DATA VISUALISATION – HOW TO PRESENT YOUR RESEARCH?

EPIC SEMINAR SERIES, FEBRUARY 2024

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pa PROJECTS ASSURED

SESSION ETIQUETTE

- This session is on Zoom only, feel free to keep your camera off if preferred

- Please keep your microphone muted unless speaking to avoid background noise

- Feel free to ask questions on the chat or use Zoom "Raise Hand" option

- Dr Maria Stefaniak will be moderating the chat to alert me to any questions

- There will also be time for questions at the end

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INTRODUCTION

ABOUT ME

- Senior Consultant at Projects Assured

- Expertise in Business Analysis and Data Architecture

- Master of Data Science student at James Cook University, Australia

- Passionate about lifting data literacy

- Originally from Poland, migrated to Australia 10 years ago

- Residing in Canberra, Australian Capital Territory

- LinkedIn: https://www.linkedin.com/in/dorota-bragg/

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ABOUT THIS SESSION

PURPOSE

The purpose of this session is to give fundamentals and best practices of data visualisation.

LEARNING OBJECTIVES

- Who, What, How

- Cognitive Load

- Gestalt Principles of Visual Perception

- Pre-attentive Attributes

- Channel Effectiveness

- Example

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Who, What, How

THE BIG QUESTIONS OF DATA VIS

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WHO, WHAT, HOW

WHO

Your audience:
- Be specific to enable successful communication
- Avoid generalisations
- Identify decision makers

Why is this important:
- Visual accommodations for audience (e.g. colour vision deficiency in ~8% of people assigned male at birth: https://www.toptal.com/designers/colorfilter)
- Style and complexity of visualisation in line with audience's abilities
- Cultural connotations of colours

You:
- Have you met your audience before?
- Are you building your position or are perceived an expert?

Why is this important:
- Determines the level of trust your audience has in your data visualisation
- Supports the flow of the story you aim to tell

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WHO, WHAT, HOW

WHAT

What do you need your audience to do:
- Is there knowledge to be shared?
- Is there action or decision that needs to be taken?

Why is this important:
- If neither is present, do we need to communicate this in the first place?

Mechanism:
- Live presentation, email, diagram?

Why is this important:
- Determines the level of control of how the audience consumes the information

Tone:
- Is the topic light-hearted or serious?
- Are we celebrating a success or trying to point out a serious issue and spark action?

Why is this important:
- Determines the choices of colour schemes and design of visualisation

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WHO, WHAT, HOW

HOW

Only after answering the questions of **who** and **what**, can we determine what data is available that help convey the story we are trying to tell!

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Tools

HOW SCIENCE WORKS IN YOUR FAVOUR

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TOOLS

COGNITIVE LOAD

Cognitive load can be described as the amount of effort that is required to process information. We want to **avoid effort** that is required to process the visualisation, but does not lead to increased understanding of the information.

Ways to do this:

- **Reduce clutter** – every single element on the page takes up cognitive load

- **Maximise data-ink ratio** – graphics "ink" devoted to data should be maximised

- **Simplify where possible** - aim for plain backgrounds, consistent fonts, alignment of elements

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TOOLS

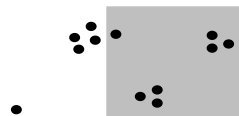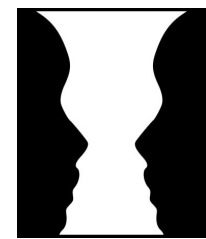## GESTALT PRINCIPLES OF VISUAL PERCEPTION

Proximity
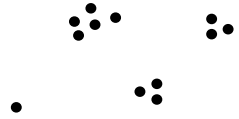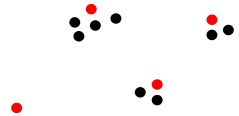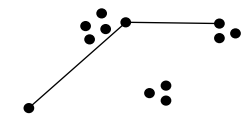
Similarity

Enclosure

Closure

Continuity

Connection

Figure/Ground

TOOLS

GESTALT PRINCIPLES OF VISUAL PERCEPTION

Number of cellphones (total, millions)
Total number of postpaid subscriptons and active prepaid accounts

Connection – all data points on the line belong to the same group

Proximity – the label corresponds with the data series

Similarity – data points belong to the same group

Based on free material from GAPMINDER.ORG, CC-BY LICENSE (*www.gapminder.org*)

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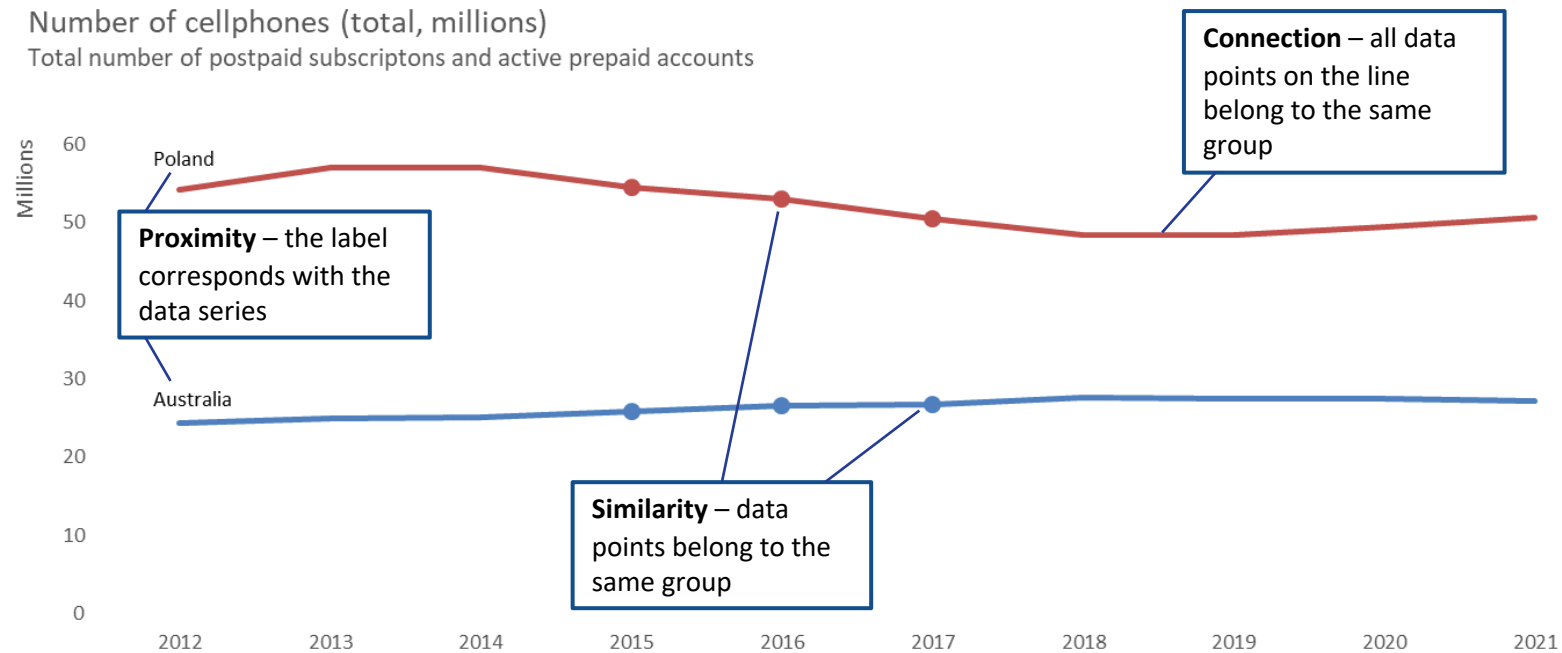
TOOLS

