

Can we have a hierarchical model of Scientific Understanding? A response to Batens

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With support of UNAM-PAPIIT projects

PAPIIT IN 403719 “Intensionalidad hasta el final: un nuevo plan para la relevancia lógica”
and PAPIIT IG400219 “Conciencia y normatividad”

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June 3, 2019

UNAM

Can we have a hierarchical model of
Scientific Understanding?

Yes.

What is the role of scientific understanding when
explaining the tolerance of defectiveness in the
sciences?

It could be explanatory as to why and how scientists
tolerate certain defects in their day-to-day practice

Can we have a hierarchical model of
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Yes.

What is the role of scientific understanding when
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It could be explanatory as to why and how scientists
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Can we have
a hierarchical
model of
Scientific
Understanding
?

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- 1 (Batens-ian) Preliminaries
- 2 Scientific Understanding
- 3 Knowledge & Understanding
- 4 Understanding defectiveness: contradictions
- 5 Final remarks

Preliminaries

ScUnderstanding

Knowledg &Un

Defectiveness

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(1991)

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Do We Need a Hierarchical Model of Science?

Diderik Batens

Hierarchical models

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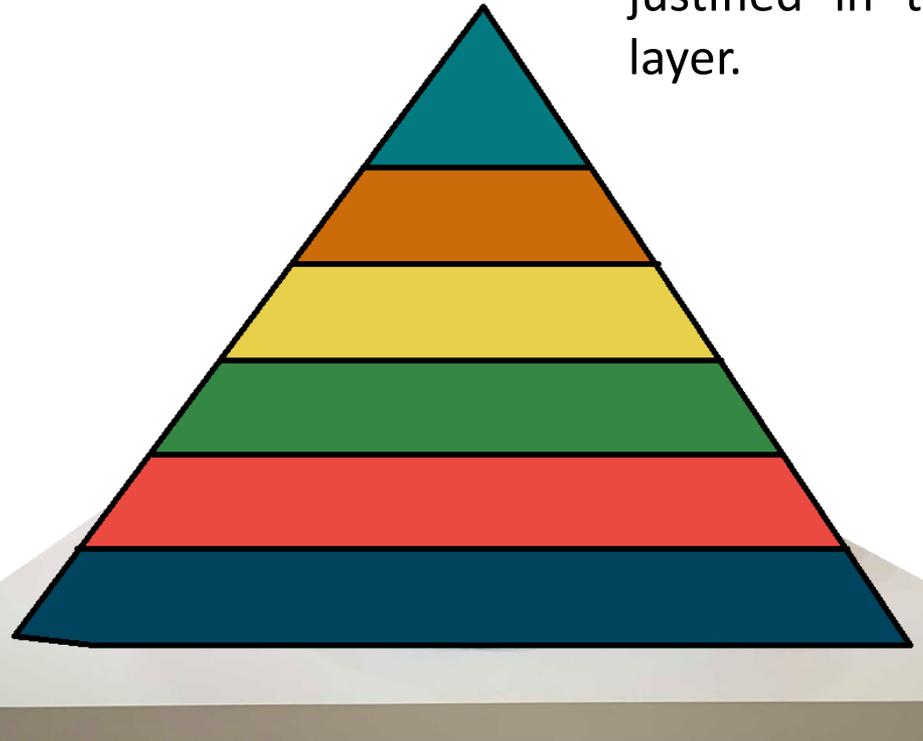
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... to hierarchical models of science, our scientific knowledge (...) forms a knowledge system that has two properties: (i) it is stratified, and (ii) the items of some layer are or should be justified in terms of items of a higher layer.

(Batens, 1991: 1999)



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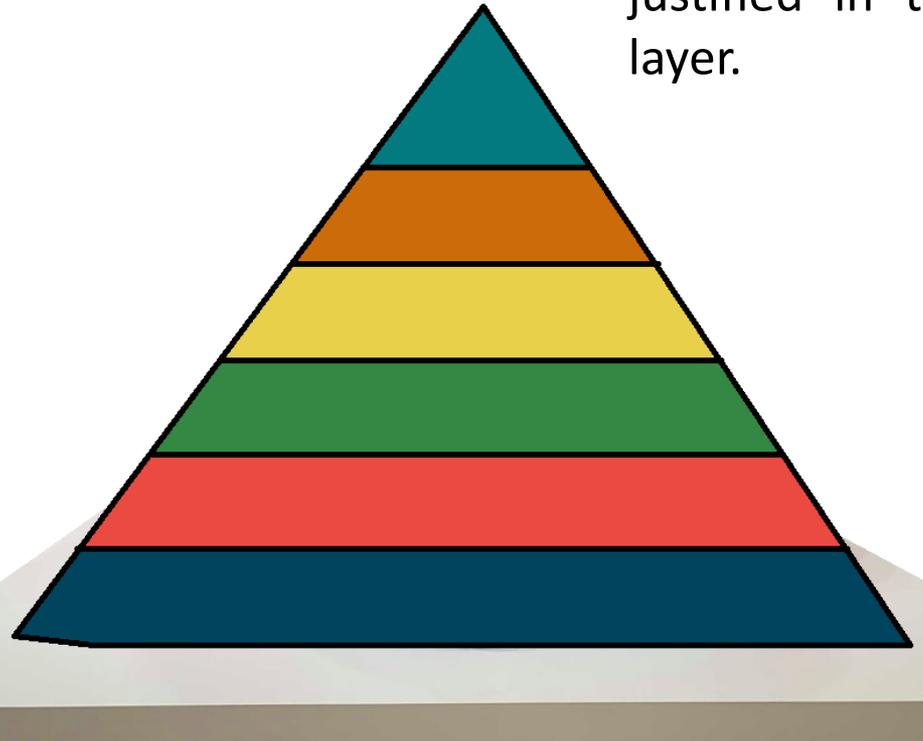
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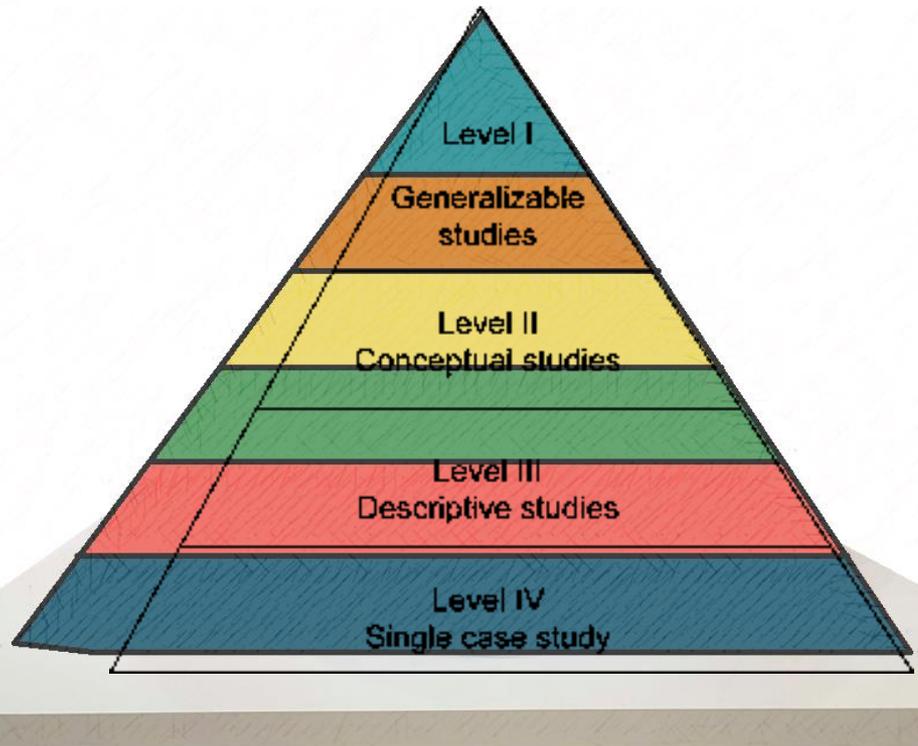
... to hierarchical models of science, our scientific knowledge (...) forms a knowledge system that has two properties: **(i) it is stratified**, and (ii) the items of some layer are or should be justified in terms of items of a higher layer.

(Batens, 1991: 1999)



Hierarchical models

(i) it is stratified



(Jeanne Dalya, Karen Willisb, Rhonda Smalla, Julie Greenc, Nicky Welchd, Michelle Kealya, Emma Hughes; 2006: 45)

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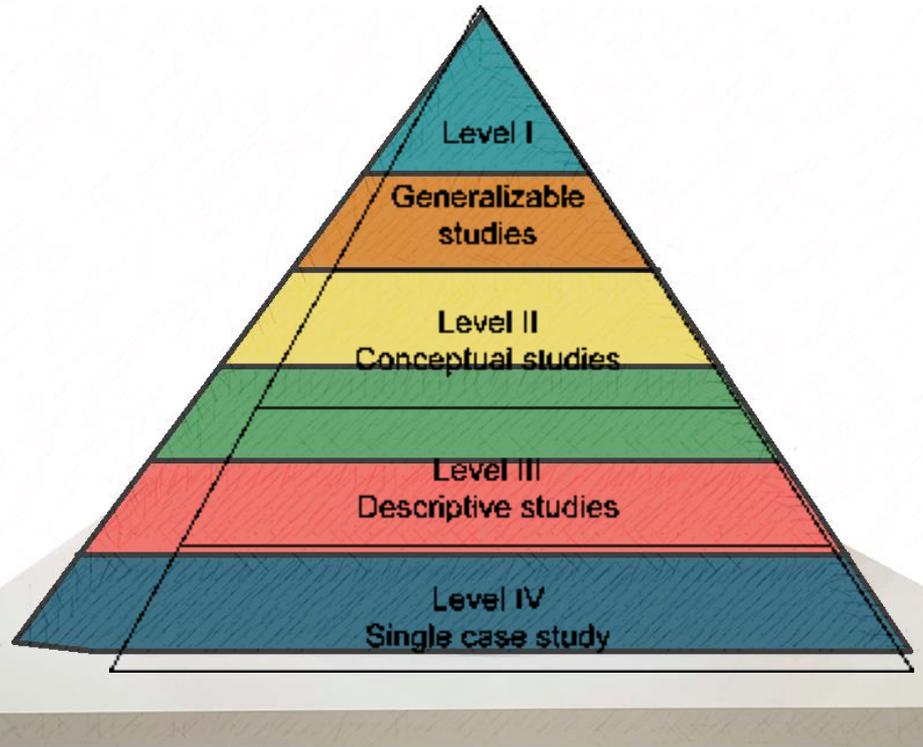
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Examples

(i) it is stratified



(Jeanne Dalya, Karen Willisb, Rhonda Smalla, Julie Greenc, Nicky Welchd, Michelle Kealya, Emma Hughes; 2006: 45)

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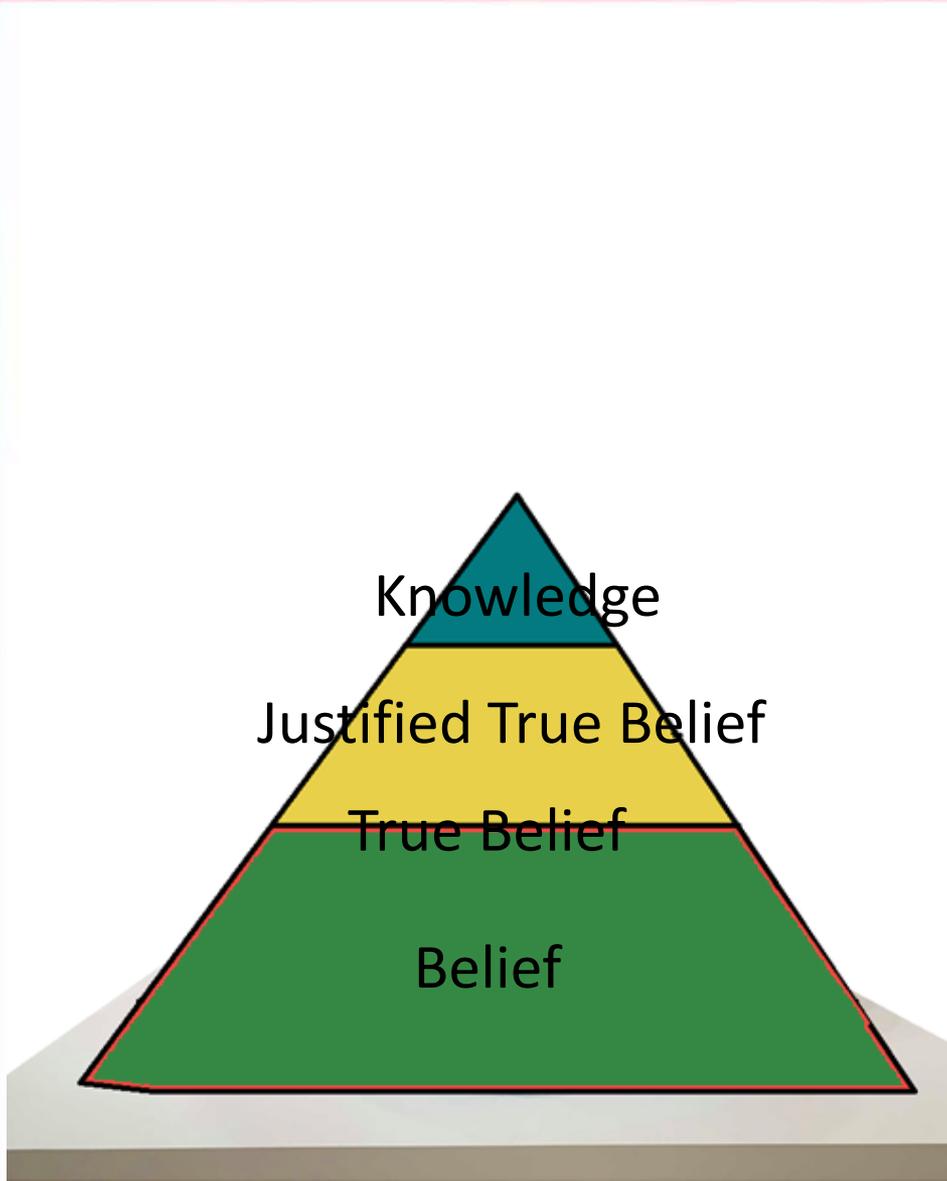
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Examples

