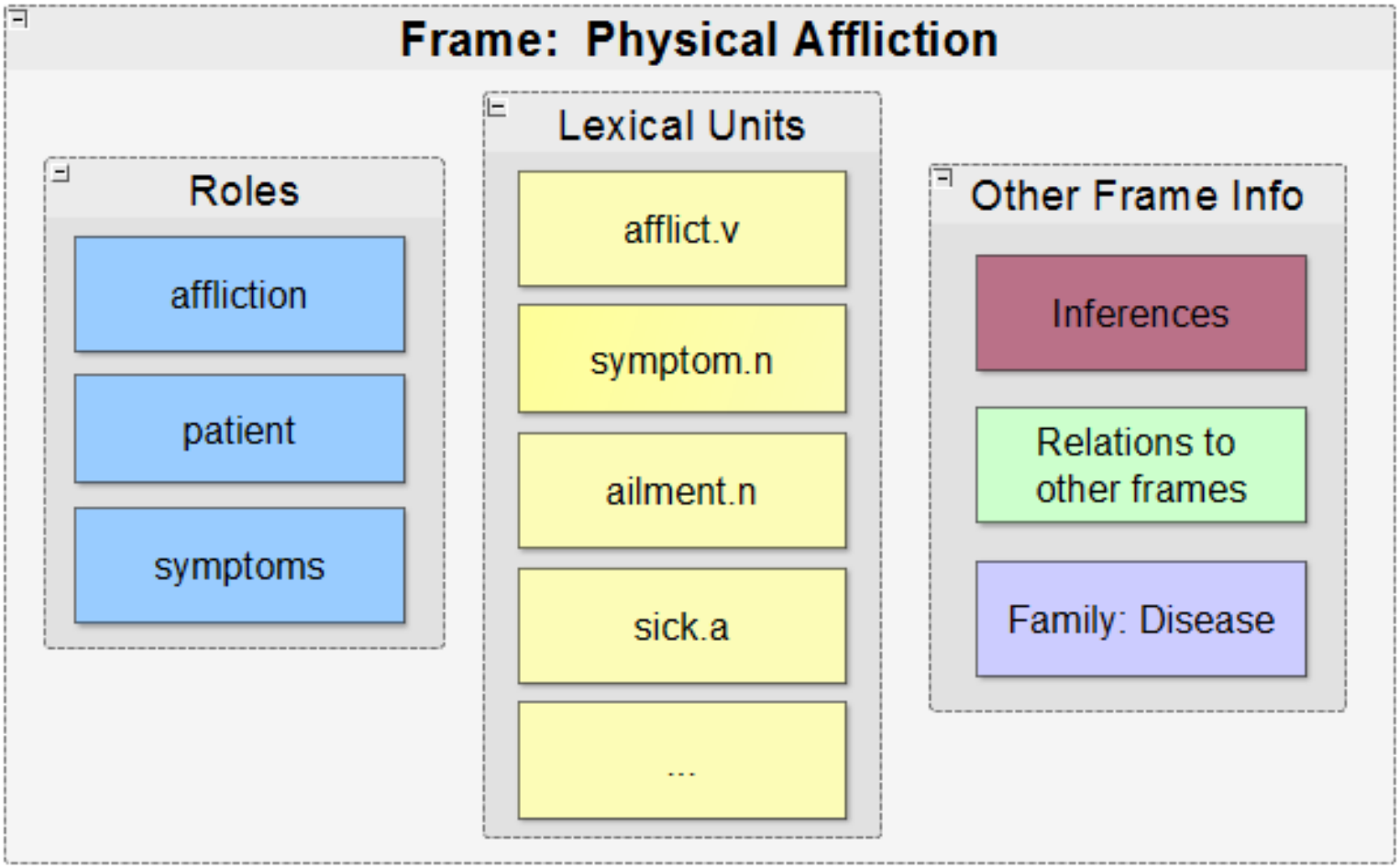
E cont.

- Evil
- Evil creature
- Excess body weight
- Existence
- Experience pain
- Experiencing a negative state
- Experiencing a state
- Experiencing an economic status
- Extinguish

