Waipapa Taumata Rau
University of Auckland

Supercharge Your Research

Unlocking AI's Hidden Potential Through Prompt Engineering

1 July 2025

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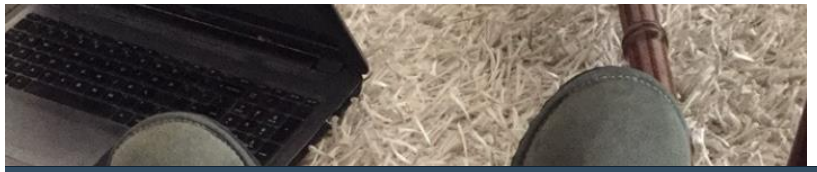
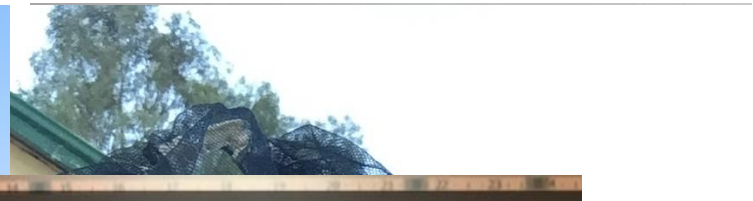
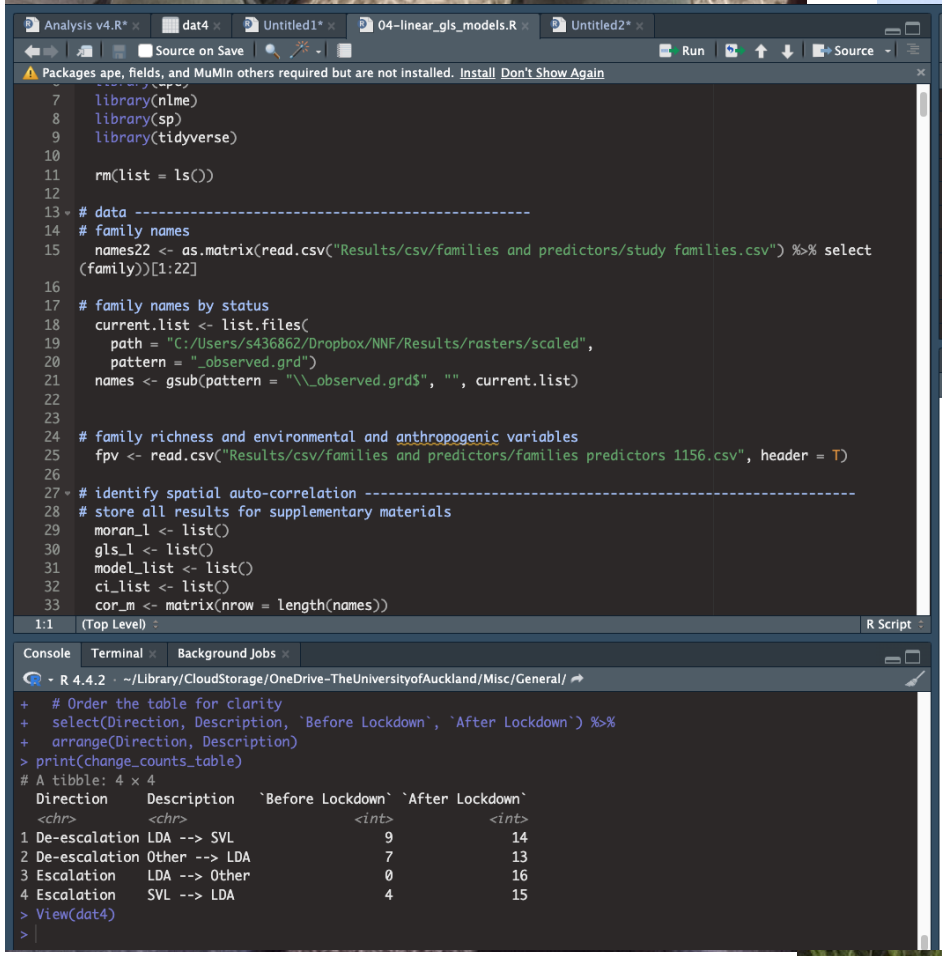
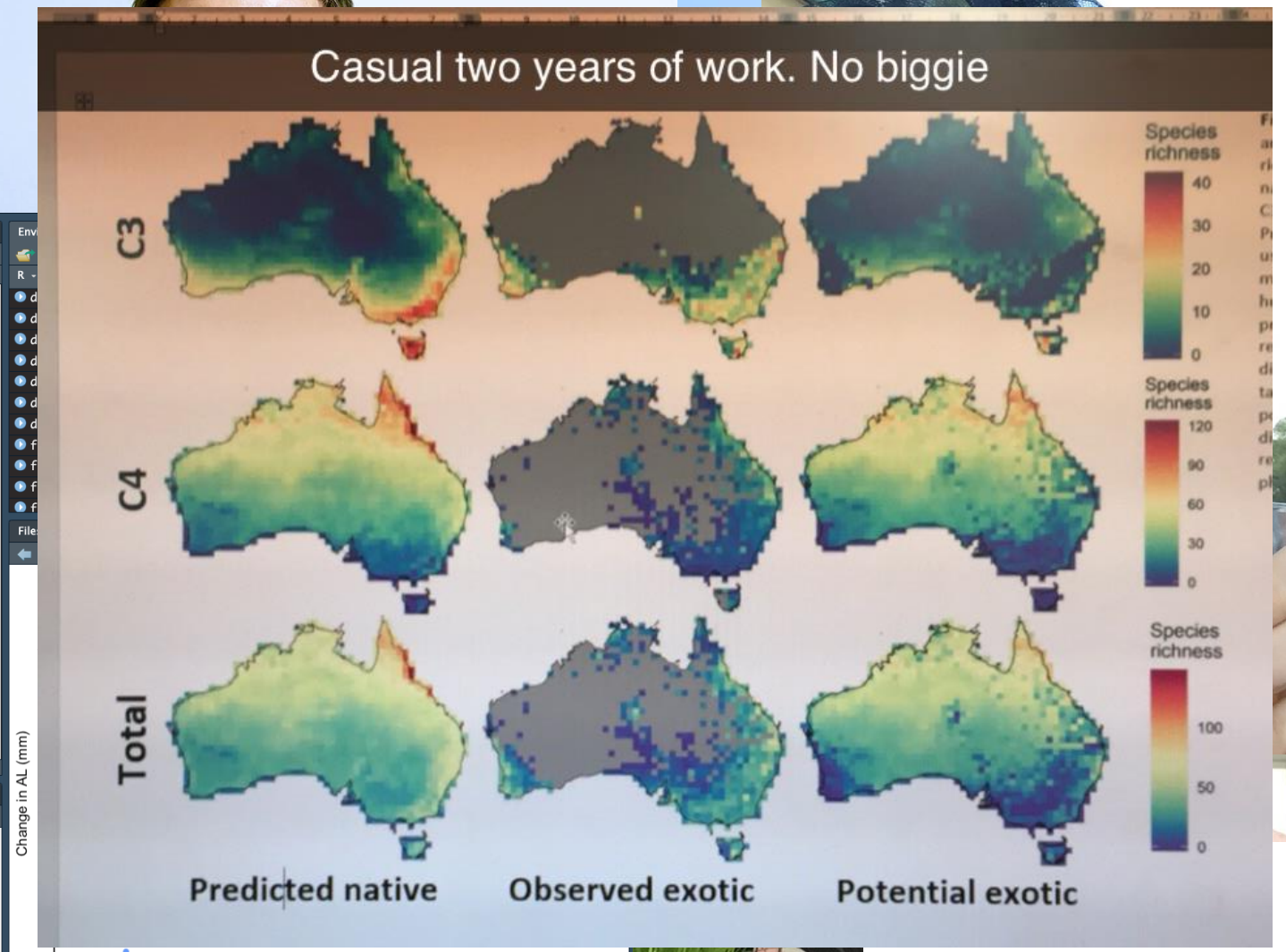
Who am I