(i) it is stratified



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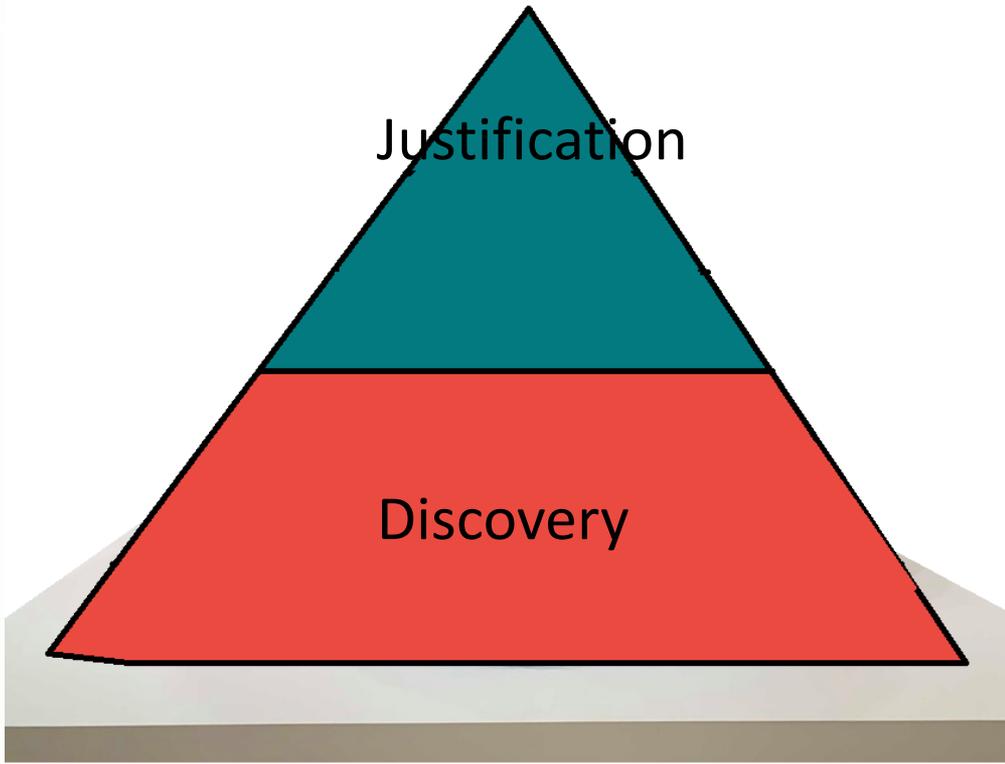
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Examples

(i) it is stratified



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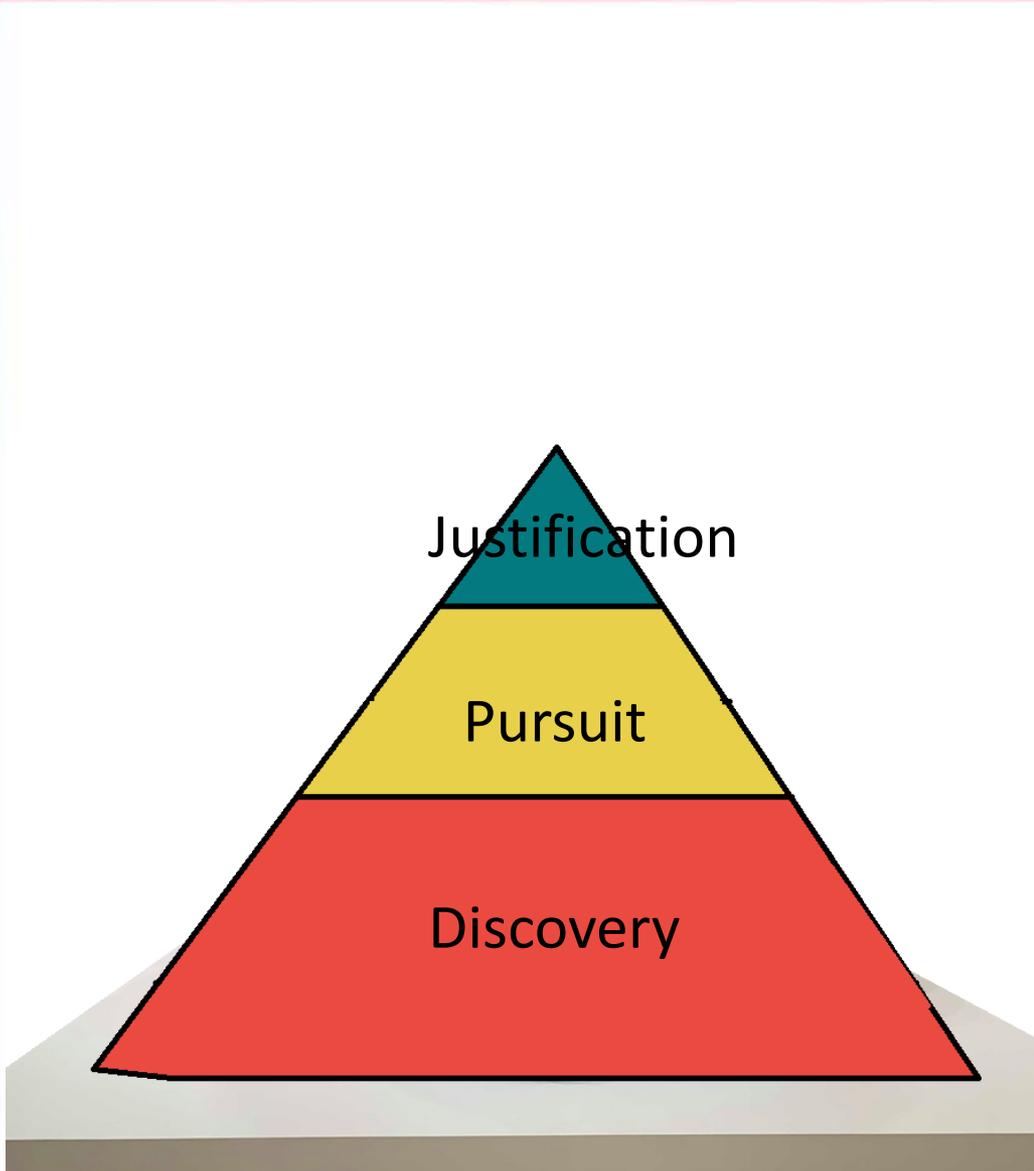
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Examples

(i) it is stratified



(Laudan, 1980)

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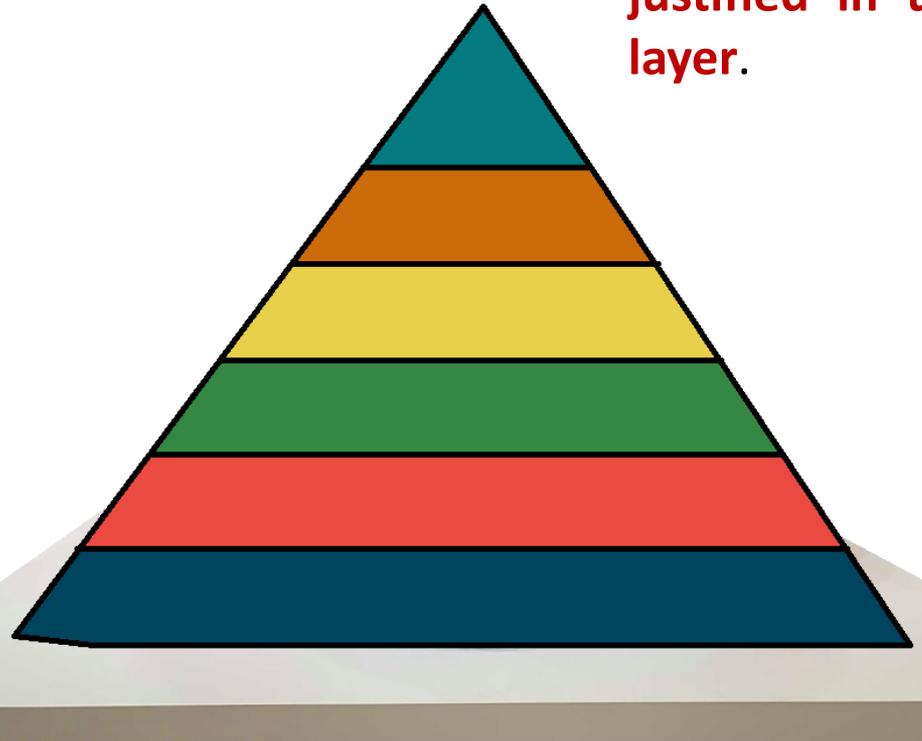
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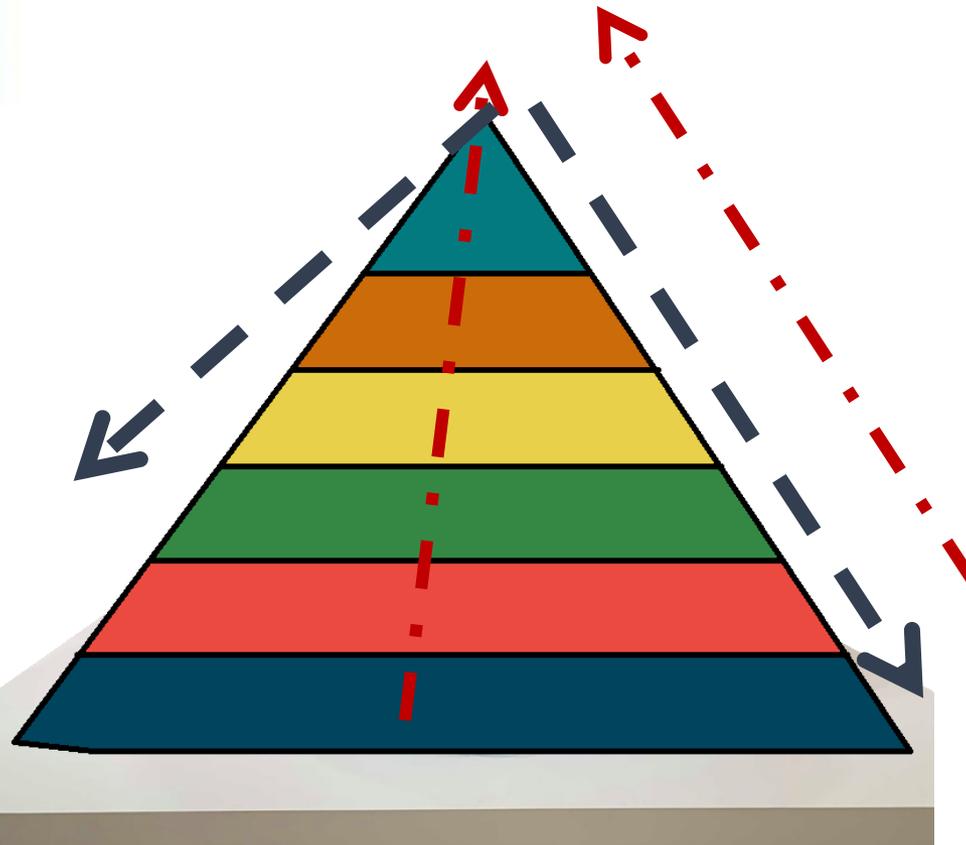
... to hierarchical models of science, our scientific knowledge (...) forms a knowledge system that has two properties: (i) it is stratified, and **(ii) the items of some layer are or should be justified in terms of items of a higher layer.**

(Batens, 1991: 1999)



Hierarchical models

Decisions at the lower level derive directly from the items at the higher level.