F

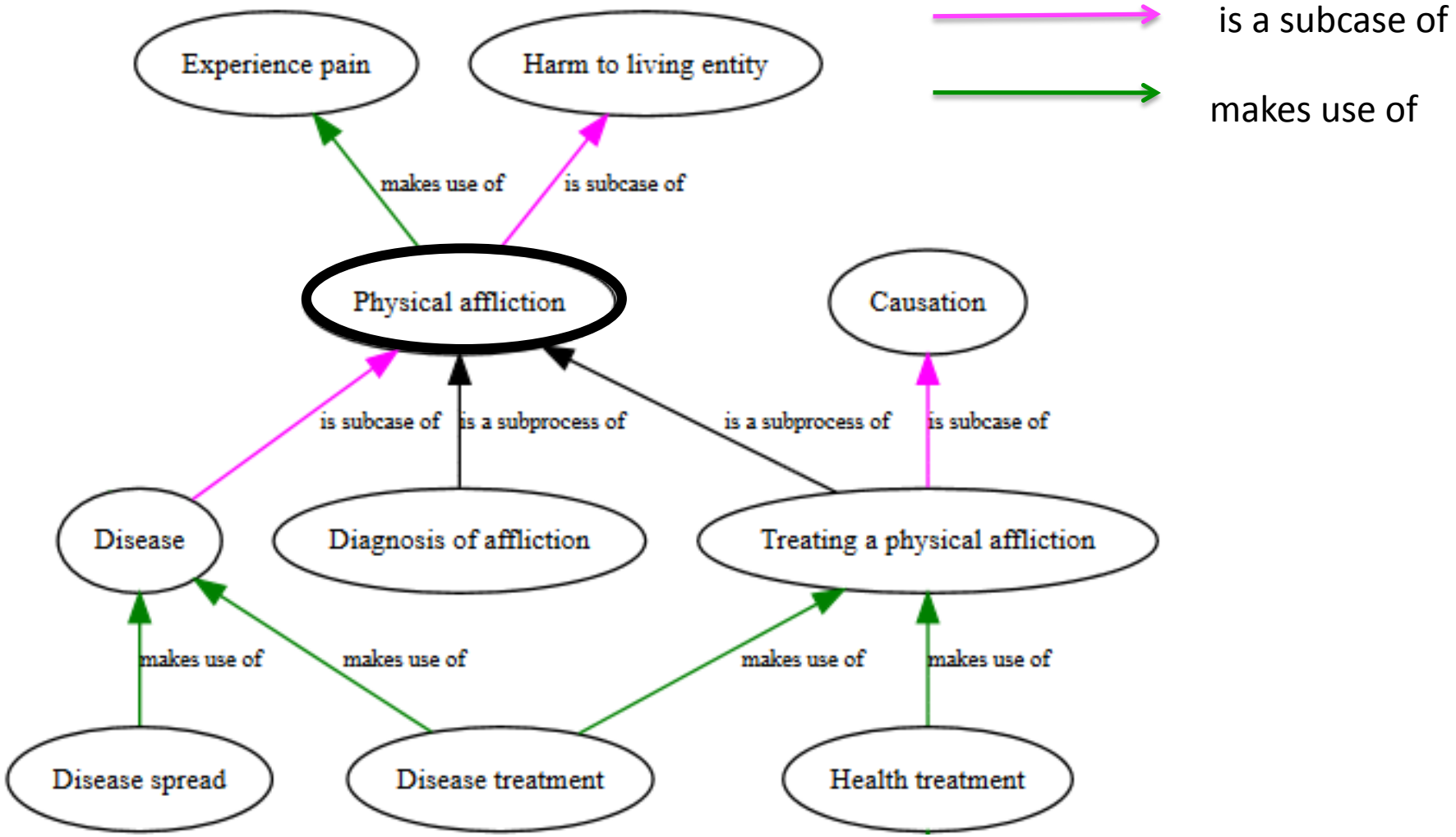
- Factory
- Fairness
- Family
- Fierce animal
- Finance

Frame: Physical Affliction



Disease Frame Family

Relations between frames in this family:



Category:Metaphor

This is the Metaphor category page. This category uses the form Metaphor.

Create or edit a Metaphor:

Create or edit

Total number of Metaphor pages: 787

Main page

Lists
- Metaphors
- Frames
- Cx Analysis
- Cxn Matching Patterns
- Metaphoric Relational Configurations
- IARPA Source Concepts
- IARPA Target Concepts

Tools
- What links here
- Related changes
- Special pages
- Printable version
- Permanent link
- Page information
- Browse properties

In other languages
- English
- Español
- فارسی

A

- ABILITY TO ACT IS ABILITY TO MOVE
- ABILITY TO EVALUATE GOVERNMENT IS ABILITY TO SEE
- ABILITY TO EVALUATE IS ABILITY TO SEE
- ABILITY TO KNOW IS ABILITY TO SEE
- ABUSIVE POLITICAL LEADERS ARE PHYSICAL BULLIES
- ACCESS TO EDUCATION IS ACCESS TO AN OBJECT
- ACCESS TO KNOWLEDGE IS ACCESS TO AN OBJECT
- ACHIEVING A PURPOSE IS ACQUIRING A DESIRED OBJECT
- ACHIEVING A PURPOSE IS GETTING SOMETHING TO EAT
- ACHIEVING A PURPOSE IS REACHING A DESTINATION
- ACHIEVING GUN RIGHTS IS REACHING A DESTINATION
- ACHIEVING POWER IS MOVING UPWARDS
- ACQUIRING IDEAS IS EATING
- ACQUIRING RESOURCE IS CONSUMING FOOD
- ACTION IS BEING IN A LOCATION

