An Empirical Study of Data Visualisation

Thank you for considering taking part in this study, it will take around 25 minutes to complete.

Information for participants:
This study, 'An Empirical Study of Data Visualisation' aims to explore the use and implementation of data visualisation as a tool for understanding data. The survey will ask you subjective questions regarding a series of data visualisations to assess how various factors may impact interpretation of the underlying data.

The survey involves reading charts and giving brief interpretations of them, in the form of multiple choice, ranking or a giving a single number. It is NOT designed to be treated as a test; all answers should be fully subjective and there are no 'correct' answers.

This survey may also investigate the impact of different visualisations on people with disorders in which visual and/or numerical processing may be inhibited. The purpose of this would be to investigate how to create visualisations more accessible to people with such disorders. However, if you feel distressed or overwhelmed by the style of questions presented, please do not hesitate to exit the survey at any point.

The data presented is not expected to involve controversial or distressing information;
 - Section 1 will contain data relating to 'American Ninja Warrior'
- Section 2 will involve sales data for some fictional companies.

Important:
1) Participation is voluntary and you may exit the survey at any time. If you decide to cease participation your responses will not be recorded.

2) Post submission, your responses will be saved anonymously in a google sheet <https://www.google.co.uk/forms/about/> and used for analysis, which may be published.

3) If you have any questions please do not hesitate to contact me at murphyka1@cardiff.ac.uk.

*Required

1. If you have read and fully understood the above information and wish to voluntarily participate in the survey, please select 'I agree' below. *

Tick all that apply.

☐ I agree

Demographic Information

(Optional)

2. Please enter your age

_____

3. If you are a university student or past university graduate please specify your area of study.

   Mark only one oval.

   ⬭ Science

   ⬭ Technology

   ⬭ Engineering

   ⬭ Maths

   ⬭ Arts

   ⬭ Social Sciences

   ⬭ Humanities

   ⬭ Business

   ⬭ N/A

   ⬭ Other: _____

How strongly do you agree with each of the three following statements?

4. I have good spatial awareness skills

   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

5. I have good observational skills

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. I have good numerical skills

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Are you colourblind?

Mark only one oval.

◯ Yes

◯ No

◯ Prefer not to answer

◯ Other: _____

8. Do you have any disorders that may affect visual processing? (this could be a general visual processing disorder or dyslexia, dyscalculia, ADHD etc)

Mark only one oval.

◯ Yes

◯ No

◯ Prefer not to answer

◯ Other: _____

American Ninja Warrior

The first sets of questions will show you a series of bar charts presenting information regarding how many times some obstacles were used over the course of 10 seasons of the TV show 'American Ninja Warrior'.

For each question you will be asked to look at a bar chart and answer the corresponding questions, where the height of each bar shows how many times the obstacle was used.

Please note that the answers to these questions are meant to be subjective, and that there are no correct answers.

American Ninja Warrior - Part 1

The following bar charts present data for 4 of the most frequently used obstacles. Please look at the following charts and answer the corresponding questions.

American Ninja Warrior - Part 1, Question 1

Please refer to bar chart A, below.

Bar chart A
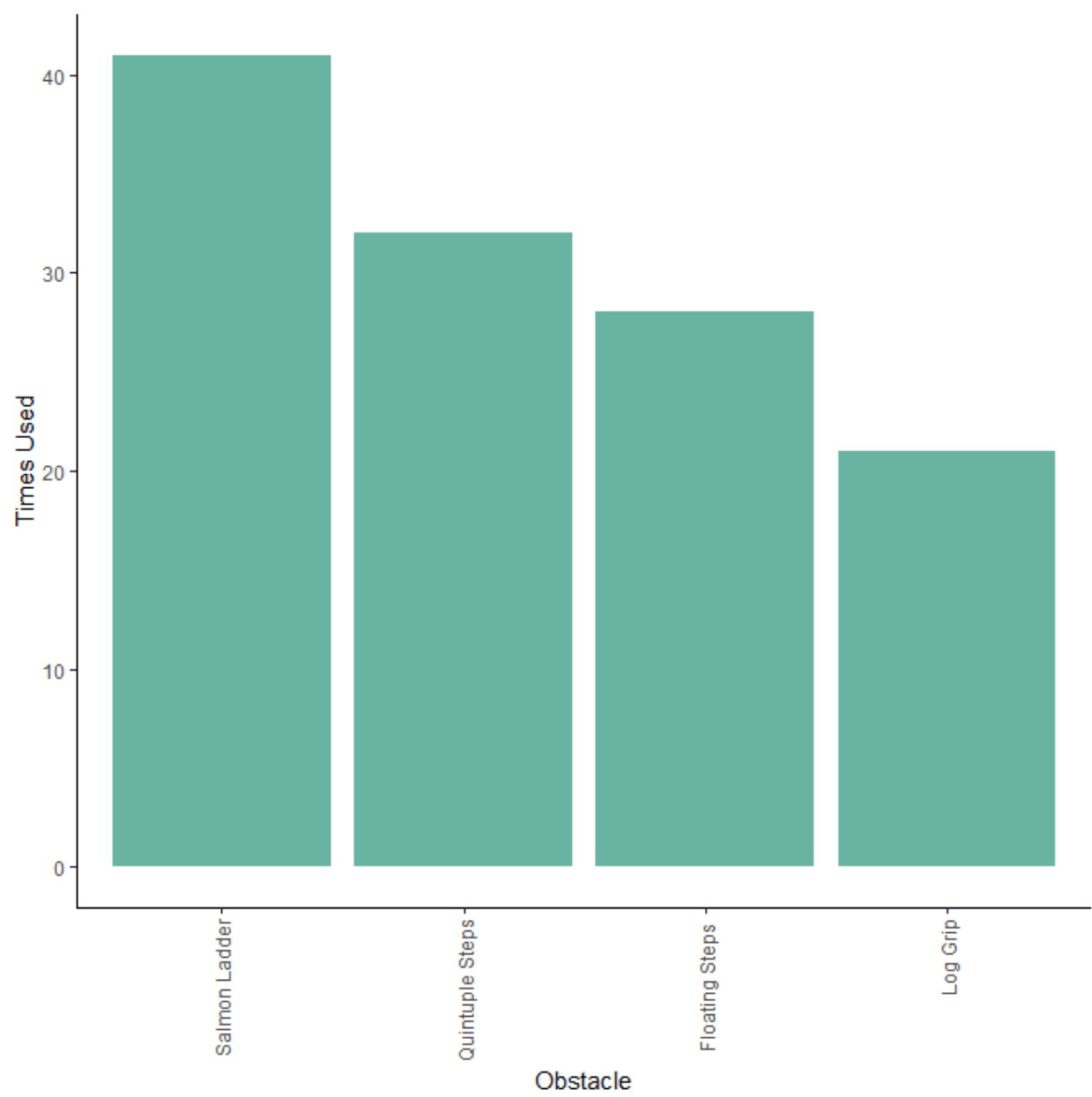
In relation to bar chart A:

9.   Approximately many times would you say the 'Salmon Ladder' was used?

_____

10. Approximately how much more than 'Log Grip' would you say 'Salmon Ladder' was used?

Mark only one oval.

	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

11. Approximately how much more than 'Quintuple Steps' would you say 'Salmon Ladder' was used?

Mark only one oval.

|	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

12. In your opinion, approximately how many times would you say 'Log Grip' was used, as a percentage of the number of times 'Salmon Ladder' was used?

For example, if you think 'Log Grip' was used half as much as 'Salmon Ladder', enter 50%. If you think 'Log Grip' was used a quarter as much as 'Salmon Ladder', enter 25%, and so on.

_____

American Ninja Warrior - Part 1, Question 2

Now consider the below bar chart, B.