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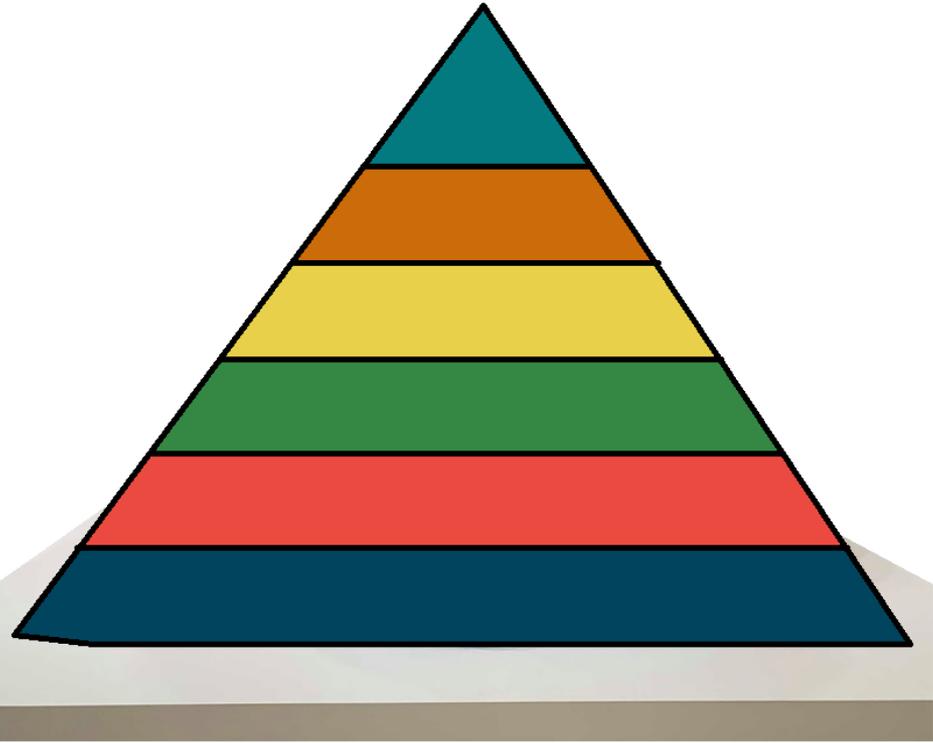
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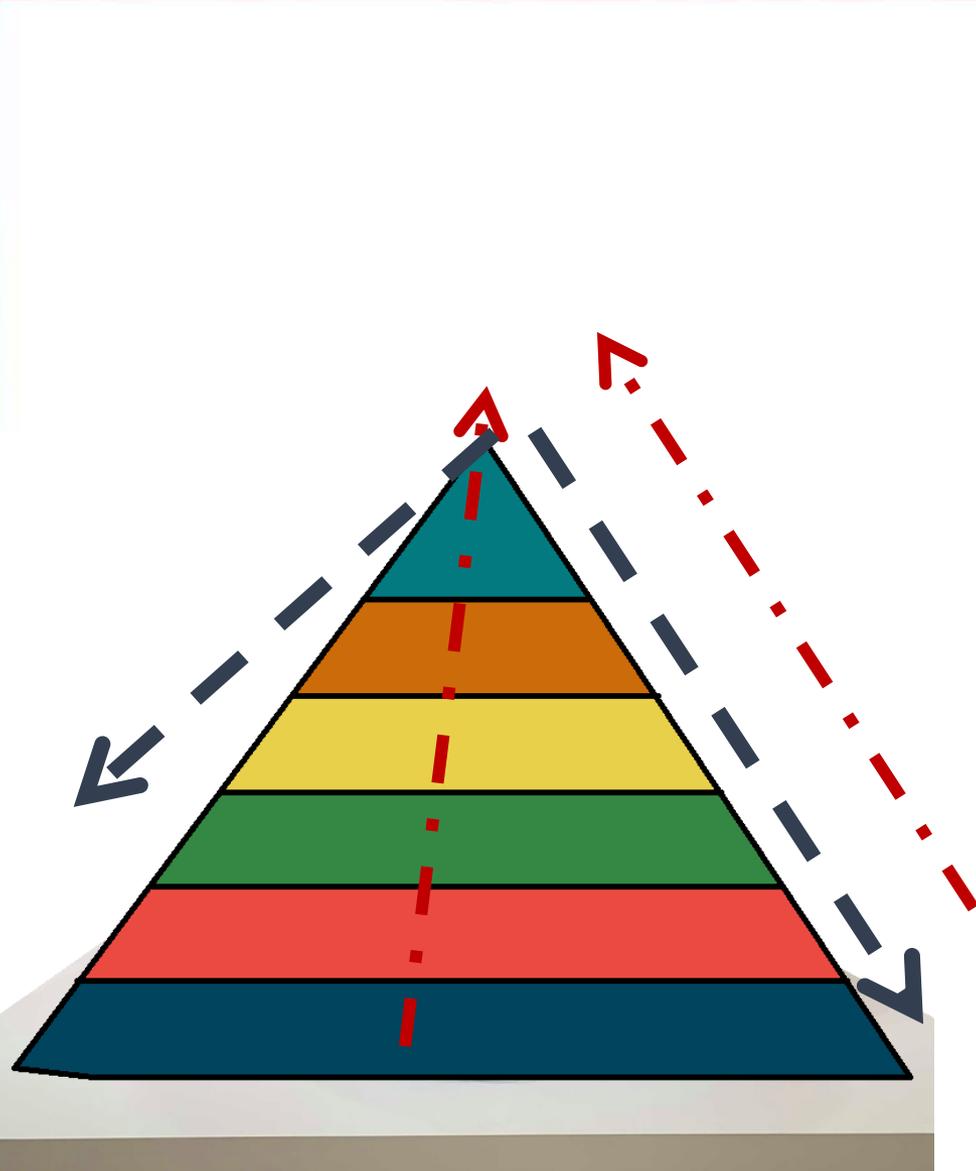
- Scientific disciplines
- Types of knowledge
- Types of justification
- Emp. Adequacy
- Accuracy
- Truth
- (...)

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- Cumulative (?)
- Certainty (?)
- *Mp* foundations (?)
- Emp. Adequacy
- Accuracy
- Truth
- (...)

Hierarchical models: problems

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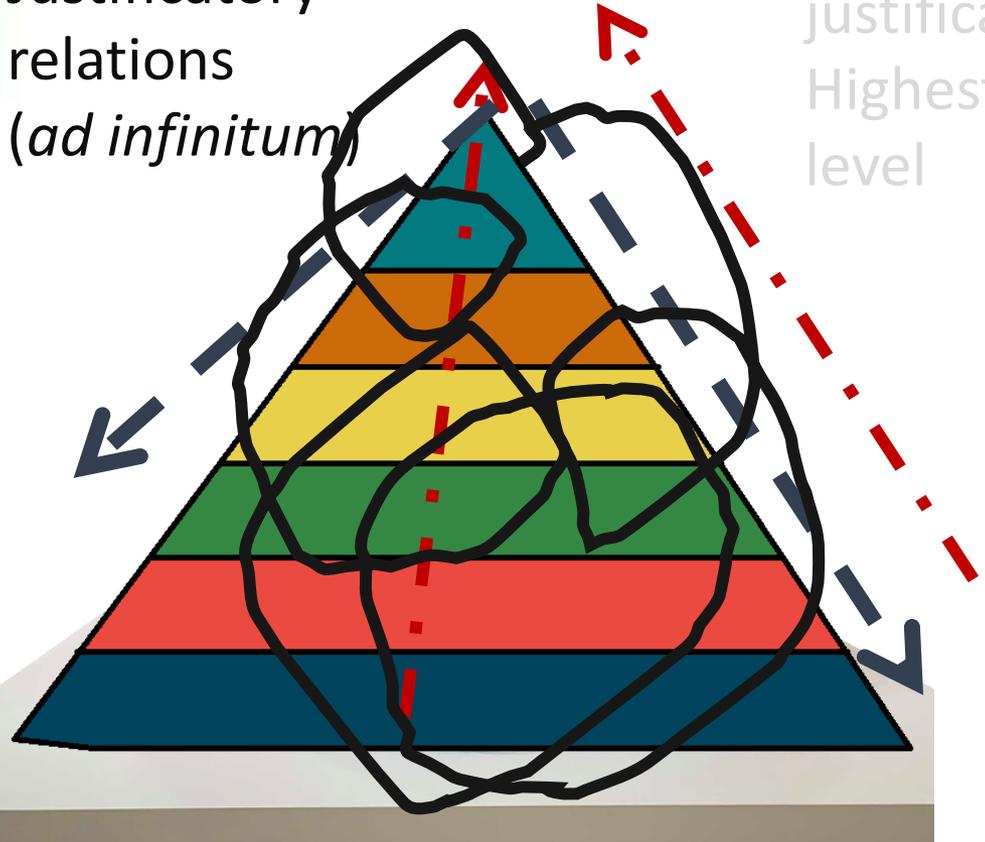
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Absolute
certainties

Instrumental
justification
Highest
level

Justificatory
relations
(*ad infinitum*)

Humans cannot
do it



Hierarchical models: problems

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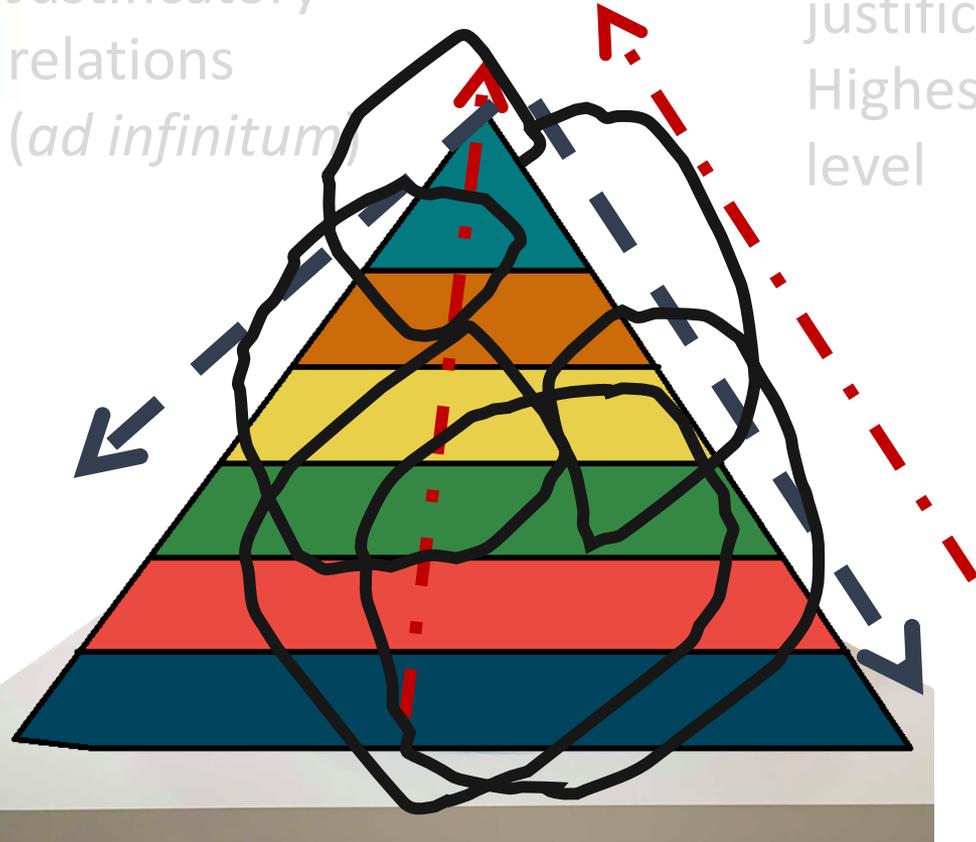
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Absolute
certainties

Justificatory
relations
(*ad infinitum*)

Instrumental
justification
Highest
level

Not possible
(Disagreement)