PRE-ATTENTIVE ATTRIBUTES

388428936
018373495
573221071
883378109
586023710
930259831
158042754

Example inspired by (Knaflic, 2015)

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PRE-ATTENTIVE ATTRIBUTES

3 8 8 4 2 8 9 3 6
0 1 8 3 7 3 4 9 5
5 7 3 2 2 1 0 7 1
8 8 3 3 7 8 1 0 9
5 8 6 0 2 3 7 1 0
9 3 0 2 5 9 8 3 1
1 5 8 0 4 2 7 5 4

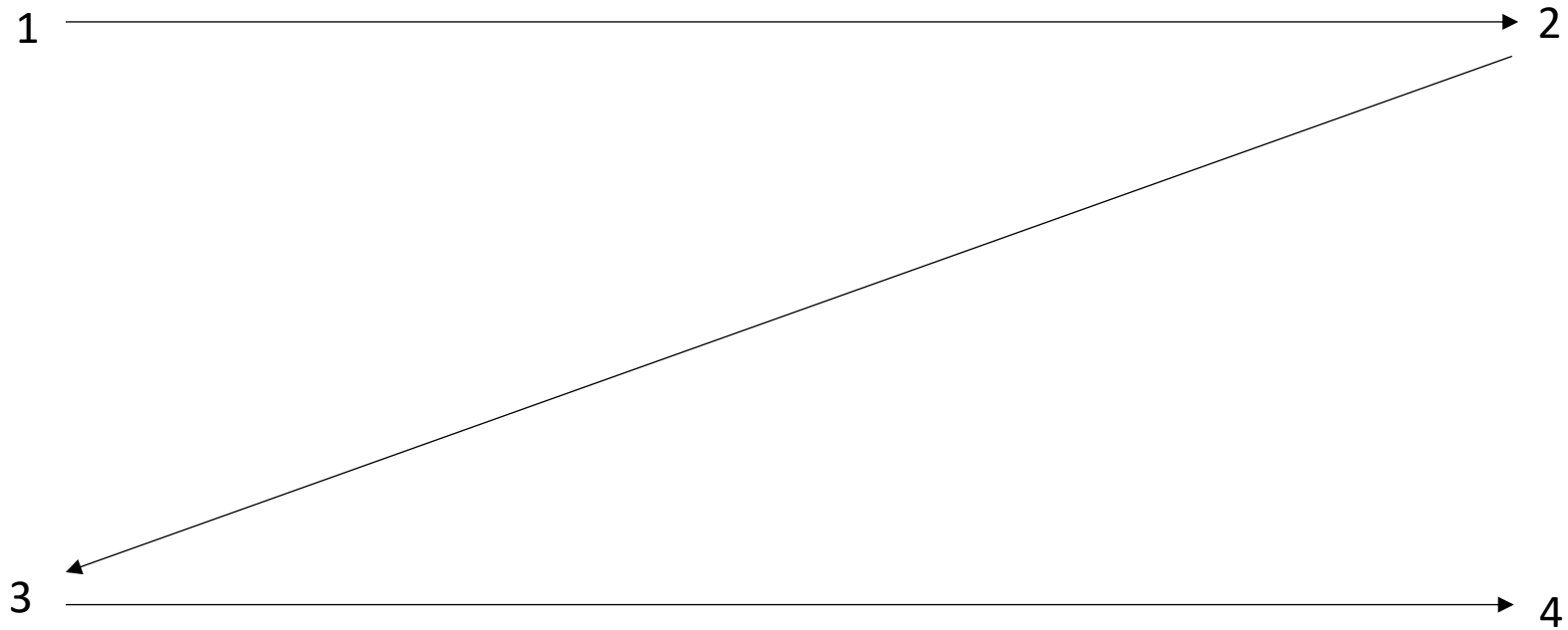"Enable our audience to see what we want them to see before they even know they are seeing it!"

Example inspired by (Knaflic, 2015)