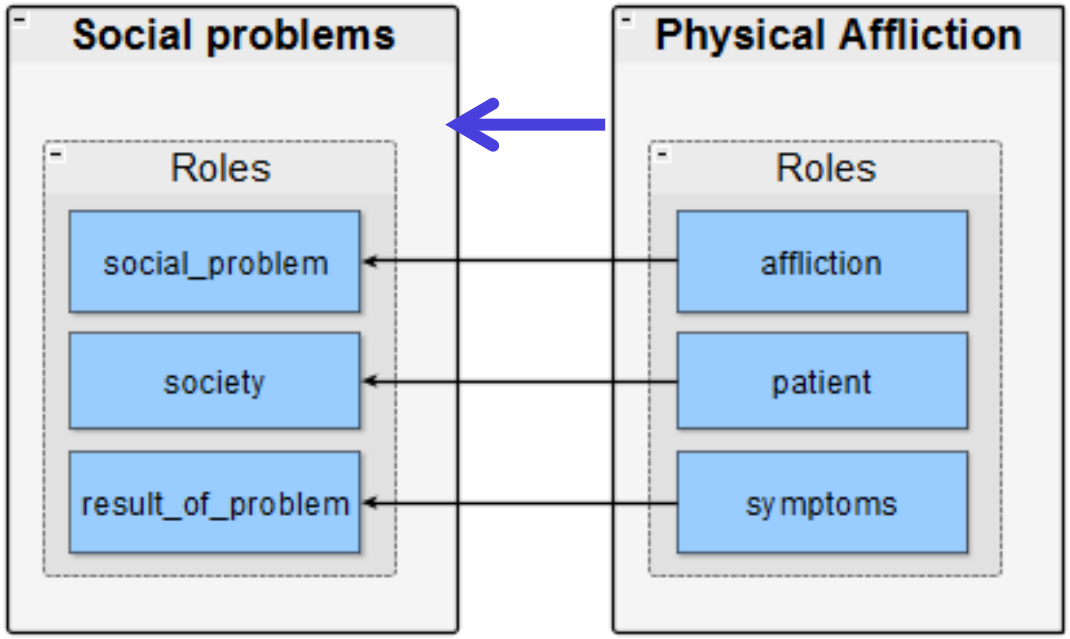
E cont.

- EMOTIONS ARE SUBSTANCES
- ENABLE ABILITY TO UTILIZE RESOURCES IS ENABLE ABILITY TO ACCESS LOCATIONS
- ENABLEMENT OF WORSENING OF ECONOMIC CONDITION IS ENABLEMENT OF DOWNWARD MOTION
- ENACTING LEGISLATION IS CAUSING MOTION ALONG A PATH
- END OF AN ACTION IS THE END OF A PATH
- ENJOYING A RIGHT IS POSSESSING AN OBJECT
- ENTITLEMENT HOLDERS ARE LEECHES
- ENVIRONMENTAL HARM IS PHYSICAL INJURY
- EQUALITY IS BEING ON THE SAME VERTICAL LEVEL
- ESSENTIAL IS INTERNAL
- EVALUATION OF EDUCATION IS COMPETITION
- EVALUTION OF GOVERNMENT IS SENSORY EVALUATION
- EVENTS ARE OBJECTS

