Minding your speech while speaking about mind

On some pitfalls of the ways we talk as mathematics teachers and researchers

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Criticità per l'insegnamento della matematica nella scuola di oggi

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As teachers or researchers

we **talk**

about how people **think**

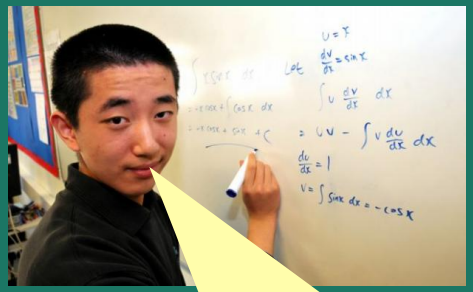
Today, I'd like us

to **think**

about how we **talk** as teachers or researchers

Mathematical facts
can be stated in different ways

one way



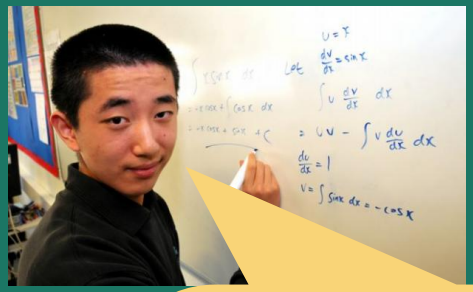
When I multiply a number by itself, the smallest value I can get is zero and I get it when I multiply zero by itself.

another way

The minimum of function x^2 is (0,0)

Mathematical facts
can be stated in different ways

one way



If I extract a square root from x and raise the result to the third power, I get the same result as when I raise x to the 3rd power and extract square root from it

another way

The 3rd power of square root equals square root of the 3rd power

Stories about math students
may be told in different ways

one way

In the majority of school tests and activities, X attained above average scores

another way

X is an able student (has a gift)

Stories about math students
may be told in different ways

one way

Z has been failing one math test after another in spite of her being taught mathematics just like everybody else.

another way

Z has learning disability (LD)

QUESTION 1

What do the descriptions on the right have in common? And those on the left?

What's the difference?

Mathematical facts
can be stated in different ways

one way	another way
When I multiply a number by itself, the smallest value I can get is zero and I get it when I multiply itself.	The minimum of function x^2 is (0,0)
If I raise x and get the result as when I raise x to the 3rd power and extract square root from it	The 3rd power of square root is equal to square root of the 3rd power

This column is much thinner!

Statements about studnts
may be told in different ways

one way	another way
In the majority of school tests and activities, X attain… ove average s…	X is an able student (has a gift)
Z … math test af… …sp… …or trying to … mathematics just like everybody else.	Z has learning disability (LD)

This column is much thinner!

QUESTION 1

But there is more!

What's the difference?

Statements on the right are ***shorter***

Speaking about **processes**

Speaking about **objects**

natical fa… d in diffe…

one … other …

When I m…tiply a number by itself, the smallest value I can get is zero and I get it when I multiply zero by itself.	Th… minimum of …unction x^2 is (0,0)
If I extract a square root from x and raise the result to the third power, I get the same result as when I raise x to the 3rd power and extract square root from it	The 3rd power of square root is equal to square root of the 3rd power

Statements about students
ld in di

Speaking about how **processes**

Speaking about **objects**

one way	an r way
In the majority of school tests and activities, X attained above average scores	X is able student (has a gift)
Z has been failing one math test after another in spite of her trying to learn mathematics just like everybody else.	Z has learning disability (LD)

Those on the left are about **what people do** and those on the right about **objects and their properties**

What's the difference?

Statements on the right are ***shorter***

QUESTION 2

Does "objectification" (transition from verbs to nouns) matter

in mathematics?

in talk about the learner?

in talk about learning?

Plan of this talk

1. **Why does the way we talk matter?**
   - the case of objectifying
2. **To objectify or not to objectify**
   when talking about math **learner**?
3. **To objectify or not to objectify**
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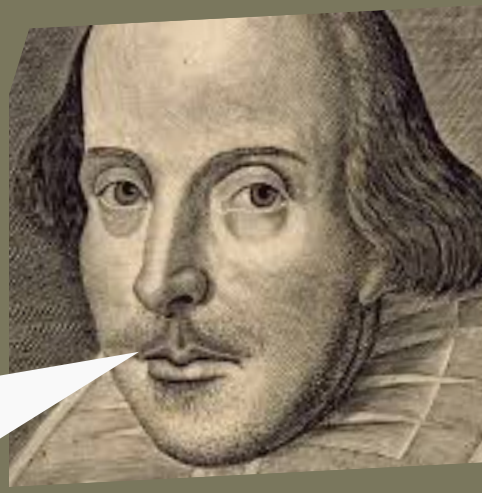
   when doing research on **learning**?
5. **A lesson on objectifying**
   for math teacher & researcher

Does it make a difference?

A rose by any other name would smell as sweet



William Shakespeare,
"Romeo and Juliet"

Saying more with less is always important, and especially in the age of information overflow.

In **mathematics,** *this is the name of the game*

More about it in a moment

What difference
objectification makes in

talk about
mathematics learner

Example 1

Difficulty in learning as a manifestation of learning disability

When you speak about difficulties in learning as resulting from something the learner is or has, you imply

- **transcendence:** the 'object' exists in the world, beyond us
- **depersonalization:** it is given, not man-made
- **permanence:** as a property of an *actor*, not of the *action*, it is rather *constant*

When you speak about difficulties in learning as resulting from something the learner is or has, you imply

- **transcend** … ject' exists …
- **depe** … it i …
- **per** … as a property of an *actor*, not o… *action*, it is rather *constant*

Conclusion: it is not up to us to change it

When you speak about difficulties in learning as resulting from something the learner **is** or **has**, you imply

- tr

- p
no

Result:

We direct those with "learning disability" to a separate life trajectory

ctor,
nstant

Example 2

grades

are among most powerful "objectifiers"

Means for turning talk about actions into talk about properties of the actor

Example 2

grades

are among most powerful "objectifiers"

rather than being a mere assessment of something a person did, they become part of this person's identity.