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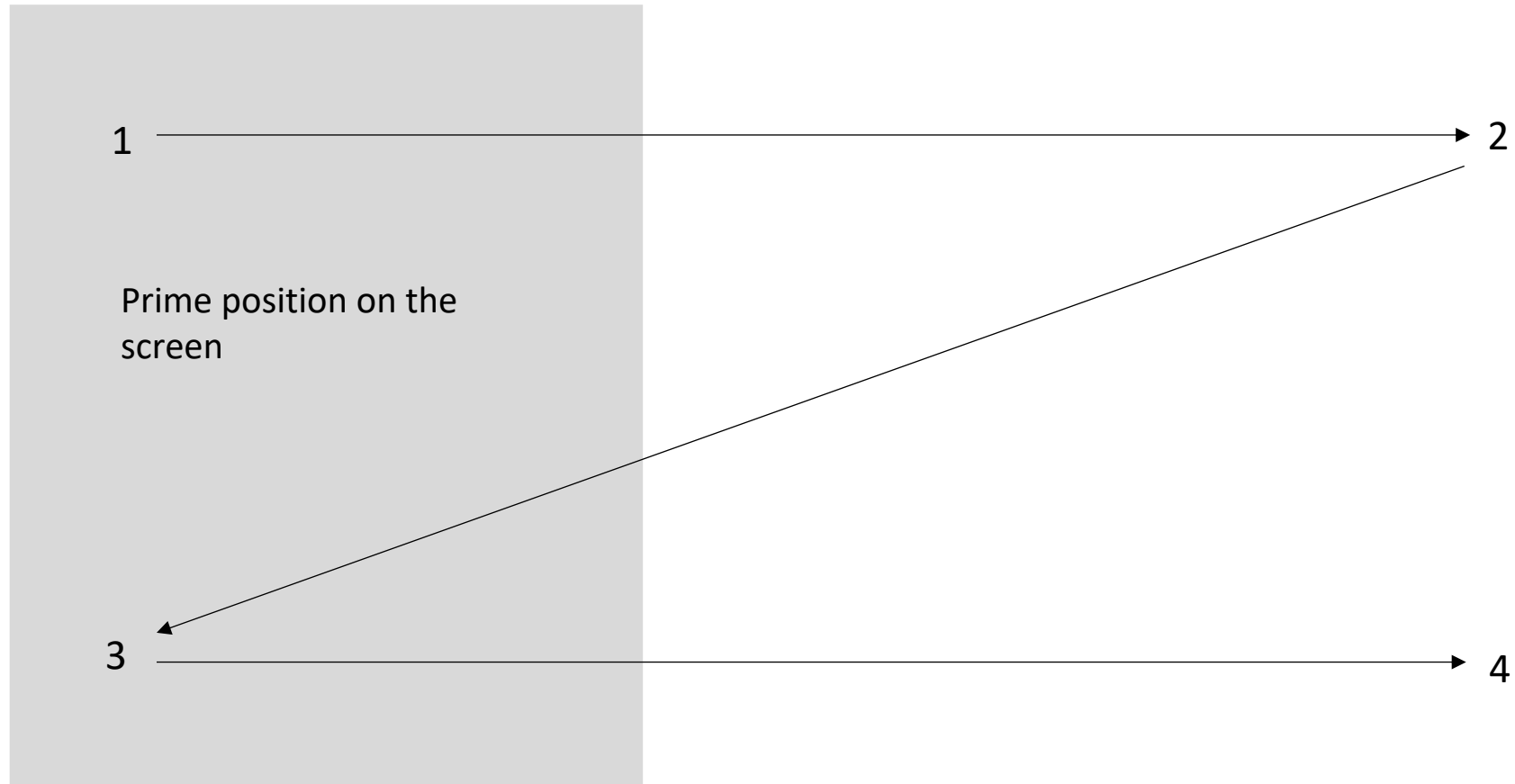
TOOLS
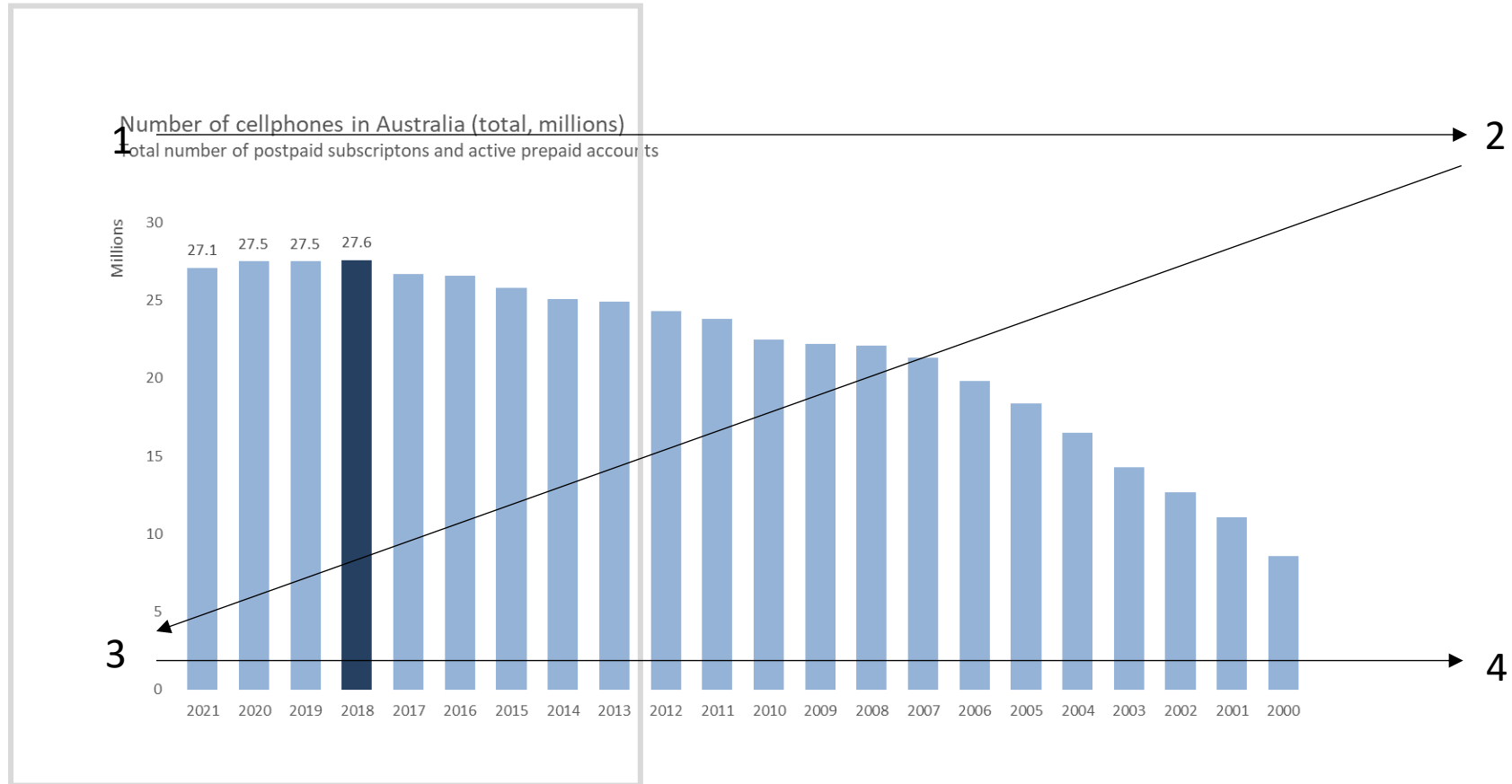
PRE-ATTENTIVE ATTRIBUTES

1 → 2

3 → 4

TOOLS

PRE-ATTENTIVE ATTRIBUTES

1 ————————————————————→ 2

Prime position on the
screen

3 ————————————————————→ 4

TOOLS

PRE-ATTENTIVE ATTRIBUTES

Number of cellphones in Australia (total, millions)
Total number of postpaid subscriptons and active prepaid accounts

1

2

3

4

Year	Millions
2021	27.1
2020	27.5
2019	27.5
2018	27.6

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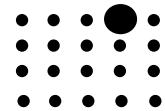
TOOLS

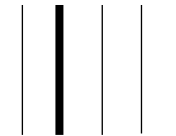## PRE-ATTENTIVE ATTRIBUTES – ADDITIONAL EXAMPLES

Hue

Size

Shape

Length

Width

Orientation

PROJECTS ASSURED
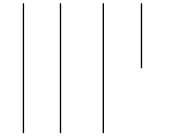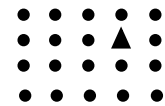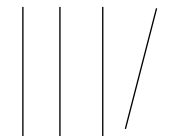
TOOLS

PRE-ATTENTIVE ATTRIBUTES IN TEXT

Our vision is to be Canberra's premier management consultancy and Canberra's best place to work. Our mission is to support and nurture our staff, win the best work and deliver superior quality.

