MODULE 6

Scientific Research and Scientific Mistakes

PART 2

Can mistakes be useful?

Warm-up

Ex.1 Look at the picture below. What mistakes made from a scientific point of view can you find in it?

READING

Ex.2 Read the conclusion of the article *How science is learning to admit mistakes*. These three pieces (1, 2, 3) were extracted from the text. Put them back into their places (A, B or C).

1) Confronted with researchers who publicly admit to errors, one should keep in mind that this is not a reliable indicator that the researchers were less diligent in their work than others — after all, errors are frequent throughout the scientific record.

On the contrary, given the potential (or perceived) costs of individual self-corrections, public admission of error could be taken as a costly and thus credible signal that the issuer cares about the correctness of the scientific record.

2) "In my view, a retraction would be appropriate if the data were faked, if the statistical analysis was wrong, or something like that," Schmukle says. The problem with his paper, however, is that some of the results, which in hindsight are important for understanding it, were not reported.

… Marcus Munafò, a biological psychologist at the University of Bristol in the U.K. who has pulled a paper after spotting an error, made a similar case. "Whether or not to retract a paper is a tricky issue," he said. "But I wouldn't retract papers that report results that are almost certainly wrong but that were conducted in good faith."

3) A research culture in which individual self-corrections are the default reaction when errors or misinterpretations have occurred might not only reduce conflict between authors and critics, but also change the way in which criticism from third parties is dealt with, as it would create more distance between researchers' identities and their findings.

Making a Virtue out of Changing Your Mind

Many of the issues around the reproducibility crisis and questionable research methods are being tackled by encouraging more transparency and closer scrutiny.

Scientists are encouraged to pre-register the hypothesis they are testing before they begin their work, to discourage p-hacking and fishing around for correlations after the fact. More journals encourage or require sharing the underlying data for calculations, making it easier for other scientists to double check their conclusions. PLOS One, a major group of open-access journals, has recently become a "retraction engine" in part because it has established a dedicated team to review questions about research integrity.

Simply greater awareness of the problem has encouraged many scholars to go back through journals and systematically check the most foundational studies in their field, something that was only rarely done before.

But all of these efforts depend on journals, universities, and other scientists policing each other's work more aggressively, and that costs time and money, and it can reduce trust between researchers. That kind of suspicion and friction between colleagues has its own costs, which are harder **to quantify** but just as significant.

The people who are most likely to know about potential issues with their research are the authors themselves, and surveys show that many scholars are well aware of issues with their methodology, data quality, or reproducibility that wouldn't be obvious to other researchers, peer reviewers, or journalists.

To try to promote a new culture of openness and self-correction in science, in 2016, a team of psychologists created a pilot program called the Loss of Confidence Project to encourage researchers to come forward with concerns or disclosures that have undermined their faith in their own work.

The project collects statements from scientists who no longer believe their research holds up. Unlike a retraction, which would be an extreme and costly punishment for messing up, a loss of confidence (LOC) statement doesn't **imply** that the authors did anything dishonest or made a major technical mistake.

Rather, the work was done in good faith and is technically correct, but the author no longer thinks the conclusion is defensible because of flaws in their methodology, design, or interpretation.

For instance, the psychologist Stefan Schmukle issued a LOC statement about a study he **co-authored** about a correlation between finger length and gender bias. Schmukle now suggests the result was a false-positive created by multiple tests, but they only published the test that gave a positive outcome.

Nonetheless, he doesn't think the paper should be outright retracted, because he and his co-authors did the work **in good faith**. In a world where the number of publications is the key to getting a job or a promotion, other scientists agree that there ought to be a way to publicly doubt a publication without losing it altogether.

[A]

The project wants to give researchers an avenue for **questioning** research that won't punish them for being honest about mistakes or changing their minds. In a paper analyzing the first round of LOC statements they collected, titled "Putting the Self in Self-Correction," the team noted that

[B]

Tavris says that simply acknowledging cognitive dissonance can help a person overcome it. **Acknowledging** that there is a difference between what you may have written and your self-image is an important way to reduce cognitive dissonance, without **digging in your heels** or losing faith in yourself as a careful, honest researcher.

In their paper, the LOC team was careful to emphasize that **admitting to mistakes** doesn't prove that someone is a bad researcher, and that correcting the record may actually be a sign of scientific virtue:

[C]

They hope this new paradigm will encourage the scientific community as a whole to practice more self-correction. They suggest journals allow authors **to attach** LOC statements, explaining their reasons for doubting a result, instead of requiring total retractions. They also mention a more radical idea: a publishing system that allows for continuously updating articles based on new evidence or understanding while still **preserving** previous versions, in a kind of "wiki for science" model.