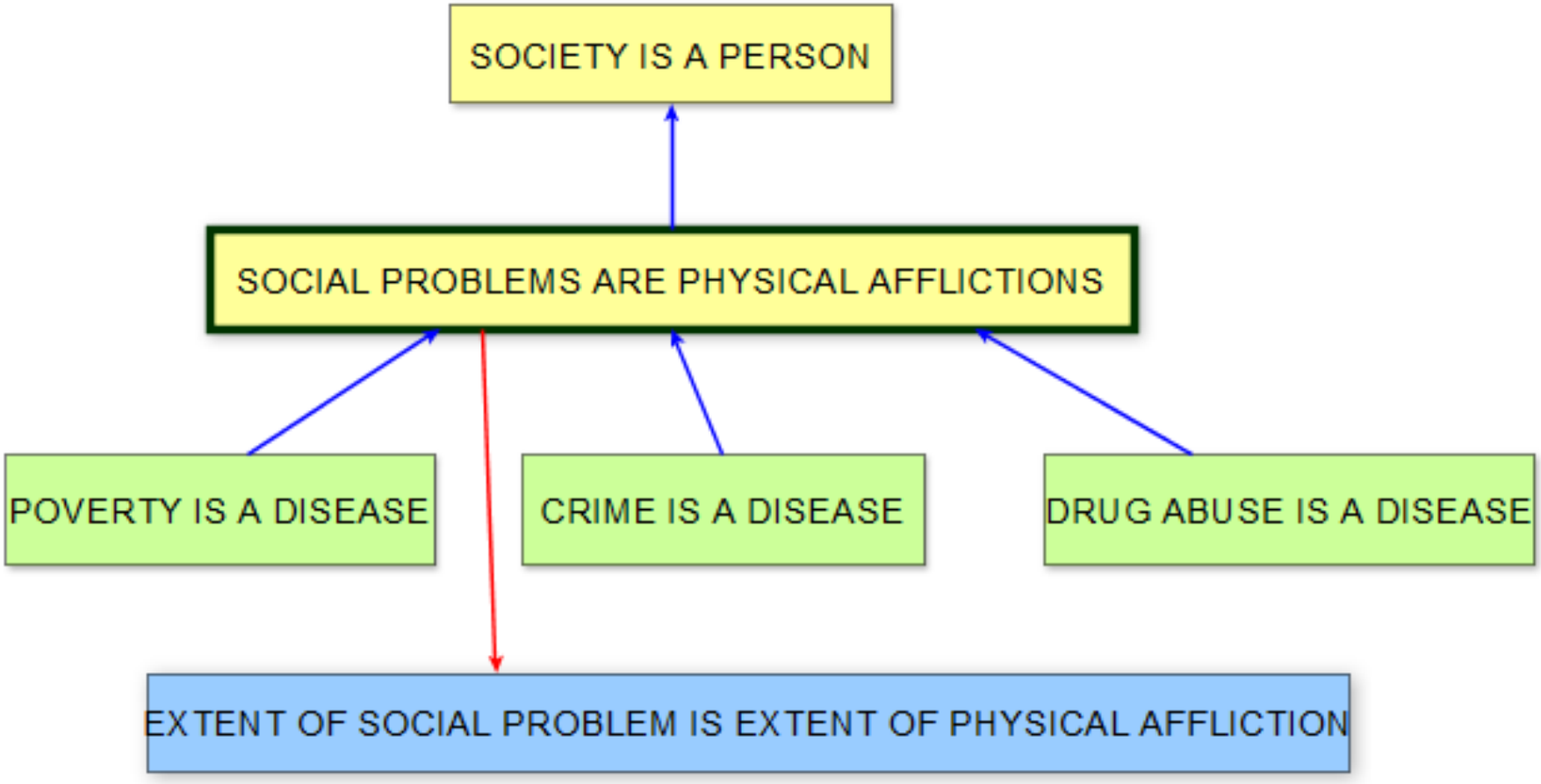
Metaphor: SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS

Poverty is infecting our nation.
We are experiencing an epidemic of drug abuse.

Target frame: **Source frame:**



Metaphor Network



is a subcase of

is an entailment of

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

Similarities of FN and MN

- frame-based meaning representation
- characterize the conceptual and linguistic means that (a) language provides to describe situations (states of affairs, events, objects)
- situate individual frames within a larger structure of interrelated frames, offering a broad perspective on the conceptual structure that (a) language expresses

Differences Between FN and MN

- State of Development
  - FN: 1997 – ongoing
  - MN: 2012 – "on hold"

  } coverage discrepancy

- Objectives
  - FN: repository of frames, LUs, annotation sets, manual FS analysis of contemporary English lexicon; semantico-syntactic mappings
  - MN: repository of conceptual metaphors; CMT analysis of linguistic metaphor; source-target domain mappings; automatic extraction and analysis system

Differences Between FN and MN

- Semantic Granularity of Frames
  - FN: mostly general vocabulary of language
  - MN: tends to be specific for metaphor

  FN: *poverty*.n – `Wealthiness` frame, including *affluent*.a, *rich*.adj, *wealth*.n, etc.