Bar chart B
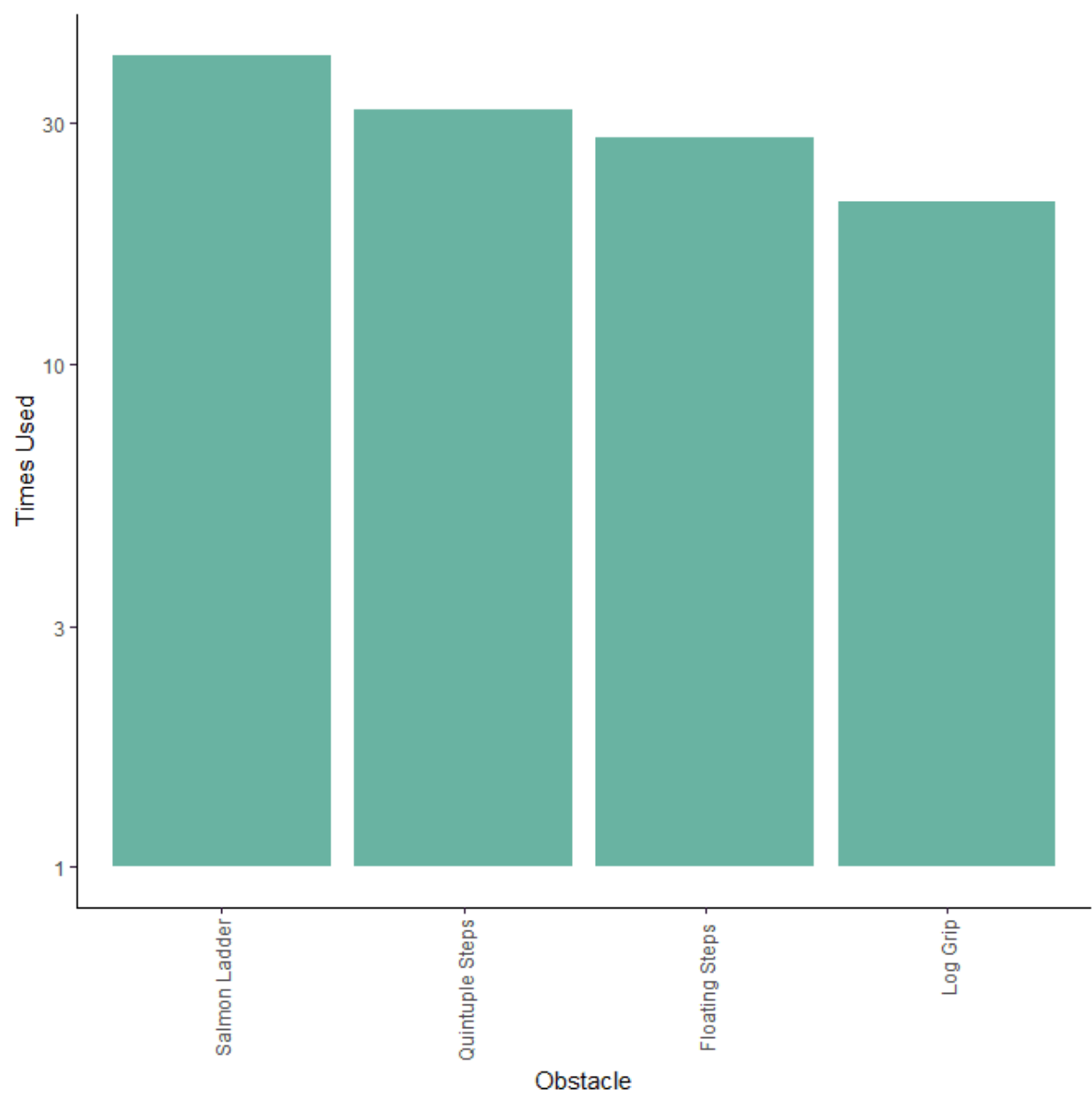
In relation to bar chart B:

13. Approximately many times would you say the 'Salmon Ladder' was used?

_____

14. Approximately how much more than 'Log Grip' would you say 'Salmon Ladder' was used?

Mark only one oval.

	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

15. Approximately how much more than 'Quintuple Steps' would you say 'Salmon Ladder' was used?

Mark only one oval.

	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

16. In your opinion, approximately how many times would you say 'Log Grip' was used, as a percentage of the number of times 'Salmon Ladder' was used?

For example, if you think 'Log Grip' was used half as much as 'Salmon Ladder', enter 50%. If you think 'Log Grip' was used a quarter as much as 'Salmon Ladder', enter 25%, and so on.

_____

American Ninja Warrior - Part 1, Question 3

Now consider bar chart C, below.
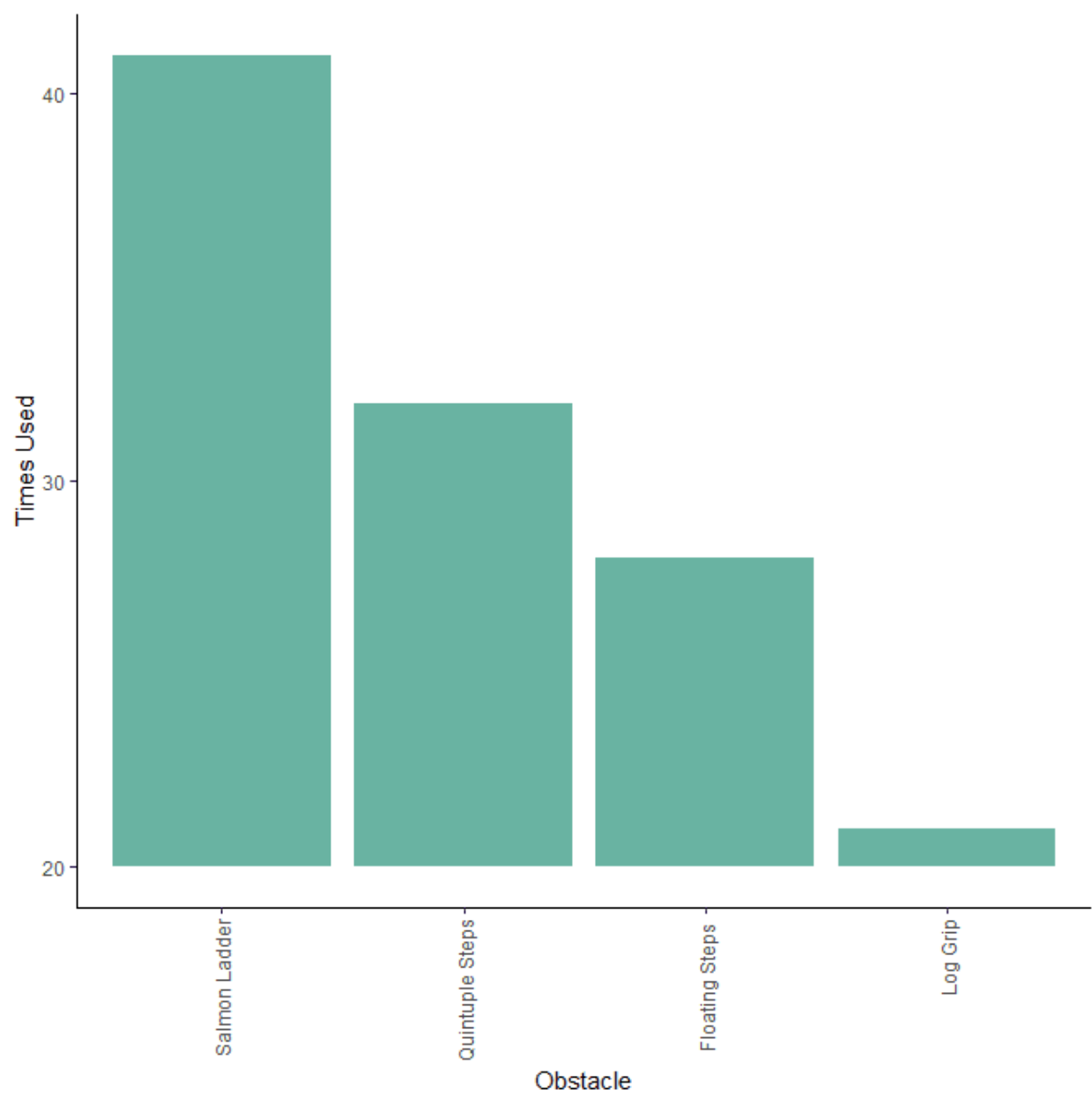
Bar chart C

In relation to bar chart C:

17.   Approximately many times would you say the 'Salmon Ladder' was used?

_____

18. Approximately how much more than 'Log Grip' would you say 'Salmon Ladder' was used?

Mark only one oval.

	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

19. Approximately how much more than 'Quintuple Steps' would you say 'Salmon Ladder' was used?

Mark only one oval.

	1	2	3	4	5	6	7	
Not much more	◯	◯	◯	◯	◯	◯	◯	A lot more

20. In your opinion, approximately how many times would you say 'Log Grip' was used, as a percentage of the number of times 'Salmon Ladder' was used?

For example, if you think 'Log Grip' was used half as much as 'Salmon Ladder', enter 50%. If you think 'Log Grip' was used a quarter as much as 'Salmon Ladder', enter 25%, and so on.

_____

American Ninja Warrior - Part 2

You will now see bar charts regarding 7 of the most frequently used obstacles. Once again, for each question you will be asked to consider the bar chart and answer the corresponding questions. Again note that the answers to these questions are meant to be subjective, and that there are no correct answers.

American Ninja Warrior - Part 2, Question 1

Please see bar chart A, below.

Bar Chart A

In relation to bar chart A:

21. How large would you say the difference between 'Jumping spider' and 'Salmon Ladder' is?

Mark only one oval.

	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

22. How large would you say the difference between 'Log Grip' and 'Floating Steps' is?
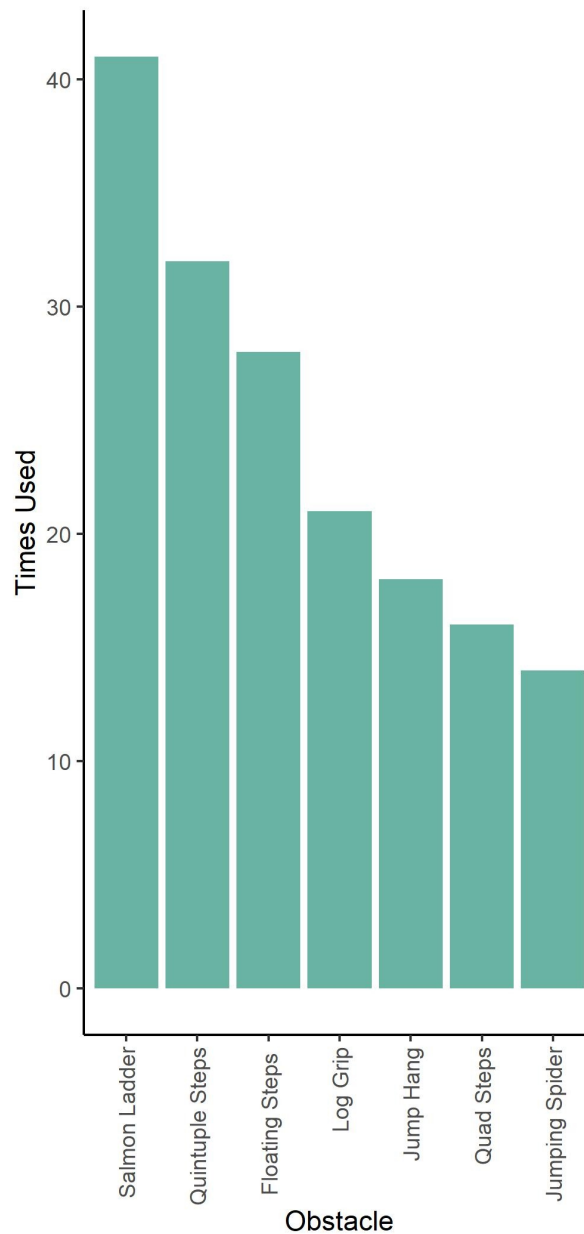
Mark only one oval.

|	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

23. How many times would you say 'Floating Steps' were used?

_____

American Ninja Warrior - Part 2, Question 2

Now please see bar chart B.

