Why journalists
don't understand science
&
Why scientists
don't understand science journalism

Ernesto Lozano Tellechea

Science Editor

The tension

Scientists

Scientist

Expects Next Article To Be Published In	18 months
Area of Expertise	role of P32 protein in suppression of expression of X8732 in lymphoma cells
Idea of an interesting article about cancer	Knockout mice lacking P32 develop 94% higher rates of minimally differentiated acute myeloblastic leukemia but P32/X8732 double knockouts only have a 34% elevated rate

Journalists

Journalist

	18 hours
	Writing really fast
	Scientists Find Leukemia Gene: Is Your Child At Risk?

The tension

Let's go back to July 4th 2012...

"CERN discovers Higgs boson"

Hi Prof. Scientist, Is this right?

The tension

"**The ATLAS and CMS experiments at CERN** **discovers** **Higgs boson**"

Well...

OK...

The tension

"The ATLAS and CMS experiments at CERN have seen strong indications, with a statistical significance of 5 standard deviations,

Higgs boson"

Well…
actually…

OK…
????

The tension

"The ATLAS and CMS experiments at CERN have seen strong indications, with a statistical significance of 5 standard deviations, of a new particle consistent with the Standard Model Higgs boson"

Well…
actually…
and also……

OK…
????
WTF!?

The tension

"CERN FINDS GOD PARTICLE!"

Why this tension?

Communicating science to the public implies:

- ✓ Selecting the information
- ✓ Simplifying the information
- ✓ Creating a narrative

Why this tension?

Communicating science to the public implies:

- ✓ Selecting the information (**"CERN"**)
- ✓ Simplifying the information (**"finds"**)
- ✓ Creating a narrative (**"God particle"**)

Model of science journalism

Complex science issue

⬇

Selecting the information

Simplifying the information

Creating a narrative

⬇

Science story

Why journalists
don't understand science

Bad science journalism

'Spooky' Quantum Entanglement Finally Captured in Stunning Photo

By Yasemin Saplakoglu   almost 2 years ago

Physicists take first-ever photo of quantum entanglement. (Image credit: University of Glasgow/CC by 4.0)

Scientists just captured the first-ever photo of the phenomenon dubbed "spooky action at a distance" by Albert Einstein. That phenomenon, called quantum
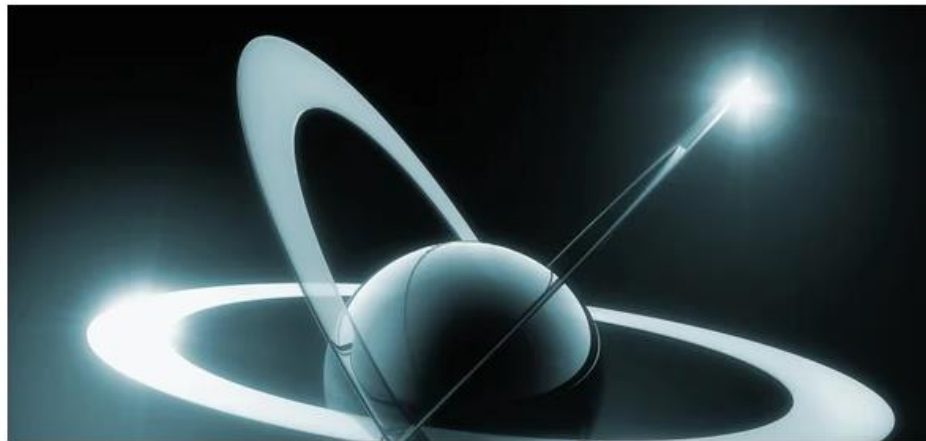
Bad science journalism

'Spooky' Quantum Entanglement Finally Captured in Stunning Photo

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WRONG SCIENCE

Physicists t... ...entanglement. (Image credit: University of Glasgow/CC by 4.0)

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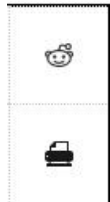
Bad science journalism