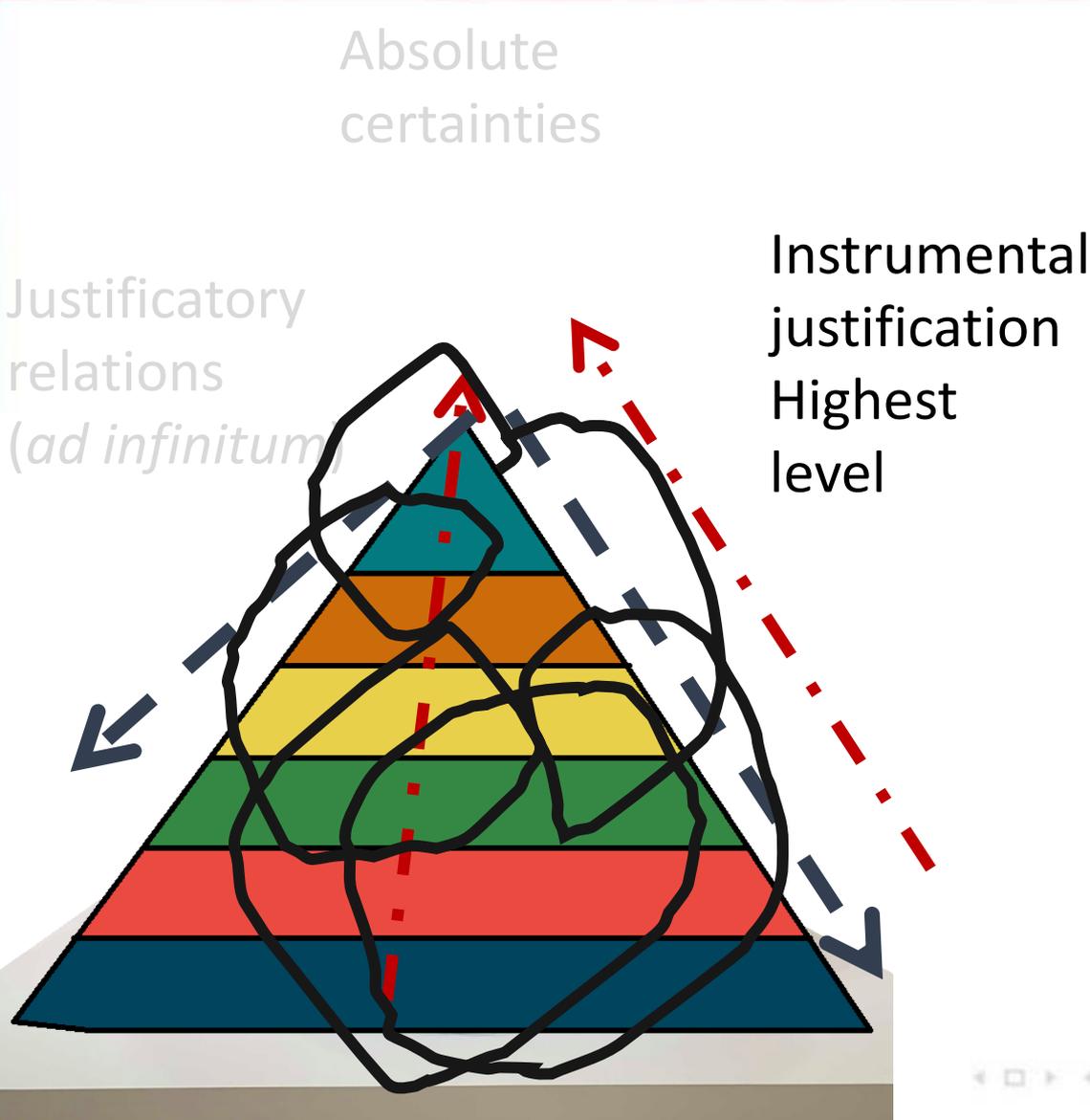


Hierarchical models: problems

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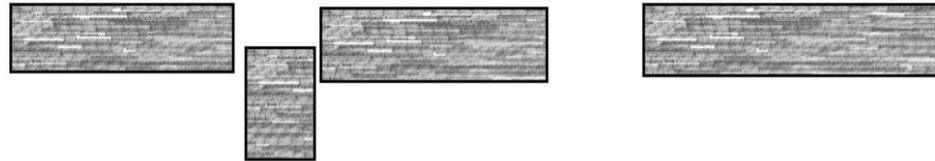
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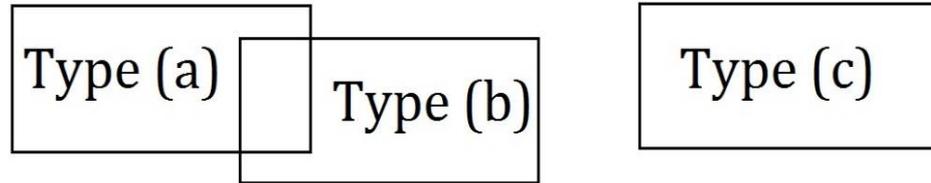


Scientific knowledge is, most of the time, **incomplete**.

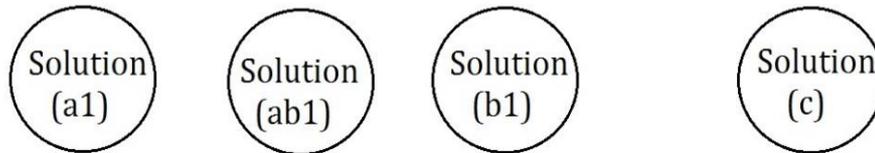
Phenomena:



Problems:



Solutions:



Scientific knowledge is, most of the time, **incomplete**.

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Contextual Problem Solving

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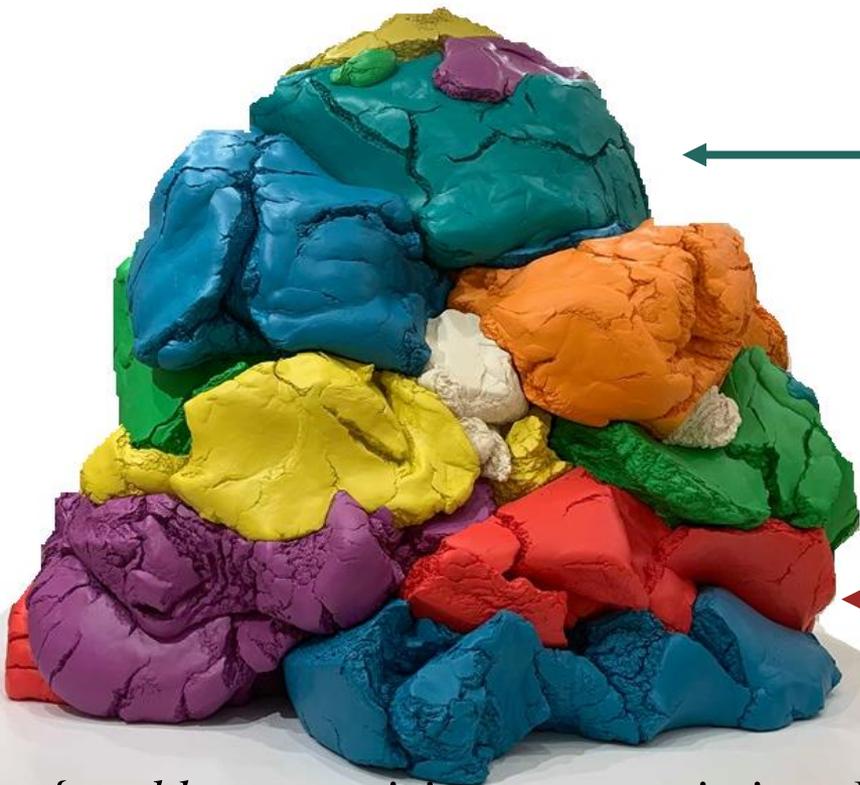
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$\{problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A\}$



$\{problem_B, participants_B, certainties_B, Rel_B(x, problem_B), meth_B\}$

Contextual Problem Solving

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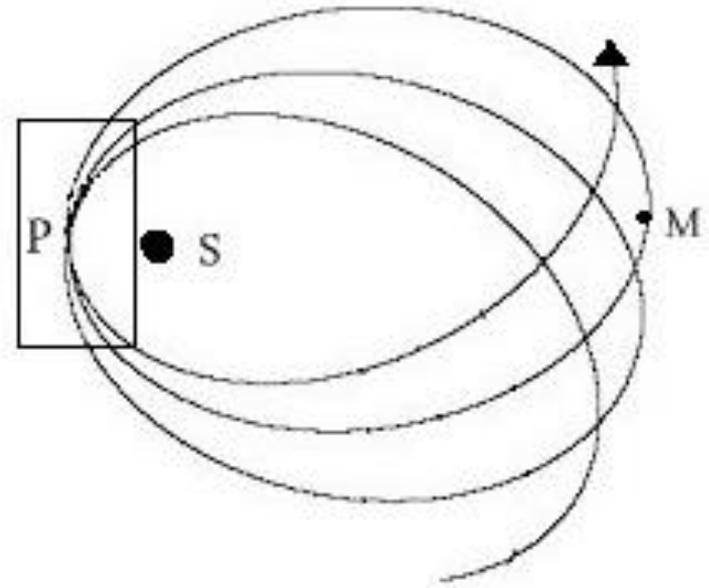
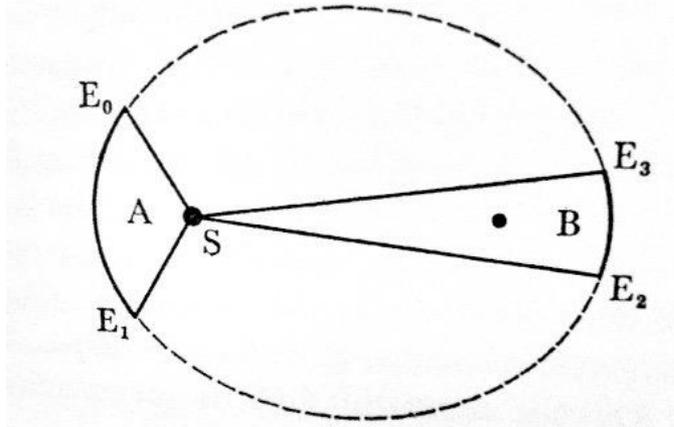
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Context vs contex

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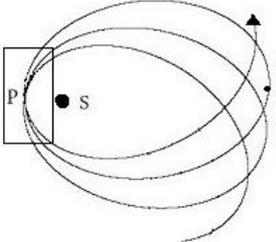
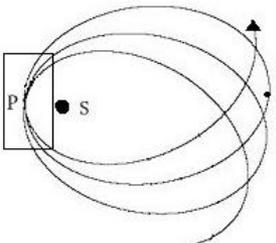
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$\{problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A\}$				
				
	<p>“Even so, the idea that such anomalies are something that gravity research ought to be pursuing did not come fully to the forefront in the literature until after the discovery of Neptune.” (Smith, 2014: 84)</p> <p>And after that they were positively pursued as they were regarded as extremely informative.</p>			

The result

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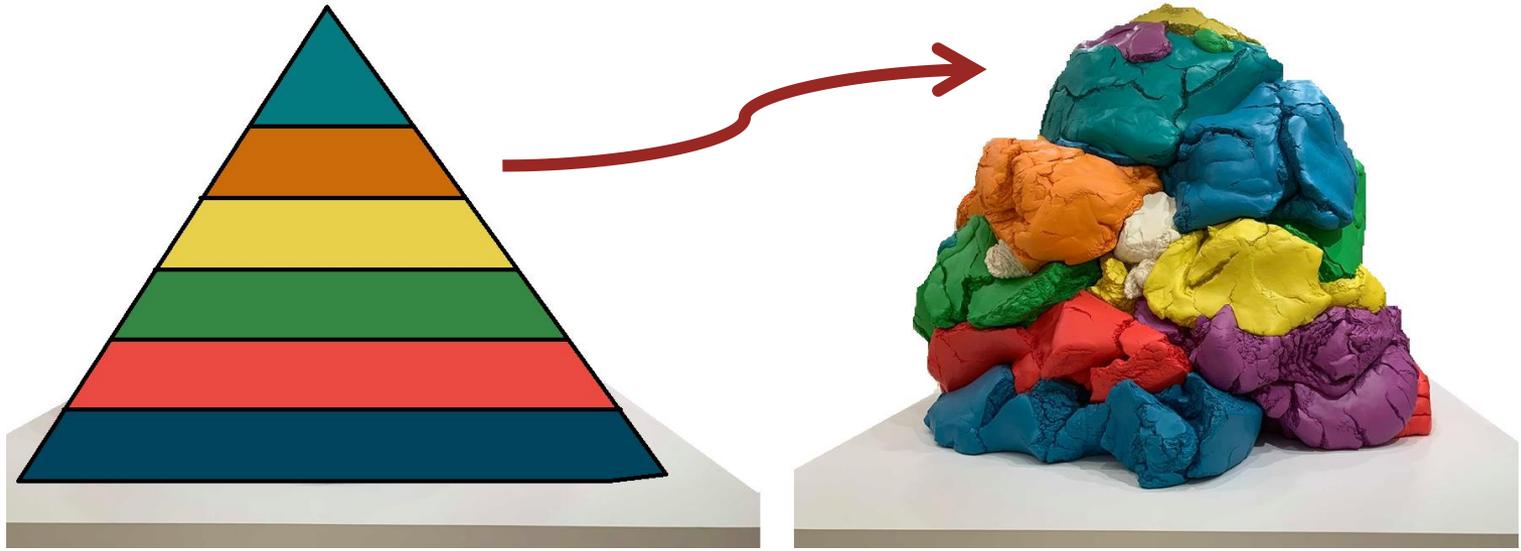
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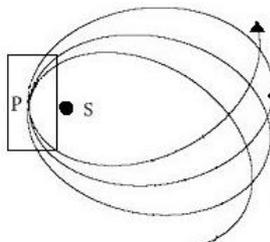
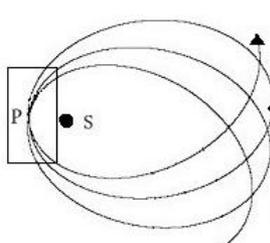
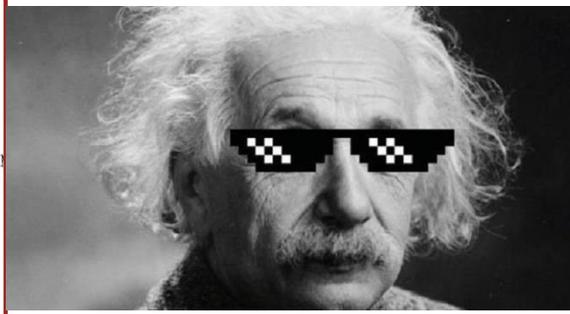
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$\{problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A\}$		
	<p>When you discover gravity but can't attract anyone</p> 	<p>contradiction</p>
		<p>Exp. gap</p>

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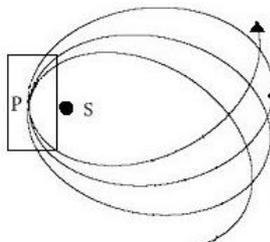
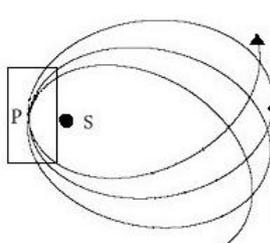
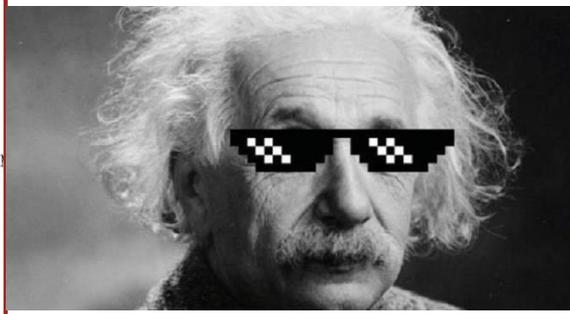


Context vs contex

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$\{problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A\}$

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Do we need a hierarchical model of *Scientific Knowledge*?