Bar Chart B

In relation to bar chart B:

24. How large would you say the difference between 'Jumping spider' and 'Salmon Ladder' is?

Mark only one oval.

	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

25. How large would you say the difference between 'Log Grip' and 'Floating Steps' is?

Mark only one oval.

	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

26. How many times would you say 'Floating Steps' were used?

_____

American Ninja Warrior - Part 2, Question 3

Consider bar chart C, below.
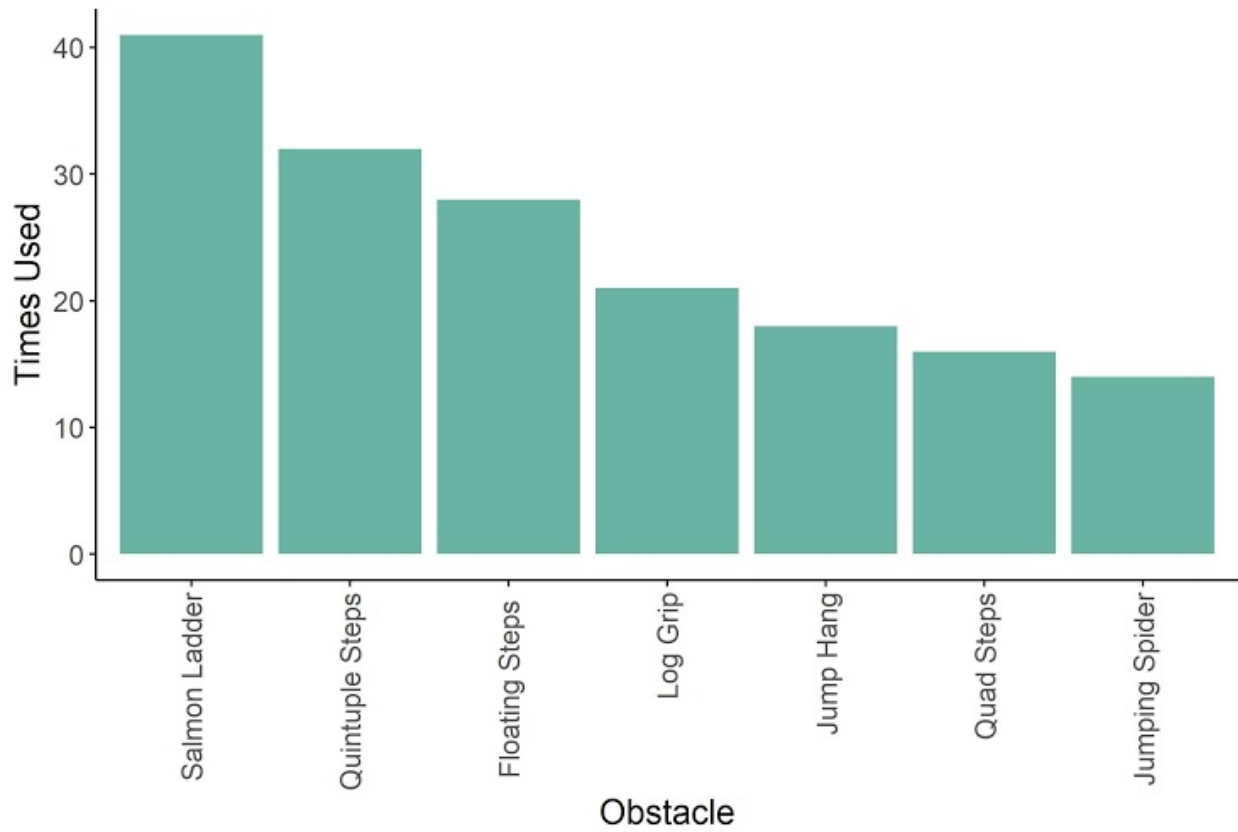
Bar Chart C

In relation to bar chart C:

27. How large would you say the difference between 'Jumping spider' and 'Salmon Ladder' is?

Mark only one oval.

	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

28. How large would you say the difference between 'Log Grip' and 'Floating Steps' is?

Mark only one oval.

	1	2	3	4	5	6	7	
Very Small	◯	◯	◯	◯	◯	◯	◯	Very Large

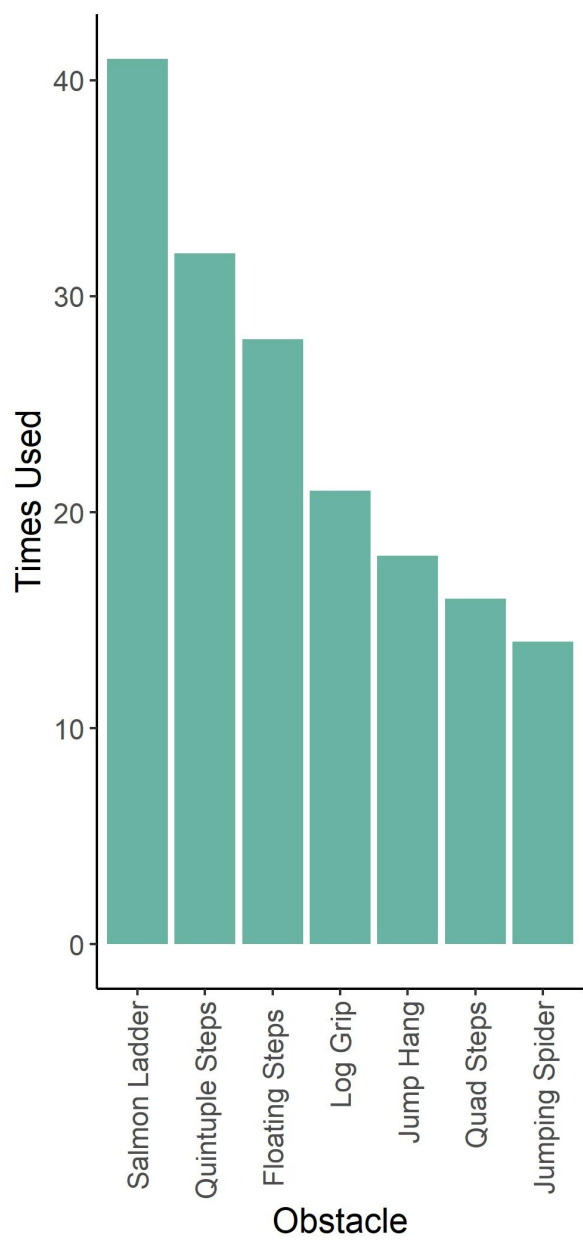29. How many times would you say 'Floating Steps' were used?

