

Proportional reasoning across formats

Madison Chin¹

¹ Rutgers University

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Introduction

Comparing proportions is sometimes very hard! But, even infants seem to be able to do it a little bit. The purpose of this science project was to better understand how well people compare proportions when the proportions are presented in different formats. The purpose of this class assignment is to take the R-code and plots we've been generating over the last several weeks and put it all together into one poster format.

Research Objectives

- 1.Does average performance vary across format type?
- 2.Does average performance vary across numerator congruency status?
- 3.Does numerator congruency vary across format type?(ie., is there an interaction)

Methods

Participants

A total of 99 adults participated in the study.

Methods

First participants were introduced to a story about a magic ball and that the outcome(ie., blue or orange) depended on the proportions. They were then asked to compare the proportions of different images.

In other words, participants were shown two images of the same kind at the same time and asked to decided which had a higher proportion of the shape (or dots) colored in blue.

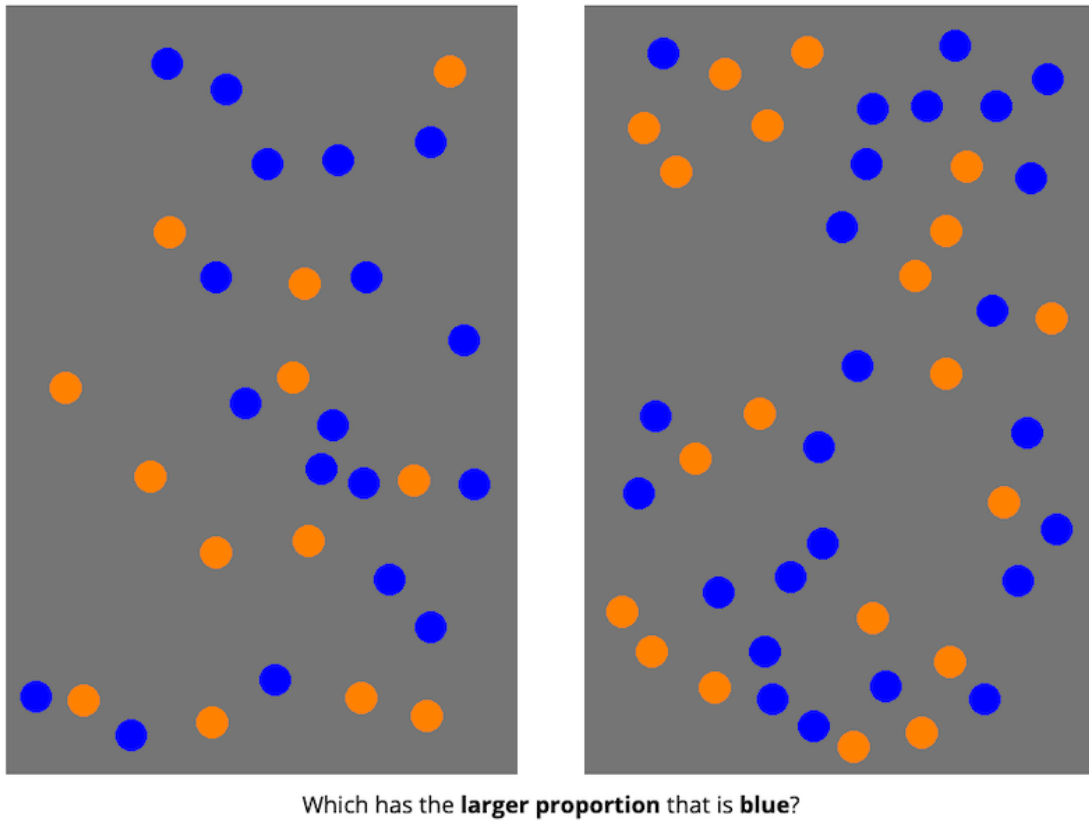


Figure 1. An example of integrated blobs

Figure 1 shows a clear example of what the “mixed” example of dots would look like to a participant.