  MetaNet:

  Conceptual Metaphor: Poverty is a Harmful Agent

  Linguistic Metaphor: *Poverty* attacks children.
- Frame-to-Frame Relations

Frame-to-Frame Relations in FN and MN

FrameNet	FrameNet Only	MetaNet	MetaNet Only
Inheritance		is subcase of	
Uses		makes use of	
Subframes		is a subprocess of	
Perspective_on		is a perspective on	
	Precedes		
			incorporates as a role
			is in scalar opposition to
	Inchoative_of		
	Causative_of		is in causal relation with
	See_also[5]		

Example: `Attack`.attack.v

- `Attack`: a situation in which an ASSAILANT physically attacks a VICTIM (usually sentient), causing or intending to cause the VICTIM physical damage; a WEAPON that the ASSAILANT uses may also be mentioned
- LUs: *ambush*.n, *assailant*.n, *assail*.v, *assault*.n, *assault*.v, *attacker*.n, *attack*.v, *bomb*.v, *charge*.n, *bombardment*.n, *bombing*.n, *charge*.v, *offensive*.a, *set (upon)*.v, *small arms fire*.n

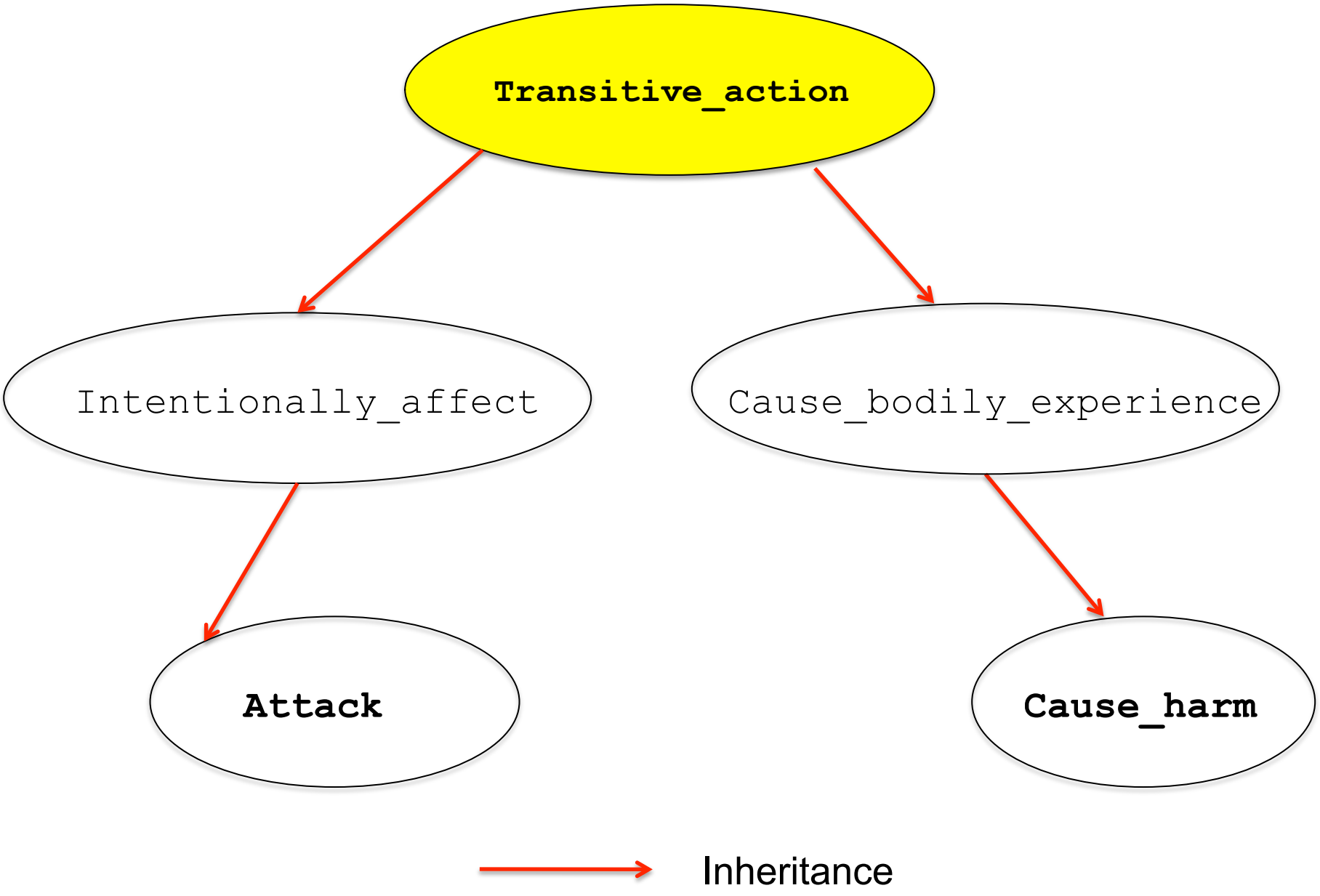
Example: `Attack`.attack.v

[The bear $_{\text{ASSAILANT}}$] **ATTACKED** [the man $_{\text{VICTIM}}$].