_____

American Ninja Warrior - Part 2, Question 4

You will now see the bar charts A, B and C from part 2 again. Please answer the corresponding questions.
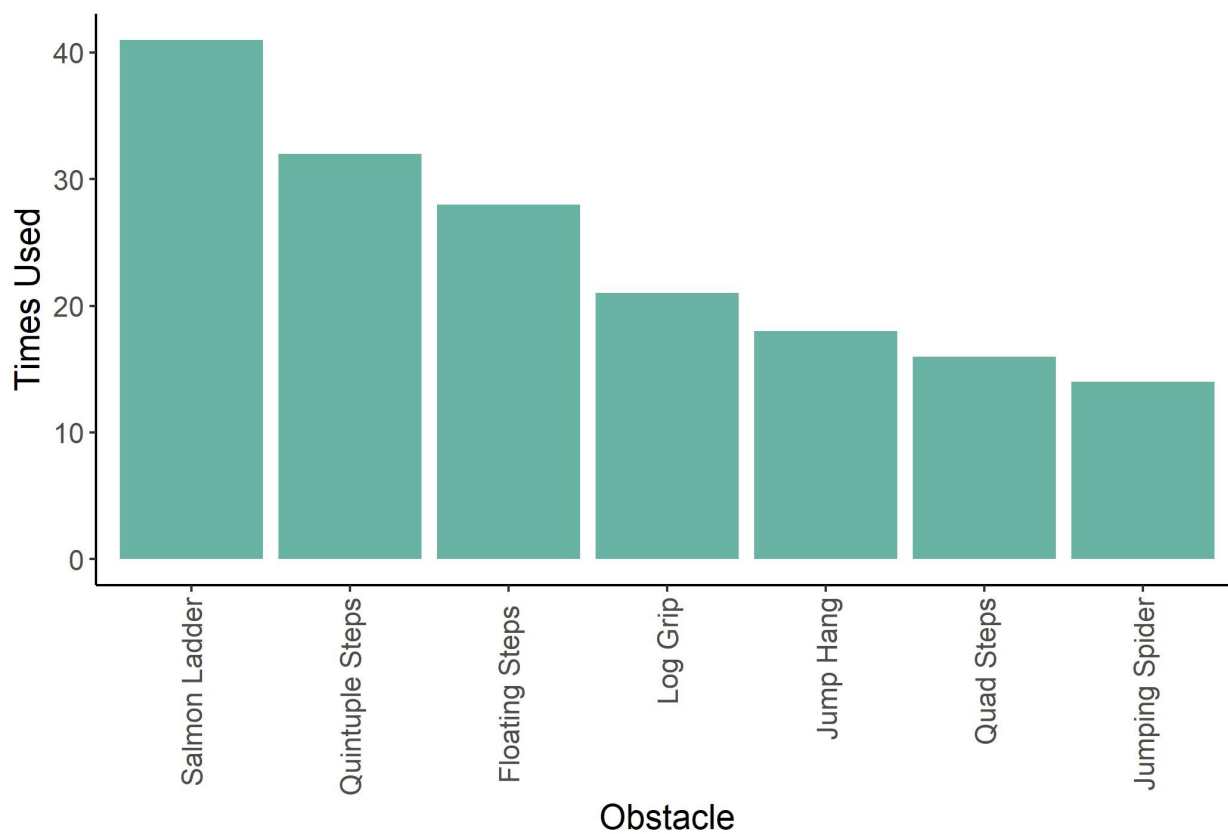
Bar chart A
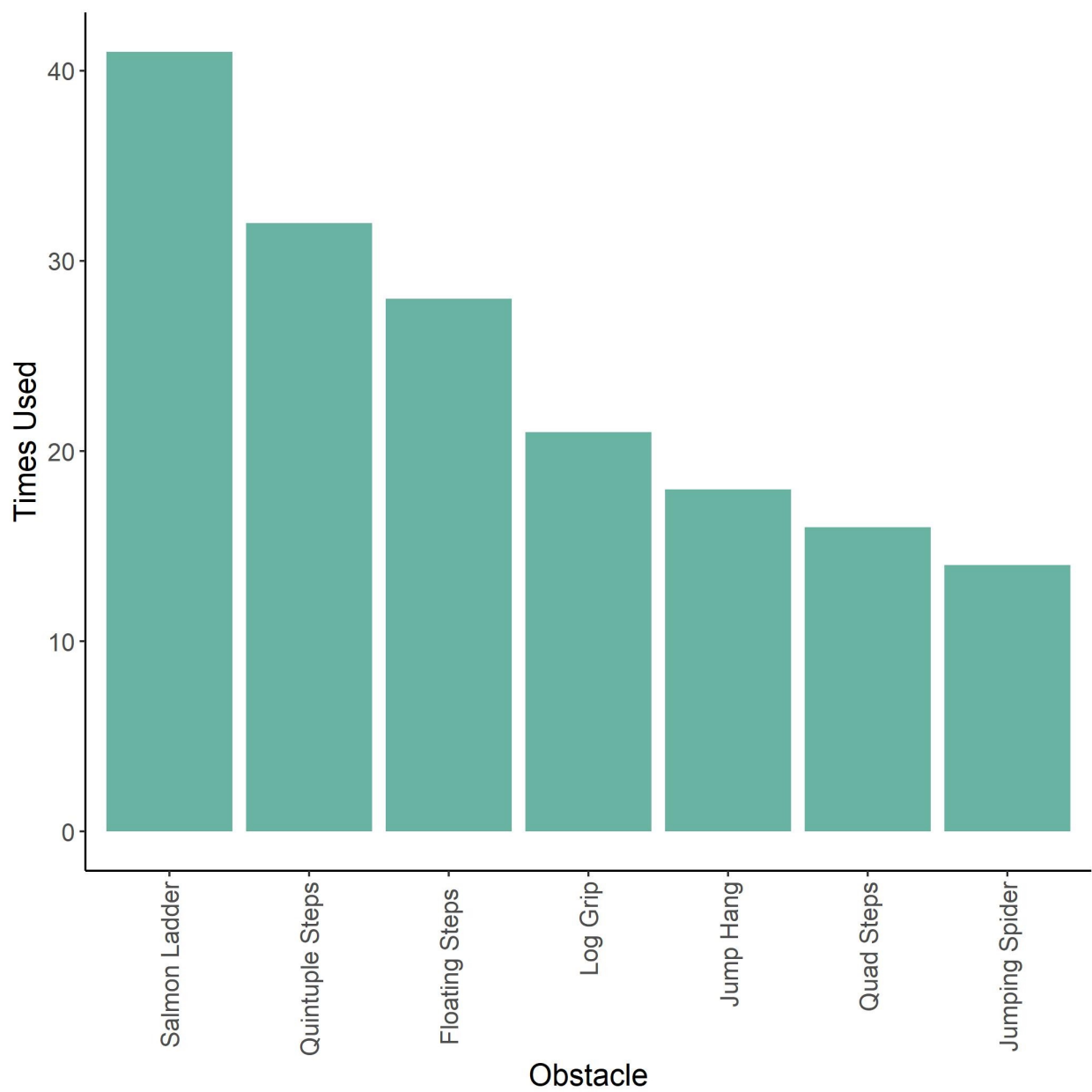
Bar chart B

Bar chart C

30. Which of the three bar charts do you find most aesthetically pleasing?

Mark only one oval.

◯ A

◯ B

◯ C

31. **Which bar chart do you feel is easiest to read and interpret?**

This includes ease in reading labels, ease of reading the value of each bar, and ease in seeing the relative differences in values of the bars.

Mark only one oval.

○ A

○ B

○ C

32. **Which bar chart do you find hardest to read and interpret?**
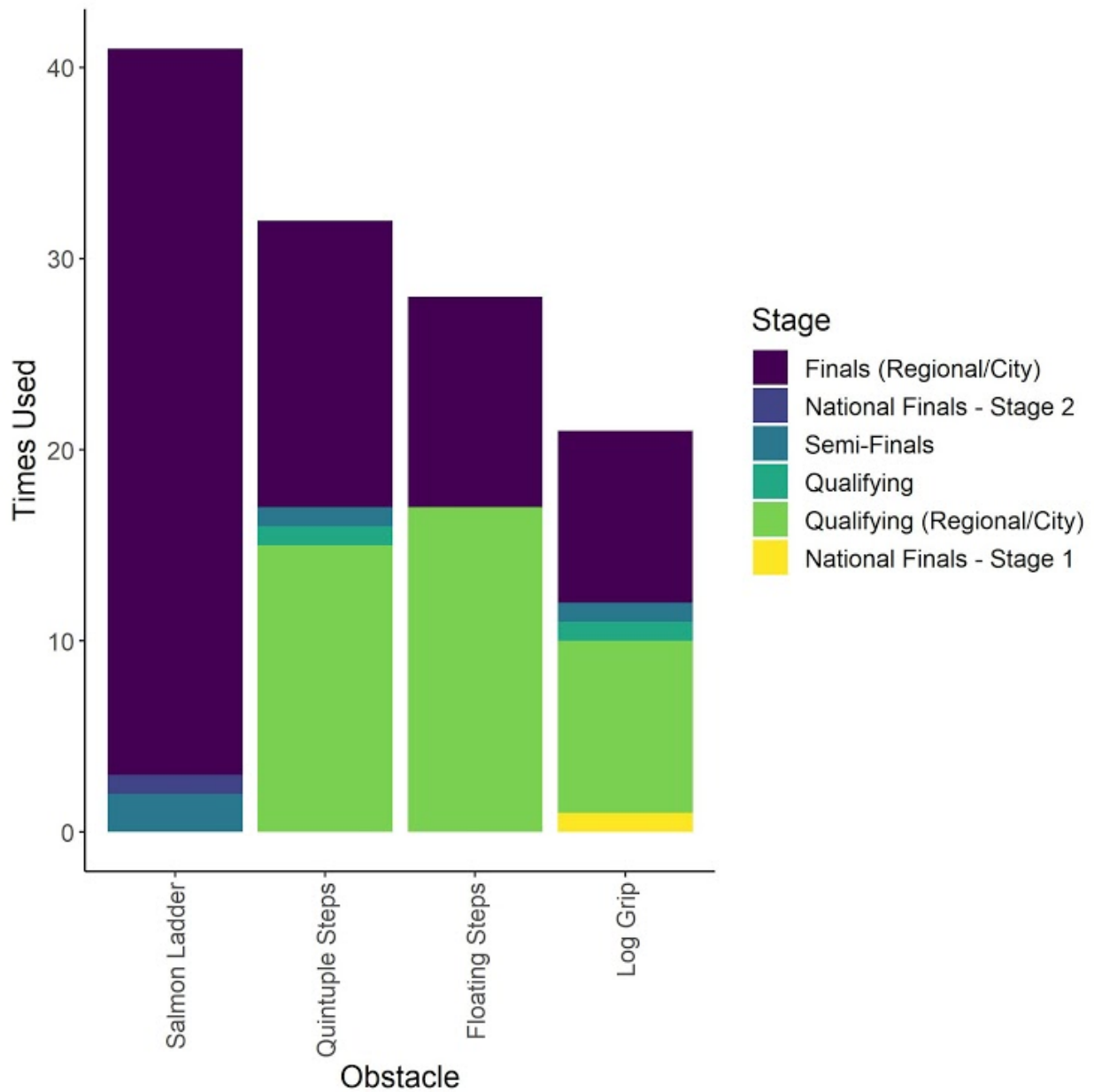
Mark only one oval.