Conditions. There were four different conditions that changed what kinds of images the participants saw:

- divided blobs: blue and orange were entirely separate.
- integrated blob: one blob, divided to be part blue and part orange.
- separated dots: blue and orange dots were on opposite sides of the image.
- integrated dots: blue and orange dots were intermixed.

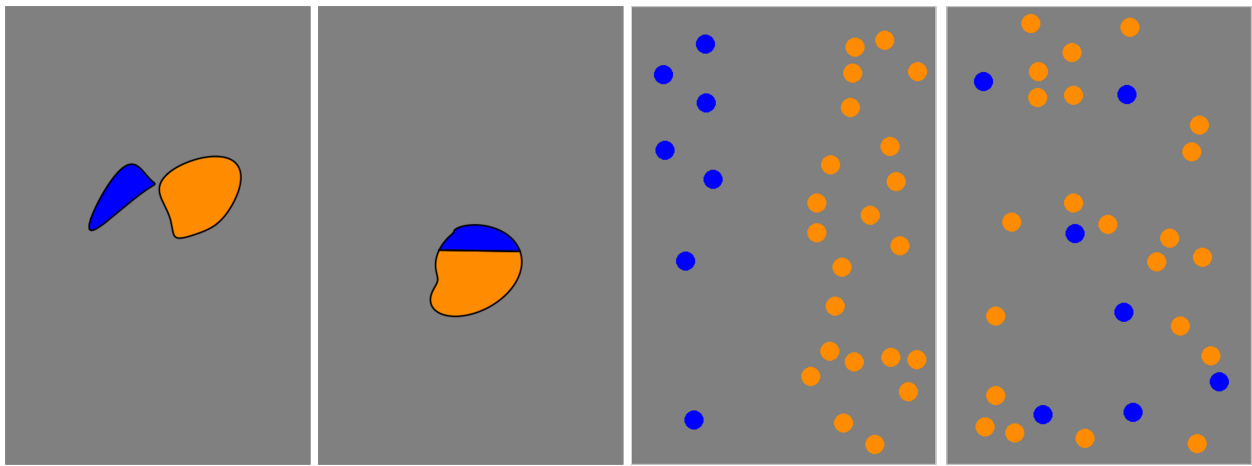


Figure 2. A formats in the study

Figure 2 shows the following from left to right : divided blobs, integrated blobs, separated dots, integrated dots.

Results

1. Does average performance vary across format type, ignoring all other aspects of the stimuli?

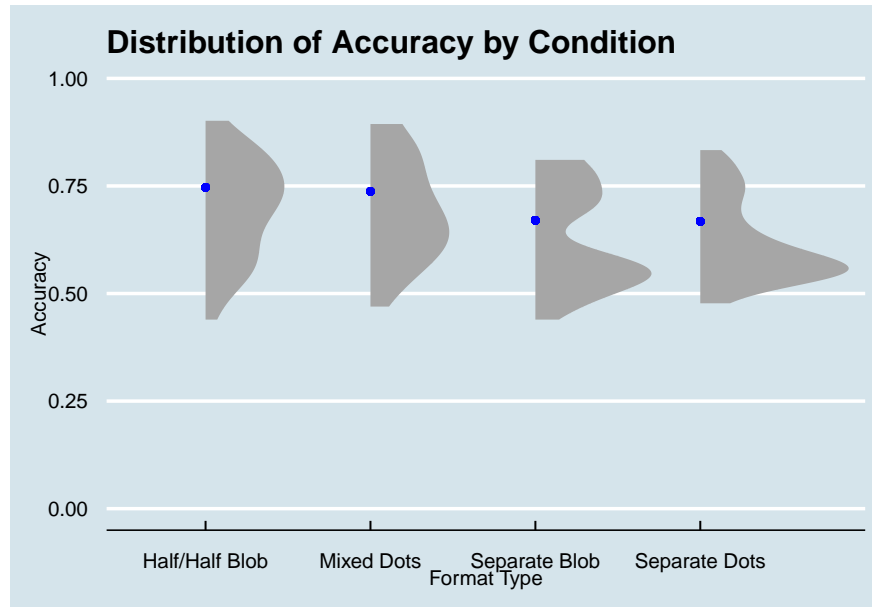


Figure 3. Plot of Distribution of Accuracy by Condition

Yes, the blue dots in Figure 3 prove that the average performance varies across formatting types.