Example 2

grades

are among most powerful "objectifiers"

As such, they may be more harmful than helpful

Dubious "truths" about grades

Grades are given to the learner in her or his best interest

On the website
"Get through te

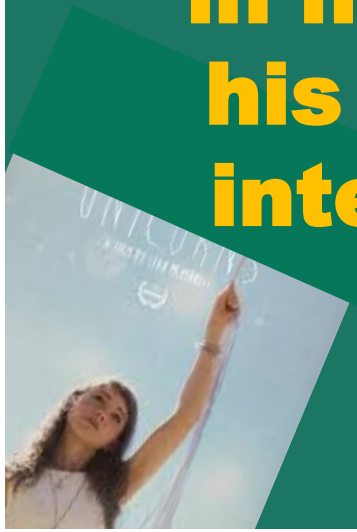
"[if y

Is this the learner's best interest?

ger,

sadness,

al sickness or hopelessness."



Dubious "truths" about grades

Grades promote learning

On the website
"Get through tough times"

Advice for those who get

Sometimes, grades obstruct learning

different/more effective learning

Dubious "truths" about grades

Grades reflect reality in a reliable, objecti

On the website
"Get through tough times"

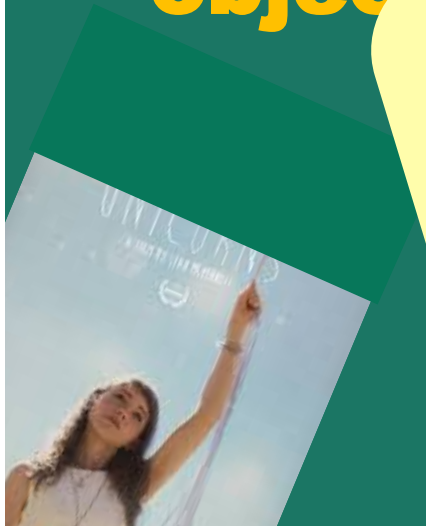
"Even though

not b

to achieve

ings."

There would be no need for this disclaimer if **grades did not serve as the ticket to one's future**



Dubious "truth" … grades

… reality in a reliable, objective way

But many bad grades will!

Grades not just reflect reality – they actually shape it!

… the course of the …

And not always in the most beneficial way

Objectification is

both

advantageous

and

dangerous

To objectify

or **not to objectify?**

Plan of this talk

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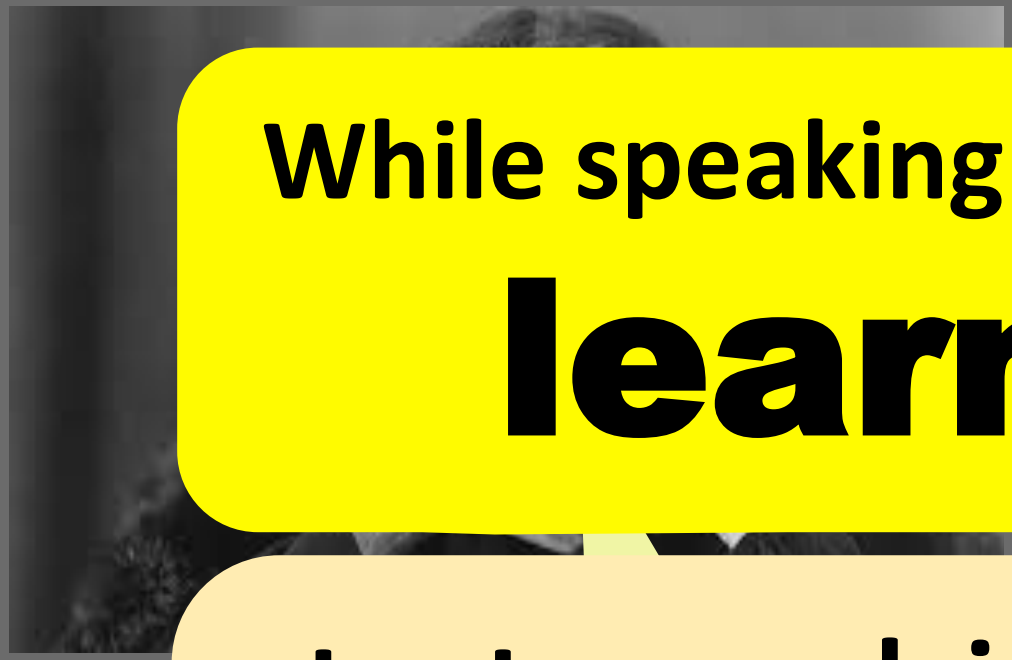


While speaking about the

learner

try to speak in verbs
(about doing) rather than objects
(about what one *is* or *has*)