Scientific Knowledge

Do we need a hierarchical model of *Scientific Knowledge*?

No.



Can we have
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Can we have a hierarchical model of *Scientific Knowledge*?



Scientific Knowledge

Can we have
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Can we have a hierarchical model of *Scientific Knowledge*?
No (if we want it to be descriptive and explanatory)



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Can we have a hierarchical model of
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However, while many different ways to attain and assess scientific understanding have been put forward by epistemologists of science, there is still no unanimous view on how to characterize it and so, depending on the particularities of the cases of understanding that are studied, different philosophical approaches have been presented.

Understanding

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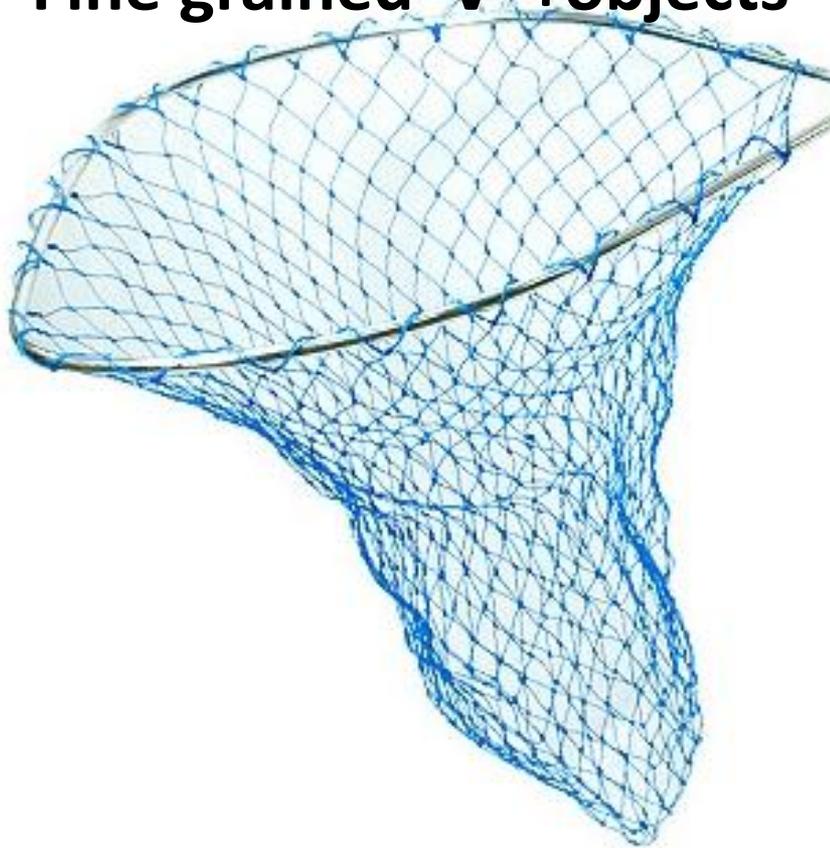


Understanding

Grasping

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Fine grained \vee +objects \vee Truth



Understanding

Grasping

Putting together

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Understanding (I)

(Khalifa, 2017: 2)

Non-Explanatory

Explanatory

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Understanding (I)

(Khalifa, 2017: 2)

Table I.I: *Different Kinds of Non-Explanatory Understanding*

Kind of understanding	Typical Complement	Examples
Propositional	<i>that</i> + declarative sentence	I understand that you might not enjoy reading this book.
Broad Linguistic	The name of a language	Schatzi understands German.
Narrow Linguistic	<i>what</i> + a linguistic expression + <i>means</i>	Schatzi understands what “Ich bin Berliner” means.
Procedural	<i>how</i> + infinitive	Miles understands how to play trumpet.
Non-explanatory Interrogative	Embedded question that does not seek an explanation as its answer (most who, where, what, and when questions)	I understand who my friends are. I understand where my friends will be going. I understand what my friends are doing. I understand when my friends need a good laugh.

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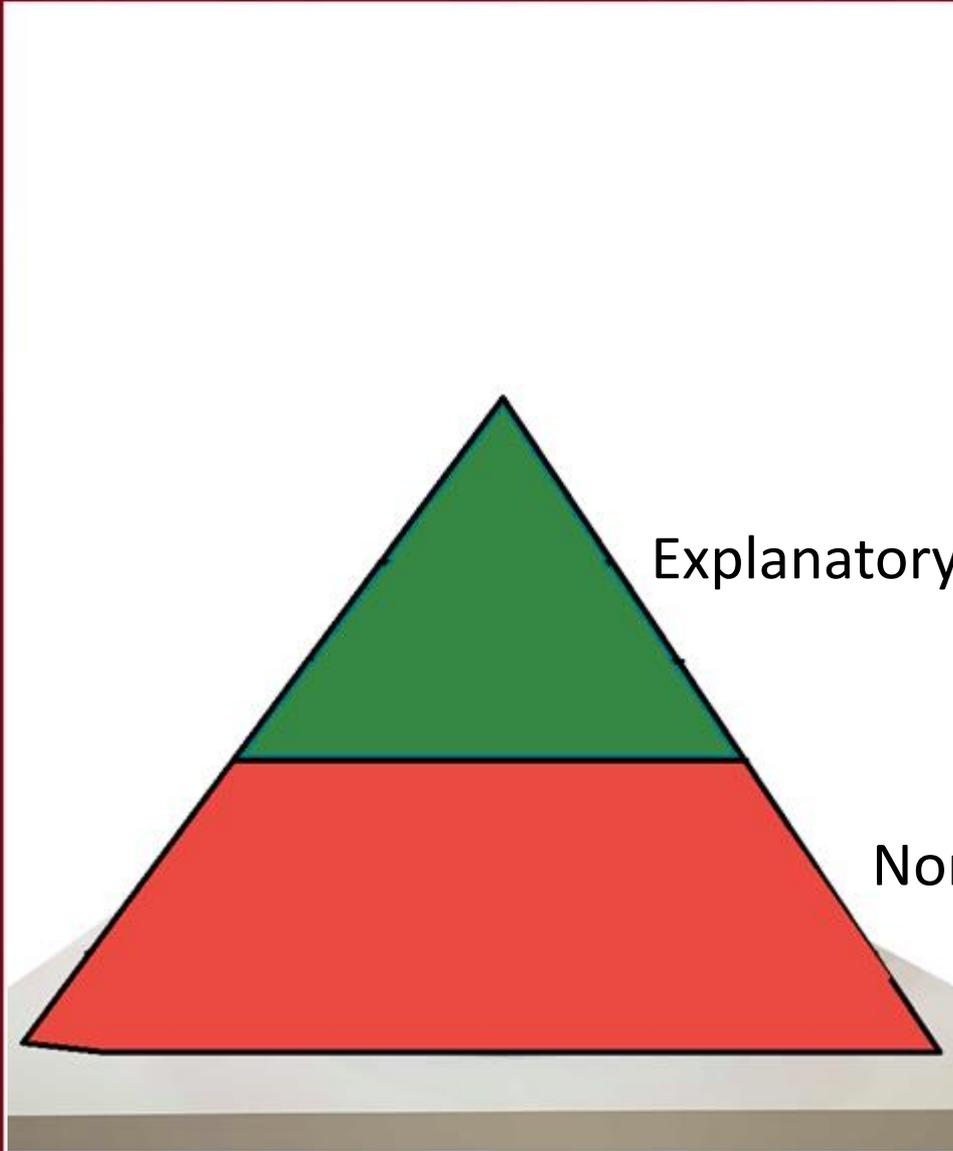
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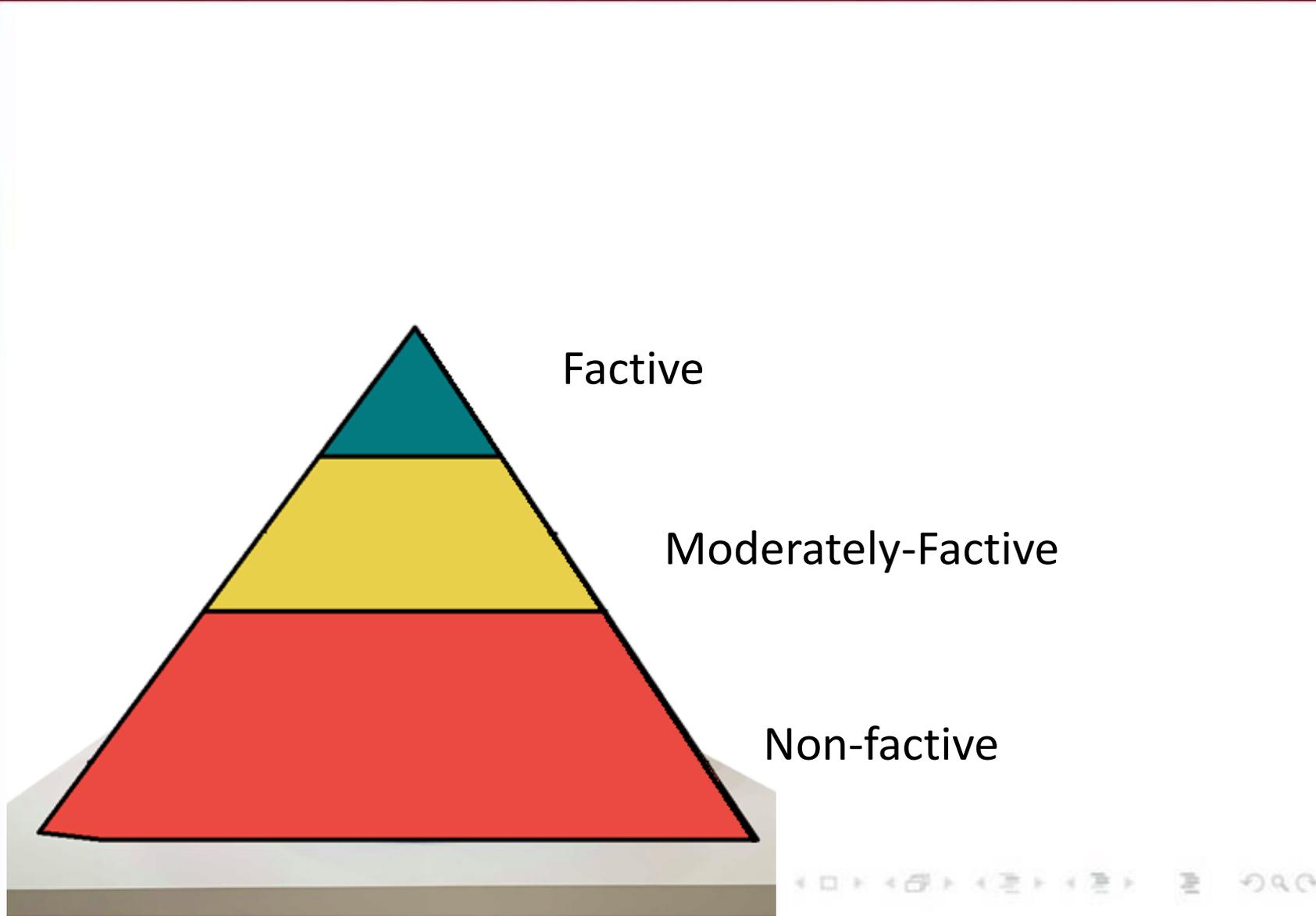
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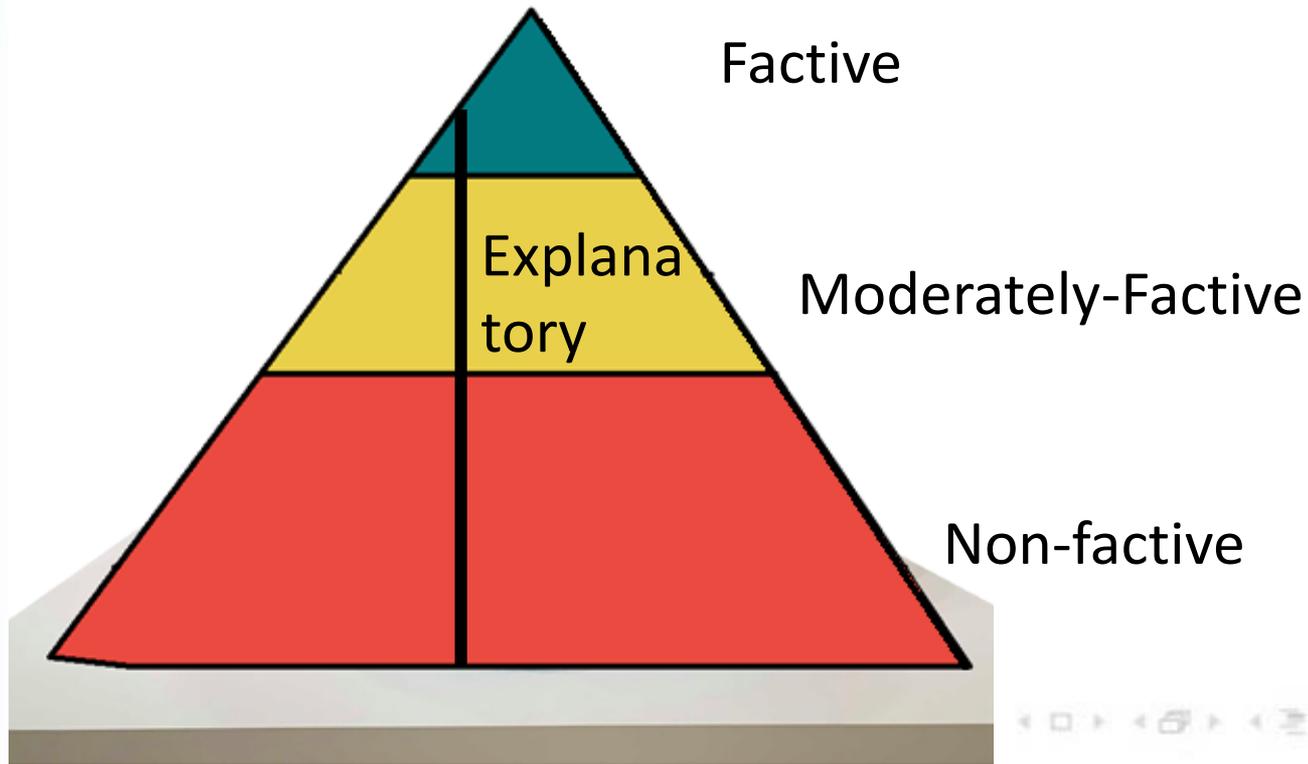
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Hierarchical models of understanding

