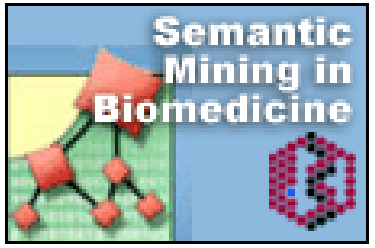
MIE2005 GENEVA SWITZERLAND August 28 to 31, 2005

The XIX International Congress of the European Federation for Medical Informatics



Semantic Clarification of the Representation of Procedures and Diseases in SNOMED CT

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Context: SNOMED CT (Clinical Terms)

- Comprehensive clinical terminology system
- Constructed by merging, expanding, and restructuring SNOMED RT and Clinical Terms Version 3 (former Read Codes).
- 364,000 concepts, 984,000 terms, 1.45 million defined relationships between concepts
- Government agreements in U.S. & U.K.
- Increasing interest into SNOMED CT in other countries

SNOMED CT
OAV and DL notation

- Object – Attribute – Value (OAV) Triplets
- Objects and Values are SNOMED "concepts"
- Attributes are SNOMED "relations"

SNOMED Concept 1	SNOMED Relationship	SNOMED Concept 2
Renal glomerular disease	*is_a*	*Renal disease*
Renal glomerular disease	*has_finding_site*	*Kidney*
Glomerulum	*part_of*	*Kidney*

- Description Logics (DL) representation:

cf. Kent Spackman, AMIA 2002

Renal glomerular disease $\sqsubseteq$ *Renal disease*

Renal glomerular disease $\sqsubseteq \exists$ *has_finding_site.Kidney*

Glomerulum $\sqsubseteq \exists$ *part-of.Kidney*

Syntax	*Semantics*
C	$\{d \in \Delta^{\mathcal{I}} \mid \mathcal{I}(C) = d\}$
R	$\{(d,e) \in \Delta^{\mathcal{I}} \times \Delta^{\mathcal{I}} \mid \mathcal{I}(R) = (d,e)\}$
$\exists R.C$	$\{d \in \Delta^{\mathcal{I}} \mid R^{\mathcal{I}}(d) \cap C^{\mathcal{I}} \neq \emptyset\}$
$C \sqsubseteq D$	$C^{\mathcal{I}} \subseteq D^{\mathcal{I}}$

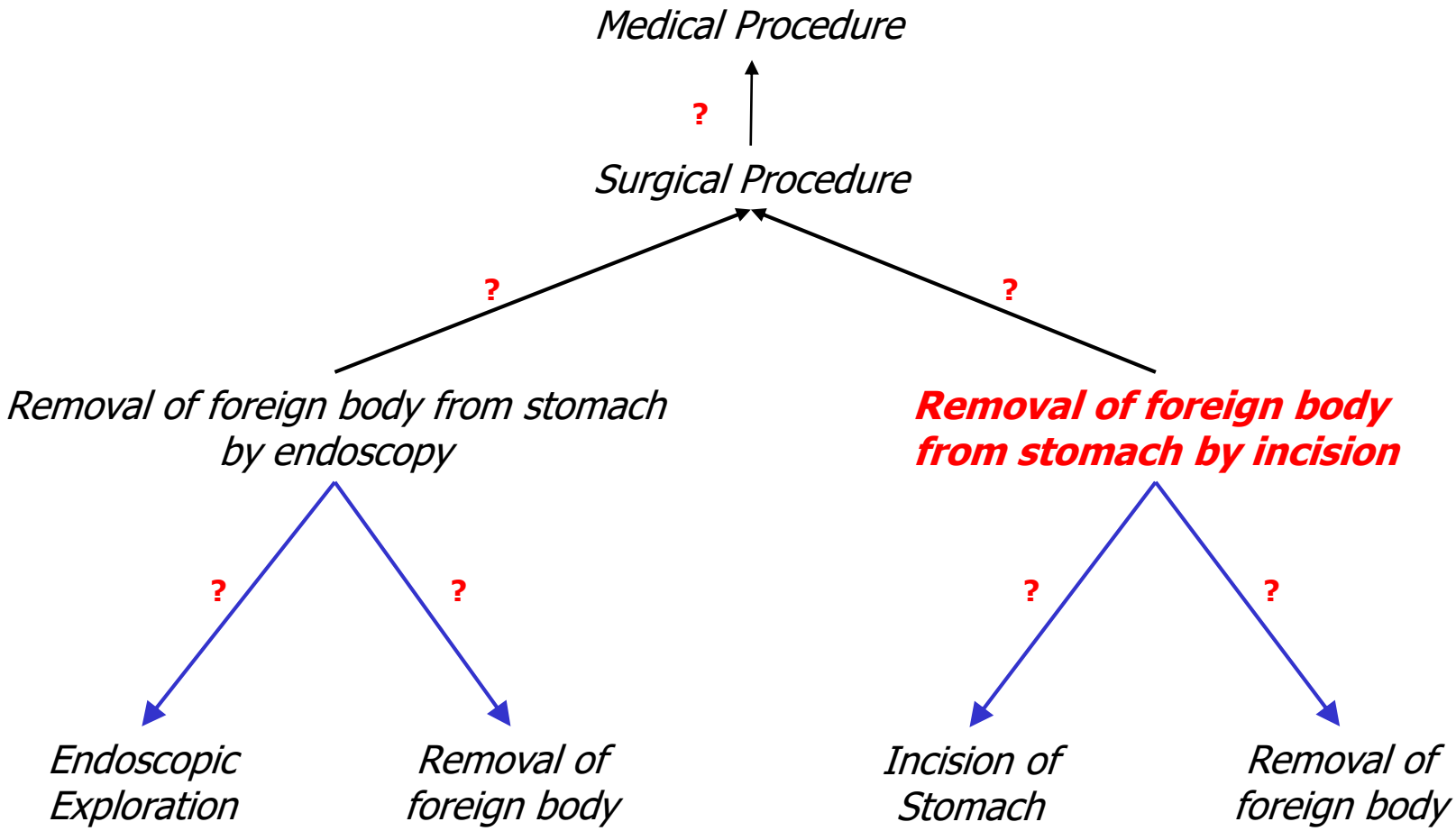
cf. Baader et al. Description Logics Handbook