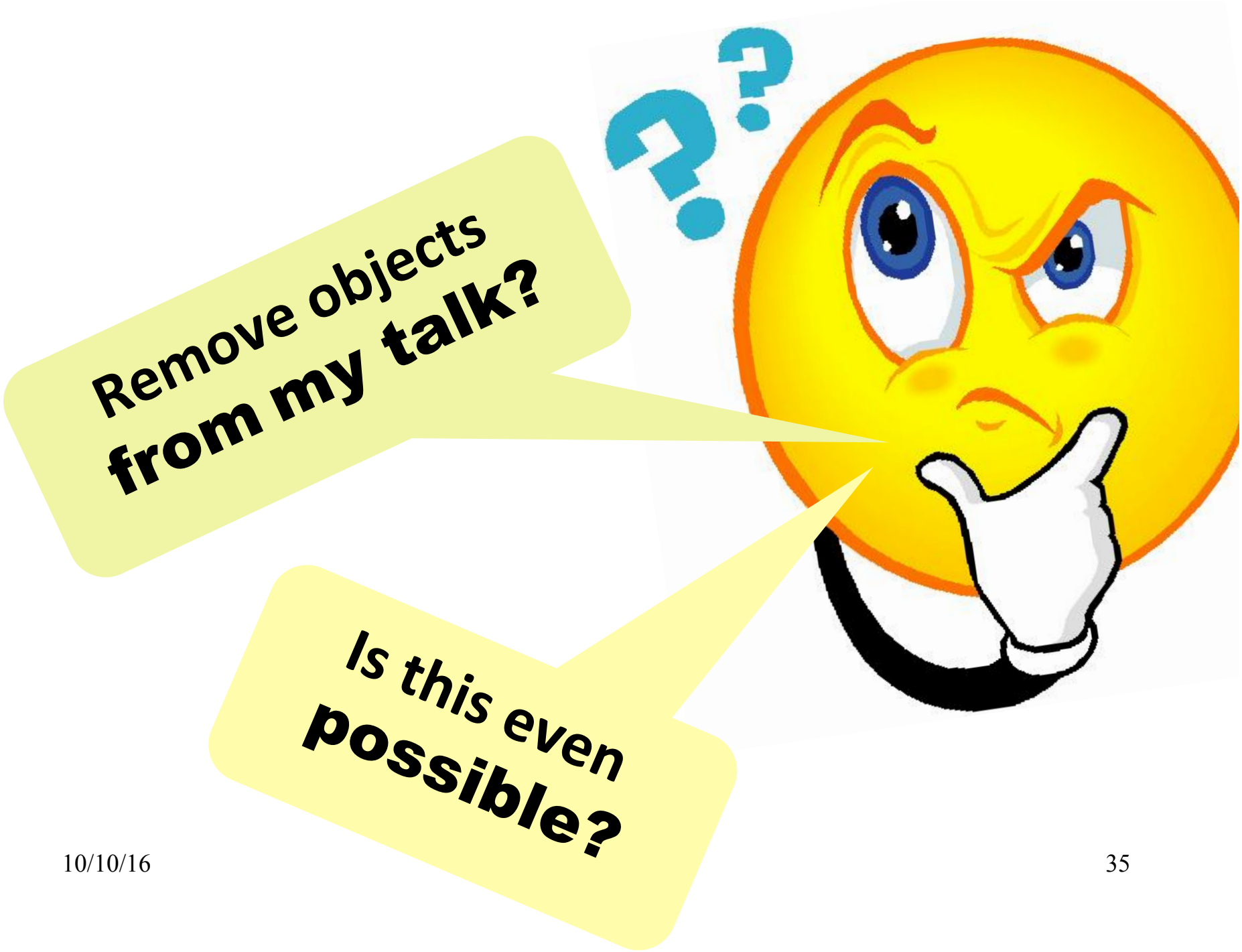
Stories about math students
may be told in different ways

one way

Z has been failing one math test after another in spite of her being taught mathematics just like everybody else.

another way

Z has learning disability (LD)


Remove objects
from my talk?
Is this even
possible?

In **Chinese**, people say **only in verbs** much of what in **English** is said with **nouns** (Perry Link)

"in Western languages … we sometimes use nouns to conceive things when we don't really need to" (Perry Link)

Yes!

In **Dong-Joong Kim** study:

Korean-speaking students have difficulty using the **noun infinity,** although they do use the **adjective infinite** and the **adverb infinitely.**

don't really need to" (Perry Link)

But how is this language game going to help?

Will removing objects **from my talk**

make them disappear **from the world?**

Will erasing the word

discalculia

cure my student **from this disability**

Well, some of these objects,

dyscalculia included,

do not exist **unless you speak about them**

More precisely,

Many of the objects we talk about

are **discursive constructs**

They are just our **way of talking** about phenomena

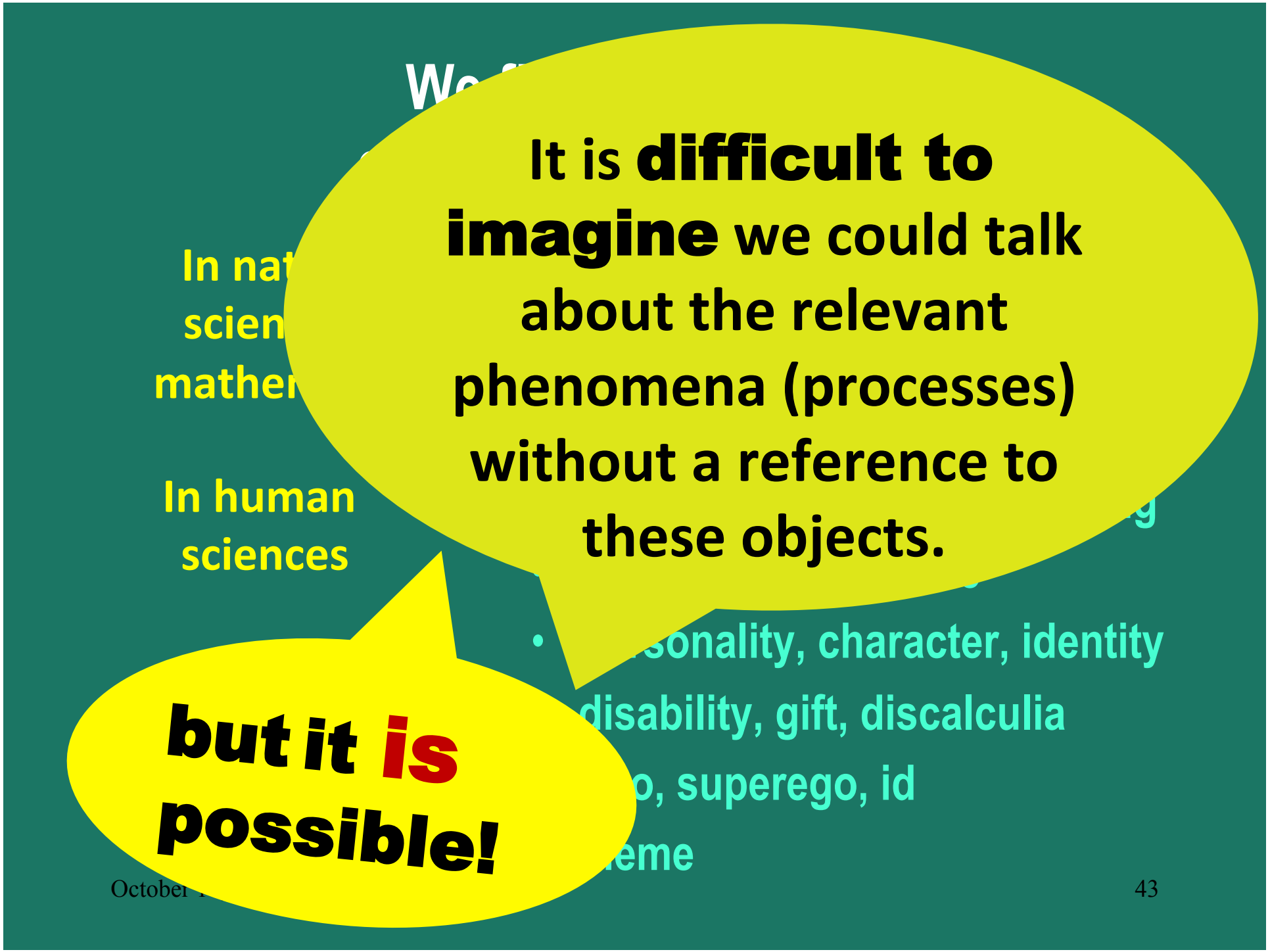
We find **objects** everywhere in research

