EXPLAINING THE TECHNICAL

Buying the Audience Time
When your audience is learning something new, pacing (how quickly you move from one idea to the next) is important.

If you go too fast, you lose them. Too slow, you bore them.

Pacing becomes especially important when you are trying to teach something technical. The audience needs time to think about whether or not what you just said makes sense given their understanding so far.

For example: the Jaccard Distance of \{1 2 3\} and \{3 4 5\} should be higher than \{1 2 3\} \{2 3 4\} because the first two sets are more "dissimilar" than the second two.

\[ J(A,B) = \frac{|A \cup B| - |A \cap B|}{|A \cup B|} \]
They need time to wrap their heads around it, understand it, and then anchor it into their mental model.
AND SO YOUR JOB IS TO BUY THEM THE TIME TO DO THIS BEFORE MOVING ON TO THE NEXT IDEA.

THE DENSER THE MATERIAL, THE MORE TIME THEY'LL NEED.

HOW DO YOU DO THIS?

HOW DO YOU SLOW DOWN YOUR PACE?

THE IDEA IS TO BE REPEETITIVE - WITHOUT BEING REPEETITIVE.
Tell them what you've just told them but in a different way, so that you can reinforce, clarify, and fill in some details about what you just said.

In this comic so far, I've already shown you five ways to do this.

Reread the start of this comic to see if you can spot them.

Go ahead, I'll wait.
DID YOU FIND THEM?

THEY, IN ORDER OF APPEARANCE, ARE:

1. AN “I.E. CLAUSE”
2. AN “E.G. CLAUSE”
3. AN EXPLANATION OF WHY
4. AN ELABORATION, AND -
5. A REPHRASING
I'm being repetitive.

- Without being repetitive.

You may be wondering.

"Wait!"

-I didn't see an i.e. nor an e.g. anywhere.

They're not explicit, but they're there.

Here are the first two sentences again with these explicitly written in.
WHEN YOUR AUDIENCE IS LEARNING SOMETHING NEW, PACING I.E. (HOW QUICKLY YOU MOVE FROM ONE IDEA TO THE NEXT) IS IMPORTANT.

FOR EXAMPLE

IF YOU GO TOO FAST, YOU LOSE THEM.

TOO SLOW, YOU BORE THEM.

PACING BECOMES ESPECIALLY IMPORTANT WHEN YOU ARE TRYING TO TEACH SOMETHING TECHNICAL. THE AUDIENCE NEEDS TIME TO THINK ABOUT WHETHER OR NOT WHAT YOU JUST SAID MAKES SENSE GIVEN THEIR UNDERSTANDING SO FAR.

For example: the Jaccard Distance of \{1\ 2\ 3\} and \{3\ 4\ 5\} should be higher than \{1\ 2\ 3\} \{2\ 3\ 4\} because the first two sets are more “dissimilar” than the second two.

$$J(A,B) = \frac{|A \oplus B|}{|A \cup B|}$$
Here are examples of the remaining three:

EXPLANATION OF WHY

The audience needs time to think about whether or not what you just said makes sense given their understanding so far.

Explanation and should be \{1 2 3\}, and the more the more the.

Elaboration

Understand it

They need time to wrap their head around it.

And then anchor it into their mental model.

Rephrasing

How do you do this?

How do you slow down your pace?
EVEN THOUGH I’VE USED THEM HERE IN A NON-TECHNICAL EXAMPLE, THEY CAN ALSO BE USED IN TECHNICAL MATERIAL.

WAIT... DID SHE JUST SAY SECOND POWER?

...THEN WE RAISE THE RESULT TO THE SECOND POWER!

MOMENTS LIKE THESE PROVIDE OPPORTUNITIES TO REPEAT WHAT YOU SAID DIFFERENTLY—WHICH ALLOWS LEARNERS TO DOUBLE-CHECK THEIR UNDERSTANDING.

YES, SHE DID. OK.

THE REASON WE SQUARE THE DIFFERENCE IS SO THAT WE CAN...