Objective of this talk

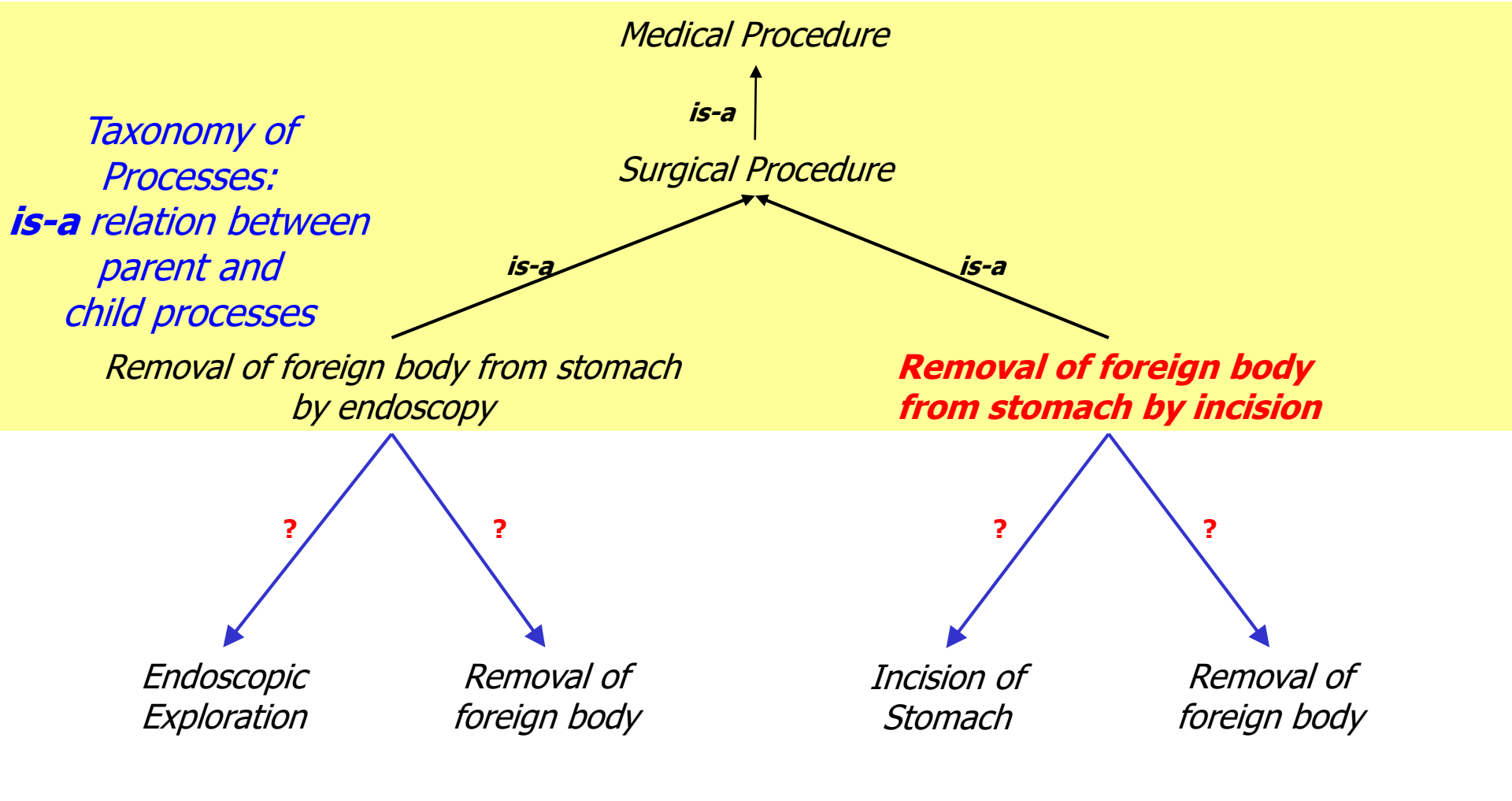
- Ontological Inquiry of the representation of Processes in SNOMED CT
- Clarification of the meaning of the "relationship group" attribute in SNOMED CT
- „Process" in the sense of
  - Diagnostic or Therapeutic Procedures
  - Pathological and Physiological Processes