X-Ray Lasers Make Atoms Act Like "Black Holes" in Molecules

Findings could improve scanning of proteins, viruses and bacteria

By Charles Q. Choi on June 1, 2017

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TECH
Superpowerful X-Ray Lase
in Molecules, Nanosystems
Explodes Proteins--All in tl

Bad science journalism

PHYSICS

X-Ray Lasers Make Atoms Act Like "Black Hole" Molecules

Findings could imp... ...cteria

WRONG MESSAGE

READ THIS NEXT

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TECH
Superpowerful X-Ray Lase...
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Bad science journalism

Quantum computing's reproducibility crisis: Majorana fermions

The controversy over Majorana particles is eroding confidence in the field. More accountability and openness are needed – from authors, reviewers and journal editors.

Sergey Frolov ✉

Much is at stake. Majorana particles are in theory their own antiparticles, and were predicted in 1937 by Italian physicist Ettore Majorana. Computer giant Microsoft hopes to use Majorana particles to build a reliable quantum computer: the particles should make for exceptionally stable quantum bits. The scientific excitement around them is on a par with gravitational waves and the Higgs boson.

Experimentally, researchers are at loggerheads over whether Majoranas have been detected at all, let alone whether they're an asset for quantum

Bad science journalism

COMMENT · 12 APRIL 2021

Quantum computing's r̶e̶p̶r̶oducibility crisis: Majorana ferm̶i̶o̶n̶s̶

The controversy over Majorana̶s̶ ̶i̶s̶ ̶a̶ ̶w̶a̶r̶n̶i̶n̶g̶ ̶t̶o̶ ̶t̶h̶e̶ field. More accountability and openn̶e̶s̶s̶ ̶i̶s̶ ̶n̶e̶e̶d̶e̶d̶ ̶f̶r̶o̶m̶ ̶f̶u̶n̶d̶e̶r̶s̶ ̶a̶n̶d̶ journal editors.

Sergey Frolov ✉

Much̶ particles, and
we̶ Computer giant
Mi̶ ̶nable quantum
comp̶ nally stable quantum bits.
The sc̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶ a par with gravitational waves
and the H̶ ̶ ̶ ̶ ̶ ̶ ̶ ̶

Experimentall̶y̶ ̶ ̶ ̶ ̶are at loggerheads over whether Majoranas have
been detected at a̶l̶l̶,̶ ̶l̶e̶t̶ ̶alone whether they're an asset for quantum

Why does this happen?

Complex science issue

Selecting the information

Simplifying the information

Creating a narrative

Science story

Why does this happen?

Complex science issue

GETTING THE SCIENCE RIGHT

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Why does this happen?

Complex science issue

⬇

GETTING THE SCIENCE RIGHT

Selecting the information

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Creating a narrative

⬇

ARRANGING THE MESSAGE IN A USEFUL WAY

Science story

Why does this happen?

Complex science issue

DIFFICULT FOR A NON-SPECIALIST

Selecting the information

Simplifying the information

Creating a narrative

TENDENCY TO OVERDO IT

Science story

**Why scientists
don't understand journalism**

Answer

Complex science issue

⬇

Selecting the information

Simplifying the information

Creating a narrative

⬇

Science story

Answer

Complex science issue

FOCUS IS MADE JUST ON THIS

Selecting the information

Simplifying the information

~~Creating a narrative~~

PLUS: IT IS MADE IN THE WRONG WAY

Science story

Example: Higgs mechanism
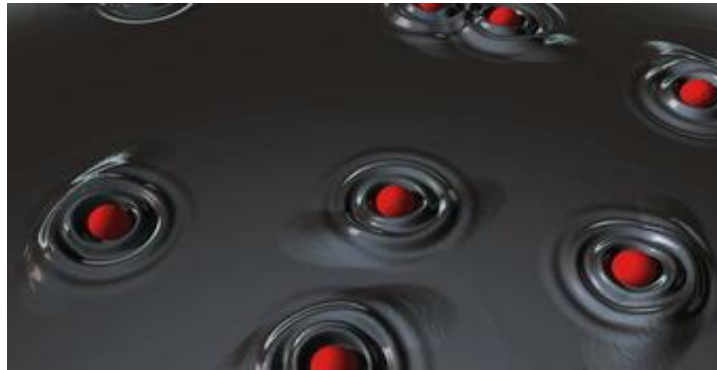
"The Higgs field is like a viscous fluid"