If Explanatory \rightarrow Factivity req.



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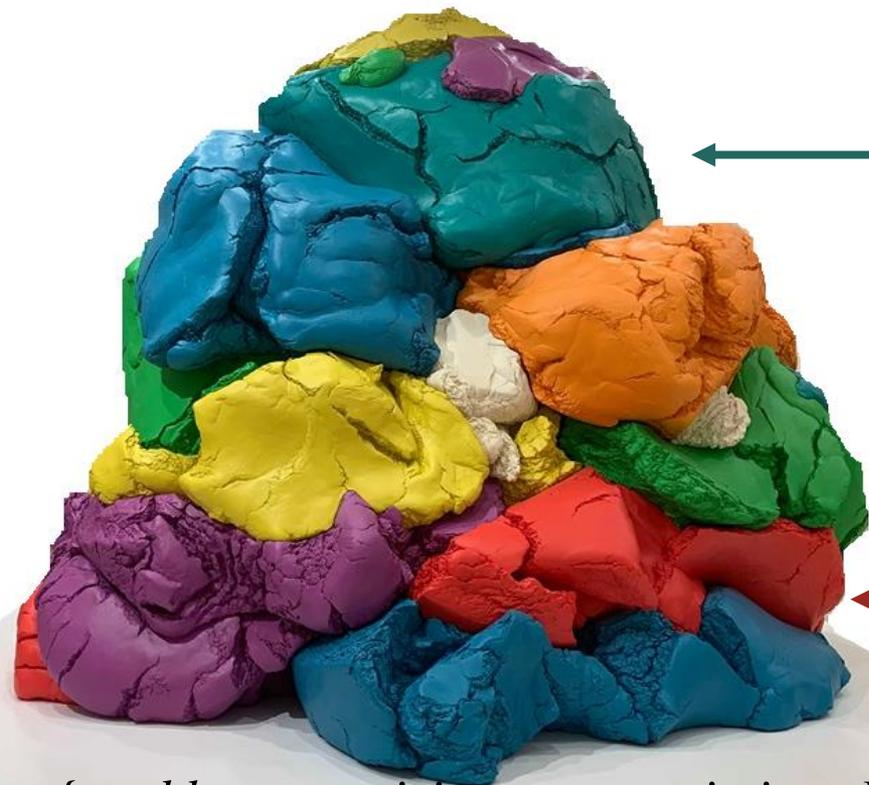
But...?

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$\{problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A\}$



$\{problem_B, participants_B, certainties_B, Rel_B(x, problem_B), meth_B\}$

Expertise (contextual)

Can we have
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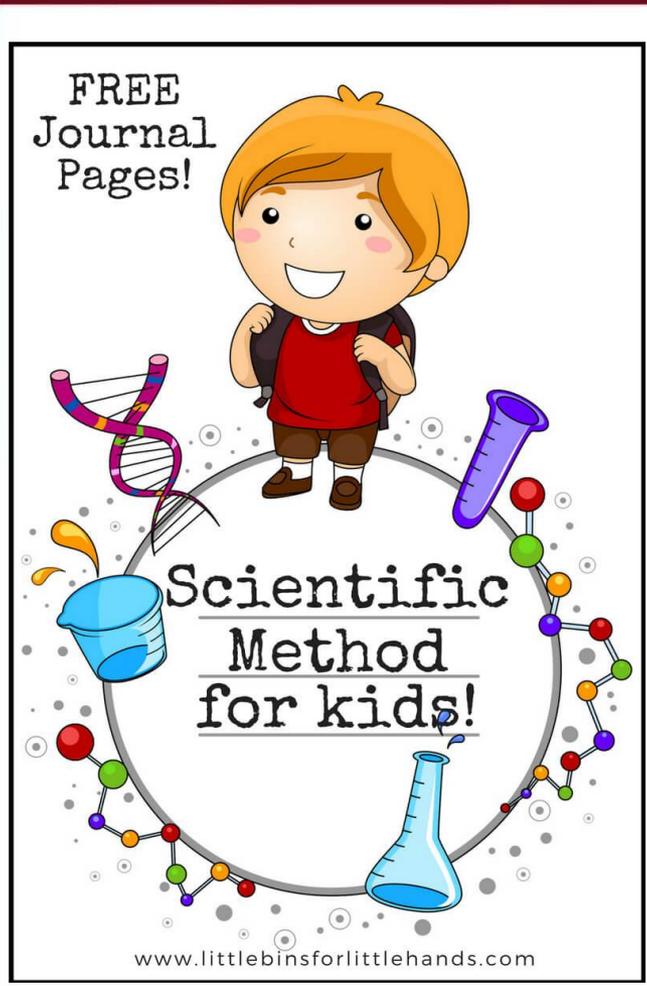
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(Ammon, 2017)



Elgin (2017), Martínez-Ordaz (2019)

(Recognizing): Identifying salient features of a particular object of study and generating an exemplar of such object guided only by the features previously selected.

(Providing): Presenting an exemplar of a particular object and explaining how the salient features of such an object are present in the provided exemplar.

(Afterlightining): Evaluating the soundness of the provided exemplar as well as the relevance of the elements previously identified as salient.

Understanding

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It has been claimed that the value of understanding seems to surpass that of knowledge; concretely, that “knowledge may easily be acquired through the testimony of experts; understanding, by contrast, seems more demanding and requires that an epistemic agent herself puts together several pieces of information, grasps connections, can reason about causes, and this too suggests an added value” (Baumberger, Beisbart & Brun, 2017: 3).

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Knowledge & understanding

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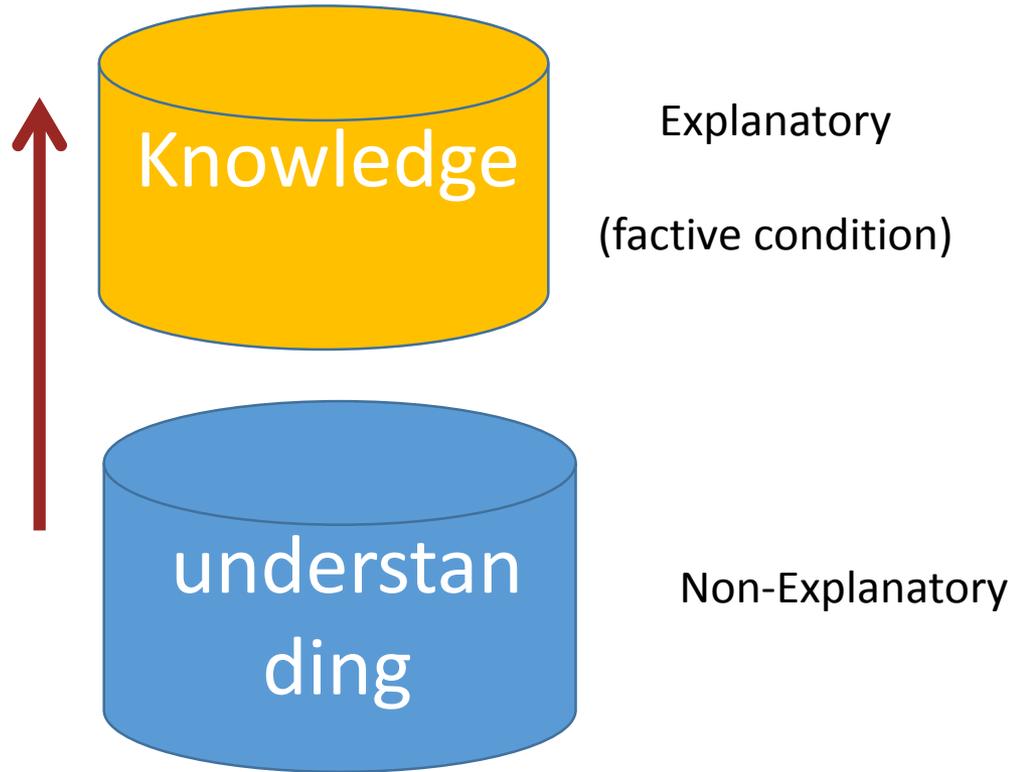
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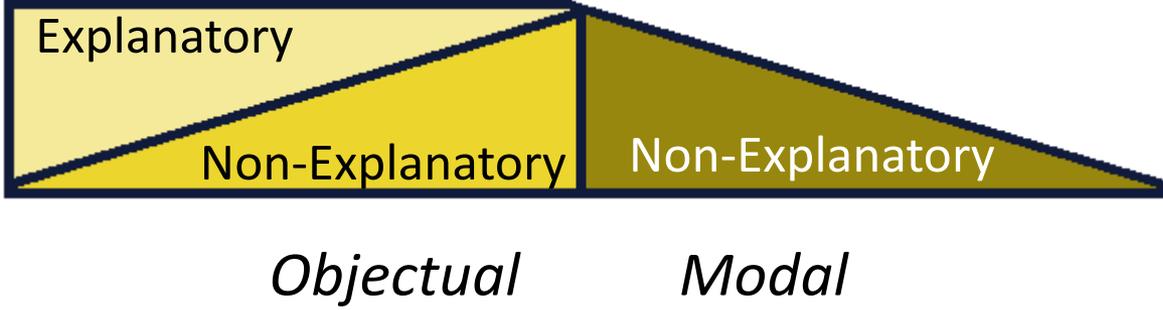
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How to integrate?

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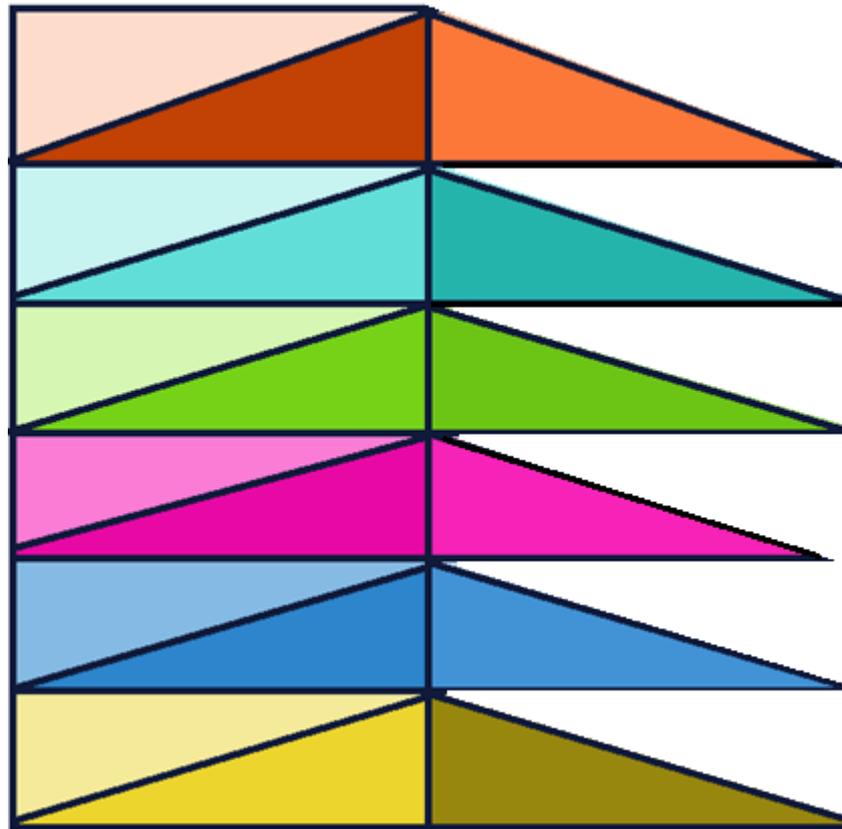


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Maximal understanding
(Kelp, 2016)

(...)