Removal of foreign body from stomach by incision

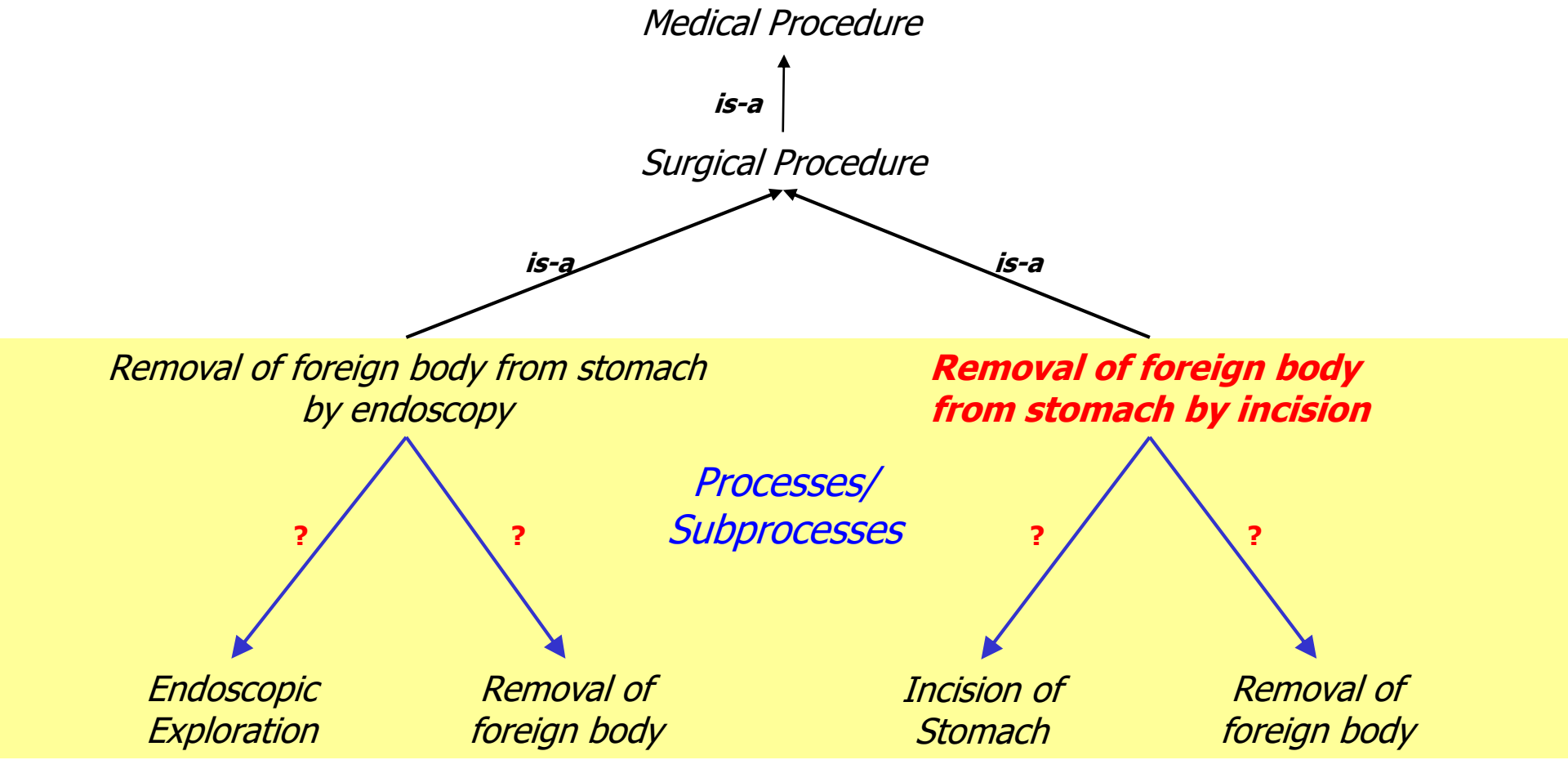
Hierarchichal Arrangement of Processes



Parent and Child Processes



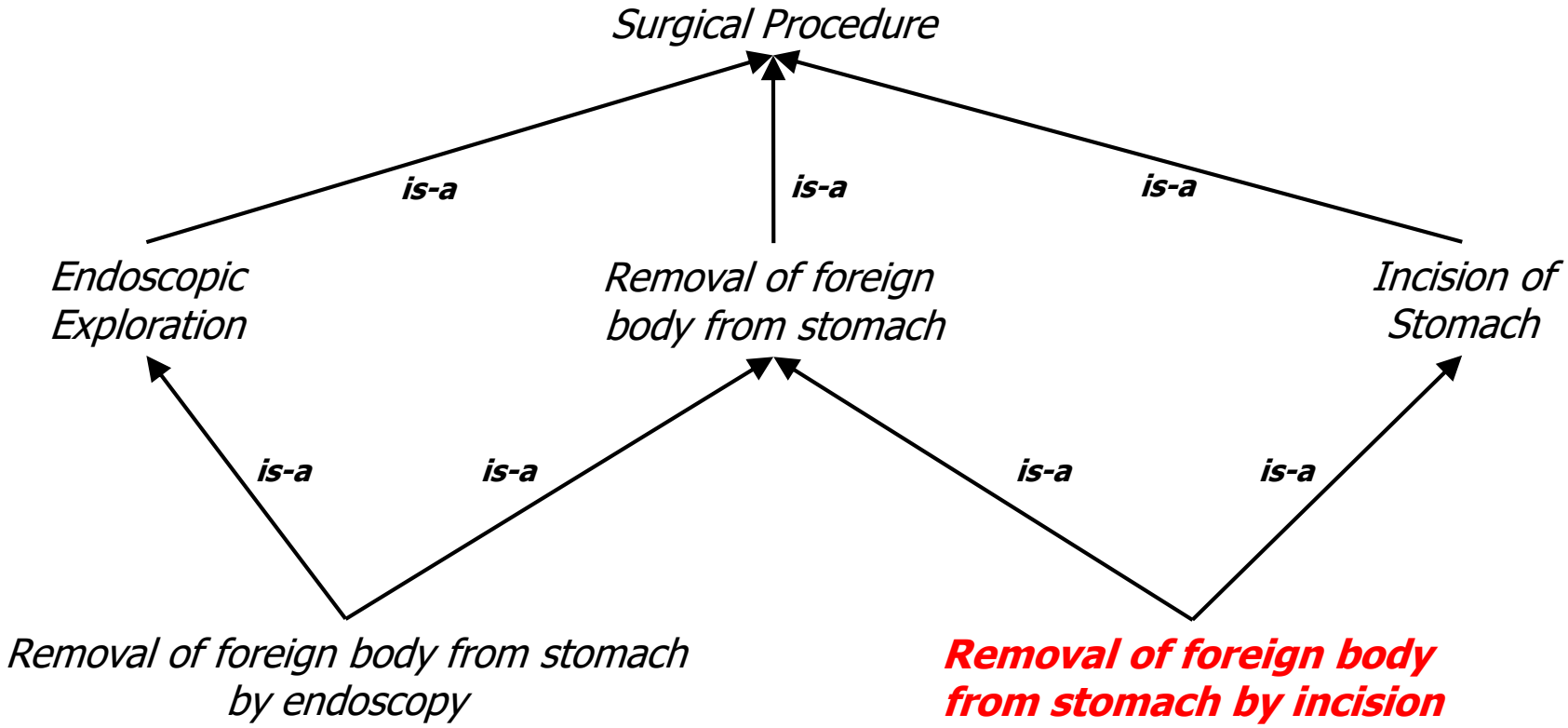
Processes and Subprocesses



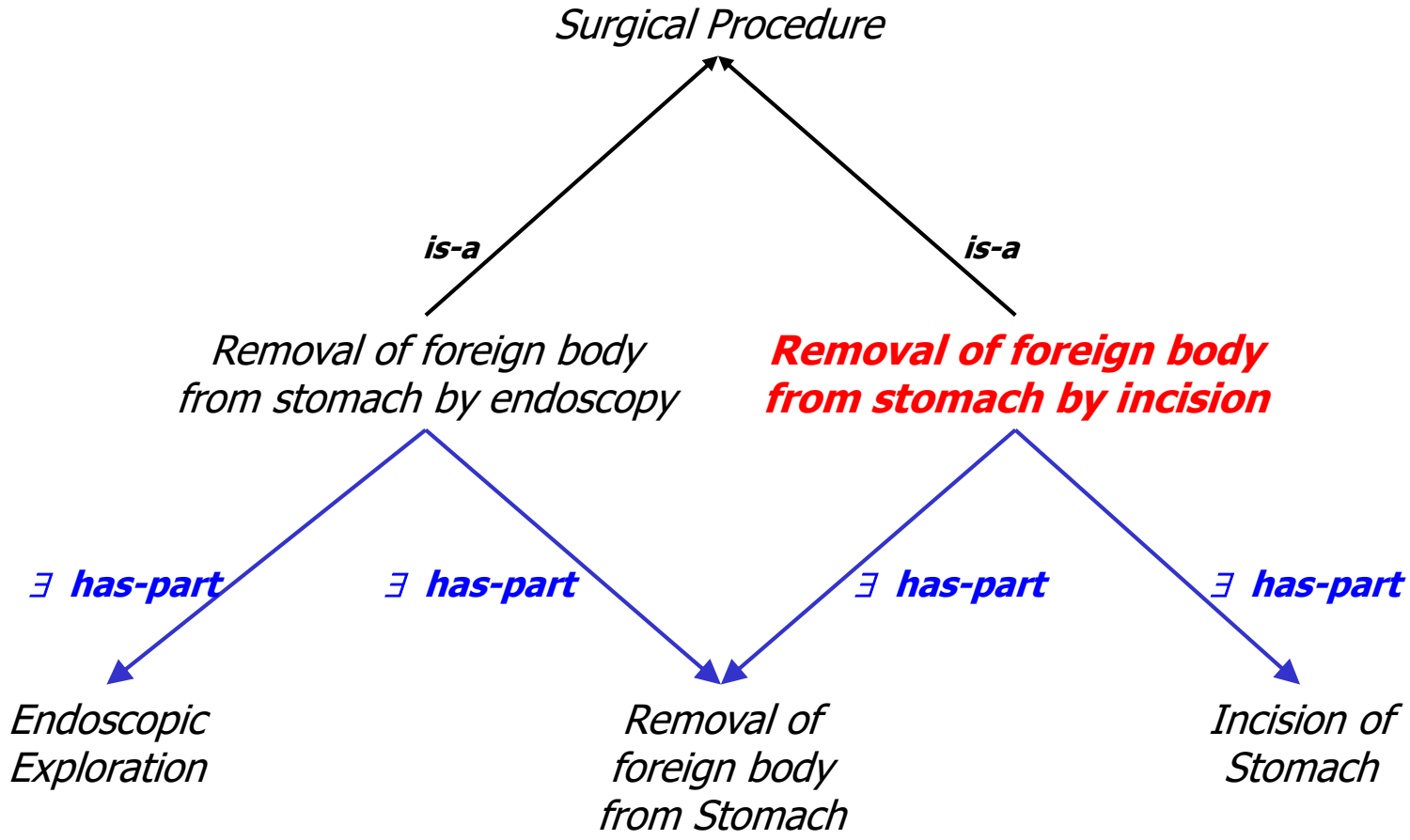
How to semantically relate processes with their subprocesses

1. A (complex) process is subsumed by its subprocesses:
   - Subprocesses do not exist simultaneously. An instance of ***Removal of foreign body from stomach by incision*** is first an instance of *Incision of stomach* and then becomes an instance of *Removal of foreign body*
2. Subprocesses are temporal parts of a (complex) process :