BUT, THERE ARE ADDITIONAL CHALLENGES WHEN EXPLAINING TECHNICAL MATERIAL.
Each field has its own “language”.

**Redox Reactions**

\[ \text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O} \]

- 1 atom is oxidized from -1 to +4
- 4 atoms are reduced from 0 to -2
- 8 electrons remain unchanged at +1

- Notation, representations, and abstractions, and-

Because the student learner may be seeing them for the first time,

Let’s add three more ways to buy your audience time when dealing with technical material.

1. “I.e. Clause”
2. “E.g. Clause”
3. Explanation
4. Elaboration
5. Rephrasing—
6. Describing what the terms represent
7. Showing how a change in one variable affects the equation
8. Discussing edge or boundary cases

Here’s an example of a transcript of me teaching the Jaccard distance to a student seeing it for the first time.

**Warning**

This will be long due to the inclusion of many “buying time” elements.

In reality, these would be optionally inserted or removed as needed, so pay attention to what the shortest version of the Jaccard distance could be!
Let's consider the Jaccard Distance:

It's a measure of how "dissimilar" two sets are, the more dissimilar the larger the Jaccard Distance.

For example, the Jaccard Distance of \{1 \ 2 \ 3\} and \{3 \ 4 \ 5\} should be higher than \{1 \ 2 \ 3\} \{2 \ 3 \ 4\} because the first two sets are more "dissimilar" than the second two.

This distance metric is given by the following formula:

\[ J(A,B) = \frac{|A \cup B| - |A \cap B|}{|A \cup B|} \]

The numerator is the number of elements that are a member of either A or B, but not both.

And the denominator is the total number of elements in A when combined with B.

So the Jaccard Distance is essentially the fraction of elements that are not common to both sets.

For the examples above, the Jaccard Distances are 4/5 and 2/4 respectively.

Note that if A equals B, then there are no elements that are not common to both, so the Jaccard Distance is 0 - i.e. the sets are not dissimilar.

As the number of elements that are not common to both sets increases, meaning the sets get more and more dissimilar, the Jaccard Distance increases from zero.

It reaches its maximum value of 1 when the sets are disjoint - when none of the elements of A overlap with those of B, so every member of A and every member of B are counted in the numerator.

And lastly, if one set is contained within the other, without loss of generality, assume A is a subset of B, then the Jaccard Distance becomes the fraction of elements that are in B, the larger set, that are not in A:

\[ J(A,B) = \frac{|A|}{|B|} \]

I.E.
SO YOU MIGHT BE WONDERING

- HOW MUCH TIME DO YOU HAVE TO BUY YOUR AUDIENCE?

TWO THOUGHTS.

FIRST - IF YOU ARE DOING THIS LIVE,

THEN YOU CAN EITHER ASK AND/OR READ YOUR AUDIENCE

AND THEN ADJUST AS YOU GO.
So for example, if I think my audience gets it, then instead of explaining the final edge case in the Jaccard example, I could leave it out - or even better, I could test their understanding by asking them what would happen with the edge case.

Second - with experience, you'll know.
Once you've tried to explain the same thing several times to different audiences, you'll have a good feel for which parts of your explanation tend to confuse an audience.

You'll know when, where, and how you'll need to buy them time.
GradX is a project that seeks to expand access to professional development to all MIT graduate students and faculty. Its first offering, Gradcommx (both an online & live course availability TBA), will focus on communication skills for graduate students.

Design Principles

Pedagogical design principles strive to make the course simple in concept, complex in practice; customizable to student needs; connected to resources via links and gateways to other MIT resources and services; and featuring differentiated approaches to increase comprehension.

Teaching materials can be adapted by faculty to any population.

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- Podcasts
- Expert Interviews
- Activity Prompts
- Research Exercises
- And more!

Topics Covered

1. Choosing appropriate language to avoid overwhelming your audience
2. Using narrative to explain why your research is important
3. Synthesizing prior work to convey where yours fits in by highlighting differences
4. Controlling focus in order to minimize cognitive load when presenting data
5. Leaving time for an audience to process when explaining how something works
6. Distilling your message when time & attention spans are short

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