

AI Prompt: What are some problems with reproducibility in scientific research published in journals? (Explain to a 15 year old)

Okay, so imagine a scientist publishes a really cool finding in a journal. Other scientists get excited and want to try the same experiment to see if they get the same result. That's called **reproducibility**. Ideally, if the original science was solid, anyone following the same steps should be able to reproduce the findings.

But sometimes, that doesn't happen. There are several reasons why it can be hard to reproduce published scientific research:

1. Missing Details (Like a Bad Recipe):

- Sometimes, the original paper doesn't give enough detail about how the experiment was done. It's like a recipe that forgets to mention how long to bake the cake or the exact temperature. If other scientists don't have all the steps, it's hard to follow exactly what was done.
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2. Messy Data or Analysis (Like a Misspelled Word in Your Homework):

- Scientists collect a lot of data, and sometimes there can be mistakes in how it's recorded or how it's analyzed using computers. If the original analysis had errors, then re-analyzing the same data might not lead to the same conclusions. Also, if the original data isn't shared, others can't even check the analysis.

3. Sneaky Statistics (Trying to Force a Good Grade (cheating)):

- Sometimes, researchers might unintentionally (or even intentionally - intentionally means knowingly, while unintentionally means unknowingly) play around with the data or the way they analyze it until they get a result that looks "significant" (like finding a pattern that might not really be there). This is sometimes called "p-hacking" or "data dredging." It's like trying different ways to solve a math problem until you get the answer in the back of the book, even if your method wasn't right.

4. Only Showing the Good Stuff (Ignoring the Failed Attempts):

- Journals often prefer to publish exciting, positive results. This can lead to **publication bias**, where studies that didn't find anything interesting (called "negative results") are less likely to get published. So, other scientists might waste time trying something that already didn't work for someone else. It's like only seeing the highlight reel of a game and not the many times the team didn't score.

5. Using Different Materials (Like Baking with Different Flour):

- In some types of science, especially biology or medicine, the exact materials used can be really important. For example, different batches of cells or even the specific brand of a chemical might affect the results. If the original paper didn't specify these things clearly, it can be hard to use exactly the same materials.

6. The Pressure to Publish (Trying to Get Famous Fast):

- Scientists are often under pressure to publish their findings to get jobs, funding, and recognition. This "publish or perish" culture can sometimes lead to rushed research or cutting corners, which can make the results less reliable and harder to reproduce. It's like trying to finish a big project the night before it's due – you might miss some important details.
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Why is this a problem?

If scientific findings can't be reproduced, it makes us question how reliable they are. This can slow down progress, especially in fields like medicine where we rely on research to develop new treatments. It can also waste time and resources if other scientists try to build on findings that aren't solid.

Scientists are now realizing how important reproducibility is, and there are efforts to make research more transparent and rigorous so that others can more easily check and build upon scientific discoveries. This includes things like sharing data and detailed methods more openly.

AI Prompt: How much of existing scientific research is reproducible? Are there any estimates?

It's tricky to give one exact number, but most estimates suggest that a significant portion of published scientific research is **not reproducible**. This has led to what's often called the "**reproducibility crisis**" in science. Here's a breakdown of what some studies and surveys have found:

Estimates from Different Fields:

- **Biomedical Research:** One study looking at in-house drug target validation in a pharmaceutical company found that they could only reproduce the results of **20-25%** of 67 high-profile academic studies. Another survey of over 1,500 biomedical researchers in 2016 indicated that over **70%** had tried and failed to reproduce another scientist's experiment, and more than **50%** had failed to reproduce their *own* work.
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- **Psychology:** A large project called the "Reproducibility Project: Psychology" attempted to replicate 100 studies from top psychology journals. They found that only about **36%** of the replication attempts had statistically significant results that matched the original findings. Another study in 2018 that tried to reproduce 21 social and behavioral science papers from the journals *Nature* and *Science* found a reproducibility rate of around **62%**.
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- **General Science:** In the same 2018 *Nature Human Behaviour* study mentioned above, which included papers from various scientific disciplines published in *Nature* and *Science*, the successful reproduction rate was about **62%**.
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What these numbers mean:

These findings suggest that a considerable amount of published research might not be as solid as we'd hope. It doesn't necessarily mean the original research was wrong or dishonest, but rather that there might have been issues with the experimental design, data analysis, or the level of detail provided, making it difficult for others to get the same results.

Important Points to Consider:

- **Defining Reproducibility:** It's important to note that "reproducibility" itself can mean different things. Sometimes it refers to whether you can get the same results using the original data and code, and sometimes it means whether you can get similar results by doing the experiment again with new data. The estimates above can vary depending on which definition is used.
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- **Publication Bias:** As we talked about before, there's a tendency for journals to publish positive or exciting results more often than negative or null results. This can create a skewed picture of what's really happening and make it seem like more research is reproducible than it actually is. If many failed attempts to reproduce a finding aren't published, we don't get the full story.
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- **Efforts to Improve Reproducibility:** Scientists and journals are becoming more aware of the reproducibility crisis. There are increasing efforts to promote transparency in research, encourage the sharing of data and methods, and even publish replication studies. This is a step in the right direction to make science more reliable.
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So, while we don't have one perfect number, the evidence suggests that a significant chunk of published scientific research faces challenges when it comes to being reproduced by other scientists. This is a serious issue that the scientific community is actively working to address.

AI Prompt: Answer the same question again in the language of a 10 year old.

Okay, imagine scientists are like chefs sharing their recipes (their experiments) in cookbooks (scientific journals). When another chef tries to follow the recipe exactly, they should get the same yummy dish (the same results), right? That's what we hope for in science – that experiments can be **reproduced**.

But sometimes, it's like the recipe is missing a secret ingredient or a step, or maybe the first chef accidentally used a little too much salt that they didn't write down. Then, when the second chef tries, their dish doesn't taste the same!

Scientists have been trying to figure out how often these "recipes" in science don't work out the same way when someone else tries them. It's hard to get an exact number, but it looks like it happens quite a bit.

Think of it this way:

- Some studies say that maybe only **2 or 3 out of every 10** science "recipes" (experiments) can be followed exactly by other scientists to get the same results, especially in things like medicine and how our brains work. That means many times, the second scientist gets a different result.
- Other times, maybe a bit more than **half** of the "recipes" seem to work out the same.

Why does this happen?

- Sometimes, the first scientists didn't write down *everything* they did. It's like forgetting to say you stirred the soup for exactly 5 minutes.
- Maybe there were tiny little differences in the stuff they used that they didn't even realize were important. Like using apples from a different farm.
- Sometimes, scientists might have looked at their results in a way that made it look more exciting than it really was, like seeing shapes in the clouds.

Is this a big deal?

Yes, it can be! If we can't trust that one scientist's discovery will happen again when someone else tries it, it makes it harder to build new knowledge. It's like if every time a chef tried to make a cake from the same cookbook, it came out different – we wouldn't know which recipe to trust!

So, scientists are trying to be more careful about writing down all the steps and sharing their "secret ingredients" so that other scientists can try their experiments and see if they get the same yummy results. This makes science more trustworthy!