   - A complex process can be aborted before completion. The complex process ***Removal of foreign body from stomach by incision*** can only be instantiated if the subprocesses have been completed.

Theory 1: A (complex) process is subsumed by its subprocesses



Theory 2: Subprocesses are temporal parts of a (complex) process

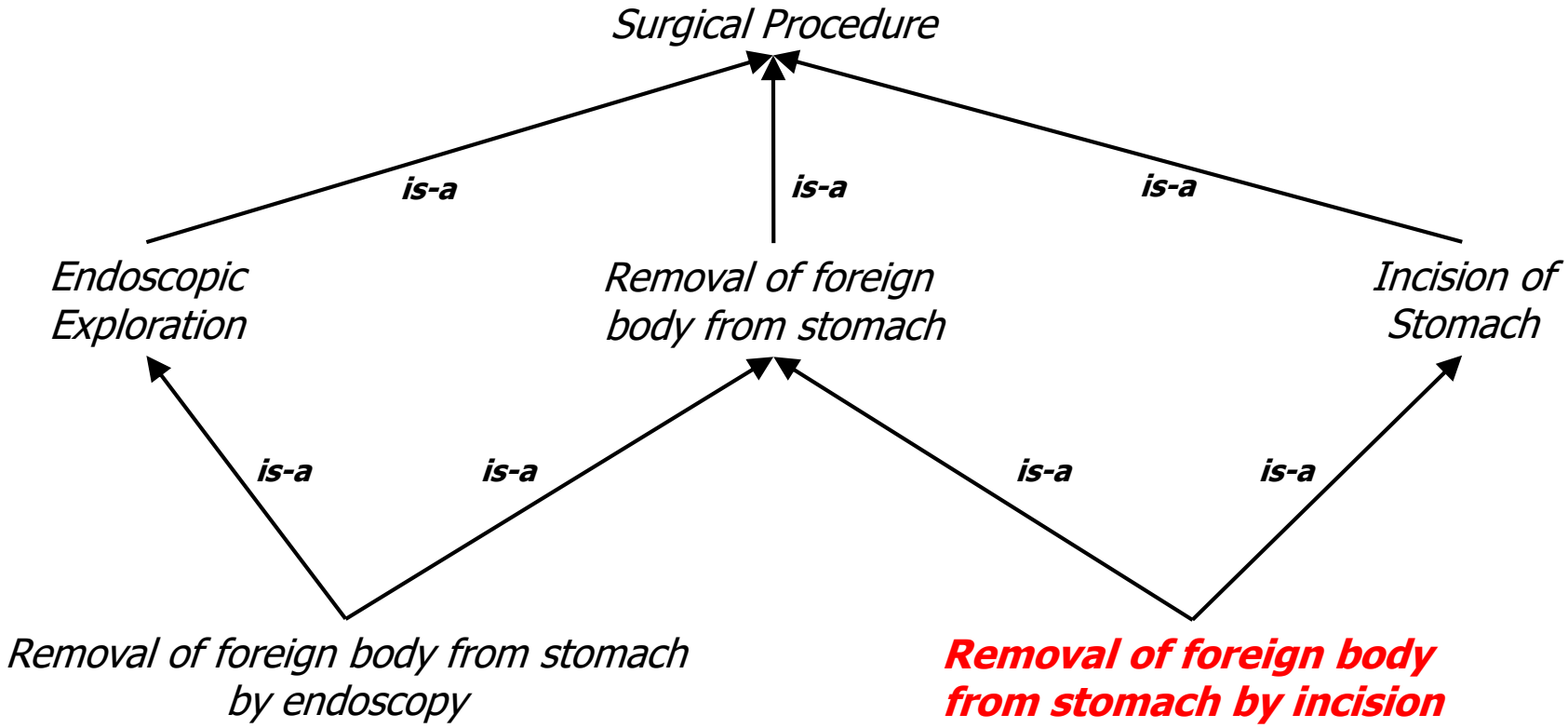


Representation in SNOMED CT

SNOMED® Concept 1	SNOMED® Relationship	SNOMED® Concept 2
Removal of Foreign Body from the Stomach by Incision	*Is A*	*Removal of foreign body from digestive system*
	Is A	*Removal of foreign body from stomach*
	Is A	*Incision of stomach*
	Method	*Removal - action*
	Direct Morphology	*Foreign body*
	Method	*Incision - action*
	Procedure site	*Stomach Structure*