Our vision is to be *Canberra's premier management consultancy* and Canberra's *best place to work*. Our mission is to support and nurture our staff, win the best work and deliver *superior quality*.

Our vision is to be Canberra's **premier** management consultancy and Canberra's **best place to work**. Our mission is to support and nurture our staff, win the best work and deliver **superior quality.**
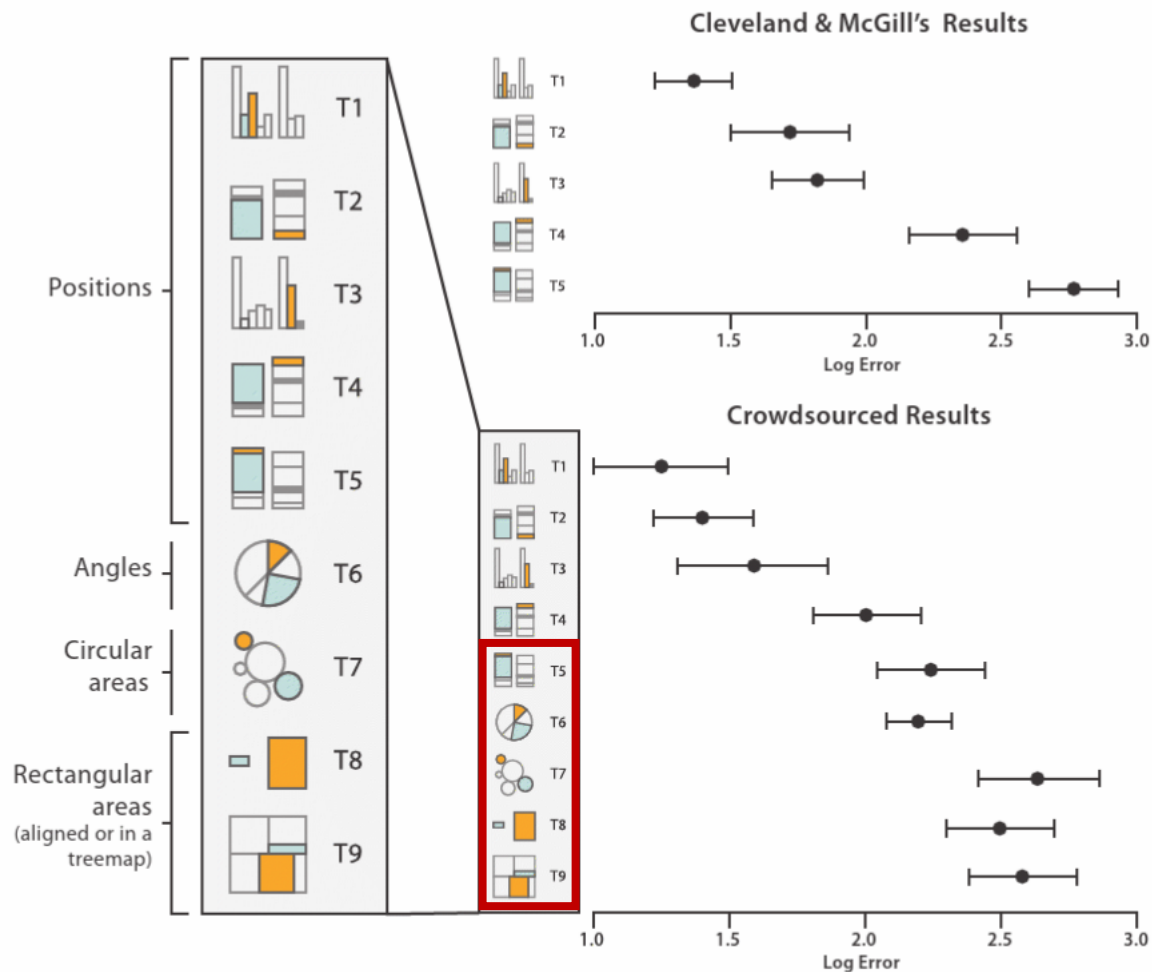
Our vision is to be Canberra's **premier** management consultancy and Canberra's **best place to work.** Our mission is to support and nurture our staff, win the best work and deliver **superior quality.**

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Channel Effectiveness

WHY ONLY THING WORSE THAN
PIE CHARTS ARE PIE CHARTS IN 3D

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Reprinted from (Munzer, 2014)

Most accurately perceived:
1. Aligned position against a common scale
2. Unaligned position against an identical scale
3. Length

Prone to inaccurate perceptual judgement:
- **Angles**
- **Circular areas**
- **Rectangular areas**

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CHANNEL EFFECTIVENESS

Most accurately perceived:
1. **Aligned position against a common scale**

Unaligned position   Aligned position

Weber's Law tells us that we judge difference in objects based on **relative** differences, not absolute. This confirms that unaligned measures are less effective than when in an aligned position (Munzer, 2014).

CHANNEL EFFECTIVENESS

PIE-CHARTS

Q1CAL23

■ Product A ■ Product B ■ Product C ■ Product D ■ Product E ■ Product F
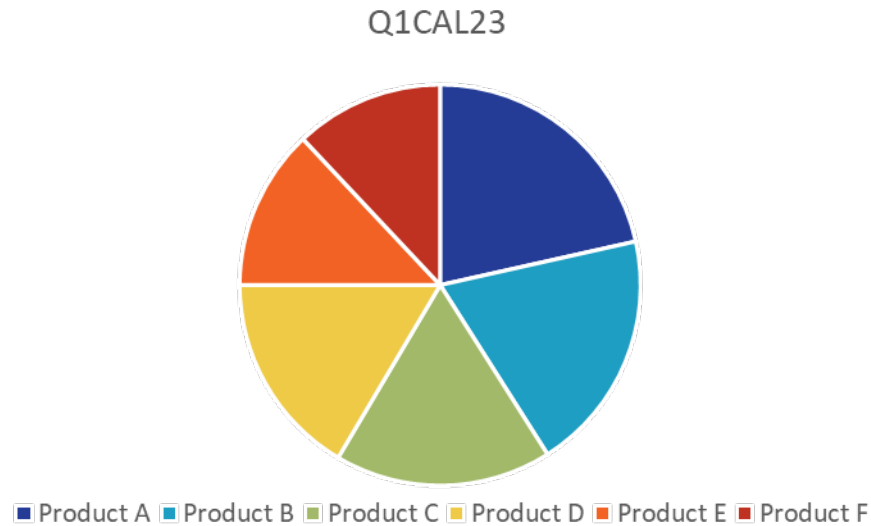
With pie charts, we are asking the audience to compare **angles** and **areas,** that are in an **unaligned position**.
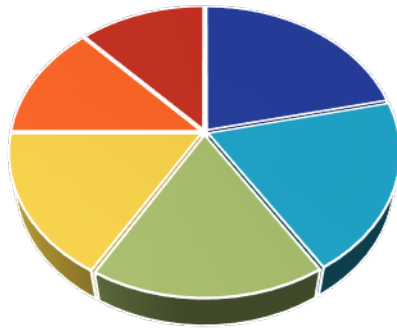
AVOID PIE CHARTS