In natural science & mathematics

- Force, energy
- Number, function, set

In human sciences

- Knowledge, concept, meaning
- Belief, attitude, value
- Personality, character, identity
- disability, gift, discalculia
- Ego, superego, id
- meme


It is **difficult to imagine** we could talk about the relevant phenomena (processes) without a reference to these objects.
but it is possible!

DISCLAIMER

The request to **avoid** the word "**dyscalculia**" does not mean denying the **existence of the phenomena** that gave raise to this word.

Stories about math students
may be told in different ways

one way

Z has been failing one math test after another in spite of her being taught mathematics just like everybody else.

another way

Z has learning disability (LD)

conclusion

It is up to us whether

to objectify

(to speak in nouns, not verbs) or not

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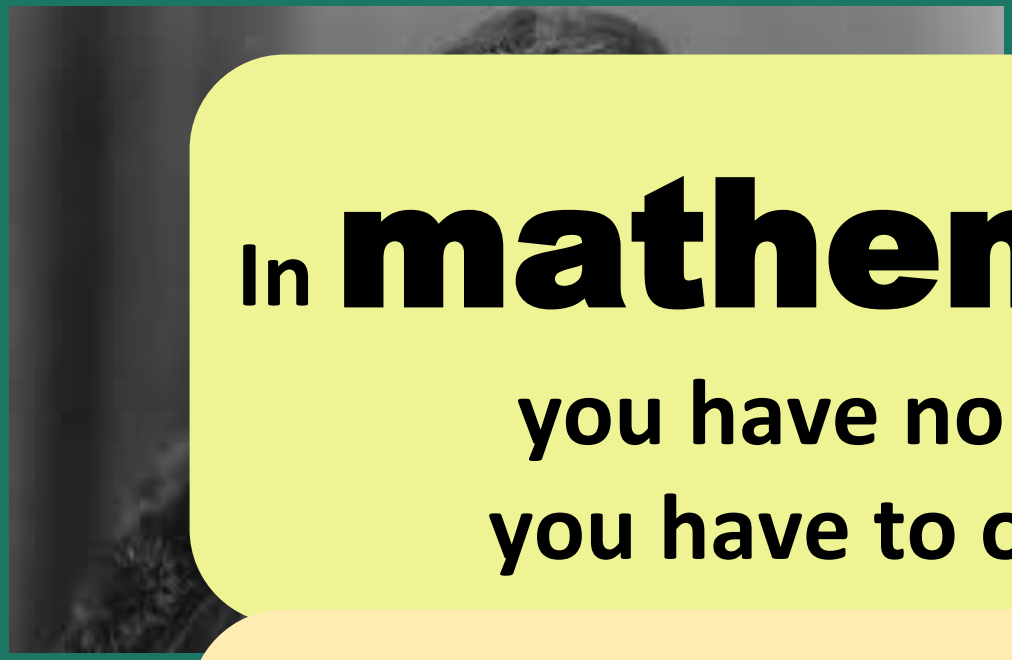


In **mathematics**

you have no choice:
you have to objectify!

Mathematics

simply does not exist without objectification

What is **mathematics?**

- Just like **biology** is the activity of telling useful stories about **living things** (plants, animals)
- and as **physics** is telling useful stories about **natural things** (moving bodies, light, etc.)

so is **mathematics** an activity of telling useful stories about **mathematical objects** (numbers, sets, functions, geometric figures)

What is mathematics?

But unlike in the case of biology or physics, in mathematics **all** these **objects** are **created in the act of storytelling itself**!

(In spite of this, math stories are useful in **real world.** How? This is a different story!)

tellinguseful stories

natural things
(moving bodies, light, etc.)

umbers,

unctions,
geometric figures)

So...

How and why do mathematical objects come into being?