…compatible with Theory 1

Theory 1: A (complex) process is subsumed by its subprocesses



Naïve DL Transcription

RemovalOfForeignBodyFromStomachByIncision ≡

RemovalOfForeignBodyFromDigestiveSystem AND

RemovalOfForeignBodyFromStomach AND

IncisionOfStomach AND

∃ Method.RemovalAction AND

∃ DirectMorphology.ForeignBody AND

∃ Method.IncisionAction AND

∃ ProcedureSite.stomachStructure

…indistinguishable from "incision of foreign body and removal of stomach" ???

Relationship Groups in SNOMED CT

SNOMED® Concept 1	SNOMED® Relationship	SNOMED® Concept 2	RG
Removal of Foreign Body from the Stomach by Incision	*Is A*	*Removal of foreign body from digestive system*	*0*
	Is A	*Removal of foreign body from stomach*	*0*
	Is A	*Incision of stomach*	*0*
	Method	*Removal - action*	*1*
	Direct Morphology	*Foreign body*	*1*
	Method	*Incision - action*	*2*
	Procedure site	*Stomach Structure*	*2*

Nesting with relationship groups (RGs) in DL formalism

RemovalOfForeignBodyFromStomachByIncision ≡

RemovalOfForeignBodyFromDigestiveSystem AND

RemovalOfForeignBodyFromStomach AND

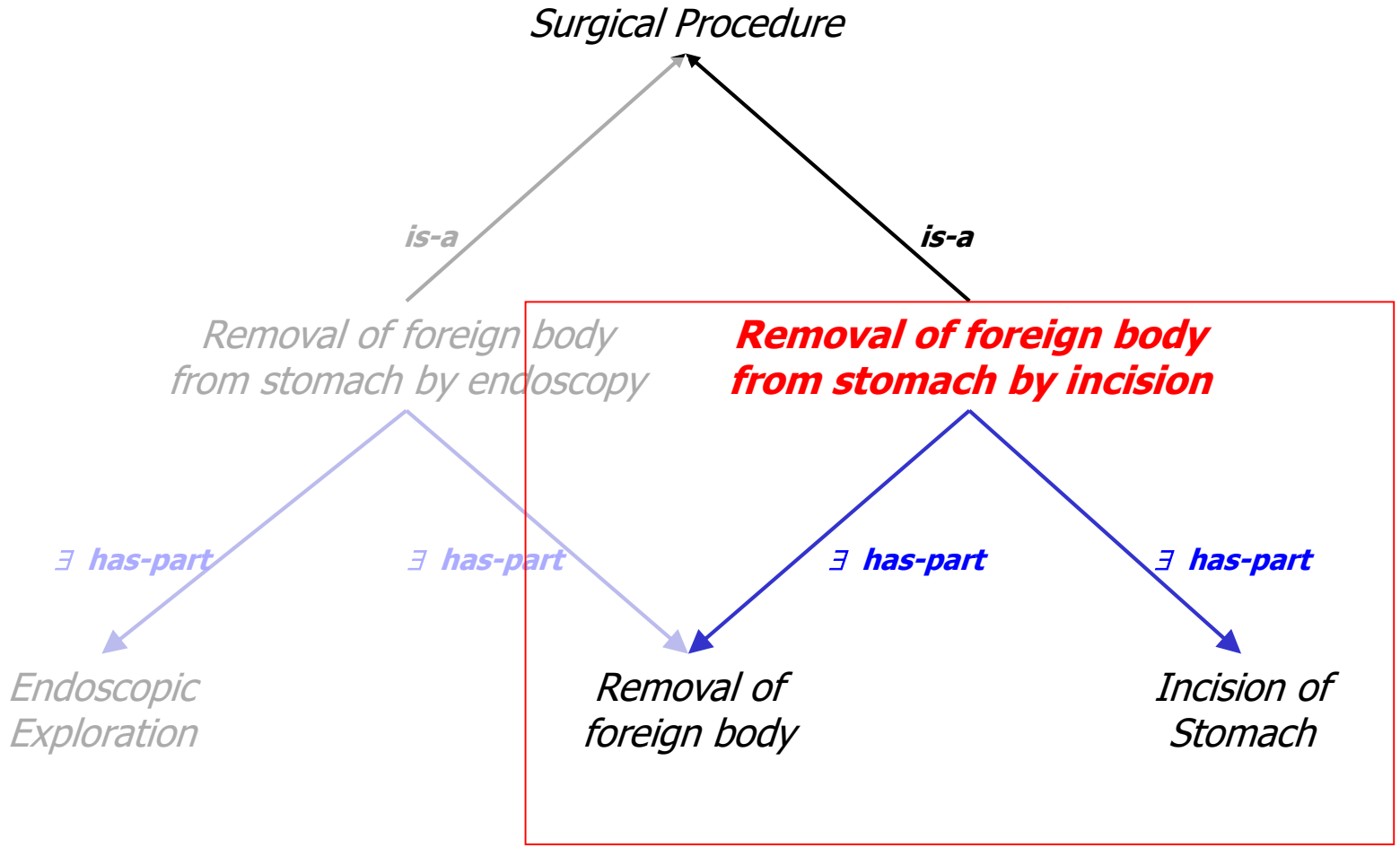
IncisionOfStomach AND

RG1 — ∃ RG.(∃ *Method.RemovalAction AND*
∃ *DirectMorphology.ForeignBody) AND*

RG2 — ∃ RG.(∃ *Method.IncisionAction AND*
∃ *ProcedureSite.stomachStructure)*

Mix-up prevented. Compatible with which theory ?