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CHANNEL EFFECTIVENESS

NO UNNECESSARY 3D

Which product held the largest share of the market?

Q1CAL23

■ Product A ■ Product B ■ Product C ■ Product D ■ Product E ■ Product F

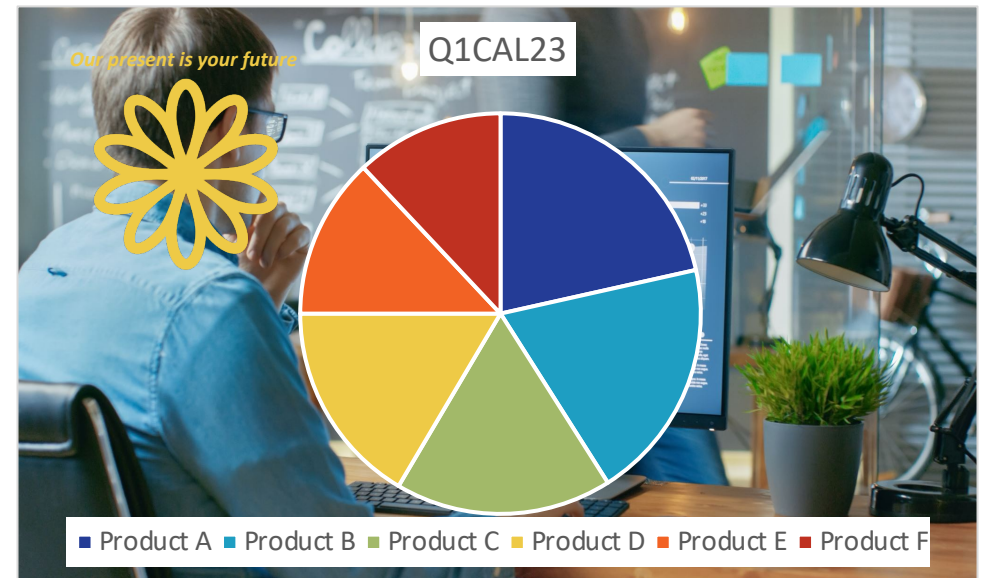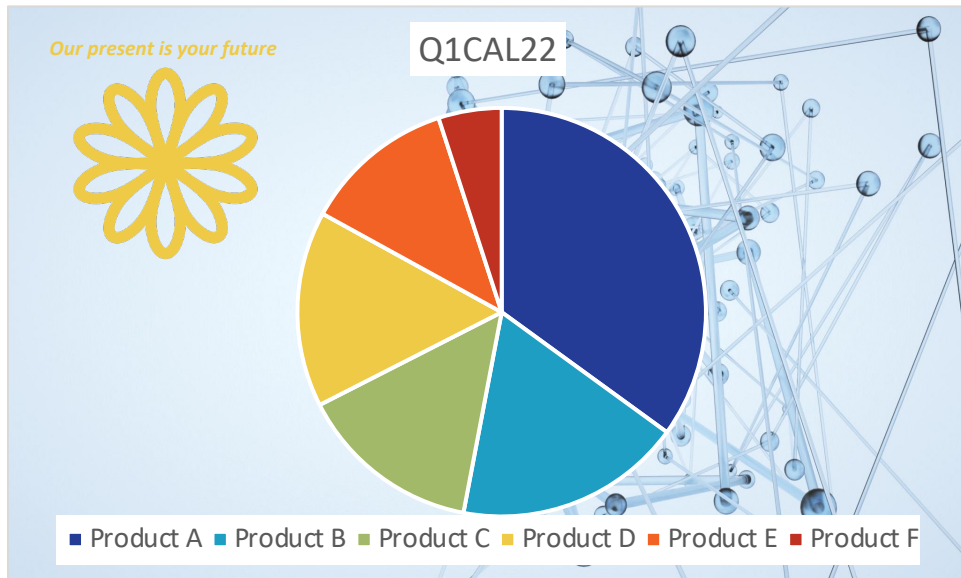**Depth perception is non-linear.** This means distances and angles are distorted when depth is added.