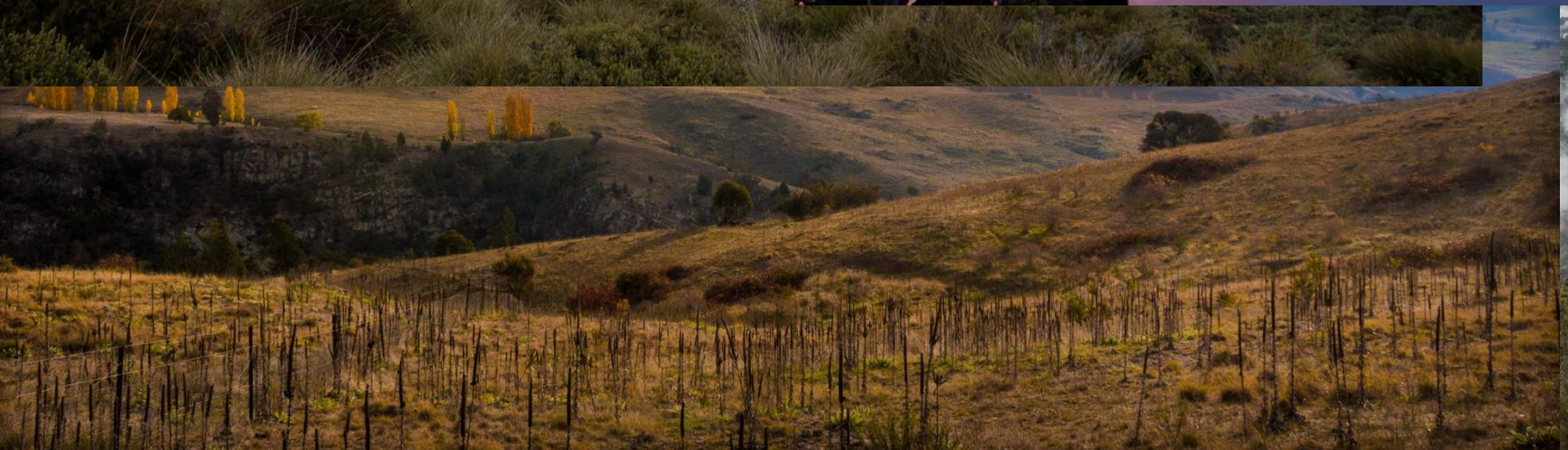


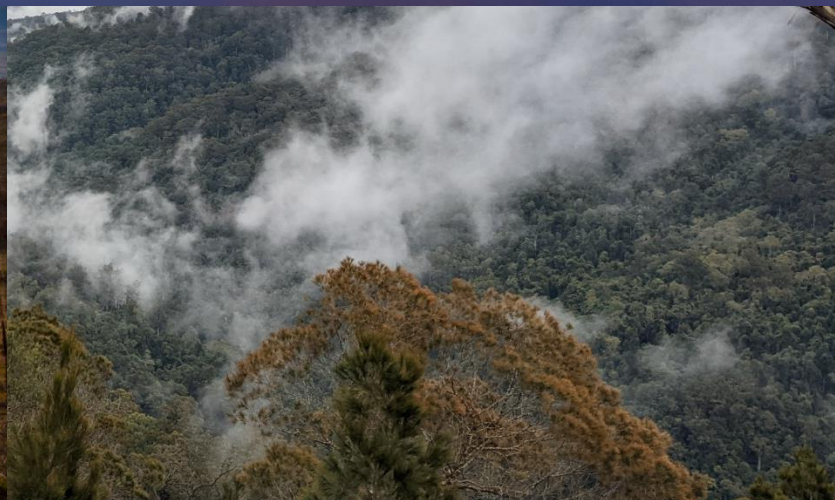



Analysis v4.R*
dat4
Untitled1*
04-linear_gls_models.R
Untitled2*
Source on Save
Run
Source
Packages ape, fields, and MuMIn others required but are not installed. Install Don't Show Again
library(nlme)
library(sp)
library(tidyverse)
rm(list = ls())
# data
# family names
names22 <- as.matrix(read.csv("Results/csv/families and predictors/study families.csv") %>% select(family))[1:22]
# family names by status
current.list <- list.files(
path = "C:/Users/s436862/Dropbox/NNF/Results/rasters/scaled",
pattern = "_observed.grd")
names <- gsub(pattern = "_observed.grd$", "", current.list)
# family richness and environmental and anthropogenic variables
fpv <- read.csv("Results/csv/families and predictors/families predictors 1156.csv", header = T)
# identify spatial auto-correlation
# store all results for supplementary materials
moran_l <- list()
gls_l <- list()
model_list <- list()
ci_list <- list()
cor_m <- matrix(nrow = length(names))
1:1
(Top Level)
R Script
Console
Terminal
Background Jobs
R 4.4.2 · ~/Library/CloudStorage/OneDrive-TheUniversityofAuckland/Misc/General/
Order the table for clarity
select(Direction, Description, `Before Lockdown`, `After Lockdown`) %>%
arrange(Direction, Description)
print(change_counts_table)
# A tibble: 4 × 4
Direction Description `Before Lockdown` `After Lockdown`
<chr> <chr> <int> <int>
1 De-escalation LDA --> SVL 9 14
2 De-escalation Other --> LDA 7 13
3 Escalation LDA --> Other 0 16
4 Escalation SVL --> LDA 4 15
View(dat4)


Casual two years of work. No biggie
C3
C4
Total
Species richness
40
30
20
10
0
120
90
60
30
100
50
Predicted native
Observed exotic
Potential exotic
Change in AL (mm)
-1
0
500
1000
1500
Duration (days)