Theory 2: Subprocesses are temporal parts of a (complex) process



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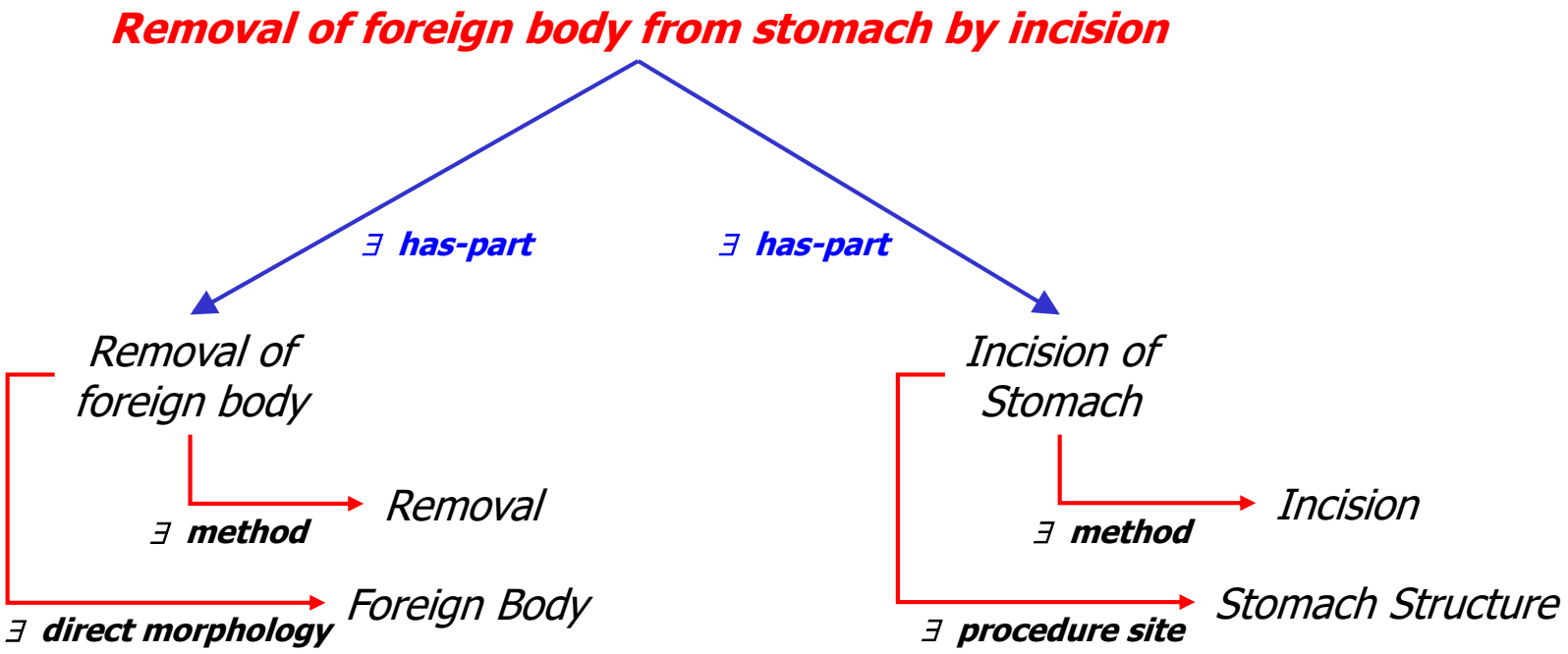

∃ has-part.(∃ Method.Removal AND ∃ DirectMorphology.ForeignBody)

∃ has-part.(∃ Method.Incision AND ∃ ProcedureSite.stomachStructure)

Nesting with relationship groups (RGs) in DL formalism

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RemovalOfForeignBodyFromDigestiveSystem AND

RemovalOfForeignBodyFromStomach AND

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RG2 — ∃ RG.(∃ *Method.IncisionAction AND*
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SNOMED relation groups can be re-interpreted as has-part

RemovalOfForeignBodyFromStomachByIncision ≡

RemovalOfForeignBodyFromDigestiveSystem AND

RemovalOfForeignBodyFromStomach AND

IncisionOfStomach AND

RG1 ∃ has-part.(∃ *Method.RemovalAction AND*
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Difference between "X" and "X-Action" in SNOMED CT

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Conclusions

- Relationship groups in SNOMED CT may represent the mereological relation between procedures / actions / processes and their parts.
- Suggest: Rename the relationship group attribute *RG* by *has-part* or *has-subprocess* in these cases.
- Make a clearer distinction between atomic classes (such as *IncisionAction*) and those classes which have atomic classes as parts (such as *IncisionProcess*). The present names are misleading.

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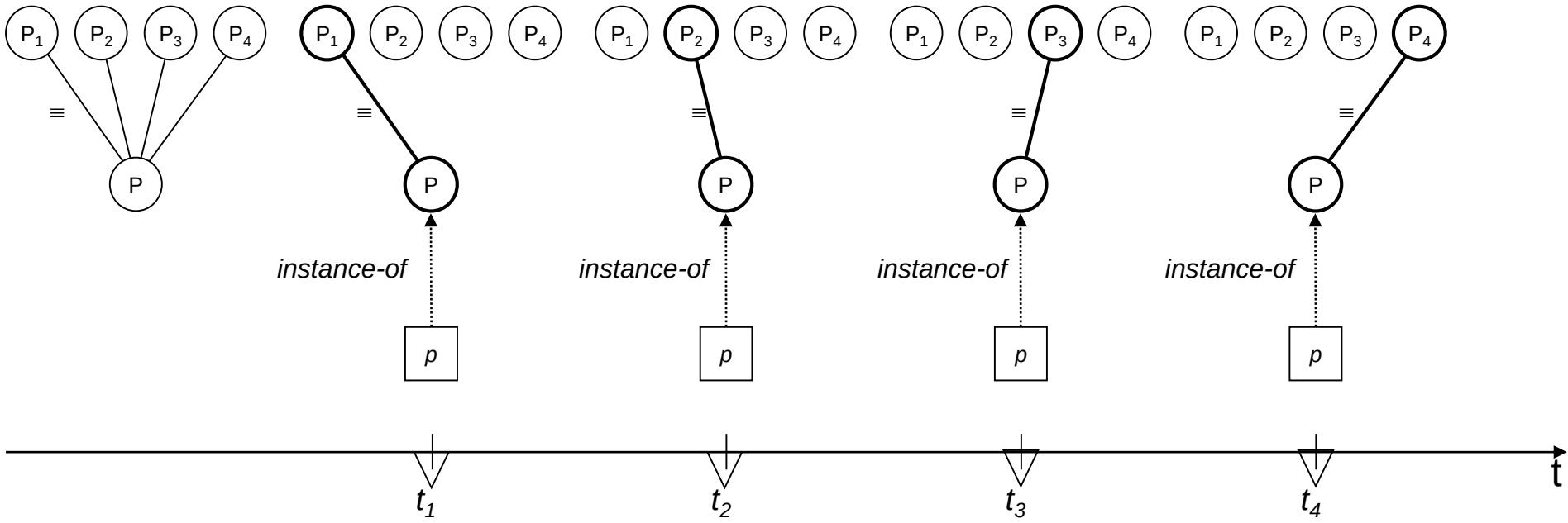
Theory 1: Process is instantiated by its subprocesses