Contextual (expertise)

Afterlightening

Positive+Neg
identification

Positive
identification

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Hierarchical model of ScUnderstanding

Coherence: consistency, compatibility, reinforcement.

(Elsamahi, 2005)

Maximal understanding
(Kelp, 2016)

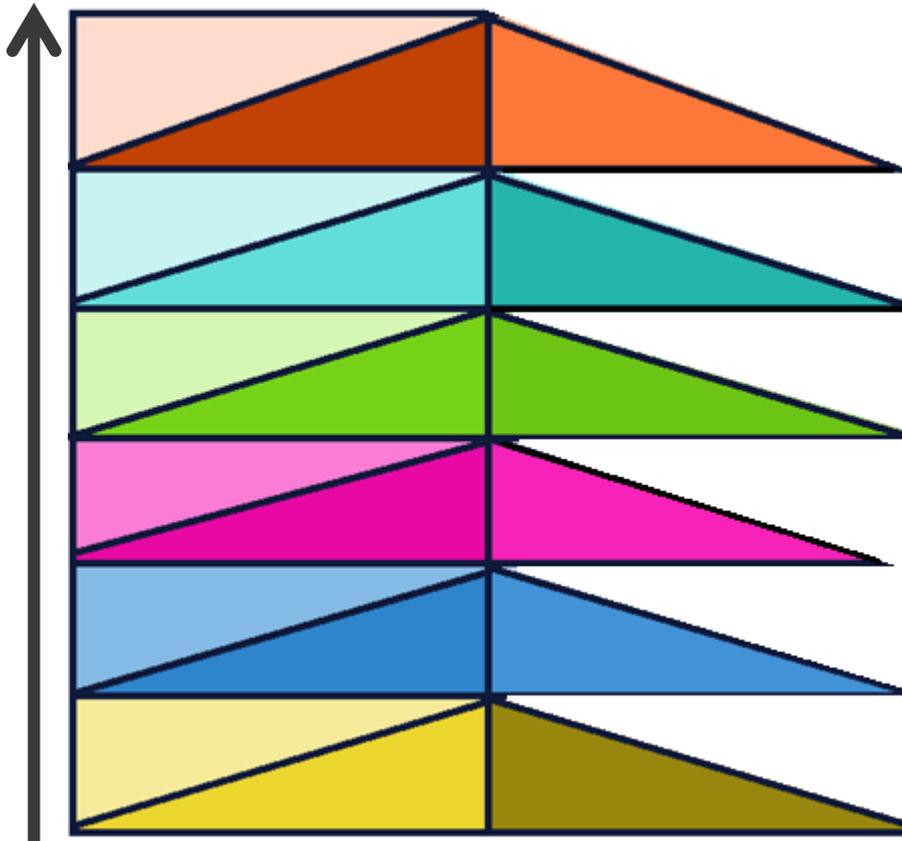
(...)

Contextual (expertise)

Afterlightening

Positive+Neg
identification

Positive
identification



Can we have
a hierarchical
model of
Scientific
Understanding
?

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Martínez-Ordaz

Preliminaries

ScUnderstanding

Knowledg &Un

Defectiveness

Final remarks

What is it hierarchical about?

Can we have
a hierarchical
model of
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Understanding
?

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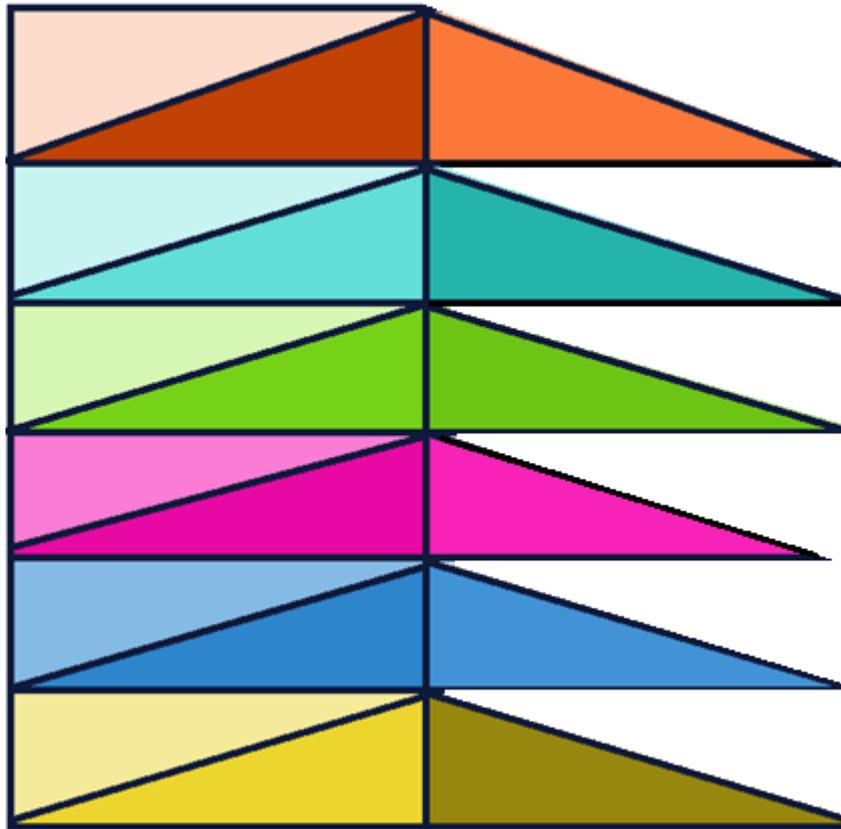
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- Cumulative (?)
- ~~Certainty~~ (?)
- ~~foundations~~ (?)
- Emp. Adequacy
- Accuracy
- ~~Truth~~
- (...)

Neutrinos case

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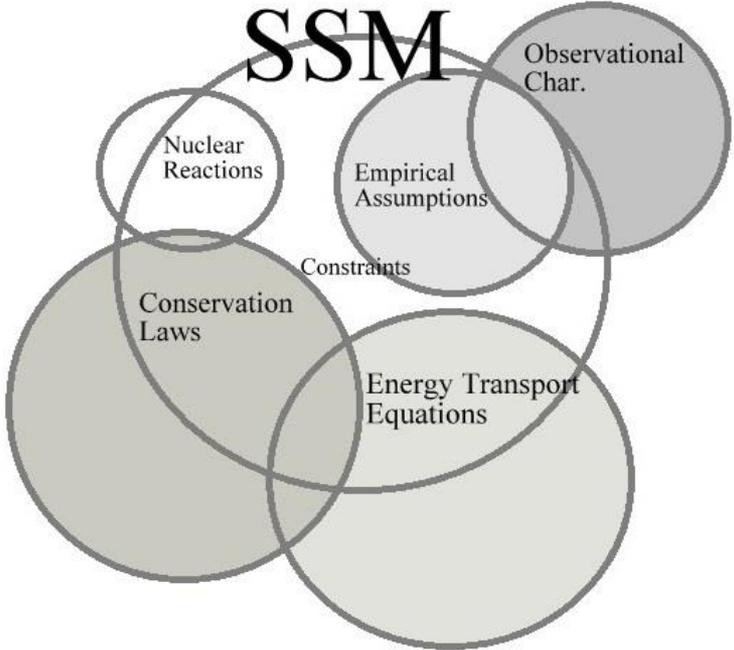
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1960-1970

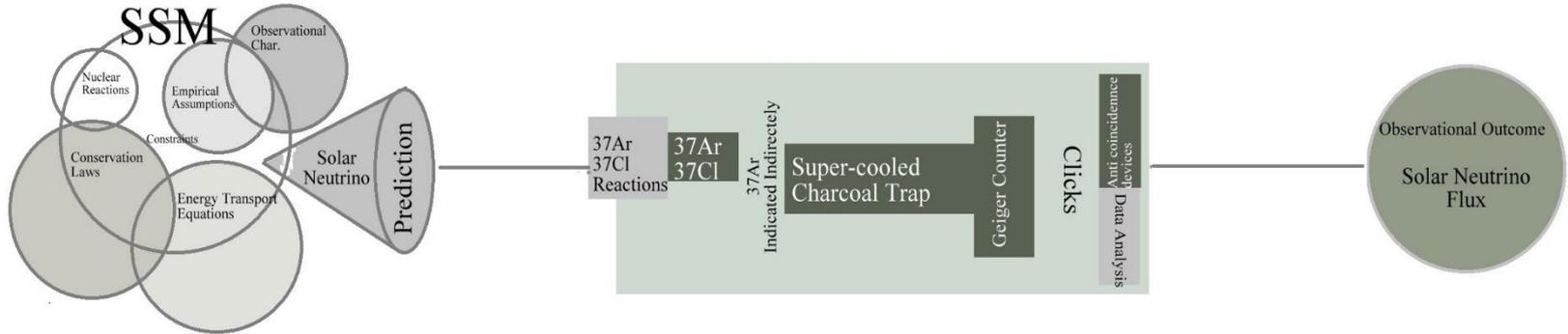
Standard Solar Model (SSM)

Measuring Solar Neutrino's flux

John Bahcall & Ray Davis'
Experiment

**Prediction _ Observational
outcome:**
+ 60% diff.

Neutrinos case



Measuring Solar Neutrino's flux

Contradiction between theory and observation

What was causing this?

John Bahcall & Ray Davis' Experiment
Prediction _ Observational outcome:
+ 60% diff.

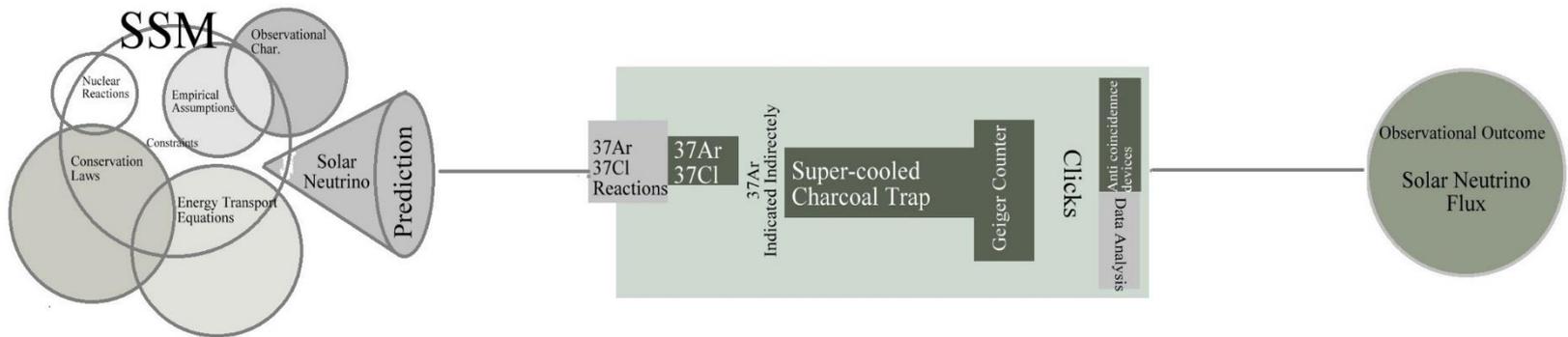
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Neutrinos case

$\{ problem_A, participants_A, certainties_A, Rel_A(x, problem_A), meth_A \}$

Contextual Certainties:

- Neutrinos have no mass
- Neutrinos are of just one type
- $Ar37 + Cl37 \rightarrow$ Neutrinos
- (...)