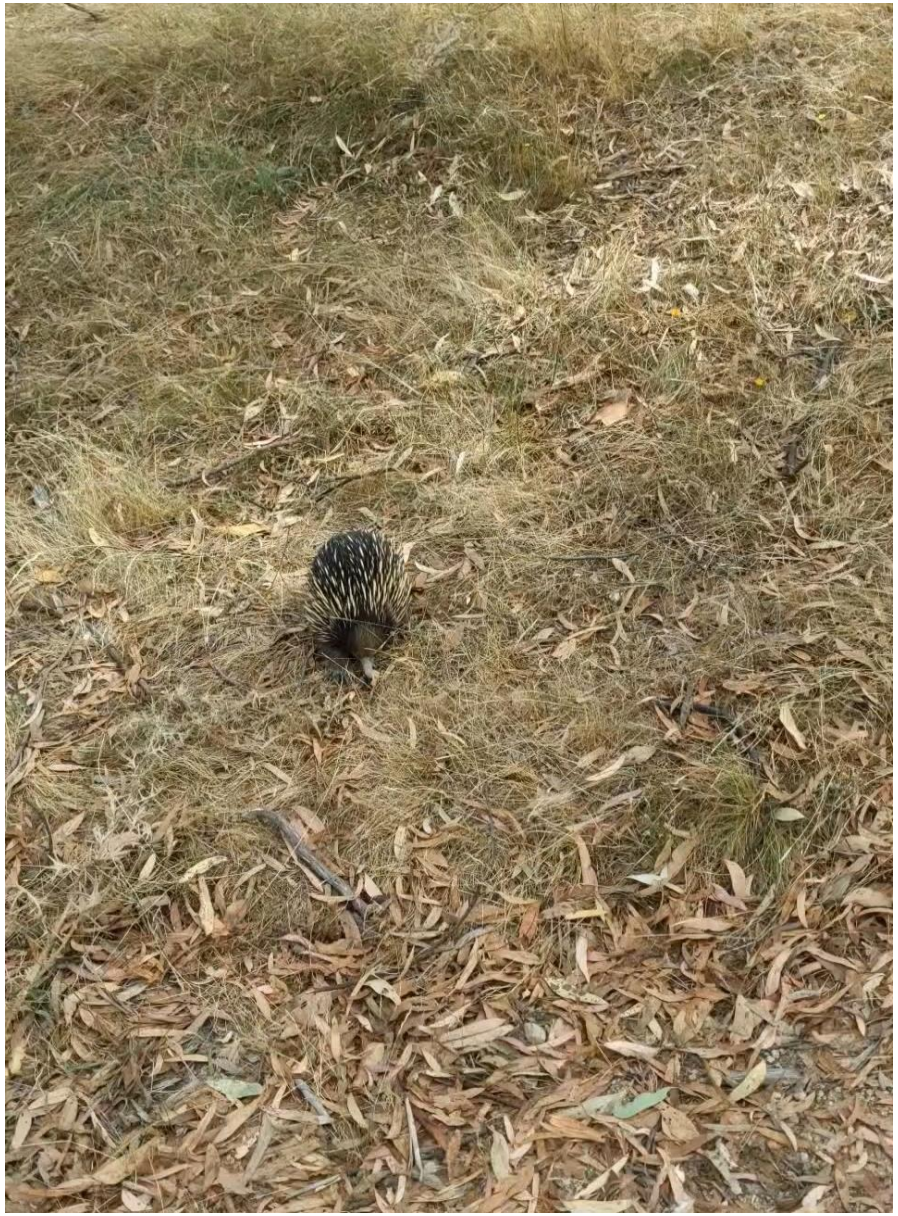
Australia





Agenda

1. Visit Australia (& come back!)
2. What is prompt engineering (PE)
3. PE principals
4. Responsible AI
5. PE research examples
6. Where to next



Learning outcomes

1. Define prompt engineering and its relevance to research
2. Understand core principles for crafting effective prompts
3. Apply responsible AI for research practices
4. Evaluate the use of different AI tools for research tasks
5. Critically evaluate AI for use in your research

What is prompt engineering

Defining prompt engineering

Art of communicating with AI for desired, high-quality outputs

Use in research - summarising text, exploring data, coding, explaining research methodologies, …

Effective prompting enhances research productivity[1, 2, 3]

Common AI tools

Copilot (Microsoft)

- We'll use it for thematic exploration
- Maybe Enterprise Licence, maybe approved for Sensitive Data

Gemini (Google)

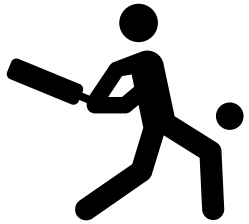
- Quantitative analysis example
- Data Science Assistant, coding; approved…?

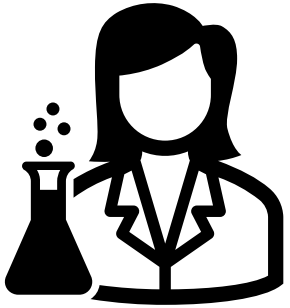
Claude

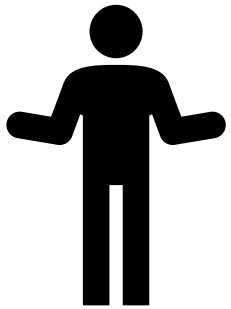
- Coding support, teaching example
- Complex reasoning, troubleshooting; approved…?