○ A

○ B

○ C

American Ninja Warrior - Part 3

The below plots show the same data as part 1, but are additionally coloured to show how many times each obstacle was used in each stage of the competition.

American Ninja Warrior - Part 3, Question 1

Please answer the questions below, for bar chart A.

Bar chart A

In relation to bar chart A:

33. How many times would you say 'Floating Steps' were used in the Finals (Regional/City) rounds?

_____

34. How many times would you say 'Log Grip' was used in the Finals (Regional/City) rounds?

_____

35. Please select the statement you feel applies to the bar chart above.

Mark only one oval.

◯ 'Log Grip' was used MORE in Finals (Regional/City) rounds than in Qualifying (Regional/City) rounds.

◯ 'Log Grip' was used LESS in Finals (Regional/City) rounds than in Qualifying (Regional/City) rounds.

◯ 'Log Grip' was used an EQUAL number of times in Finals (Regional/City) rounds and Qualifying (Regional/City) rounds.

36. Which obstacle do you think was used MORE in Finals (Regional/City) rounds, 'Log Grip' or 'Floating Steps'?
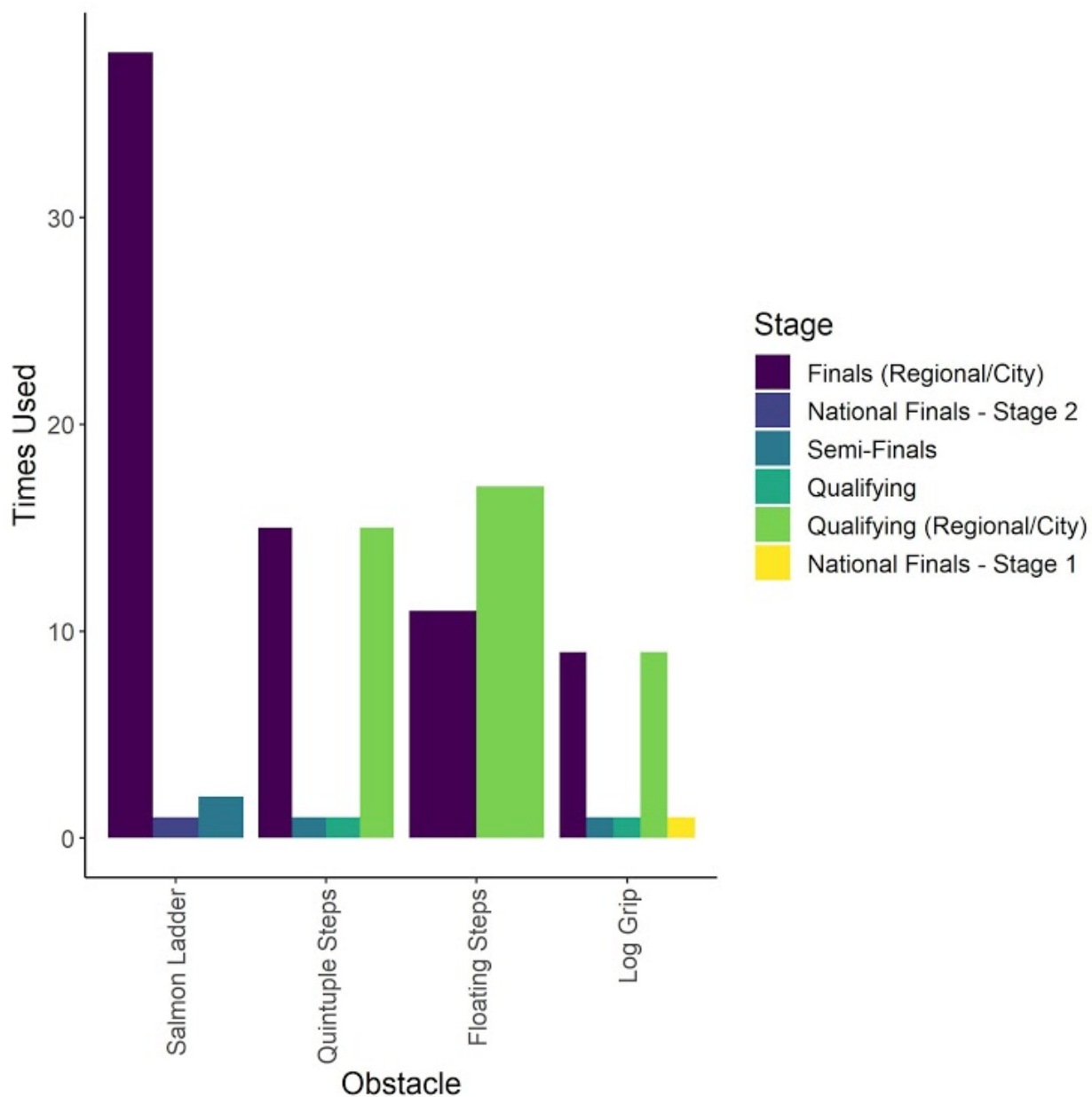
Mark only one oval.

◯ 'Log Grip'

◯ 'Floating Steps'

◯ They were used the same amount of times

American Ninja Warrior - Part 3, Question 2

Now please answer the questions again, for bar chart B.

Bar chart B

In relation to bar chart B:

37. How many times would you say 'Floating Steps' were used in the Finals (Regional/City) rounds?

    _____

38. How many times would you say 'Log Grip' was used in the Finals (Regional/City) rounds?

_____

_____

_____

_____

_____

39. Please select the statement you feel applies to the bar chart above.

Mark only one oval.
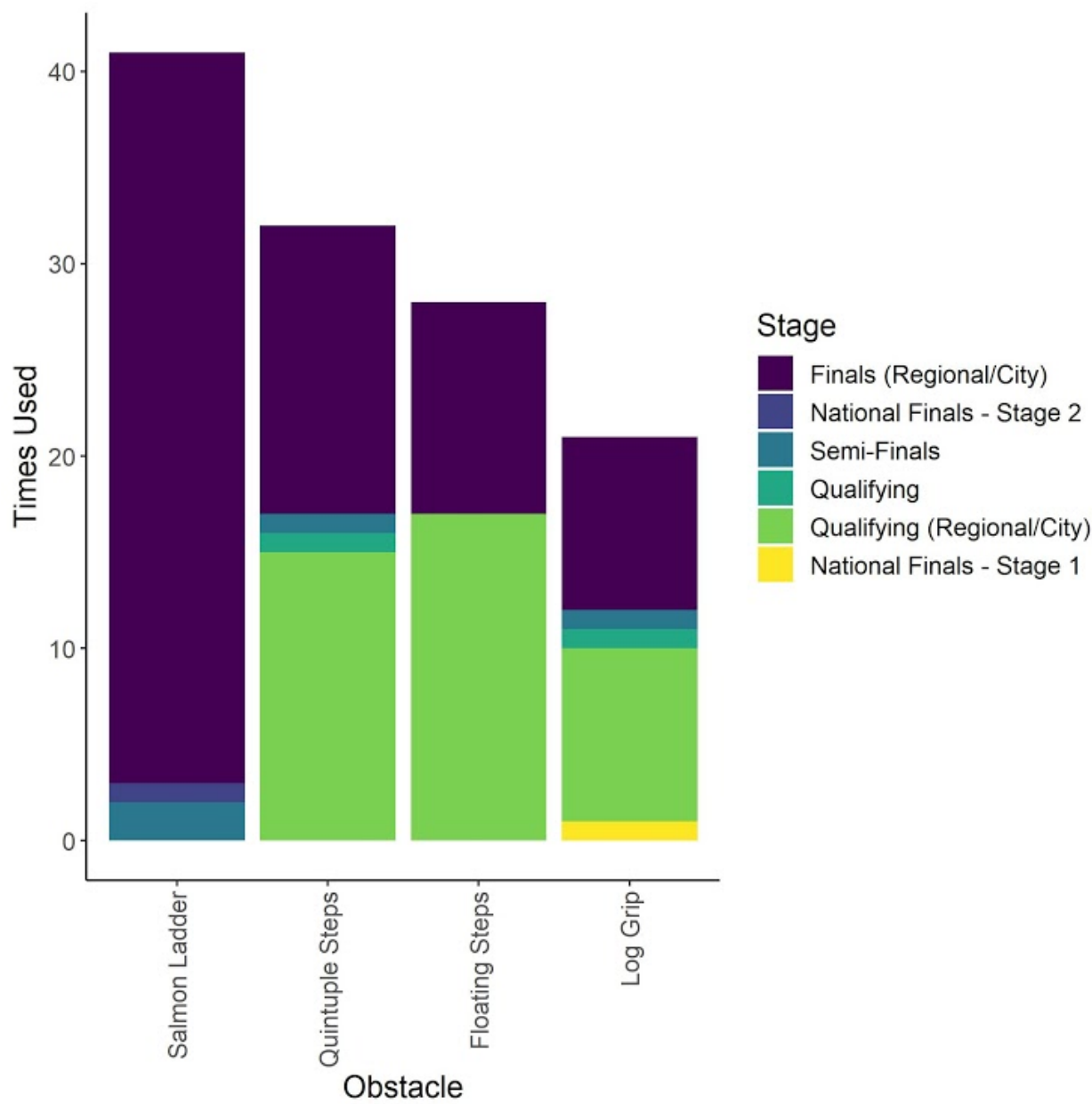
◯ 'Log Grip' was used MORE in Finals (Regional/City) than in Qualifying (Regional/City).

◯ 'Log Grip' was used LESS in Finals (Regional/City) than in Qualifying (Regional/City).