[Poverty $_{\text{ASSAILANT}}$] **ATTACKS** [children $_{\text{VICTIM}}$].

Example: `Attack`.attack.v

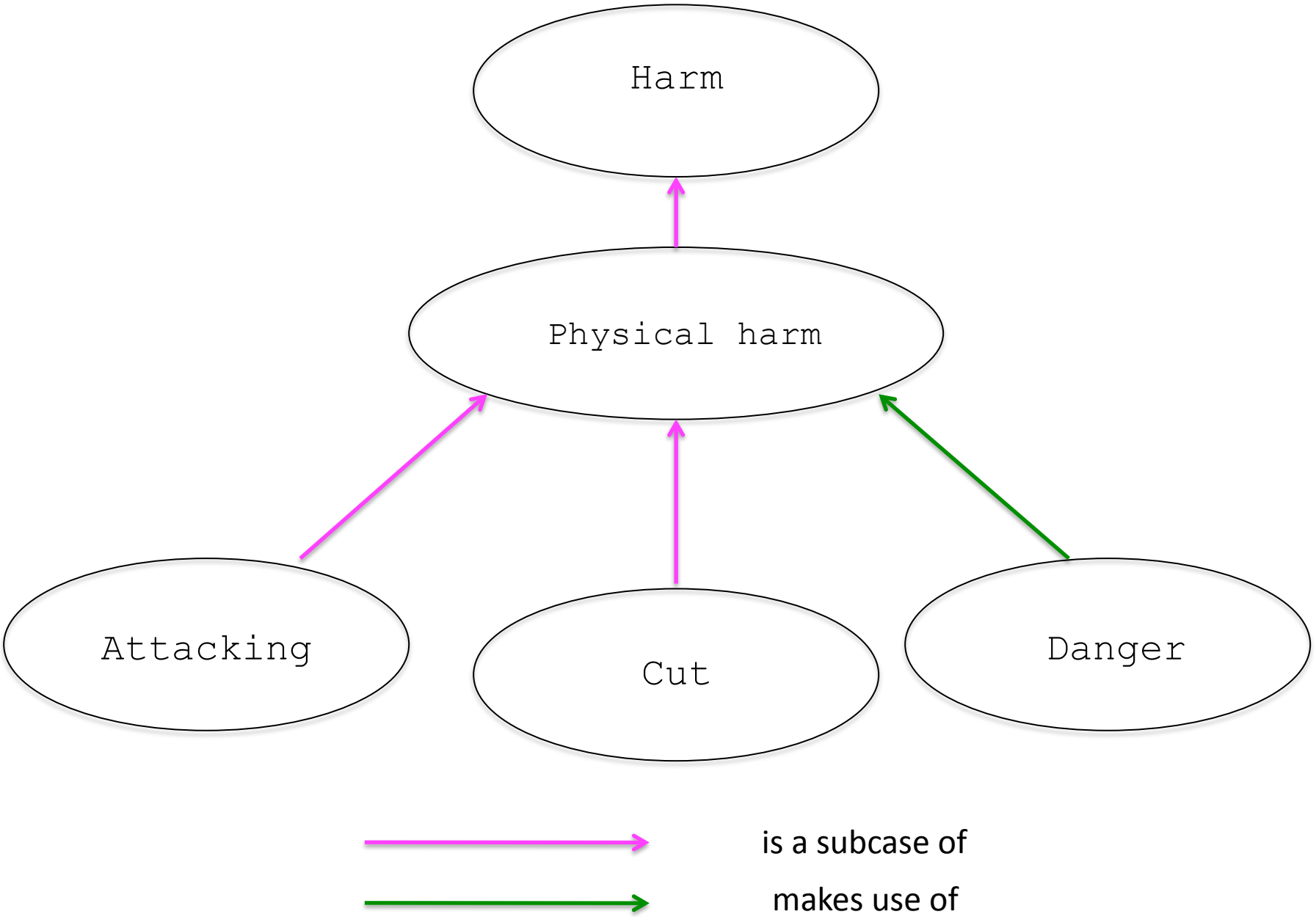
- Frame-to-Frame Relations: `Attack` and `Cause_harm` are related via a higher-level frame. `Attack` and `Cause_harm` inherit from `Transitive_action`.
- The two FN frames share a grandparent, not a parent; `Attack` and `Cause_harm` are NOT in a parent-child relationship.