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Example

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EXAMPLE

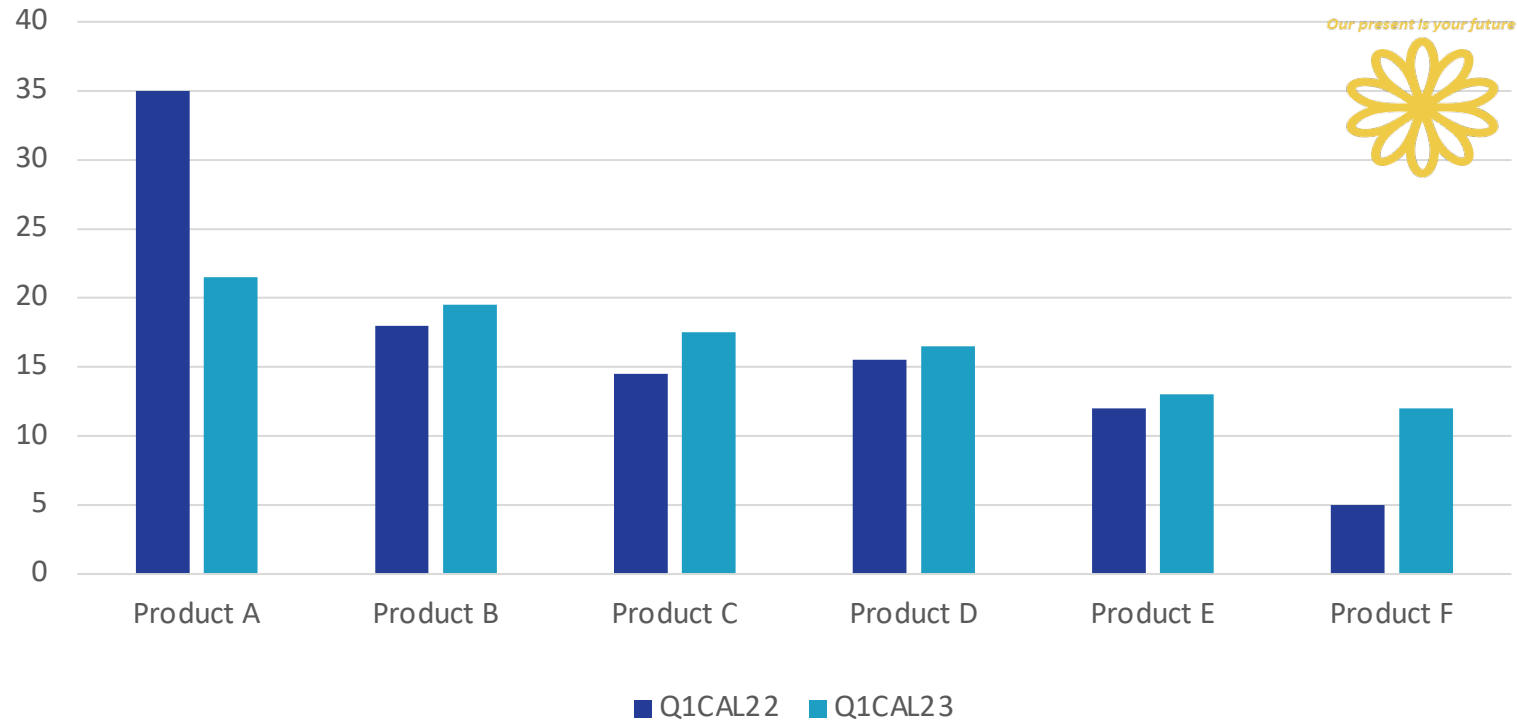We work for the company that sells Product B. We want to show our position on the market amongst the competitors.

EXAMPLE

Get rid of pie-chart!

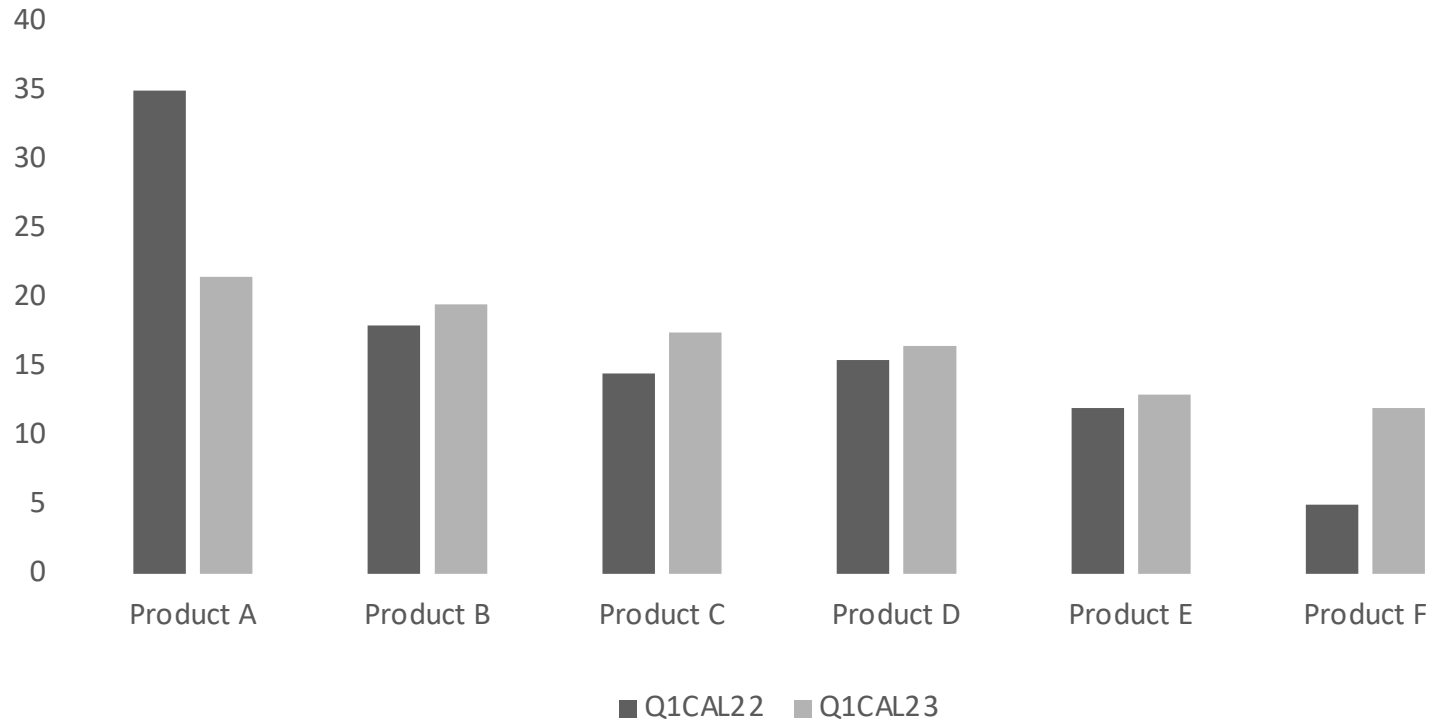- Choose appropriate channel
- A common, aligned scale