◯ 'Log Grip' was used an EQUAL number of times in Finals (Regional/City) and Qualifying (Regional/City).

40. Which obstacle do you think was used MORE in Finals (Regional/City) rounds, 'Log Grip' or 'Floating Steps'?
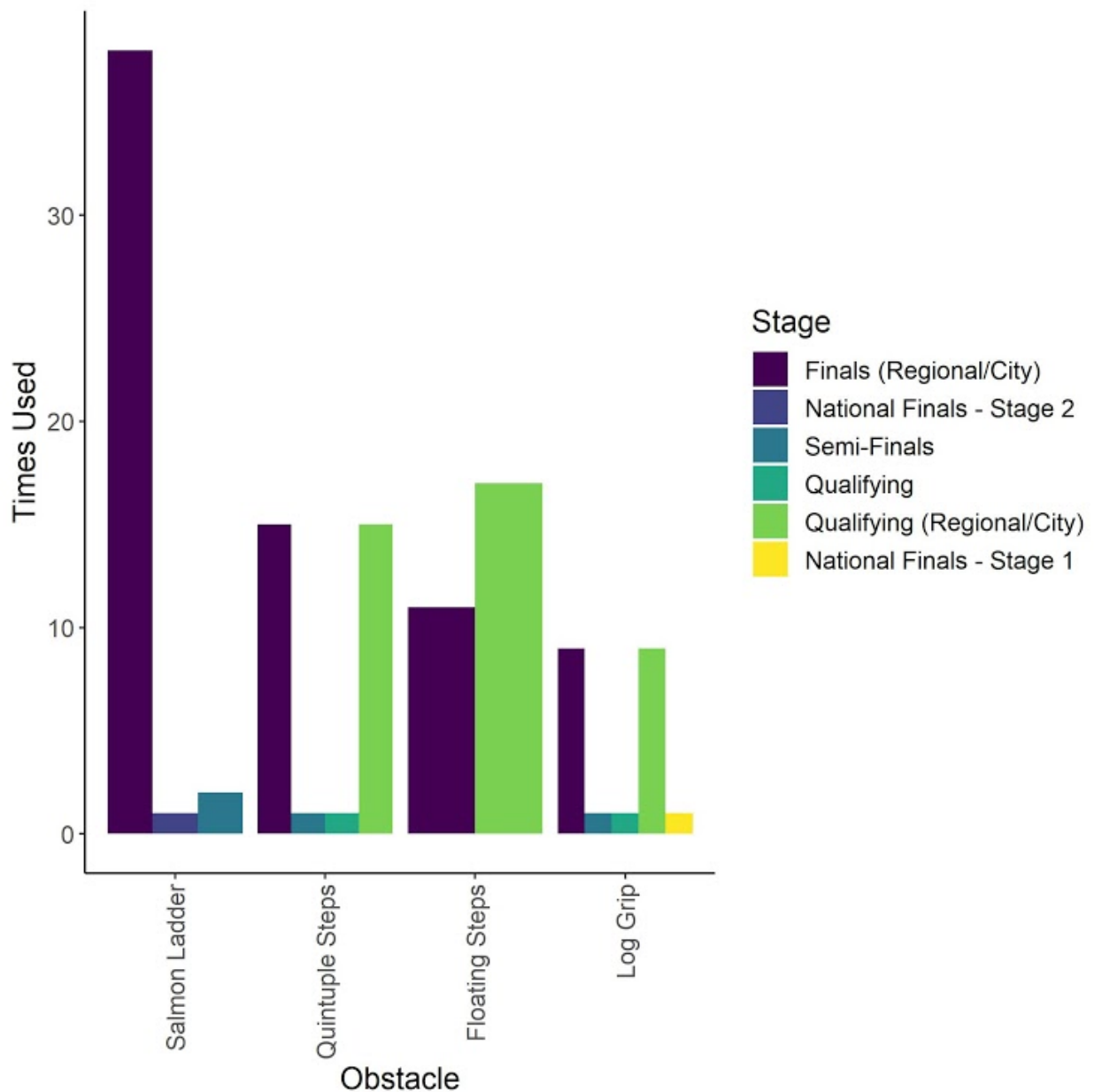
Mark only one oval.

◯ 'Log Grip'

◯ 'Floating Steps'

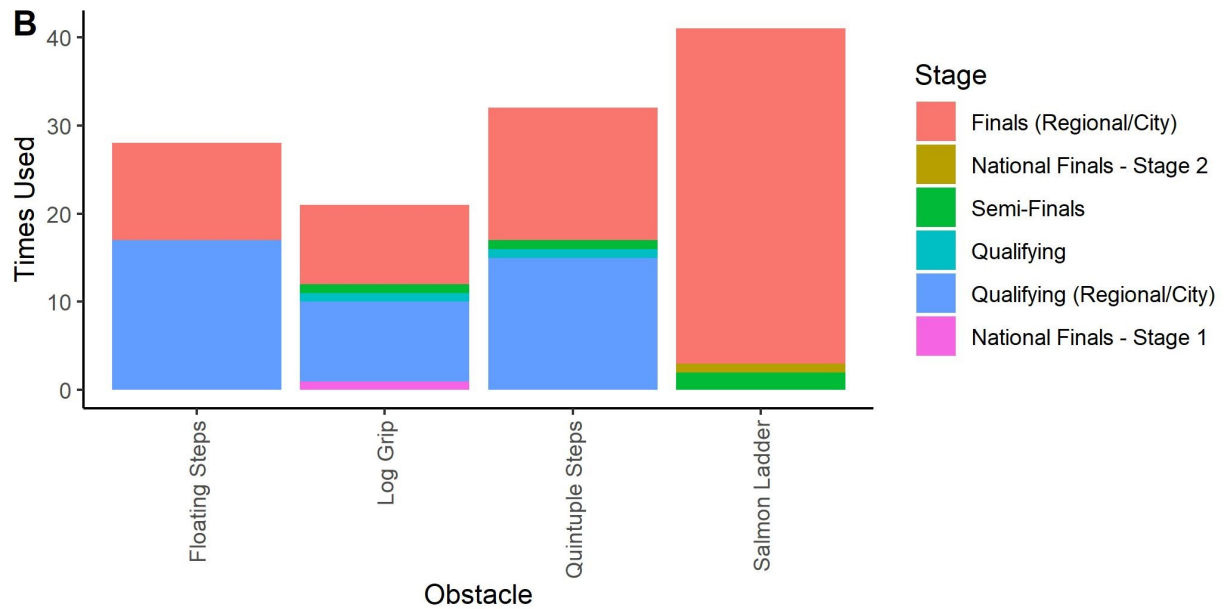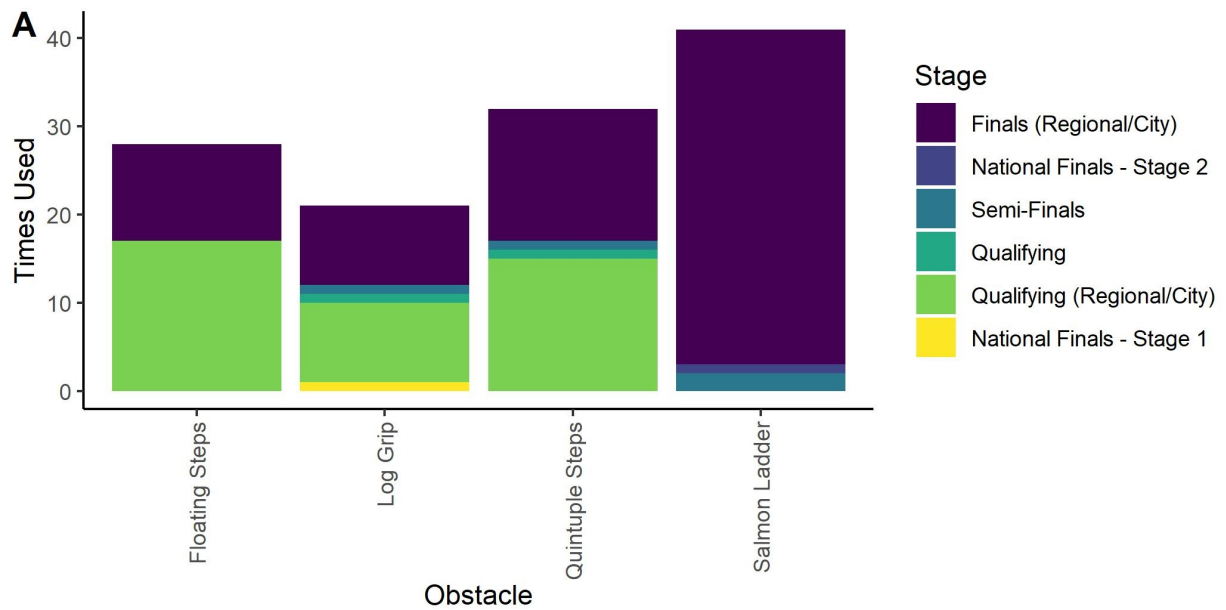◯ They were used the same amount of times

American Ninja Warrior - Part 3, Question 3

You will now see the two bar charts again. Please answer the question below.

Bar Chart A

Bar chart B

41. Which bar chart do you feel is easiest to read and interpret?

   Mark only one oval.

   ◯ A

   ◯ B

American Ninja Warrior -
Part 3, Question 4

Below compares the color scheme of the charts above, colour
scheme A with another colour scheme, B.

42. Which colour scheme do you find most aesthetically pleasing?

Mark only one oval.

◯ A

◯ B

43. Do you feel that one of the colour schemes makes it easier to read and interpret the data than the other? If so, please select which one.