You have a context – it matters

You have a context – it matters







Prompting principles

a) Role / Persona
b) Instruction
c) Context
d) Output Format
e) Input Data
f) Iterate

Prompting principles in action

Qualitative analysis using Copilot

Scenario

- Summarise river perspectives from local community

Without Principals Prompt:

- *“Summarise river perspectives from local community”*

Principals-based prompt:

a) Role / Persona

b) Instruction

c) Context

d) Output Format

e) Input Data

f) Iterate

Benefits of applying PE principals

a) Role / persona

- Focusses AI lens to pitch the right language, complexity

b) Instructions

- AI gives you exactly what you want; it doesn't guess

c) Context

- lens to provide nuanced, useful structure and details

d) Output format

- Easy to export → saves you time

e) Input data

- Providing examples help make (a)-(d) better

e) Iterate

- Clarifies problem, gets you learning, time saver

How to prompt: takeaways

- Prompting is the art of communicating with AI
- Using prompting principles gets the most out of AI
- Realise the greatest benefits for you & your research
- Check outputs, AI is convincing > truthful

Responsible AI: considerations, limitations & biases

Considerations: your data

Google AI terms of use

What data is collected? How is it used?

When you use generative AI features in Colab, Google collects prompts, related code, generated output, related feature usage information, and your feedback. Google uses this data to provide, improve, and develop Google products and services and machine learning technologies, including Google's enterprise products such as Google Cloud.

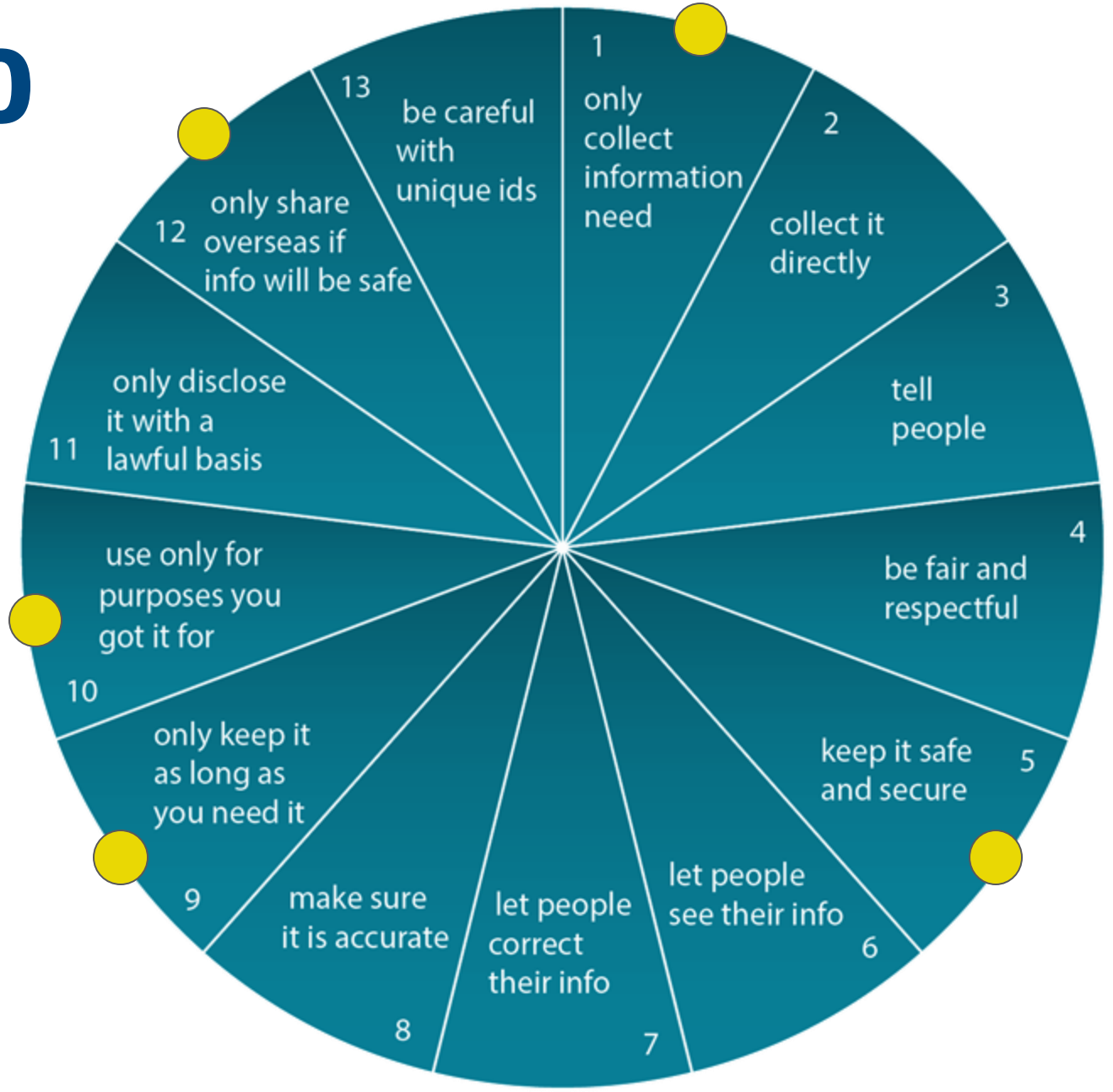
To help with quality and improve our products, human reviewers may read, annotate, and process your prompts, generated output, related feature usage information, and your feedback. Please do not include sensitive (e.g., confidential) or personal information that can be used to identify you or others in your prompts or feedback. Your data will be stored in a way where Google cannot tell who provided it and can no longer fulfill any deletion requests and will be retained for up to 18 months.

https://research.google.com/colaboratory/faq.html#generate-chat

Privacy Act 2020

Assume if you talk to it, it is saving your conversation

Interview or group discussion recordings assumed to contain personally identifiable information.



