

# A Replication of Visual Perception Studies with Tactile Representations of Data for Visually Impaired Users

Areen Khalaila  
Brandeis University



Lane Harrison  
Worcester Polytechnic Institute



Nam Wook Kim  
Boston College



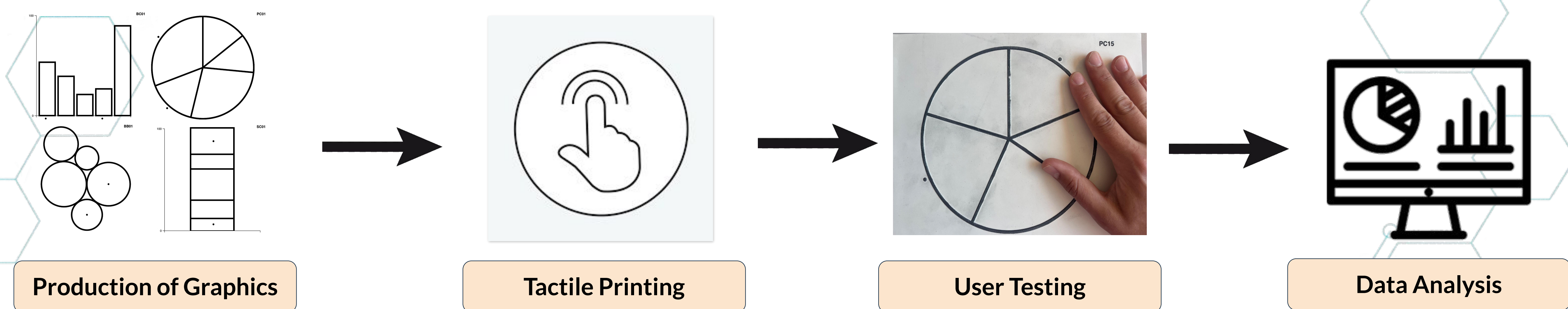
Dylan Cashman  
Brandeis University



## Motivation

- Visually impaired people have higher unemployment and underemployment rates than the general population
- Data science careers rely on visualization to communicate and explore trends in data
- Tactile graphics displays and printers promise to make visualizations accessible to the visually impaired
- It isn't clear if visualizations designed for the **visual perception** system are accurately perceived by the **tactile perception** system