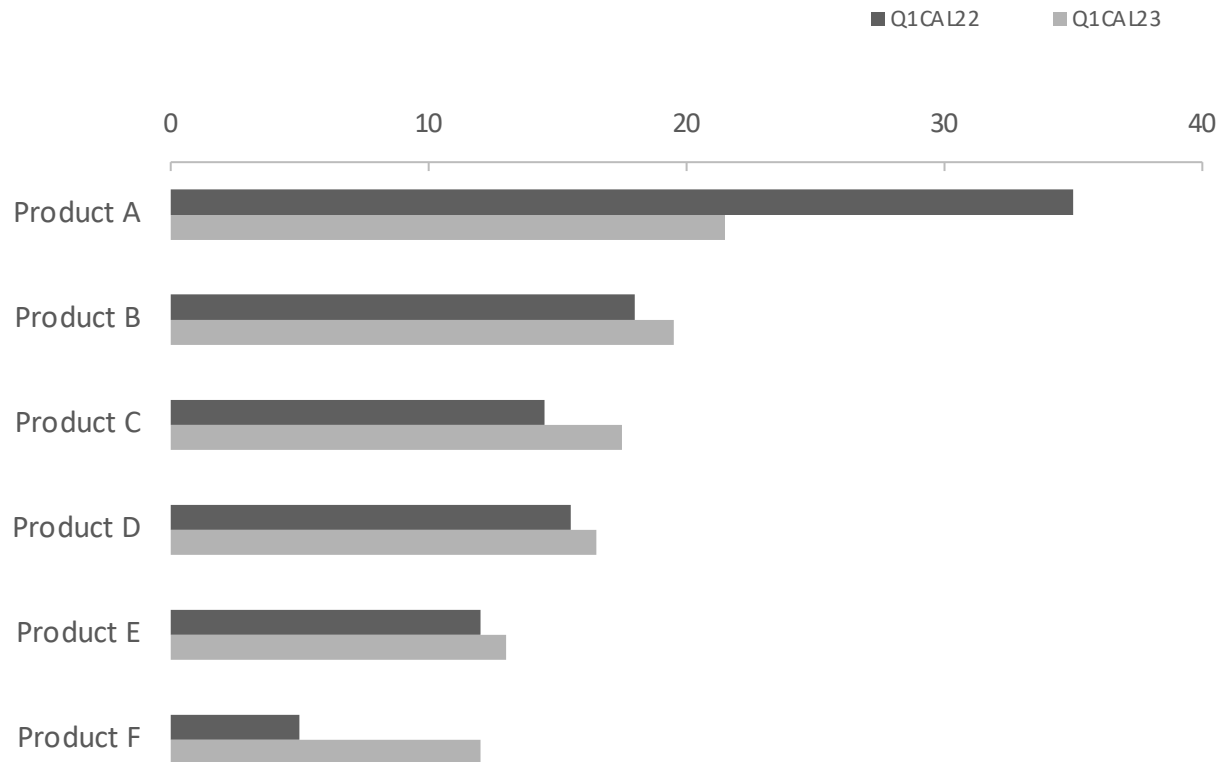**Remove clutter**

- Choose a plain background

EXAMPLE

Keep removing clutter!

- Use grey-scale to open door to pre-attentive attributes
- Use principles of closure and continuity to remove gridlines and axis
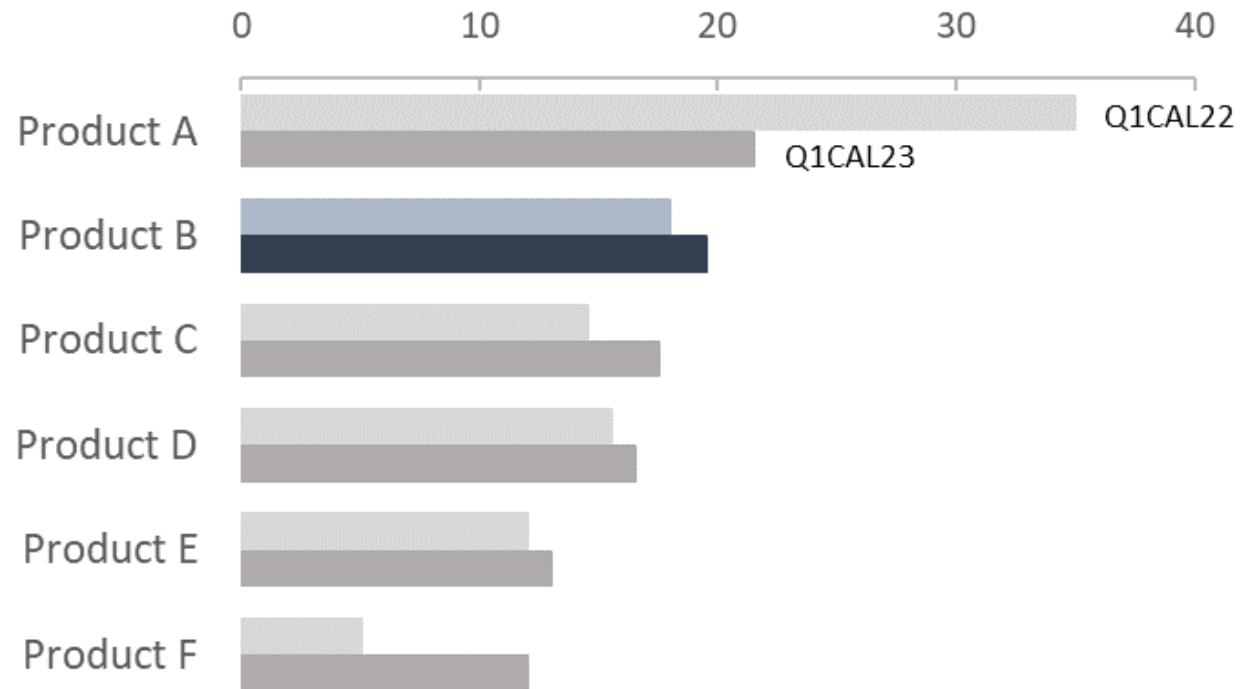
EXAMPLE

Reduce cognitive load

- Horizontal bars are easier to read
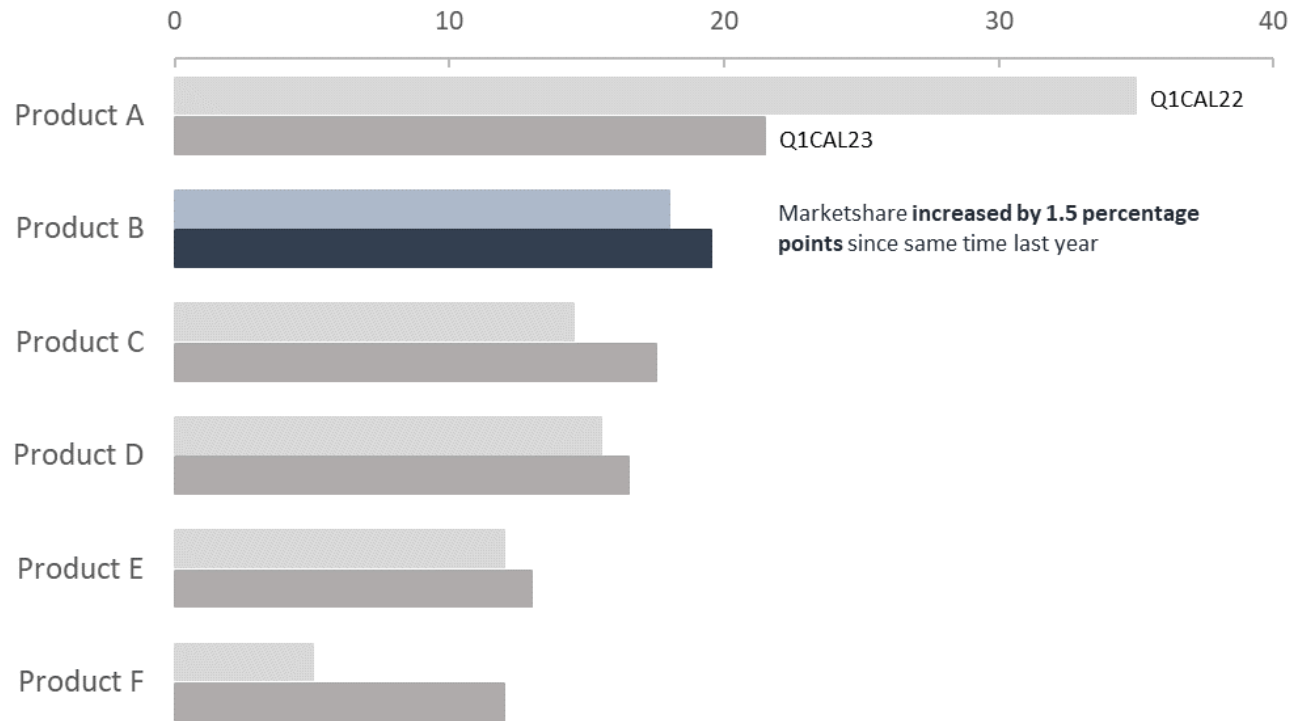- "Z" path utilised to point attention at product labels