Considerations: laws, policies

Some considerations

- Privacy Act 2020
- University/ Institutional policies
  - Data classification (sensitivity)
  - Ethics
  - Approved tools
  - Cite AI usage
  - +…
- Data Sovereignty
- +…

Benefits of acting responsibly

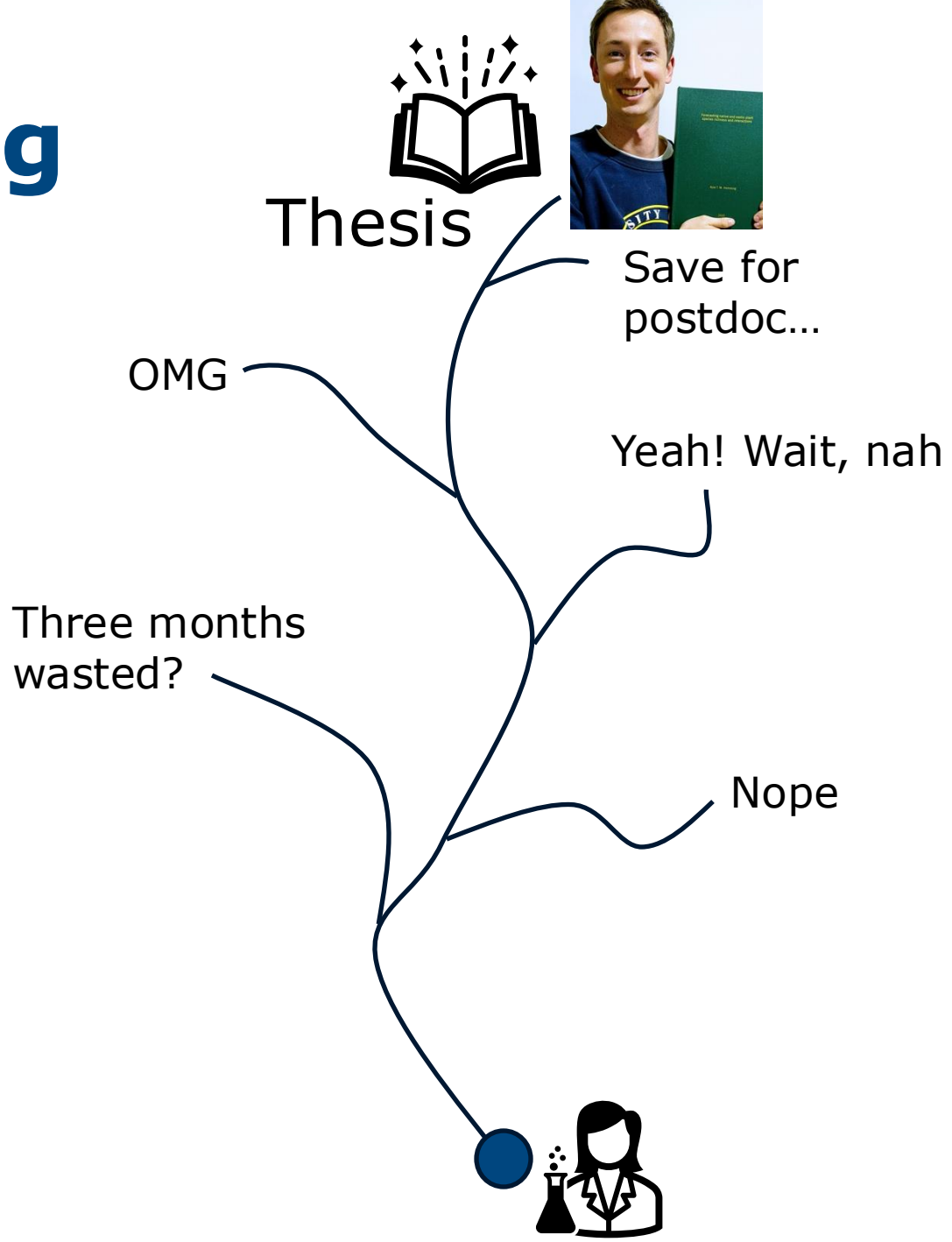
- Robust & defensible research practices
- Participant trust & safety
- Institutional reputation
- Streamlined processes and approvals, e.g. Ethics

Go find your institutional policies

- Get clarity on what you can use
- How you can use it
- Or not

Build critical thinking skills using AI

- Explaining why you didn't choose a path is as important as why you did
- Offloading all exploration can also offload important outcome of PhD: *learning how to research*
- AI is an assistant to help accelerate learning & inform decision points
- Build critical thinking skills alongside AI