Mark only one oval.

( ) No

( ) Yes, A is easier

( ) Yes, B is easier

Sales

Thank you for completing the first section of this survey. The second, and final, section is shorter and will show you a series of line graphs relating to monthly sales data from four companies over the course of a year.

Once again, please refer to the following charts and answer the questions.

Please note that the answers to these questions are meant to be subjective, and that there are no correct answers.
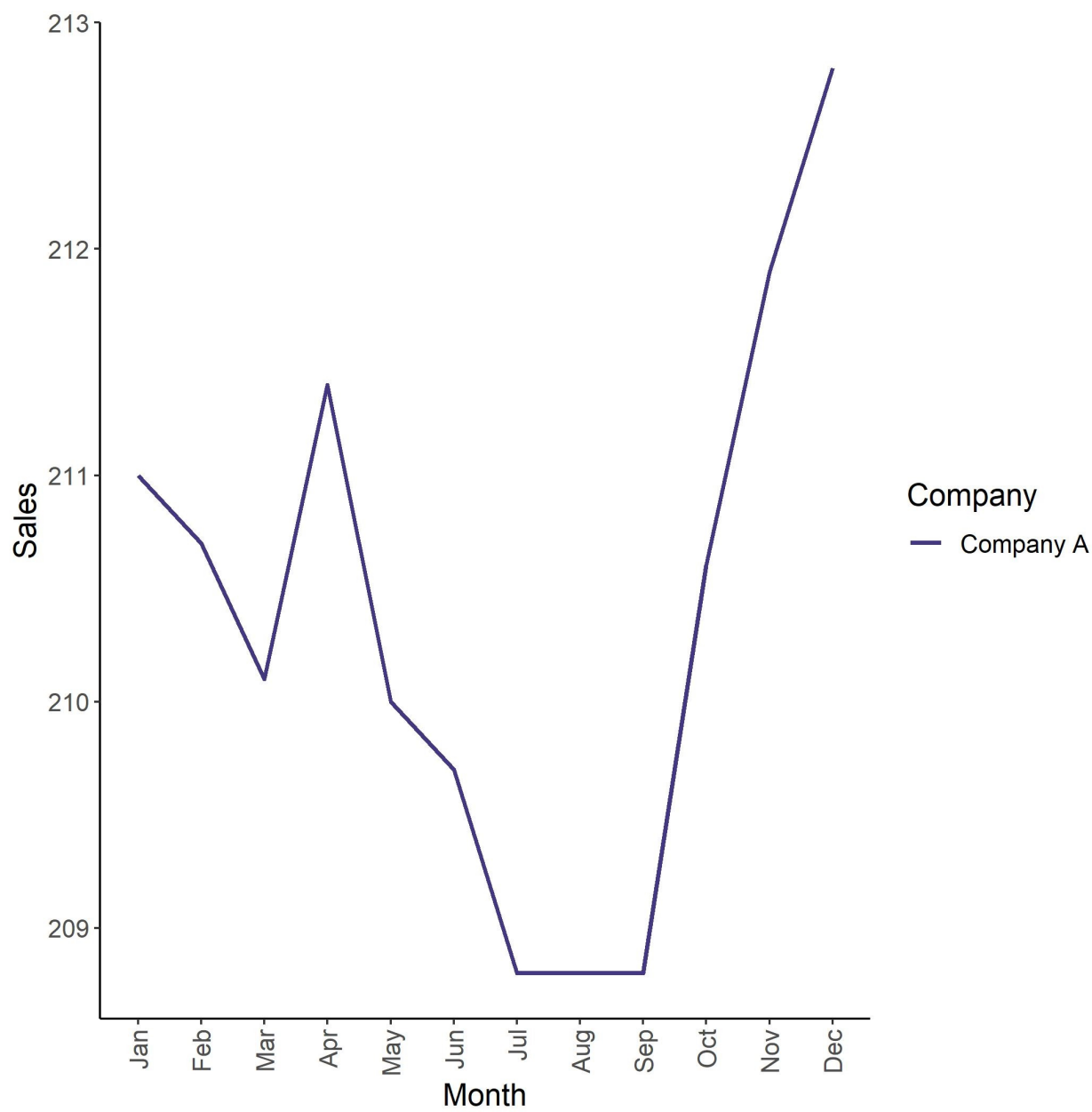
Sales

-

Part

1

The following section will present graphs showing monthly sales data of two competing companies over the course of a year, and ask you questions relating to the graphs.

Sales - Part 1, Question 1

Please refer to the two charts below

Sales data for Company A

Sales data for Company B

44. How much would you say sales of each company increased between January and December?

Mark only one oval per row.

	1 (A little)	2	3	4	5	6	7 (A lot)
Company A	◯	◯	◯	◯	◯	◯	◯
Company B	◯	◯	◯	◯	◯	◯	◯

45. How large would you say the drop in sales between April and July of Company A is?

Mark only one oval.

	1	2	3	4	5	6	7	
A little	◯	◯	◯	◯	◯	◯	◯	A lot

Consider the chart below

Sales - Part 1, Question 2

46. How much would you say sales of each company increased between January and December?

Mark only one oval per row.

	1 (A little)	2	3	4	5	6	7 (A lot)
Company A	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Company B	⬭	⬭	⬭	⬭	⬭	⬭	⬭

47. How large would you say the drop in sales between April and July of Company A is?

Mark only one oval.

	1	2	3	4	5	6	7	
A little	⬭	⬭	⬭	⬭	⬭	⬭	⬭	A lot

Sales - Part 1, Question 3

Consider the chart below

48. How much would you say sales of each company increased between January and December?
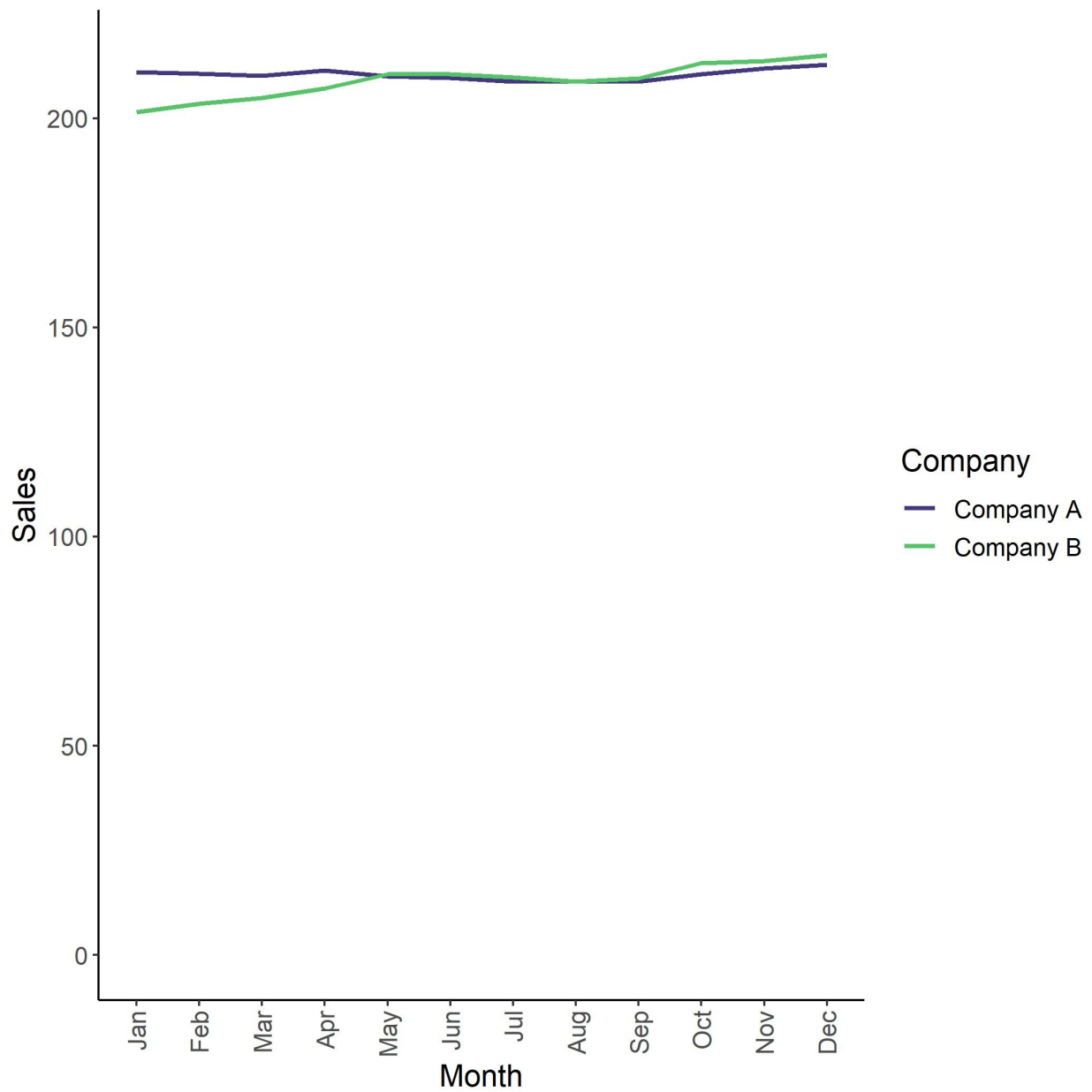
Mark only one oval per row.

	1 (A little)	2	3	4	5	6	7 (A lot)
Company A	◯	◯	◯	◯	◯	◯	◯
Company B	◯	◯	◯	◯	◯	◯	◯

49. How large would you say the drop in sales between April and July of Company A is?

Mark only one oval.