Example: Higgs mechanism
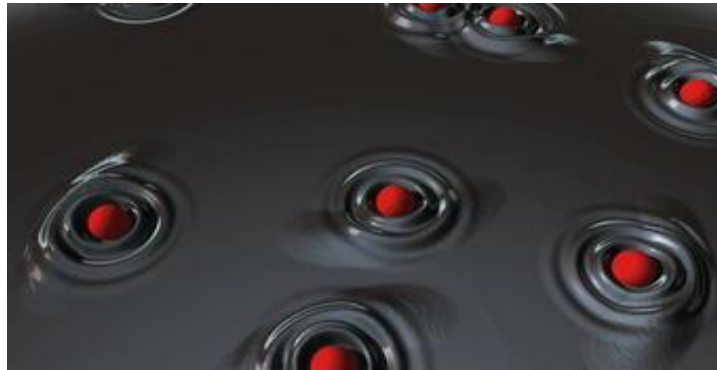
"The Higgs field is like a viscous fluid"

"Inertia is resistance to acceleration, not to velocity!" (etc. etc.)

"Scientist" model of sci-comm

Complex science issue

⬇

Selecting the information

Simplifying the information

⬇

Science story

"Scientist" model of sci-comm

Complex science issue

⬇

Selecting the information

Simplifying the information

⬇

Science story

Quality of sci-comm = f (% of truth conveyed)

"Scientist" model of sci-comm

Complex science issue

Selecti...

Sim...

...y

Quality of s... ...mm = *f* (**% of truth conveyed**)

FAIL

Why is this model wrong?

➢ This is basically the so-called **"deficit model"** of sci-comm:

1. The public **lacks interest** in science

2. This happens because of a **lack of information**

3. Solution: **provide the facts**

Why is this model wrong?

➤ This is basically the so-called **"deficit model"** of sci-comm:

1. The public **lacks interest** in science
2. This happens because of a **lack of information**
3. Solution: **provide the facts**

➤ This model (hypothesis) has been widely shown to be **wrong/incomplete**

Why is this model wrong?

➢ **Example:** *Science and Engineering Indicators* National Science Foundation, 2008

- *"Human beings developed from earlier species of animals"* **True: 42%**

Why is this model wrong?

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- *"According to the theory of evolution, human beings developed from earlier species of animals"* **True: 72%**

Why is this model wrong?

➢ **Example:** *Science and Engineering Indicators* National Science Foundation, 2008

- *"Human beings developed from earlier species of animals"* **True: 42%**

- *"According to the theory of evolution, human beings developed from earlier species of animals"* **True: 72%**

➢ **People don't react so easily to facts:**

- Motivated reasoning
- Storytelling
- …

Individuals with greater science literacy and education have more polarized beliefs on controversial science topics. Drummond et al., *PNAS, 2017*

Using narratives and storytelling to communicate science with nonexpert audiences. Dahlstrom, PNAS 2014.

Packing facts: The word budget

➤ Every story has a **"word budget"**

    ❑ **Total amount** of words

    ❑ Amount of **new words** (technical jargon)

Packing facts: The word budget

➢ Every story has a **"word budget"**

   ❑ **Total amount** of words

   ❑ Amount of **new words** (technical jargon)

➢ Exceeding the budget (i.e. "providing information") can even have **detrimental effects**

Jargon as a barrier to effective science communication: Evidence from metacognition. Bullock et al., *Public Understanding of Science*, 2019.