Transitive_action
Intentionally_affect
Cause_bodily_experience
Attack
Cause_harm
Inheritance

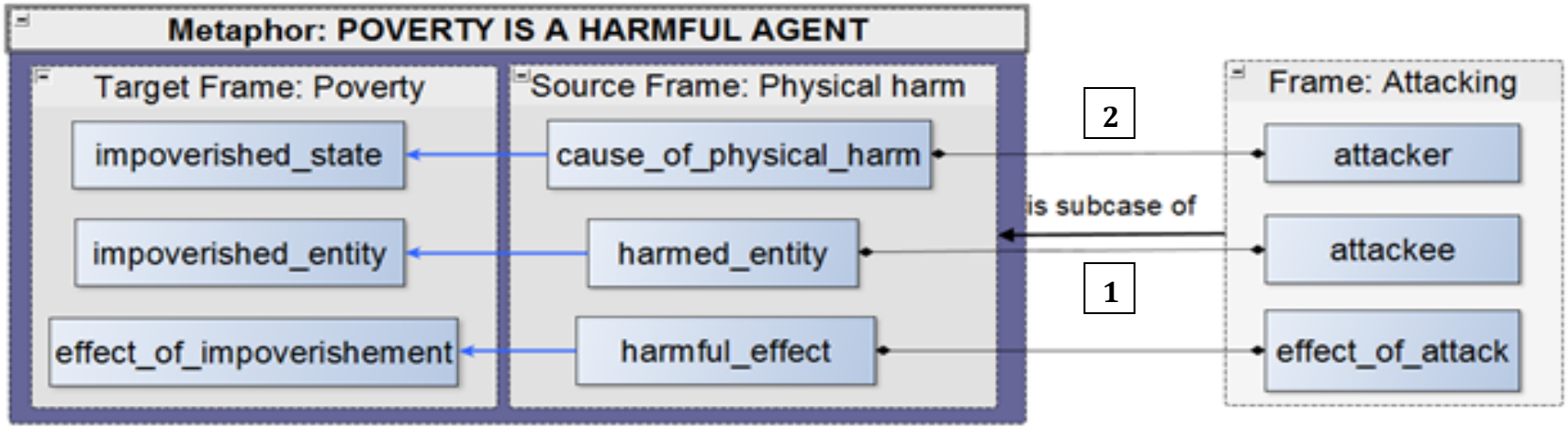
MetaNet: Attacking Frame

- Roles:
  - attacker (ASSAILANT)
  - attackee (VICTIM)
  - effect_of_attack (RESULT)

- MN's `Attacking` is a subcase of a more general `Physical_harm` frame.


Harm
Physical harm
Attacking
Cut
Danger
is a subcase of
makes use of

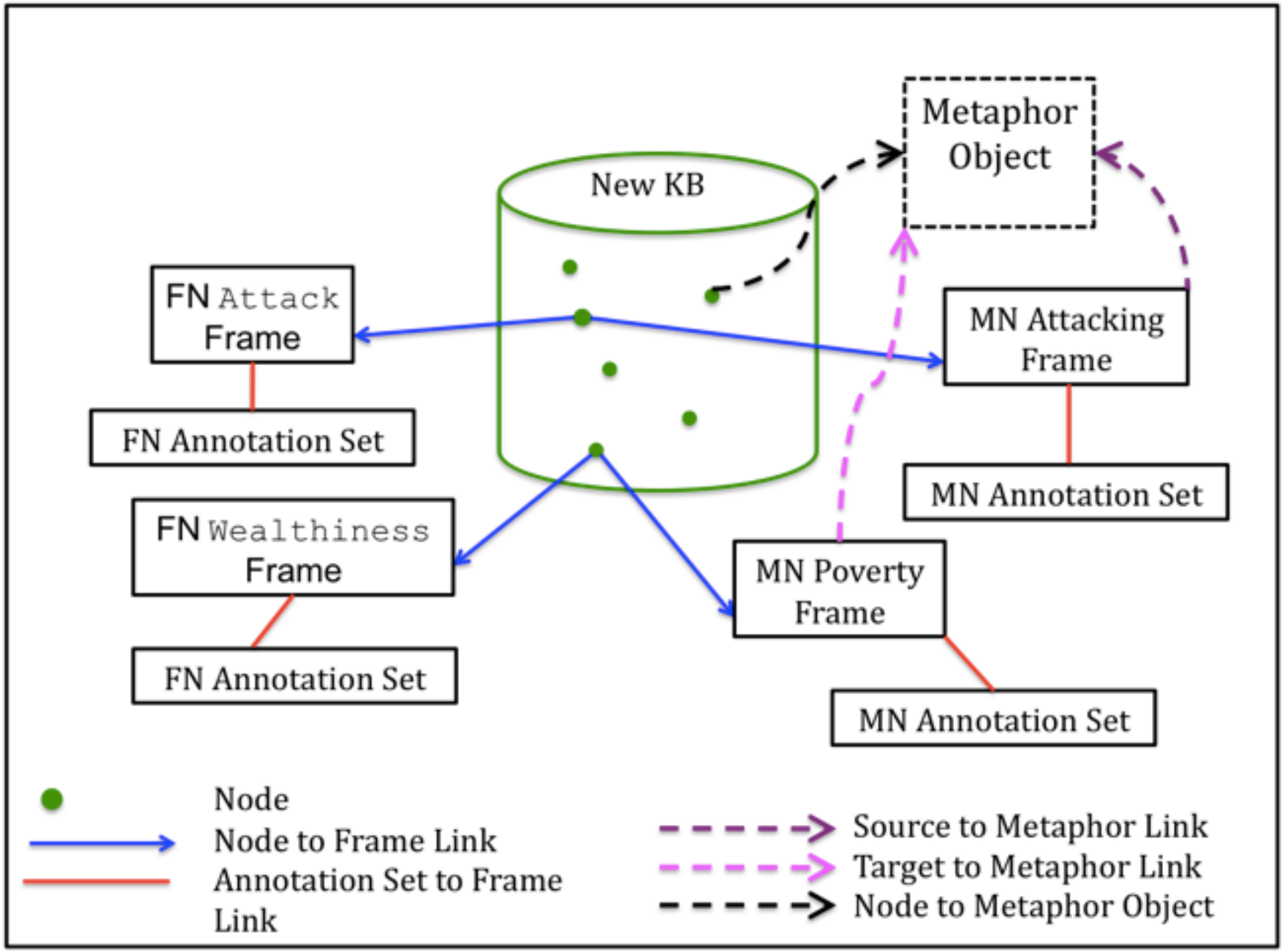
Conceptual Metaphor: Poverty is a Harmful Agent