2. How are reaction time and accuracy related?

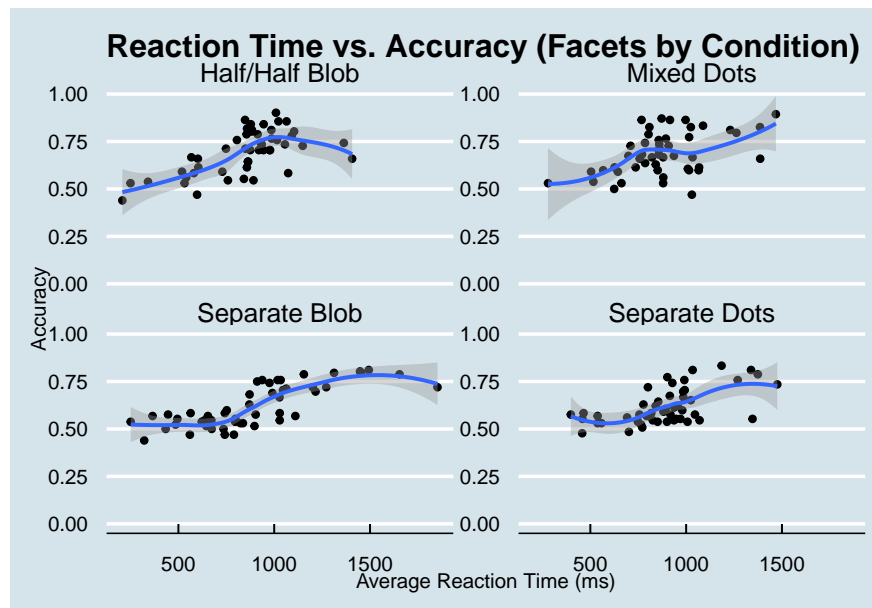


Figure 4. Plot of Distribution of Accuracy by Condition

As time increases along the x axis in Figure 4, so does the accuracy for each of the format types, until the time reaches about 1250 milliseconds.