Ultimately, regardless of the publishing model, the goal is to change the culture around scientific correction from a mostly antagonistic ethos, where other scientists must tear each other down, to permit a self-improvement track as well. With luck, seeing scientists personally practice the model of revision and self-correction that the system as a whole aspires to could be the key to restoring public confidence in the scientific community and science itself.

VOCABULARY

Ex.3 Match the following words with their meaning.

1. integrity	a. openness, not hiding any part of work
2. scrutiny	b. link between ideas
3. foundational	c. not to believe in smth
4. underlying	d. honesty
5. issue	e. fundamental
6. transparency	f. careful study
7. disclosure	g. revealing a secret or smth new
8. to undermine	h. direct, unambiguous
9. correlation	i. removing smth
10. to hold up	j. trouble, problem
11. outright	k. factors or features which are not obvious
12. retraction	l. to make smth or smb less strong
13.to doubt	m. to resist pressure or criticism

Ex.4 Find words and phrases marked in bold in the text that mean the following:

1) работать в соавторстве, 2) подсчитать, 3) ставить под сомнение, под вопрос, 4) признавать, 5) прикреплять (например, файл), 6) подразумевать, 7) добросовестно, 8) упрямо стоять на своем, 9) сохранять, 10) признавать ошибки

GRAMMAR

Ex.5 The following examples are from the article in ex.2. Fill in the gaps with Modal verbs of probability:

1) Journals, universities, and other scientists policing each other's work more aggressively, and it _____ (reduce) trust between researchers.

2) Simply acknowledging cognitive dissonance _____ (help) a person overcome it.

3) There is a difference between what you _____ (write) and your self-image.

4) Correcting the record _____ (actually be) a sign of scientific virtue.

5) Seeing scientists personally practice the model of revision and self-correction _____ (be) the key to restoring public confidence in the scientific community.

6) Public admission of error _____ (take) as a costly and thus credible signal that the issuer cares about the correctness of the scientific record.

7) A research culture _____ (not only reduce) conflict between authors and critics, but also change the way in which criticism from third parties is dealt with.

Ex.6 Go back to the text and check yourself. What is time of these verbs: past, present or future? What is their voice: active or passive? What is their degree of certainty?

Modal Verbs of Probability

Modal verbs can express the idea of **probability or how certain you are** about a situation. When we want to speculate or make deductions about a particular situation, we can use the following modal verbs:
must, can't when we are 99% sure about something
may (not), might (not), could when we think something is possible.
These modal verbs can be followed by simple, continuous or perfect infinitives.

Present/Future

We **might interpret** it. (V - simple infinitive)
Elliott thinks he **could determine** whether a signal bears the characteristics of a language.
It **can't be** true. You **must be** wrong.
They **could be listening** to our conversation right now. (be + Ving - continuous infinitive)

Past

They **can't have produced** a similar effect. (have + V3 - perfect infinitive)
Scientists **must have examined** the problem in detail.
He **might have provided** them with the information they needed.

SPEAKING

1) The article *How science is learning to admit mistakes* suggests self-correction as a way to avoid data fishing and false publication. What is your point of view on the issue? Will self-correction and revising your research work? Why?

2) What are pros and cons of making mistakes?

3) Do you know any crucial scientific mistakes?

4) Can you recall any cases from history of science when mistakes helped science to improve?

GRAMMAR PRACTICE

Probability in the Present and Future

Ex.7 Express your agreement with the following statements (but you are not sure). Use *may /might /could* in your sentences.

example:

- *The experiments in the subject will probably need access to the chemical laboratory.*
- *Yes, the experiment in the subject may need access to the chemical laboratory.*

1. They will probably develop several schemes of this type. 2 They will probably attach great importance to these facts. 3. They will probably create a satisfactory theory for such applications. 4. They will probably obtain sufficient experimental data for exotic particles. 5. Who knows, maybe they will gain more detailed information about such phenomena. 6. Maybe they will give a complete interpretation of these observations. 7. Our understanding of the properties of these particles will probably improve considerably. 8. Scientists will perhaps take into account these effects. 9. Scientists will perhaps account for the properties of these particles. 10. Engineers will perhaps apply the new method for practical purposes. 11. Physicists will perhaps make an attempt to study the phenomenon in detail. 12. Engineers will perhaps help to simplify the procedure of the experiment.