Linguistic Expression: Poverty ***attacks*** children.

Challenge of Integration

- Heterogenous structures preclude merging FN and MN through alignment and linking, a much simpler method of achieving integration than creating a new entity, albeit far from simple.
  - Multilingual FrameNet: proposal to align FNs (Brazilian Portuguese, English, French, Italian, Japanese, Swedish, etc.)
  - preliminary work shows that alignment of DBs with same structures is not “simple”.


Metaphor Object
New KB
FN Attack Frame
MN Attacking Frame
FN Annotation Set
MN Annotation Set
FN Wealthiness Frame
MN Poverty Frame
FN Annotation Set
MN Annotation Set
Node
Node to Frame Link
Annotation Set to Frame Link
Source to Metaphor Link
Target to Metaphor Link
Node to Metaphor Object

Sentence:	***Poverty***	***attacks***	***children***
FrameNet			
Frame		Attack	
Frame Element	Assailant		Victim
Metaphor Info	✔		
MetaNet			
Frame	Poverty	Attacking	θ
Metaphor Info	Target	Source	
	POVERTY IS A HARMFUL AGENT		

Combined FrameNet and MetaNet Annotation (current soa)

Road Map

- Introduction
- What is FrameNet?
- What is MetaNet?
- Integrating FrameNet and MetaNet
- So What?

So What?

- Address pertinent research questions
- Improve consistency of frame-based knowledge bases (FN and MN)
- Increase formal rigor of in FN and MN
- Facilitate corpus-based research for disciplines involving analysis of metaphorical language
- Advance/Refine Frame Semantics and Conceptual Metaphor Theory

Research Questions: 1

- How do the different objectives of FN and MN affect the formal representation of meaning?
- Can the integration of FN and MN reconcile the differences? How?
- Do the conceptual differences in the two knowledge bases necessitate using different sets of relations?
- Is using the same relations possible? Is doing so advantageous?

Research Questions: 2

- Does leveraging the common understanding about the nature of meaning in FN and MN lead to a high degree of interconnectedness of the two knowledge bases?
- Given the differences in levels of semantic granularity between FN frames and MN frames, what criteria will determine the appropriateness of integrating two similarly defined frames from each resource?
  - e.g. FN: `Cause_harm` vs. MN: Harm

Consistency and Formal Rigor

- Improve each knowledge base, independent of the other, including definitions of relations
- Extend frame-based representations to metaphoric language
- Facilitate computation over frames
- Develop NLP applications using new entity
  - comprehensive resource including rich semantic representations and annotations for literal and metaphoric language

Thanks!

http://framenet.icsi.berkeley.edu

miriamp@icsi.berkeley.edu

https://metanet.icsi.berkeley.edu

edodge@icsi.berkeley.edu