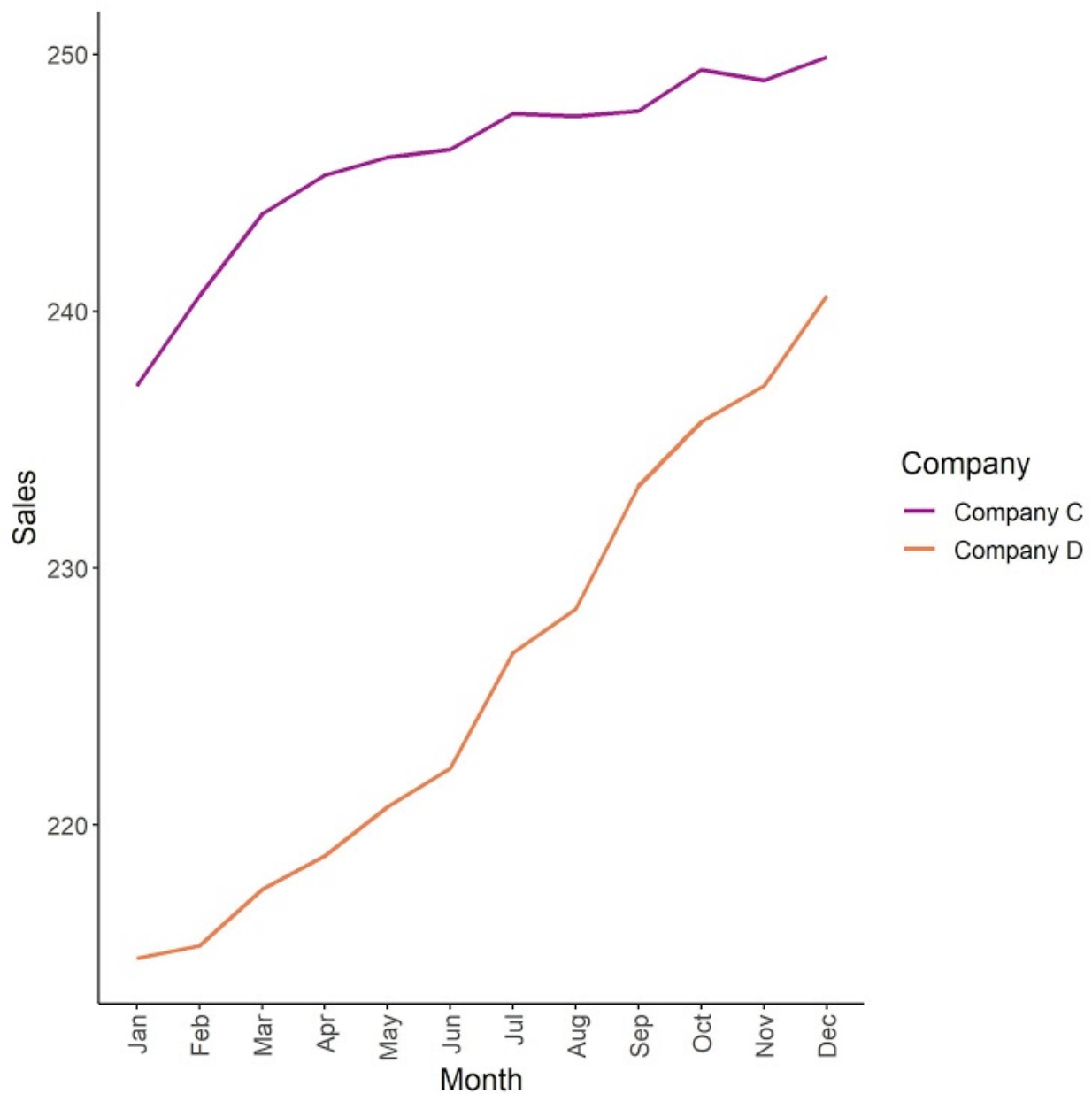|	1	2	3	4	5	6	7	
A little	◯	◯	◯	◯	◯	◯	◯	A lot

Sales -
Part 2

The graphs below show the sales data for two more companies, Company C and Company D.
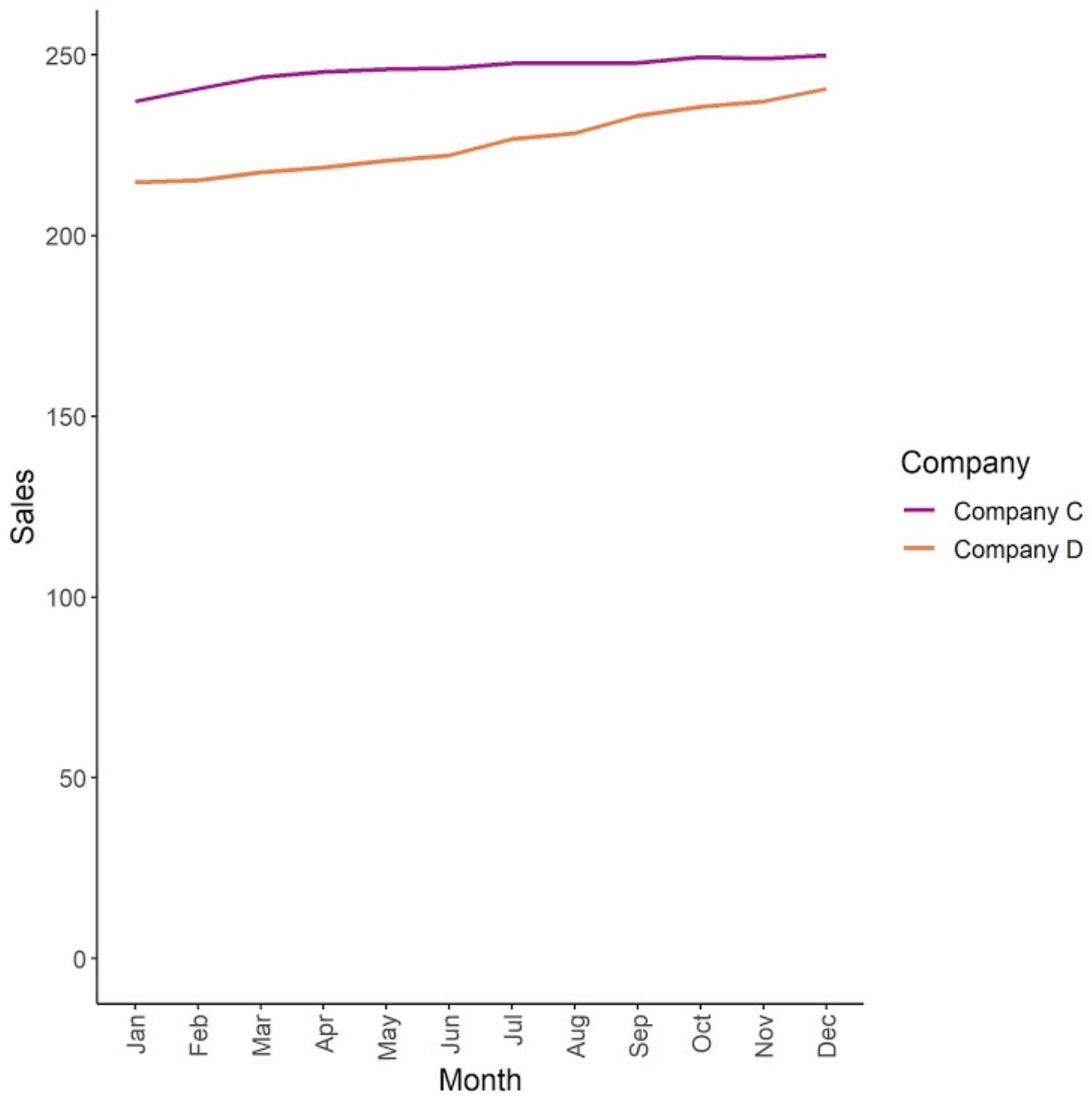
Sales - Part 2, Question 1

Consider the chart below

50. Based on the above graph, how large would you say the difference is between the number of sales Company C makes and the number of sales Company D makes?

Mark only one oval.

	1	2	3	4	5	6	7	
A little	◯	◯	◯	◯	◯	◯	◯	A lot

Sales – Part 2, Question 2

Consider the chart below

51. Based on the above graph, how large would you say the difference is between the number of sales Company C makes and the number of sales Company D makes?

Mark only one oval.

	1	2	3	4	5	6	7	
A little	⬭	⬭	⬭	⬭	⬭	⬭	⬭	A lot

Thank you for completing this survey.

Reminder - Your responses to this survey will remain anonymous.

If you would like to know more about the use of data visualisation and how different techniques may impact interpretation, please see the links below.
- https://searchbusinessanalytics.techtarget.com/definition/data-visualization
- https://datajournalism.com/read/handbook/one/understanding-data/using-data-visualization-to-find-insights-in-data
- https://heap.io/blog/data-stories/how-to-lie-with-data-visualization
- https://www.idashboards.com/blog/2019/02/27/when-data-visualizations-mislead-and-how-to-prevent-it/

If you are interested in how colour blindness can affect reading of visualisations and colour blind friendly palettes to use for data visualisation, please see the links below:
- https://blog.datawrapper.de/colorblindness-part3/
- https://www.youtube.com/watch?v=xAoljeRJ3lU

Once again, if you have any questions please do not hesitate to contact me at murphyka1@cardiff.ac.uk.