Ex.8 Say that the person mentioned *must be doing* the action now.

example:

- *They are definitely refining upon that invention yet.*
- *They **must be refining** upon that invention now.*

1. He is certainly developing the film now. 2. I'm sure they are reconstructing this experiment now. 3. I'm sure he's choosing suitable materials for the experiment right now. 4. I bet they are brainstorming the problem at the moment. 5. I'm sure he's learning the definitions at the moment. 6. Of course he is distributing the books to the students now. 7. There's every chance that they are conducting the improved version of this type of experiment.

Ex.9 Express supposition in connection with the following statements. Use the suggested words.

- *His articles are always very good. (a smart man)*
- *He **must** be a smart man.*

1. His theories are always very significant. (a talented scientist) 2. His experiments are always successful. (a skillful experimenter) 3. His articles are always carefully written. (an industrious writer) 4. His lectures are always excellent. (a brilliant speaker) 5. His students know English well. (a capable teacher) 6. His devices are always ingenious. (a talented engineer)

Modal Verbs of Probability in the Past

Ex.10 Re-state the following sentences using an appropriate modal verb with perfect infinitives.

example:
They certainly found a way to avoid such paradoxes.
The must have found ay to avoid such paradoxes.

1. They probably diminished the pressure. 2. Of course they performed the calculations in time. 3. I think they found the classical liquid structure. 4. They probably limited the heat produced to the proper amount. 5. He definitely exerted every effort to perform the task. 6. The producers probably supplied the demands of consumers.

Ex.11 Contradict the following statements. Use "It can't be so" as an opening phrase. Develop the situations saying that the person mentioned can't have done the actions.

example:
- *They have produced a similar effect.*
- *It can't be so. They can't have produced a similar effect.*

1. They applied the new device. 2. He has changed his viewpoint. 3. He has delivered a report in English.4. They have found topics of mutual interest. 4. They have simplified the procedure of the experiment. 5. They found another method of introducing ions into the system. 6. He demonstrated the truth of this hypothesis.

Ex.12 Re-state the following sentences.

example:
-He could test the device, but he didn't try.
-He could have tested the device if he had tried.

1. He could improve the device, but he didn't try. 2. He could answer the questions, but he didn't try. 3. You could encourage their discussion, but you didn't try. 3. They could check these figures, but they didn't try. 4. You could simplify the procedure of the experiment, but you didn't try. 5. They could make use of the new scheme, but they didn't try.

Ex.13 Should + perfect infinitive.

Give short negative answers to the following questions. Develop the situations saying you realize now that you should have done the action. Follow the model.

example:

-Have you observed the process carefully?

-No, I haven't. But I realize now that I should have observed the process carefully.

1. Have you specified these values? 2. Have you examined the problem in detail? 3. Have you used both systems simultaneously? 4. Did you find a more convenient way to do it? 5. Have you formed the images in the traditional way? 6. Did you make an attempt to solve the problem? 7. Have you studied the general operating principles of this device?

Ex.14 Put the following sentences in to the passive voice.

example:

-They must have overlooked this possibility.

*-This possibility must have **been** overlooked.*

1. They must have underestimated the results. 2. They should have extended the conception to include this case too. 3. They may have disregarded smaller defects. 4. They must have postponed the further work. 5. They must have overestimated the potentialities of this technique. 6. They could have reorganized the physics department long ago. 7. They must have violated the conservation law. 8. They might have neglected smaller errors. 9. They should have included other works in the review. 10. They could have estimated this contribution more precisely.

Ex.15 Translate the following sentences.

1. These important results might have been easily overlooked, as they were published in a popular science magazine. 2. Johnson's data published in 1987 could have been used in our work but they lacked precision. 3. Originally, this word must have been used to describe this process for want of a better term. 4. But for the lack of precise measuring instruments these events might have been detected much earlier. 5. These studies should have been resumed, when it became clear that the original assumption had been correct. 6. The resulting figures should have been corrected for the energy losses to make the picture look more realistic. 7. The definition of this event suggested by Smith lacked clarity; otherwise it could have been taken for general use. 8. But for the support and encouragement of my colleagues this work might not have been completed. 9. Observation of the sun and the planets must have been made long before our civilization, as evidenced by recent archaeological findings.

Ex.16 Translate into English.

1. Должно быть, они упростили методику этого эксперимента. 2. Им следовало упростить методику этого эксперимента, но они этого не сделали. 3. Неужели (разве) они упростили методику этого эксперимента? 4. Не может быть, чтобы они упростили методику этого эксперимента. 5. Они, возможно, упростили методику этого эксперимента, но я в этом не уверен. 6. Они могли бы упростить методику этого эксперимента, но они даже не попытались этого сделать.