Goals of sci-comm

➢ The goal of sci-comm is **NOT ONLY** to convey science facts to a lay audience, but also:

✓ Arouse **interest** in science (e.g. entertain)

✓ Provide **context**

✓ **Communicate**

Communicating Science Effectively: A Research Agenda. National Academies of Sciences, Engineering, and Medicine, 2017.
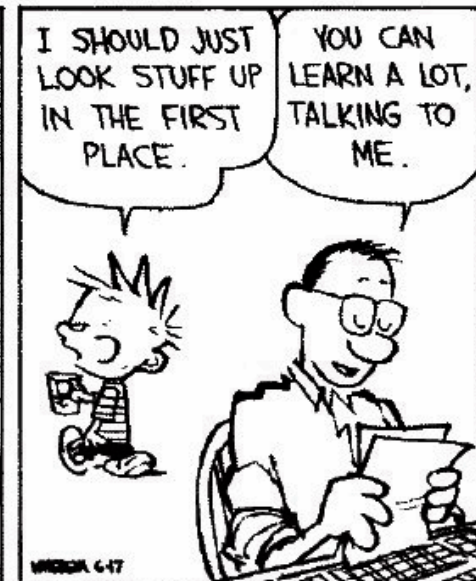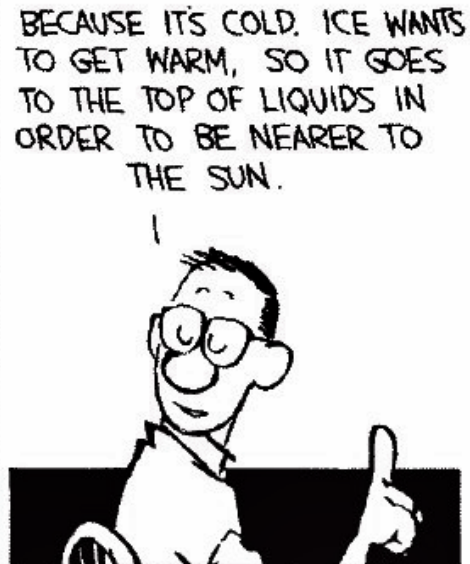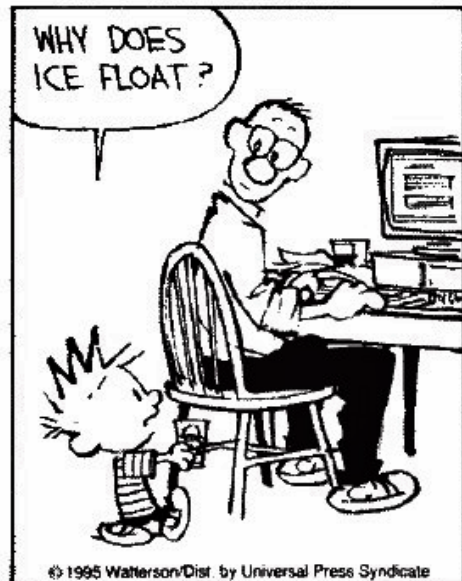
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Communicating Science Effectively: A Research Agenda. National Academies of Sciences, Engineering, and Medicine, 2017.

➢ If you communicate everything in the "right way" but **no one understands it** (or even read it) you are **not communicating!**

"Lies-to-Children"