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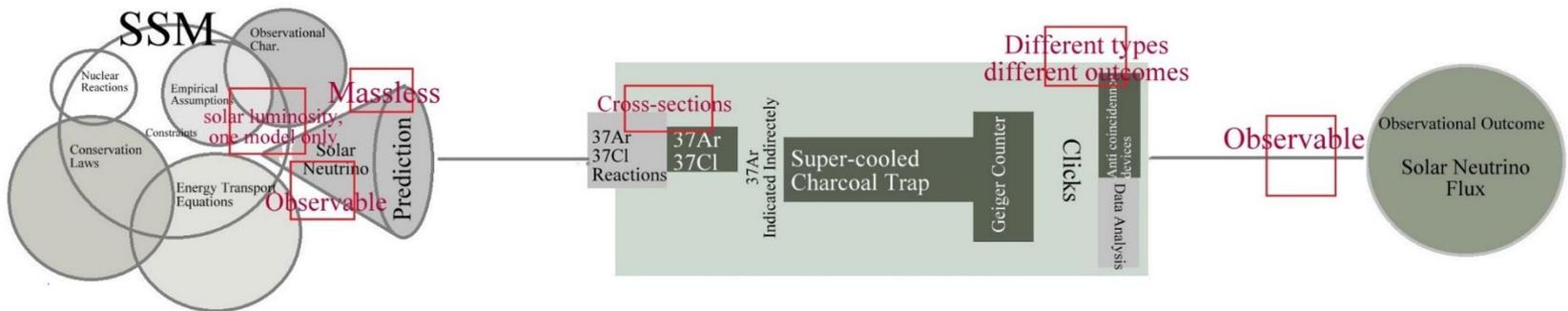
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The problem(s)...

Lack of **understanding** of

- What neutrinos are (they have mass and are of different types)
- Cross sections Ar37 and Cl37
- (...)



What happens to what scientists (thought to have) *known* and *understood* before?

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Understanding neutrinos (I)

What happens to what scientists *knew* and *understood* before?

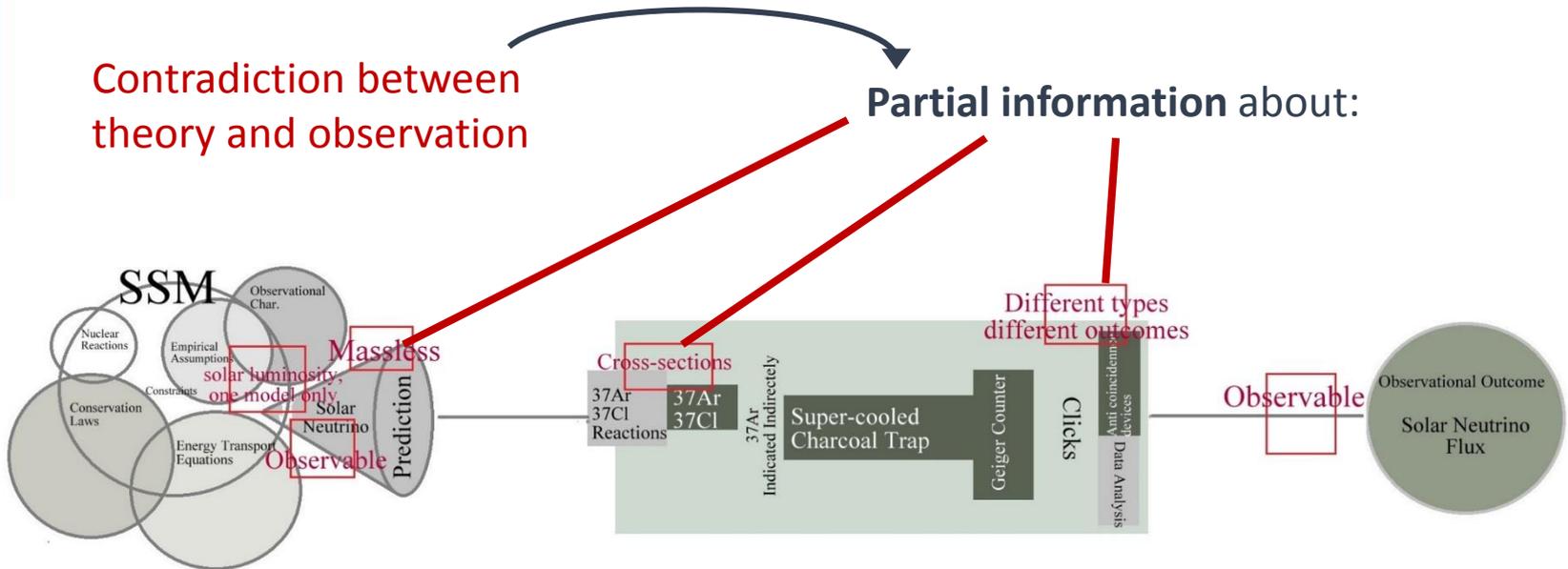
To **understand**

- What neutrinos are (they have mass and are of different types)
- Cross sections Ar37 and Cl37

Made a case of contradiction a case of incomplete information

Contradiction between theory and observation

Partial information about:



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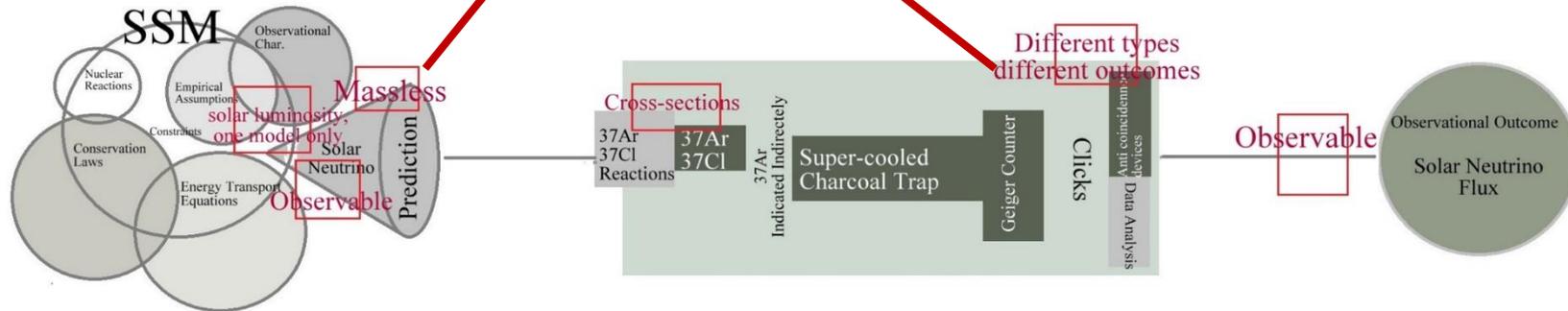
Understanding neutrinos (II)

What happens to what scientists *knew* and *understood* before?

To **understand**

- What neutrinos are (they have mass and are of different types)
- Cross sections Ar37 and Cl37

Scientists stopped *knowing* what they thought to have been the properties of neutrinos...



But, did they stop *understanding* their previous theory about solar neutrinos?

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Understanding the case

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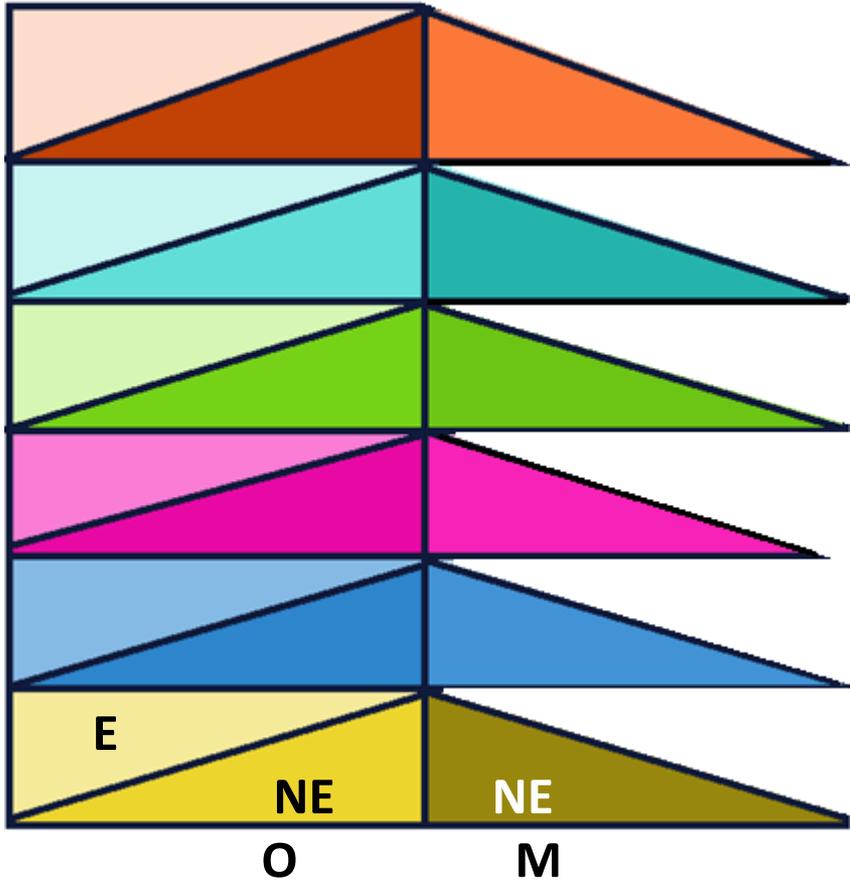
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Maximal understanding
 (Kelp, 2016)

(...)

Contextual (expertise)

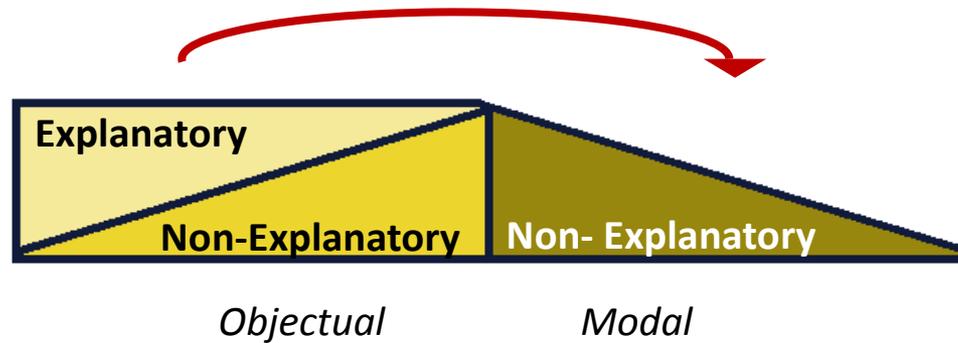
Afterlightening

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 identification

Positive
 identification

“Cumulative”

Even when we discover that the theories that we previously knew and **understood** are false, we still ‘understand’ them (at least in the sense of still being able to navigate some of the possibility space associated to the theory in question)* (which does not happen with **knowledge**).



This is, what we, initially, thought to be *objectual understanding* becomes *modal understanding*.

*A similar view can be found in [Le Bihan, 2017: 111-136]

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Can we have a hierarchical model of *Scientific Understanding*?

Yes (very likely).

What is the role of scientific understanding when
explaining the tolerance of defectiveness in the
sciences?

It *could* be explanatory as to why and how scientists
tolerate certain defects in their day-to-day practice

Even if Knowledge...

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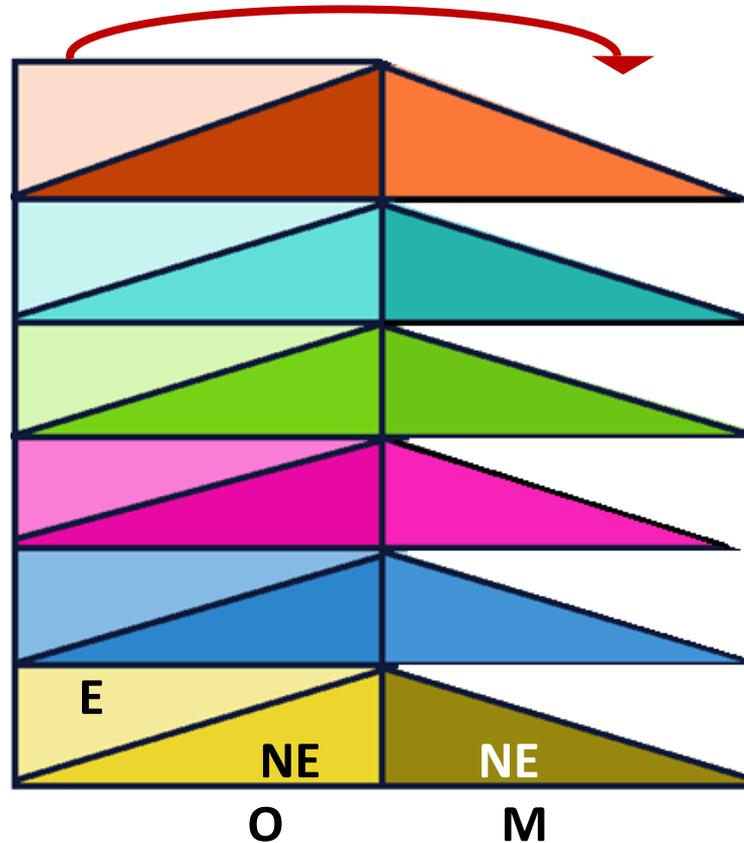
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Understanding can accommodate K

and the loss of K (when discovering that something that was thought to be the case, is false)...



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Gracias!

Can we have a hierarchical model of Scientific Understanding?

A response to Batens

María del Rosario Martínez-Ordaz¹

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With support of UNAM-PAPIIT projects

PAPIIT IN 403719 “Intensionalidad hasta el final: un nuevo plan para la relevancia lógica”
and PAPIIT IG400219 “Conciencia y normatividad”

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June 3, 2019

UNAM