Acknowledgements: Boris Hennig, unpublished

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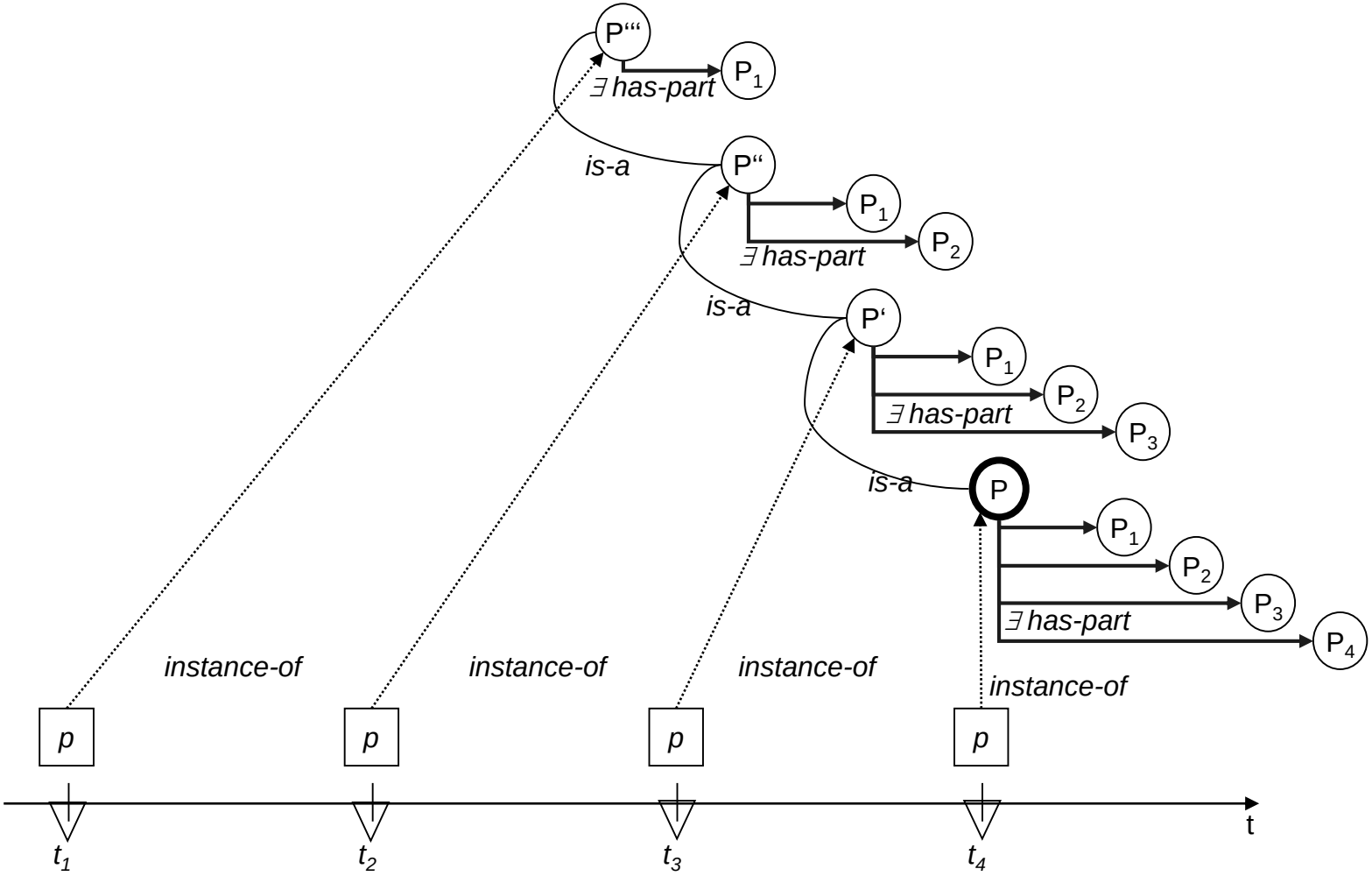
Theory 2: Subprocesses are parts of their parent processes