3. How does numerator congruency interact with format type?

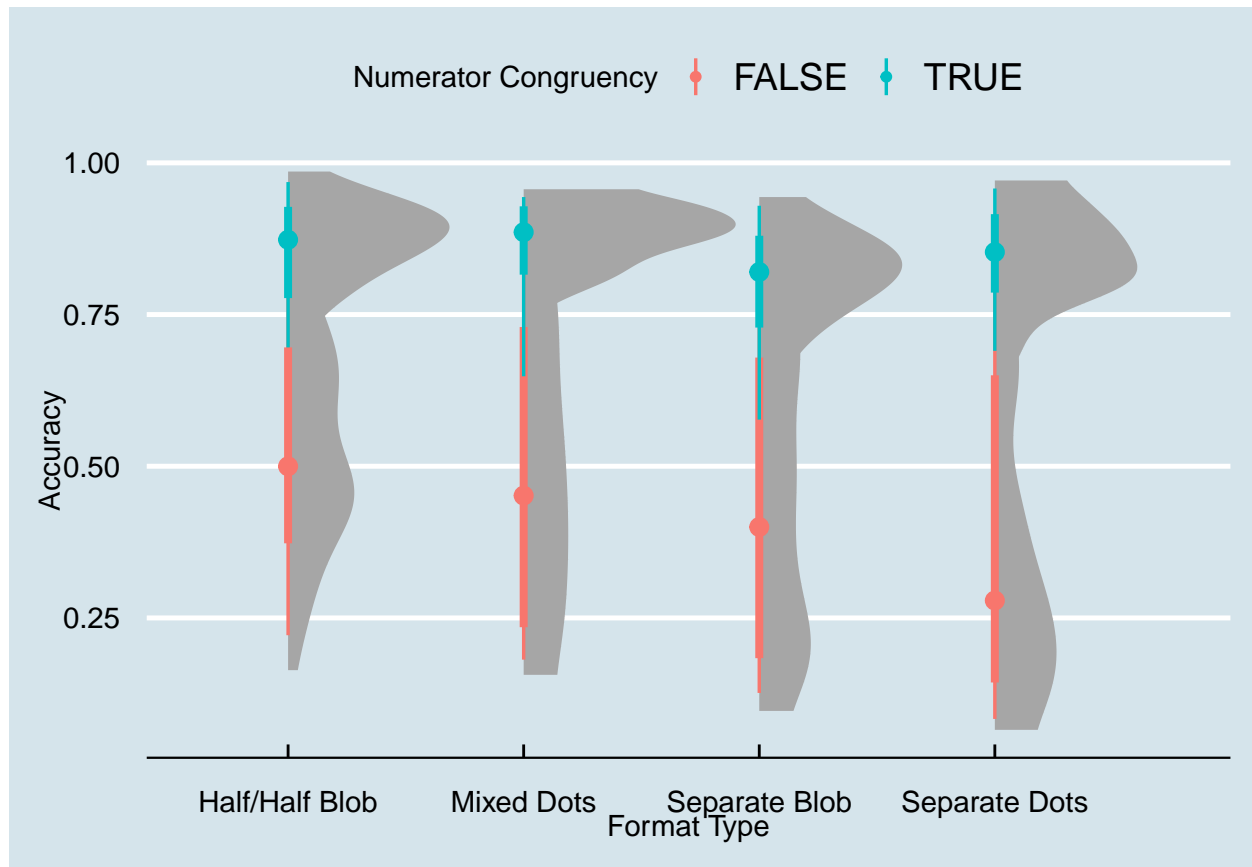


Figure 5

Numerator Congruency as shown in Figure 5 is only marked TRUE for Accuracy rates above about .60 according to the graph, across all format types. The largest range of TRUE numerator congruency is in blob_stacked format type than any other formatting.

Discussion

Interpretation

Out of the three plots that we took a look at, here are the main ideas. Average performance does vary across different formats, when we ignore all aspects of stimuli. But, we analyze how stimuli was affected by formatting type in the Numerator Congruency Plot.

Where, we concluded that higher accuracy rates all follow a similar pattern where Numerator Congruency is TRUE above Accuracy rates of about .60. Finally, in our second plot, it is clear to see that accuracy follows a steady increase up until about 1250-1500 millisecond mark where it then dips.

Conclusion

What was the most annoying or hardest thing about this assignment?

- I had previously forgot to finish re-fixing my rstudio code from previous assignments, so debugging and then reproducing them here in this poster was a bit annoying. But, I will say that although it was annoying, I was able to learn more about the data by playing around with the plot types.

What was the most satisfying or fun thing about the assignment?

- The most satisfying part was probably the first couple of questions of the assignments, as I was flying through them without having to flip constantly back and forth between the rendering and R-Studio to see if everything was working, because it was so straight-forward. I also had fun using Figure Labeling and Captioning, as it made referencing, and naming (for readers) a lot clearer, so that they can understand what was going on in my plots/figures.

Data analysis

I used R (Version 4.4.1; R Core Team, 2024) and the R-packages *dplyr* (Version 1.1.4; Wickham, François, Henry, Müller, & Vaughan, 2023), *forcats* (Version 1.0.0; Wickham, 2023a), *ggdist* (Version 3.3.2; Kay, 2024), *ggplot2* (Version 3.5.1; Wickham, 2016), *ggthemes* (Version 5.1.0; Arnold, 2024), *lubridate* (Version 1.9.3; Grolemund & Wickham, 2011), *papaja*

(Version 0.1.3; Aust & Barth, 2024), *purrr* (Version 1.0.2; Wickham & Henry, 2023), *readr* (Version 2.1.5; Wickham, Hester, & Bryan, 2024), *stringr* (Version 1.5.1; Wickham, 2023b), *tibble* (Version 3.2.1; Müller & Wickham, 2023), *tidyr* (Version 1.3.1; Wickham, Vaughan, & Girlich, 2024), *tidyverse* (Version 2.0.0; Wickham et al., 2019) and *tinylabels* (Version 0.2.4; Barth, 2023) for the entirety of this assignment.

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