Let's take

number

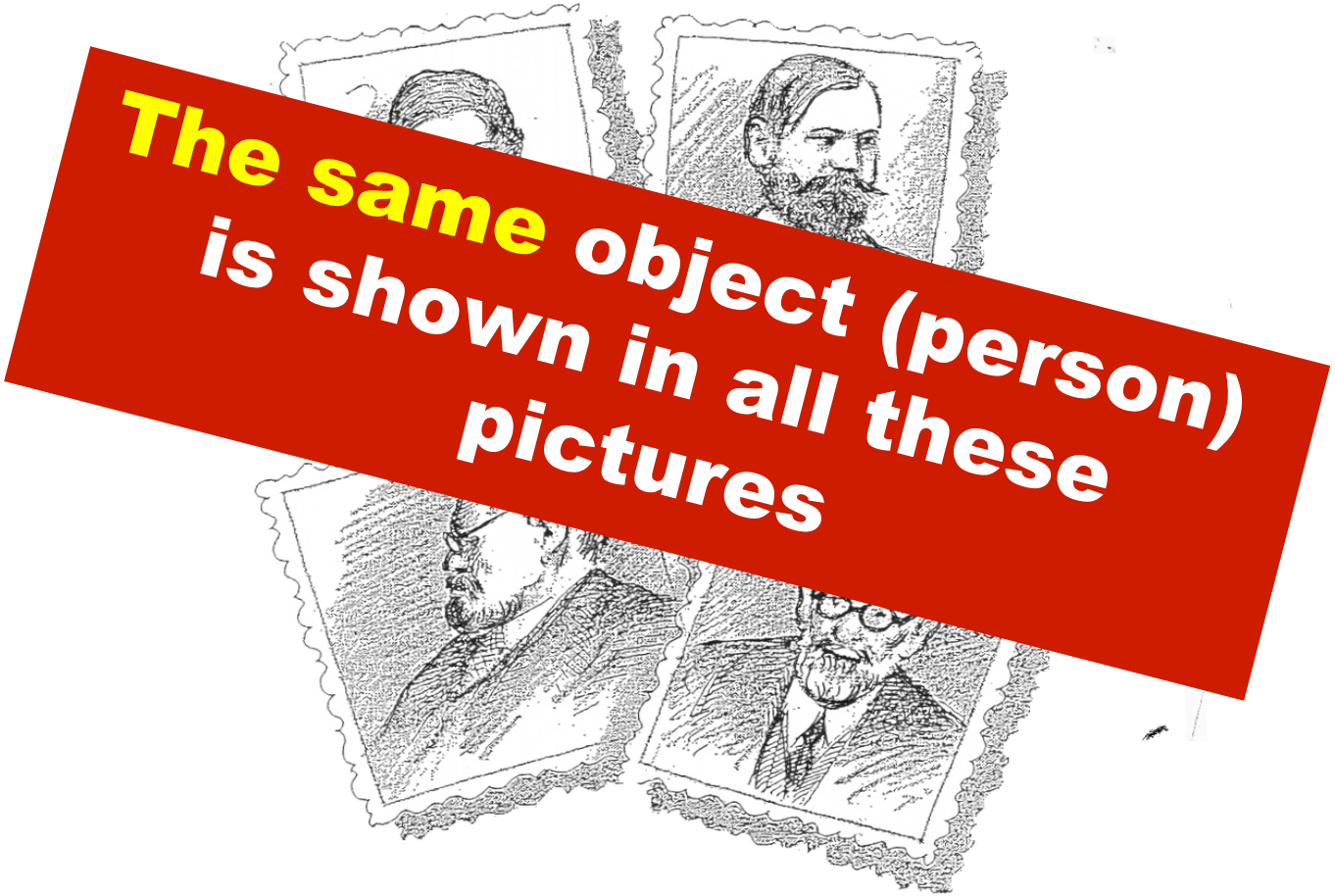
as an example

What makes us say:

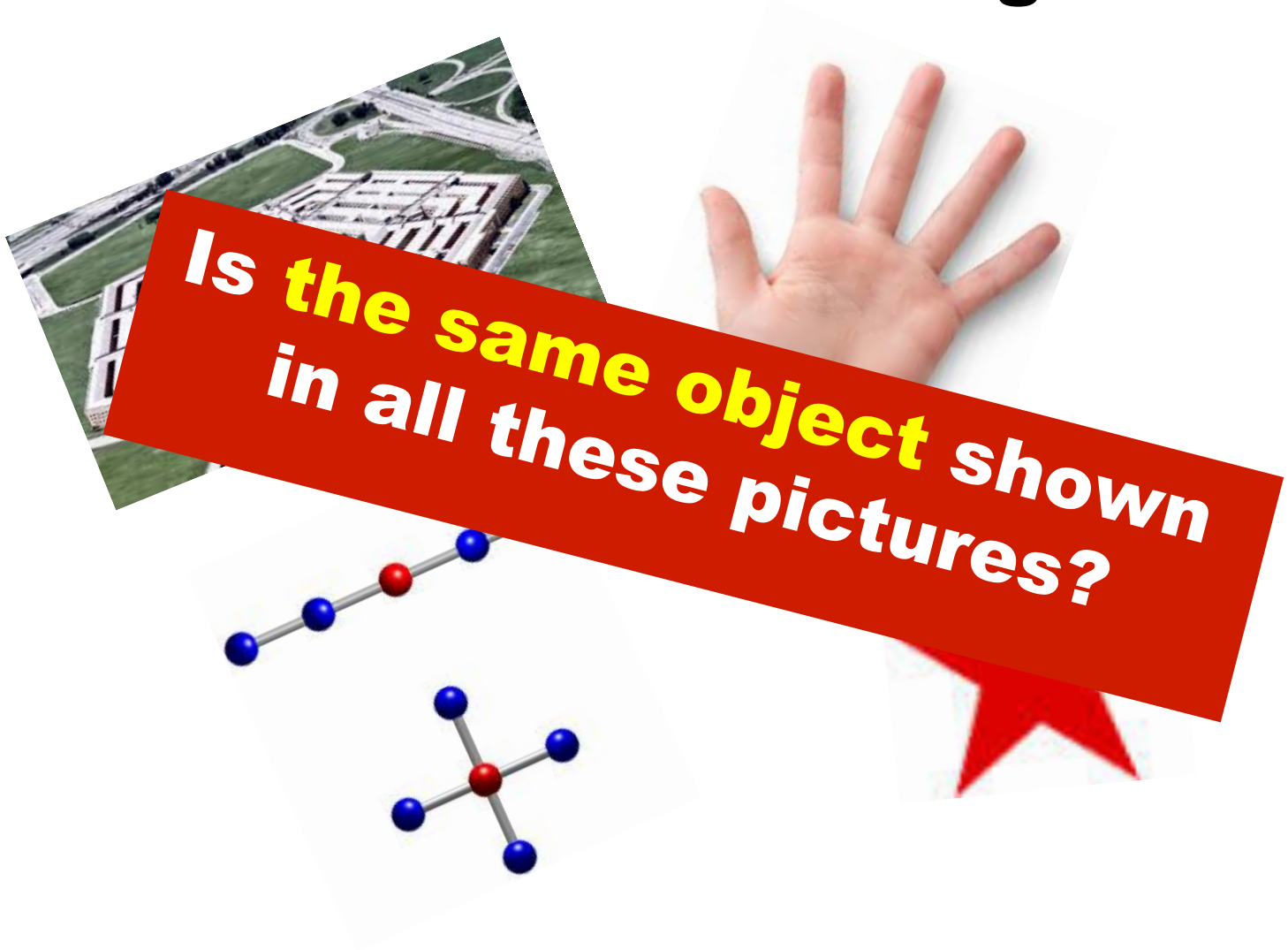
“These pictures present the same person”?