Lies to children

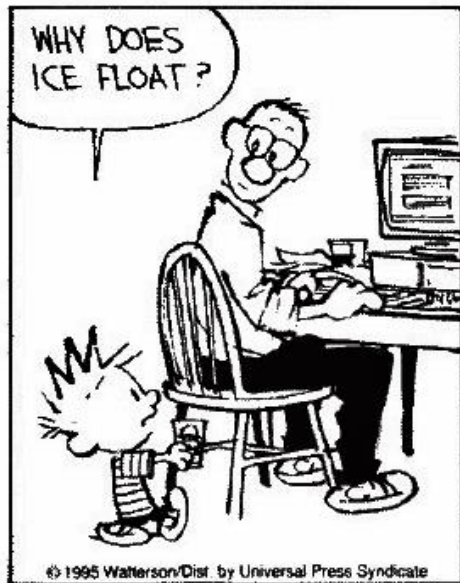# Lies to children

© 1995 Watterson/Dist. by Universal Press Syndicate
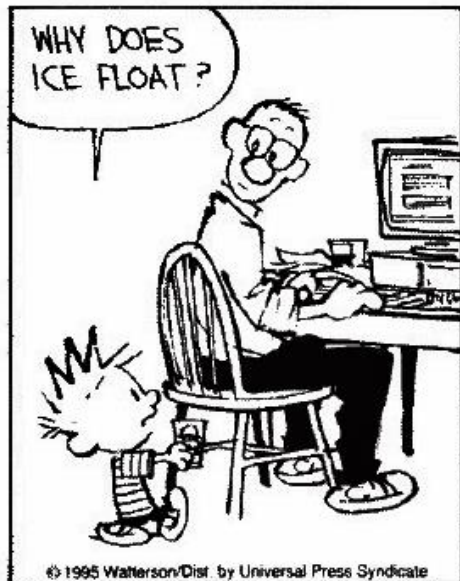
Lies to children

BECAUSE OF THE LOWER DENSITY OF ICE W.R.T. TO WATER AND BECAUSE OF THE ARCHIMEDES PRINCIPLE
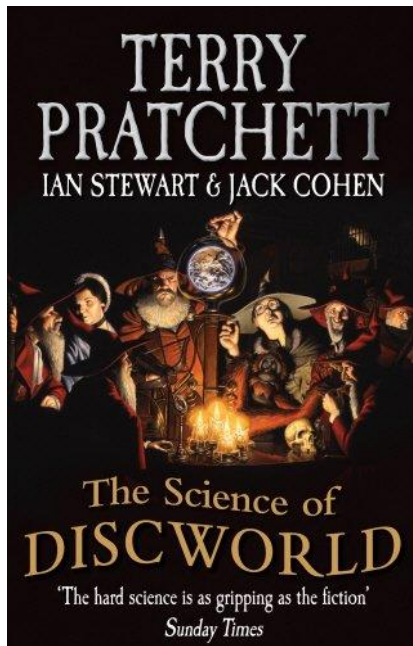
Would this answer have been better?

(for a 6 y.o. kid)

Lies to children

➢ Concept in science **education**

➢ **Simplified versions** of a subject

➢ The purpose is **NOT** to fool, rather
  ✓ give the main idea
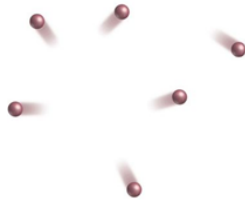 ✓ give the tools to move beyond

Lies to children

➢ First popularized in the sci-fi novel
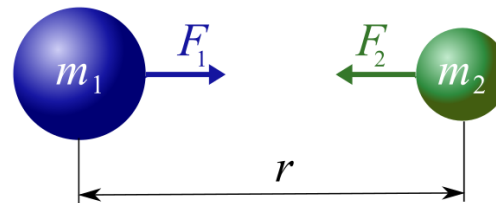***The Science of Discworld*** (1999)

*"A lie-to-children is a statement that is false, **but which nevertheless leads the child's mind towards a more accurate explanation,** one that the child will only be able to appreciate if it has been primed with the lie"*
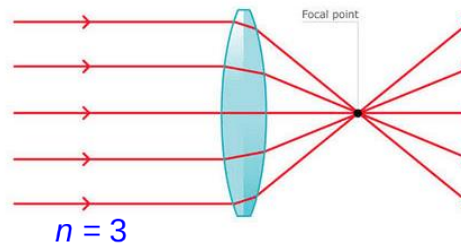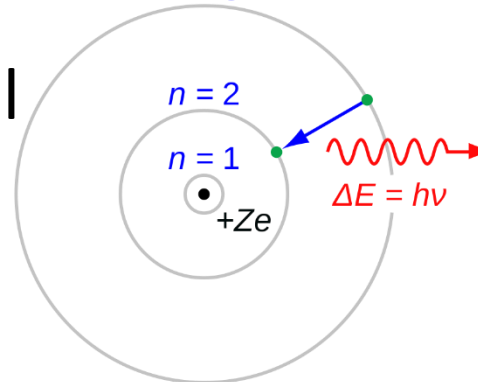
Examples in physics