## Method

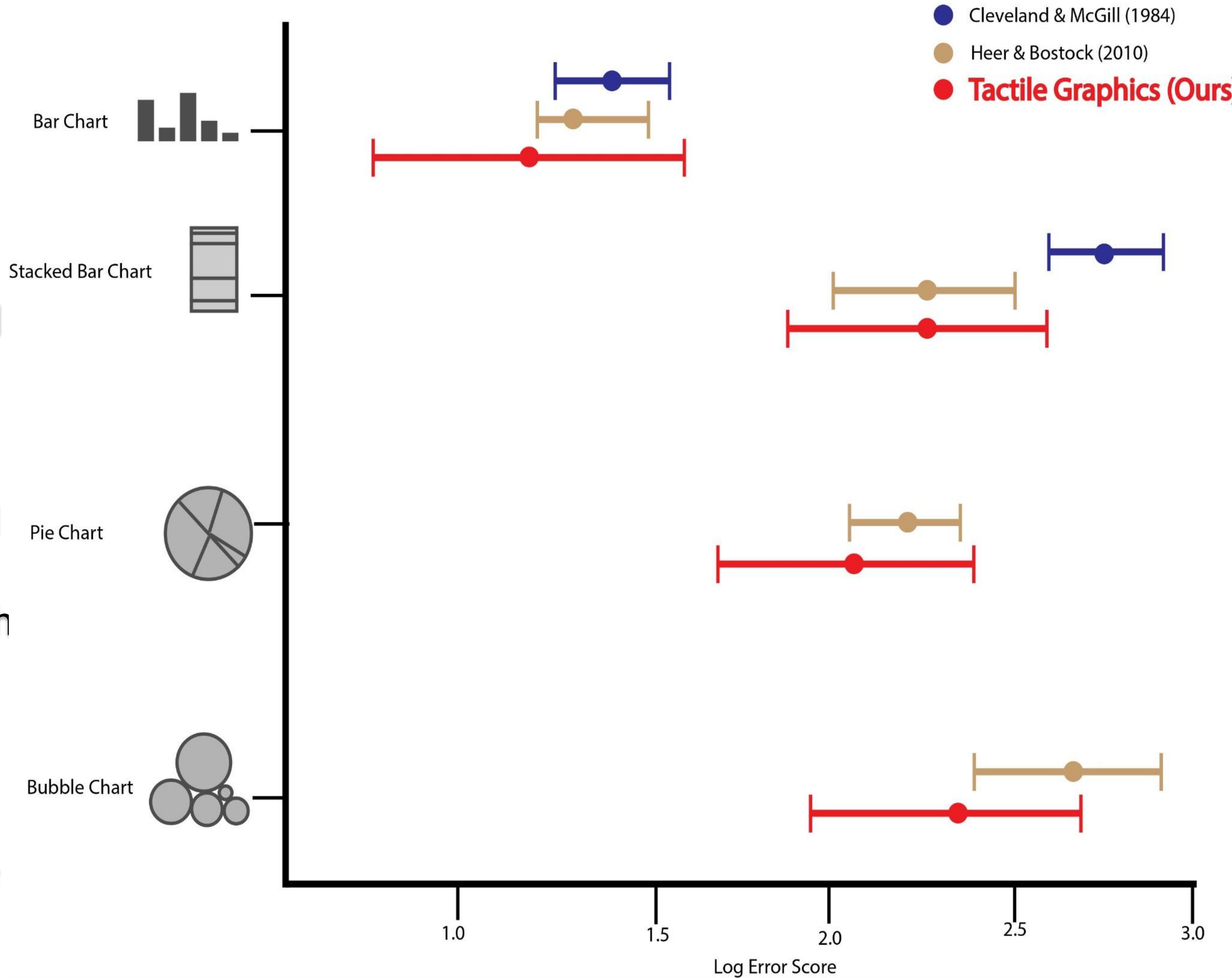


We replicate the Cleveland and McGill (1984) graphical perception study with tactile graphics on *swell-form* paper.

## Results

Comparison of Log Error with 95% CI on Perceptual Experiments

**Participant Engagement in Tactile Graphic Interpretation**  
11 visually impaired participants were given tactile representations of **bar**, **pie**, **bubble**, and **stacked bar** charts, and were tasked with determining the percentage difference between comparative elements within the charts



Graph 1: Proportional judgment results. Top: Results from our tactile study. Middle and Bottom: Estimated results from previous studies [Cleveland McGill 1984, Heer Bostock 2010]. Error bars indicate 95% confidence intervals. Detailed results will be made available in tabular form on OSF.

## How we quantified the accuracy of tactile graphic interpretation

We employed the mean log error calculation as used in the foundational Cleveland & McGill study

$$\log_2(|\text{judged percent} - \text{true percent}| + \frac{1}{8})$$

# of participants = 59

Graph 3: Average Charts Reviewed per Participant

26.74 sec



**Tactile Graphics** Heer & Bostock studys

54 sec



The Heer & Bostock study, conducted via Mechanical Turk, involved sighted users performing similar tasks with visual charts

Graph 2: Average Completion Time per Chart Judgement

## Main Findings

- Performance on all chart types was not less accurate for visually impaired users than for sighted users ( $p > 0.5$ ).
- Visually impaired users demonstrated an average completion time per chart of 26.74 seconds, notably quicker than the 54 seconds reported in Heer & Bostock's MTurk study.

## Future Work

Future research will delve deeper into optimizing tactile graphic designs through comprehensive user engagement, leveraging feedback to refine interaction strategies

## Contact Information

Areen Khalaila [areenkh@brandeis.edu](mailto:areenkh@brandeis.edu)  
Dylan Cashman [dylancashman@brandeis.edu](mailto:dylancashman@brandeis.edu)  
Lane Harrison [lharrison@wpi.edu](mailto:lharrison@wpi.edu)  
Nam Wook Kim [nam.wook.kim@bc.edu](mailto:nam.wook.kim@bc.edu)

## References

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