What makes us say:

“These pictures present the same person”?



What is “the same” about these six things?



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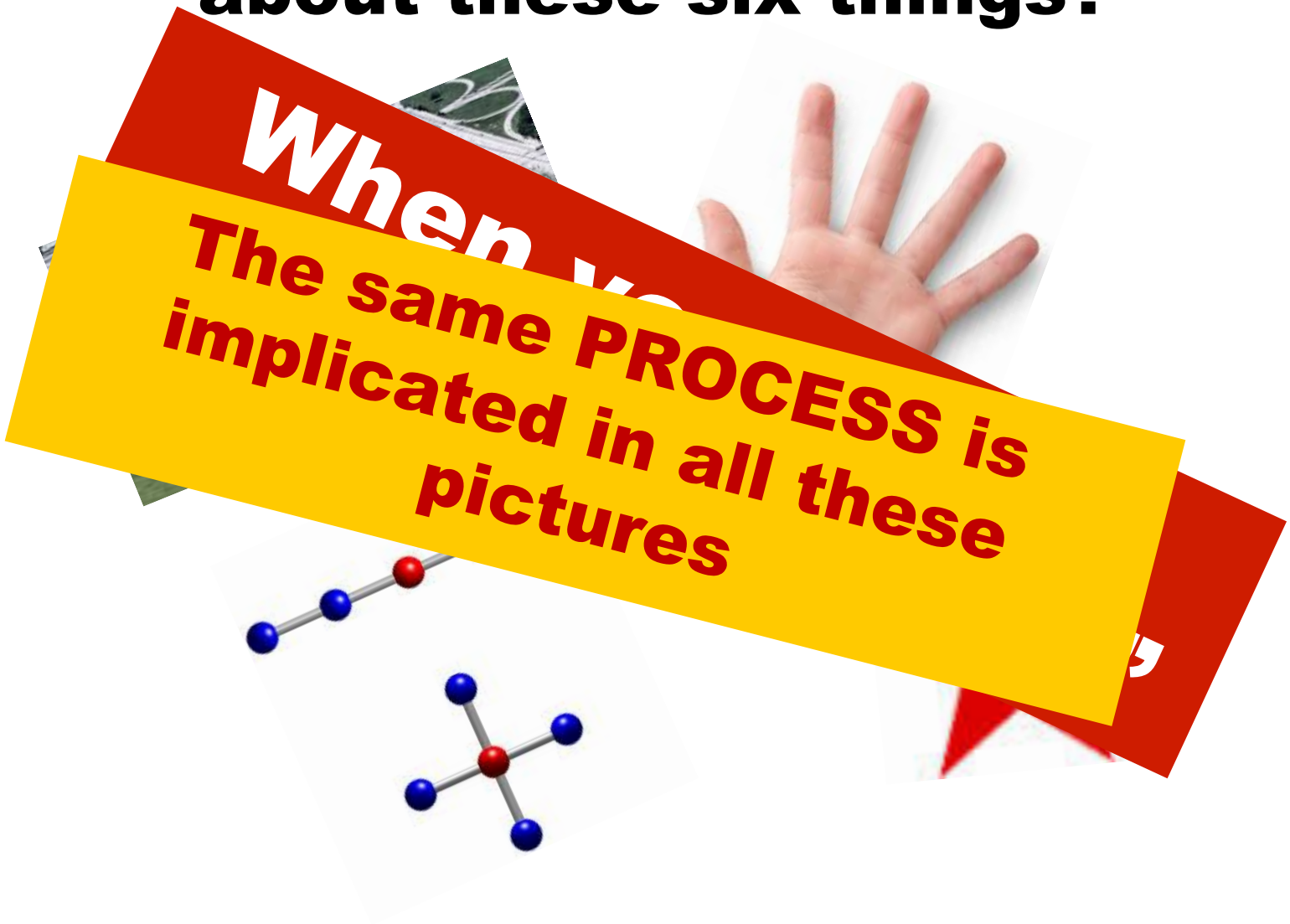


Conclusion:

Number is but a **metaphor**

It is an **objectification** of the process of counting

Objectification

us rd)

an ld

ex s

we then say the word/ symbol **represents** the object

Objectification
(a special type of metaphor)

discursive process that makes us use mathematical words and symbols as if they signified discourse-independent objects;

it includes:

reification

- replacing verbs with nouns

+

alienation

- removal of human subject

Why do we objectify number?

Imagine you were to go on **developing mathematics** based on the description on the right!

following ec
says?