Limitations & biases: data

Vague prompt

Generate a photorealistic image of a CEO in a modern boardroom

Limitations & biases: data

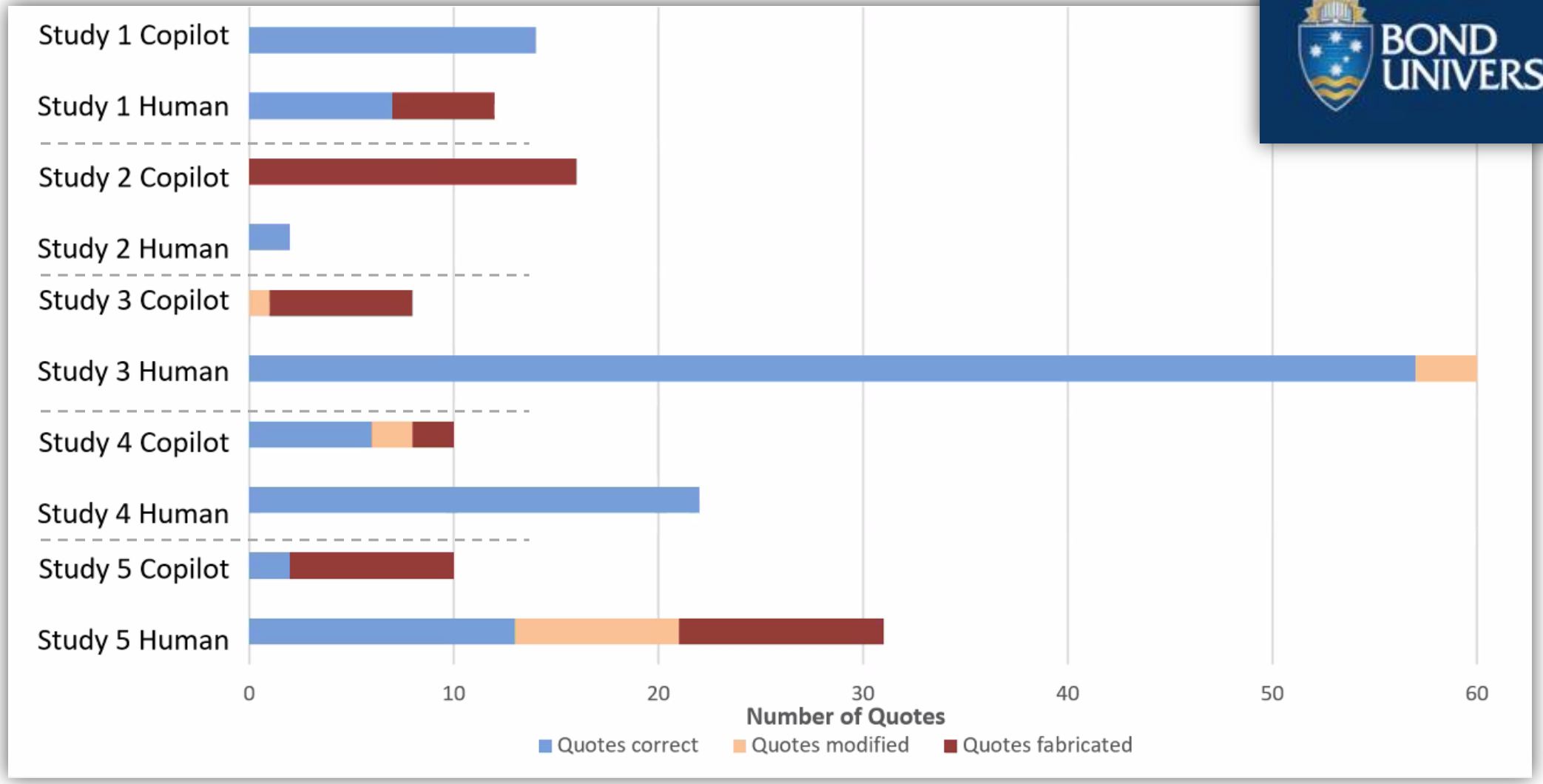
Vague prompt

Generate a photorealistic image of a CEO in a modern boardroom

Specific prompt

Generate a photorealistic image of a CEO in a modern boardroom. The CEO is a Māori woman, confidently leading a meeting with her diverse team

Limitations: fabricates, modifies



Tanisha Jowsey & colleagues (in review)

Limitations & biases: persona

The persona we assign to an AI dramatically shapes its focus and interpretation

“River perspective” data dataset has

- 90% Pro-Environment

- 8% Pro-Industry, and

- 2% Iwi Perspectives

Let's see how the persona we adopt influences this.