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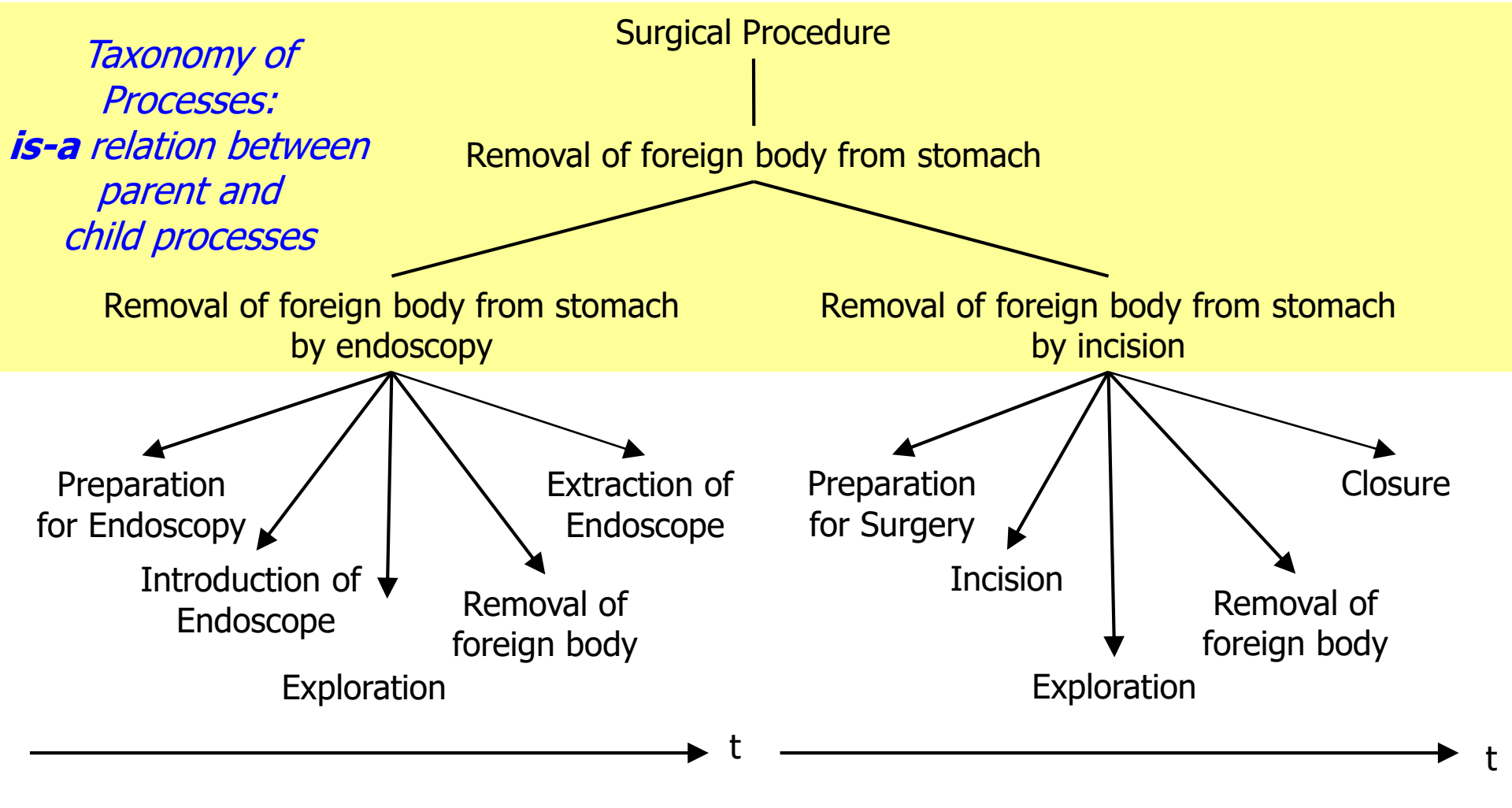
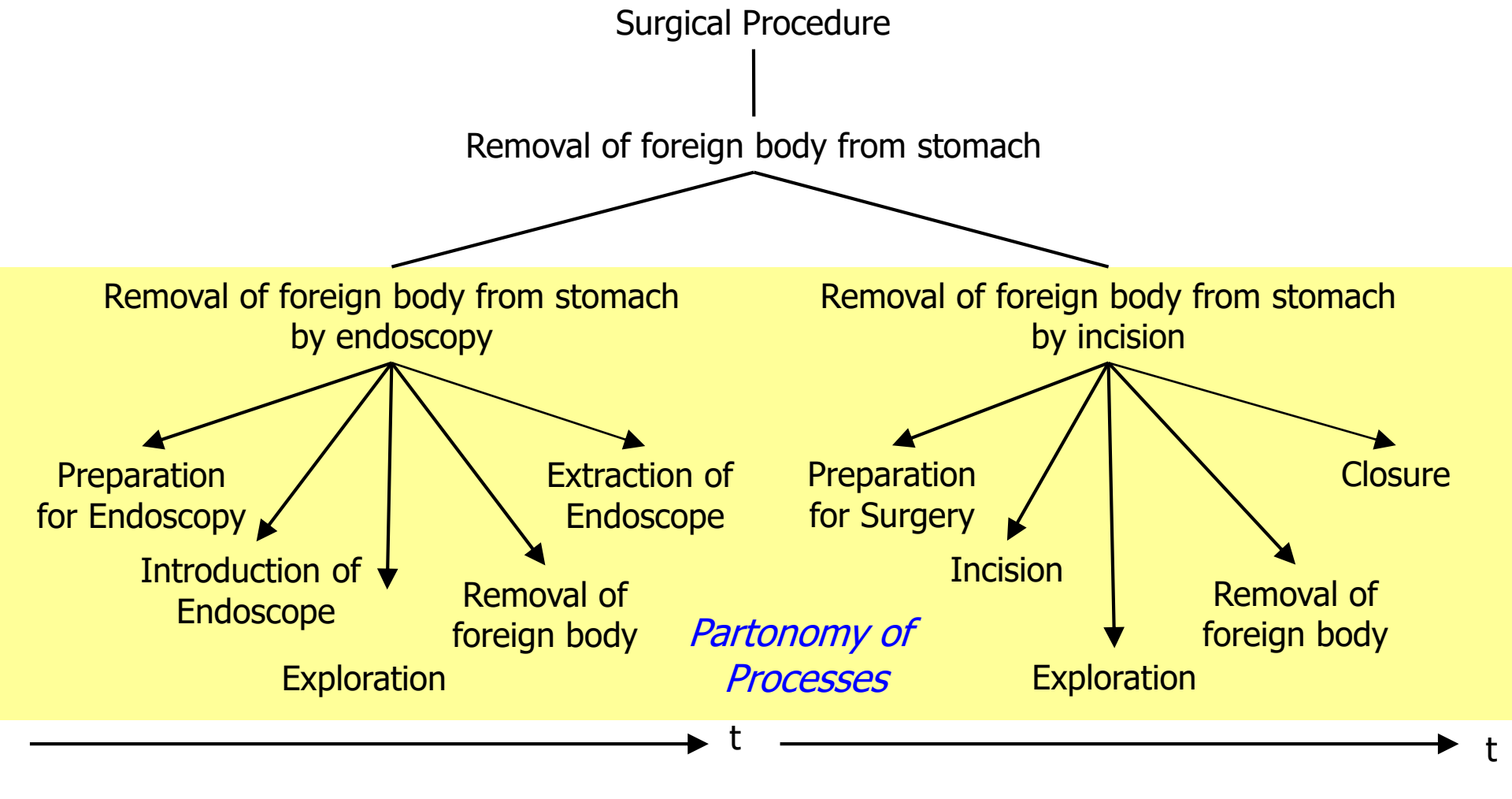
Processes and Subprocesses