➢ Ideal gases

➢ Newtonian gravity

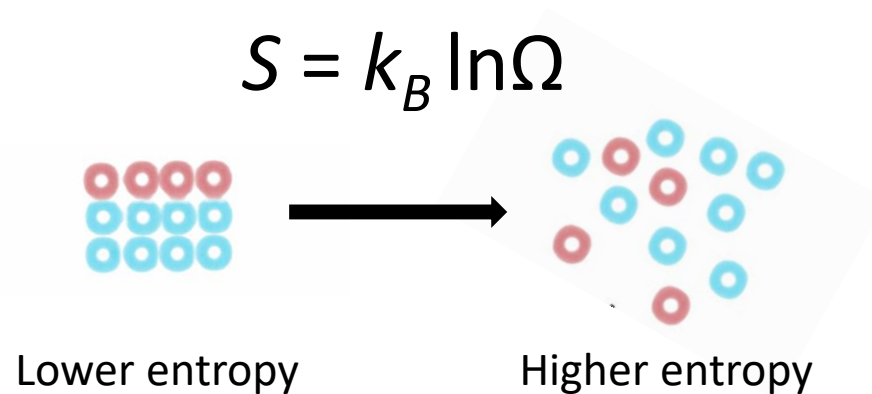➢ Geometric optics

➢ Bohr atomic model

Lies to children in sci-comm

➢ Sci-comm is **not** science education

➢ How it works in sci-comm: **metaphors**

➢ **Unavoidable** in fundamental physics
(it's all about explaining math without math)

Lies to children in sci-comm

➢ **Entropy** as **"disorder"**

$$S = k_B \ln\Omega$$

Lower entropy   Higher entropy

Lies to children in sci-comm

➢ **Entropy** as **"disorder"**

$$S = k_B \ln\Omega$$

Lower entropy   Higher entropy

*"Really the idea that entropy measures disorder is **totally not helpful**. What about **oil and water**? Entropy measures likelihood,** not disorder"*

Lies to children in sci-comm

*"Really the idea that entropy measures disorder is **totally not helpful**. What about **oil and water**? **Entropy measures likelihood,** not disorder"*

Really? Lets dissect this criticism:

Lies to children in sci-comm

*"Really the idea that entropy measures disorder is **totally not helpful**. What about **oil and water**? **Entropy measures likelihood,** not disorder"*

Really? Lets dissect this criticism:

- It is true (after all $S \sim \ln\Omega$) but:
- Think of a layperson: "likelihood" vs. "disorder"
- The nuance it introduces can only be fully appreciated if you first believed that S measures disorder

Important remarks

➢ Of course, this **doesn't justify**

- **deforming a fact** beyond recognition
- **misleading** the readers

➢ But a "wrong explanation" **might be OK** if

✓ it **arouses interest**

✓ it's leaves **room for improvement**

Important remarks

➢ There's **no "correct way"** to explain something
It's **audience-dependent**

➢ **Tricky part:** Crafting the lie **minimizing damage**

➢ The **problem** doesn't arise when X is a lie, but when X is:

- An **unnecessary** lie
- A lie that **doesn't allow to move beyond**

To sum up

➢ Science communication is **not** science education
- Different **goals**
- A variety of **audiences**

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➢ Science communication is **not** science education
- Different **goals**
- A variety of **audiences**

➢ It needs a **narrative**
- Sci-comm is not only **what** you tell
- But also **how** you tell it

To sum up

➢ Science communication is **not** science education
- Different **goals**
- A variety of **audiences**

➢ It needs a **narrative**
- Sci-comm is not only **what** you tell
- But also **how** you tell it

➢ The **tension** between   &   arises:
- Journalists: Have incentives to **overdo the narrative**
- Scientists: Have a tendency to **forget it altogether**

Final remark

➢ Getting the **facts right** is essential
But conveying them:

- is **not** an exercise of **maximization** of this
  % of truth conveyed

- but more like one of **optimization** of this
  f (**% of truth**, **# words**, **audience**, **goals**, **…**)

Thank you