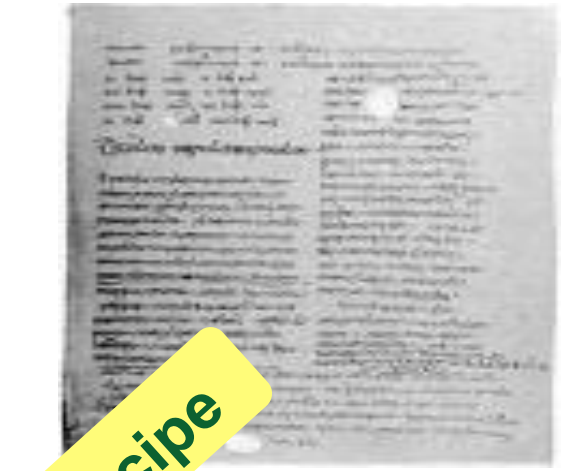
3+4 = 7

- If I have a set so that whenever I count its elements I stop at the word three,
- and I have yet another set such that whenever I count its elements I stop at the word "four",
- and if I put these two sets together,

then

- if I count the elements of the new set, I will always stop at "seven".

As an aside:
if numbers (sets, functions, etc.) are processes turned objects….



?

=

As an aside:
if numbers (sets, functions, etc.) are processes turned objects….

the idea of objectification may help us understand why so many people don't understand mathematics

Mathematics teacher

as seen through his students' eyes

Plan of this talk

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What difference

speaking "in objects" makes to

learning scientists

(those who do research on mathematics learning)

Two LSs are reporting on their studies

One researcher says:

Children under the age of five often do not realize that it is the last process that is the number of elements in the set

The other says:

Children under the age of five not … counting … me set must end with the same number word

Are they speaking about the same thing?

Talking about learning

What do they speak about?

Childr

searcher:

children under the age of five

of often do not

hat it is

the

process of

elements of a set

that is the number of elements in the set

principle of cardinality

principle of cardinality

repe

of the same

must end with the same number word

Talking about learning

Still, there is a differe

Children under the age of five often do not realize that repeated counting of the same set must end with the same number word

talk about a property of an **object**

talk about a property of a **discursive process**

the number of elements in the set

Does this difference matter?

One researcher:
Children under the age of five often do not realize that it is

the whale

that is

the largest mammal

Another researcher:
Children under the age of five often do not realize that

"whale" and "the largest mammal"

can be used interchangeably

Speaking about objects is not the same

talk about a property of an **object**

talk about a property of a **discursive process**

realize that

the whale

that is

the largest mammal

"whale" and "the largest mammal"

can be used interchangeably

Speaking about objects is not the same as speaking about their names

If you say:	you imply:
Children under the age of five often do not realize that it is	The child can have some direct **experience of whales**
the whale	
that is	**before** she knows of some of their **properties**
the largest mammal	

Speaking about objects is n
as speaking ab

If you say:

Children

the whal

that is

the largest mammal

and this sounds unreasonable –
it's a **metaphor of object**
taken too far

can have
e direct
xperience of
umbers

efore she knows
of some of their
properties

The first text implies that in the life of a child, **numbers exist prior to the talk on numbers**

The second text is in concert with the claim that **numbers arise from discourse**

From the 1st text:
the child learns
from **the world** itself.

From the 2nd text:
The child learns first and foremost
from people around her

This difference may have far-reaching implications for our
understanding of learning &
the **practice of teaching**

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Lessons about the way we talk

- We all need to take care of **how we talk**

This is true of **all** those who deal with mathematics

mathematicians,
math students,
math teachers,
researchers

Lessons about th

- We all need to take of **how we talk**
- In **mathematics**, we must learn **how to objectify**

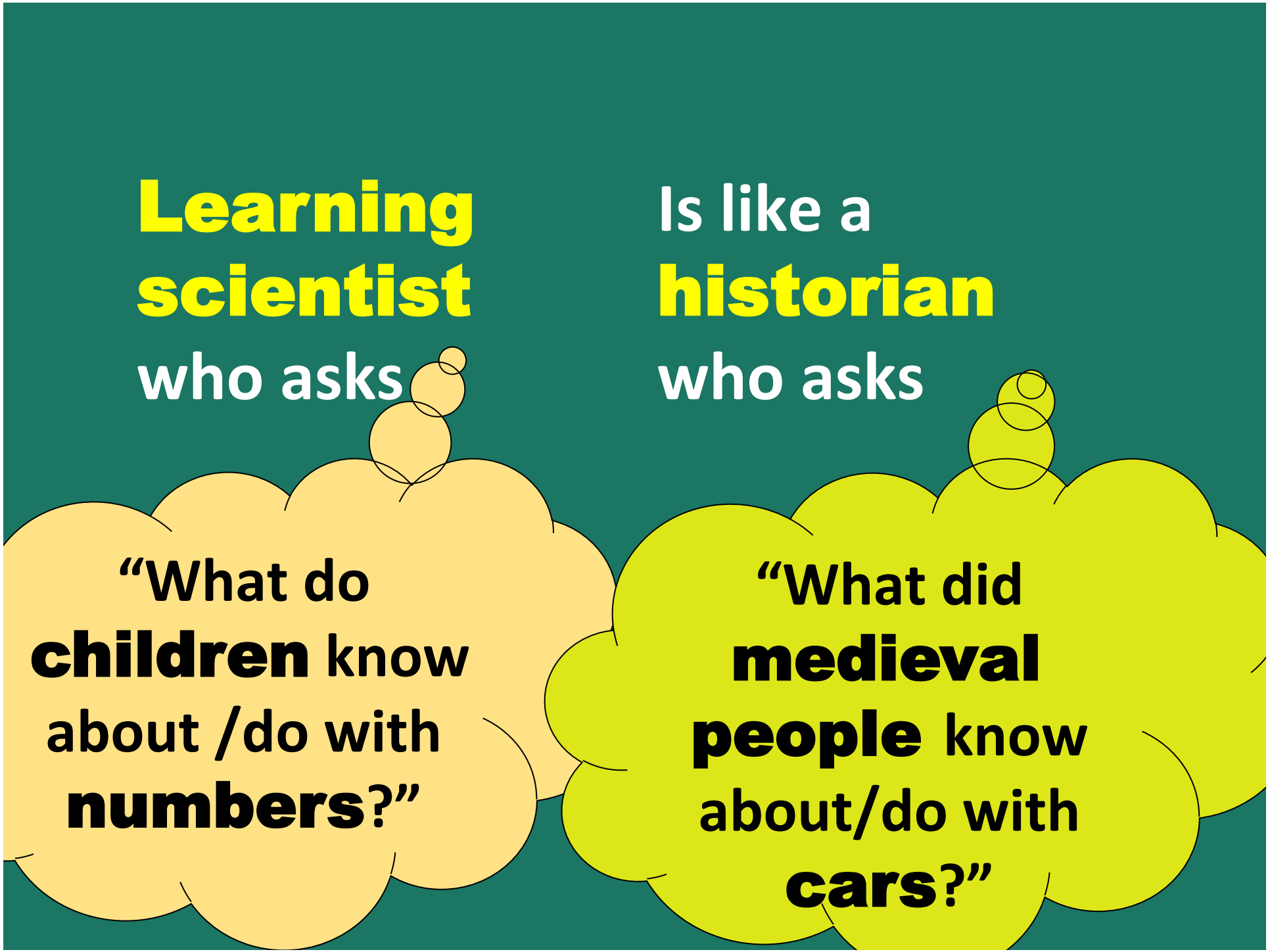
This is true of **the mathematician** who invents new mathematics