Persona A Prompt: Pro-industry focus

Persona B Prompt: Strong environmental advocacy focus

Considerations, limits, biases takeaways

- Understand data and project considerations (ethics)
- Understand AI tool behaviour (use approved tools)
- AI can reflect biases in training data, persona prompts
  - Researcher judgment is irreplaceable
- Critically evaluate outputs
  - What’s been added, subtracted, modified

Prompting in action: further research examples

Examples

Qualitative analysis using Copilot

✓ Comparing instructions

✓ Persona prompting

Visualisation using Gemini

- Statistical teaching, visualising

Coding support using Claude

- Complex instructions for coding

Visualisation using Gemini

Scenario

- Pilot study complete
- Supervisor wants statistical summary
- Stats isn't your strongest area, but you want to learn

Goal

- Utilise Gemini (Google) for exploratory data analysis

Tasks

- Code descriptive stats, plots
- Understand broad trends for formal stats later

Interviewee	Spring	Summer	Autumn	Winter
1	6	5	8	4
2	4	7	2	2
3	6	7	7	2
4	6	7	7	3
5	6	6	8	7
6	5	7	5	8

Iterate instructions using Claude

Scenario

- Need to understand a new method
- It’s complicated
- Want support to learn

Goal

- Utilise Claude (Anthropic) for iterative teaching

Task

- Legally teach me some terms, techniques

Prompting principals

a) Role / persona

- Focusses AI lens to pitch the right language, complexity

b) Instructions

- AI gives you exactly what you want; it doesn’t guess

c) Context

- AI lens to provide nuanced, useful structure and details

d) Output format

- Easy to export → saves you time

e) Input data

- Providing examples help make (a)-(d) better

f) Iterate

- Converse with AI to refine problem, get to best solution

Where to next: AI in your research

(If yes, move down)

1. Identify whether you have Ethics approval to use AI tools for your research
2. Explore whether your institution has safe/approved AI tools for your research data and context
3. What AI is your field using? (Consult lab, literature)
4. Apply PE principals + responsible AI to: learn about new techniques, deepen analysis, understand limits, build critical thinking
5. Potentially experience a deeper, more nuanced, broader, and faster research journey

<u>If no</u>, consider traditional methods; if appropriate, explore tools with made-up data to build AI literacy

Would you be surprised if…

Nine tips and tricks (1/3)

1. Name Your Conversations

Get into the habit of giving chats descriptive titles (e.g., "Qualitative Analysis - River Data," "Python Code for Stats Plots," "Lit Review Brainstorm - Grasses"). This turns your chat history into a searchable, project-specific library you can easily return to.

2. Use Delimiters to Separate Instructions from Data

Clearly wall off your instructions from the text or code you want the AI to work on. This prevents the AI from getting confused.

1. Use triple backticks (```) for blocks of code.
2. Use triple quotes (""") or hash symbols (###) for blocks of text.

3. Establish a Persona at the Start (and Stick to It)

Begin a new chat with a clear persona instruction (e.g., "Act as a critical social scientist specializing in mixed-methods research"). The AI will maintain this persona for the entire conversation, ensuring a consistent tone and focus. Start a new chat for a new persona.

Nine tips and tricks (2/3)

4. "Ask Me Questions": The Co-Creative Prompt

If you're unsure what details to provide for a complex task, ask the AI to help you build the prompt.

Example: "I need to write a research funding proposal. To help me formulate the best prompt, please ask me questions about the project's scope, the target funding body, the required sections, and the tone."

5. One Chat, One Task

Avoid "context bleed." If you're working on a Python script and then ask about email etiquette in the same chat, the AI might get confused or carry over context inappropriately. Start a new, clearly named chat for each distinct task to ensure the AI's focus remains sharp.

6. Provide Examples (Few-Shot Prompting)

If you need a specific format or style, the best way is often to show, not just tell. Provide 2-3 examples of the input-to-output transformation you want before giving it the new data to process.

Example: Example 1 Input: Group A had a mean of 15.2. Output: {"group": "A", "mean": 15.2}. Example 2 Input: For Control Group, the average was 12.8. Output: {"group": "Control", "mean": 12.8}. Now, convert this input: The Treatment Group showed a mean of 18.5.

Nine tips and tricks (3/3)

7. Regenerate for a Different Perspective

If the first response isn't quite right, don't immediately start re-writing your prompt. Use the "regenerate" or "retry" button first. This asks the AI to try a different approach to the *same* prompt and can often yield a better result or a new angle without any extra effort.

8. Refine with Follow-up Commands

Treat the first output as a draft that you can iteratively improve. Use simple, conversational follow-up commands to edit it.

Examples: "Make that more formal," "Now, expand on the second bullet point," "Can you check that for spelling and grammar?" or "Translate that explanation into Python code."

9. Use "System" or "Preamble" Prompts

For some advanced tools or API usage, you can set a "system" prompt. For web interfaces, you can achieve a similar effect by making your very first prompt a preamble that sets the rules for the whole conversation.

Example: "For this entire conversation, you are a helpful research assistant. You must always cite sources for any claims."