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EXAMPLE

Point the attention to where it is wanted
- Added pre-attentive attribute of hue
- Principle of similarity used to simplify legend

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EXAMPLE

Sales across robot vacuum market
Product B against its major competitors, Q1CAL23 against same time last year

	0	10	20	30	40

Product A — Q1CAL22 / Q1CAL23

Product B — Marketshare **increased by 1.5 percentage points** since same time last year
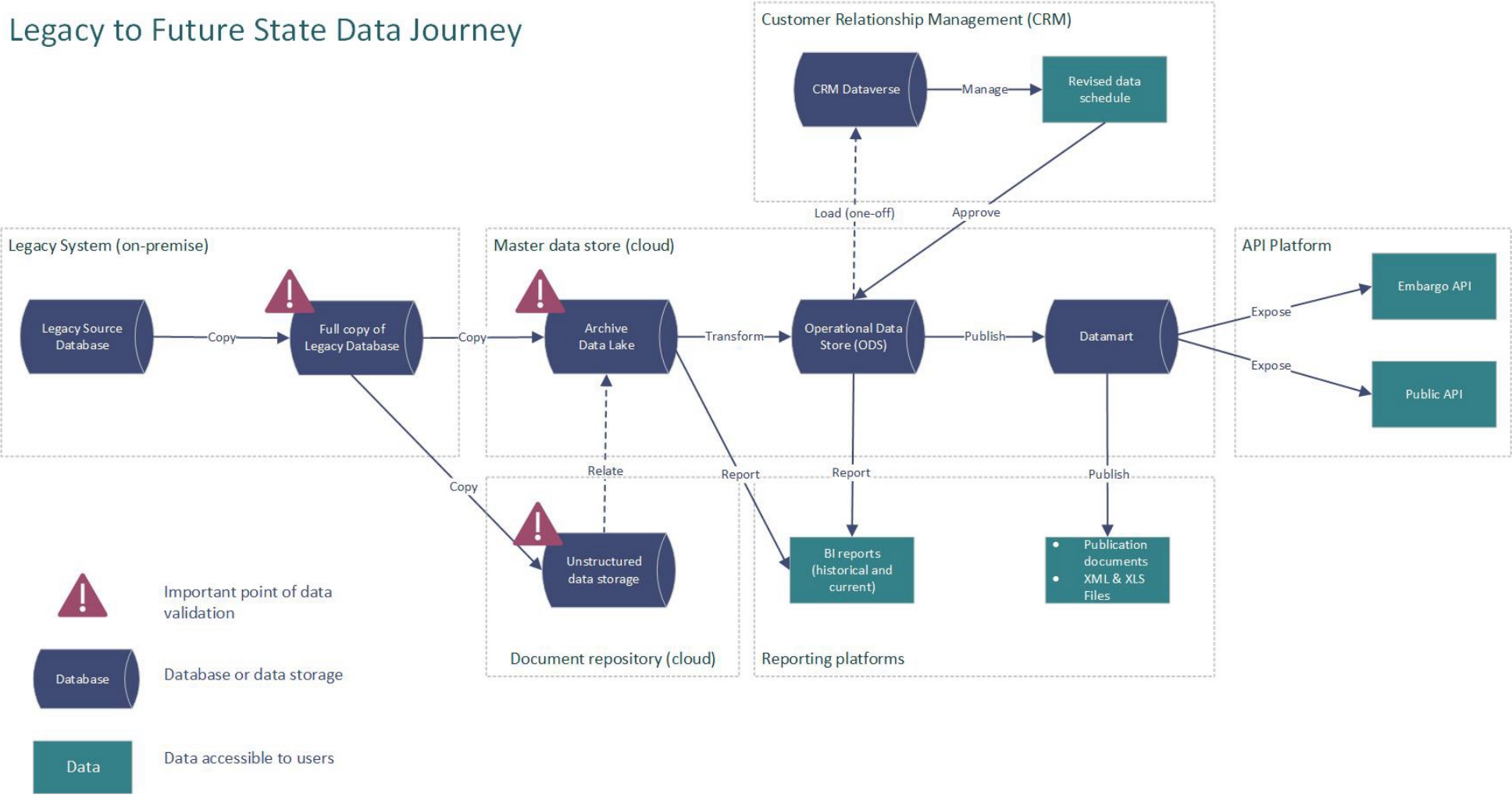
Product C

Product D

Product E

Product F

Add context and information
- Informative title
- Text that contributes to the data story

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CLIENT EXAMPLE

Legacy to Future State Data Journey

KEY TAKEAWAYS

KEY TAKEAWAYS

- **Who, What, How:** Preparing a data visualisation should begin with understanding of who and what

- **Cognitive Load:** Every item on the page contributes to cognitive load – aim to reduce clutter

- **Gestalt Principles of Visual Perception:** the way in which the human eye perceives signals can be leveraged to increase effectiveness

- **Pre-attentive Attributes:** the attention of the audience can be pointed in the desired direction, before the audience realises what they are looking at

- **Channel Effectiveness:** the channel selected for data visualisation has a significant impact on the effectiveness

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Questions?

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REFERENCES

GAPMINDER.ORG, CC-BY LICENSE. (n.d.). *Cell phones (Total).* Retrieved May 30,

2023, from Gapminder: https://www.gapminder.org/data/

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Naussbaumer Knaflic, C. (2015). *Storytelling with data.* John Wiley & Sons.

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