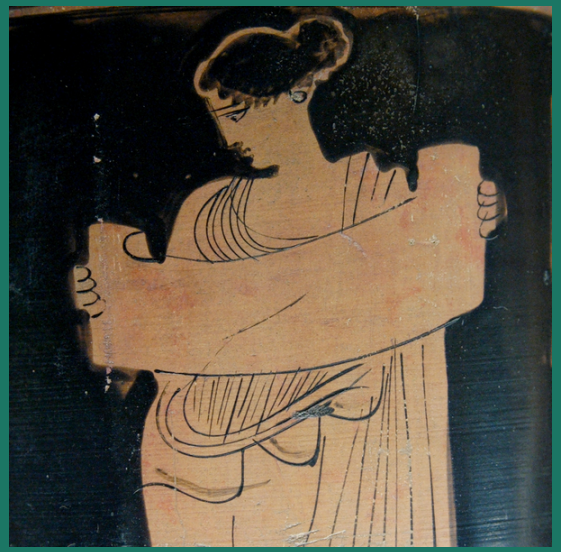
and of the **student** who tries to become a participant of the exiting mathematical discourse

Lessons about the way we talk

- We all need to take care of **how we talk**
- In **mathematics**, we must learn **how to objectify**
- As **teachers**, we need to
  - **help** learners objectify
  - **avoid** objectification while talking about learners

And what about **learning scientists** who study mathematics learning?


Learning scientist who asks
"What do children know about /do with numbers?"
Is like a historian who asks
"What did medieval people know about/do with cars?"

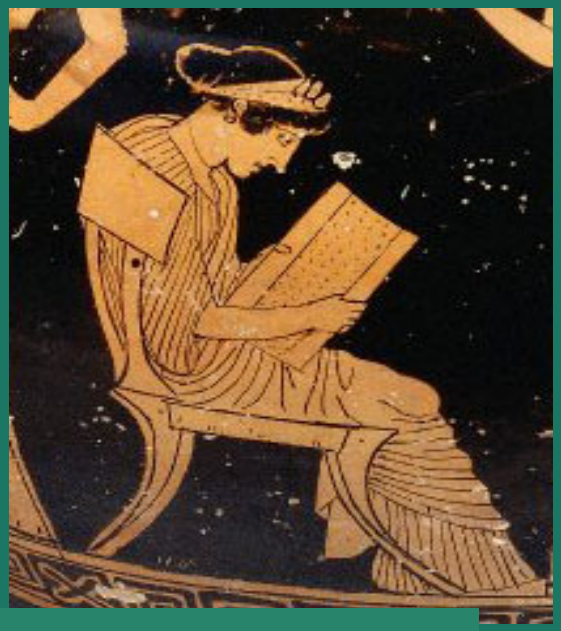


The

can move as fast as 200 km/hour

People
did not know that cars ....

They **did not use** cars
when it would be most helpful

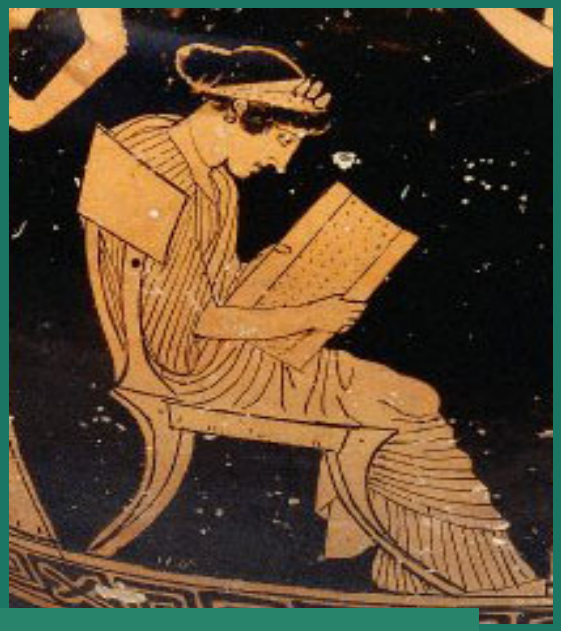


The learning scientist's report

can grow infinitely

Children **did not know** that numbers...

They **did not use** numbers when it would be most helpful



The learning scientist's report

Children **did not know** that numbers...

They **did not use** numbers when it would be most helpful

This creates **discourse of deficit** in which the learning scientist reports on what **children don't do** and ignores what they **actually do**

But just like people **did travel** even when there were no cars, so do children do without numbers **things they will later do with numbers**

For instance, children……

Make **choices**, some of them **quantitative**….

It is in the **activity of choosing** that the study of the development of numerical thinking should begin

and it should continue as a careful follow-up of **the development of their routines of choosing**

Lessons abou

- We all
  of

ng
ntists,
e need to
oscillate
between the
perspectives of
nsider and
r to our

– avo
while talkin
learners

In short,
Mind your talk!

Would you mind talking
about it now?