100 years of Pies vs. Bars

Maksuda Aktar Toma

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University of Nebraska Lincoln

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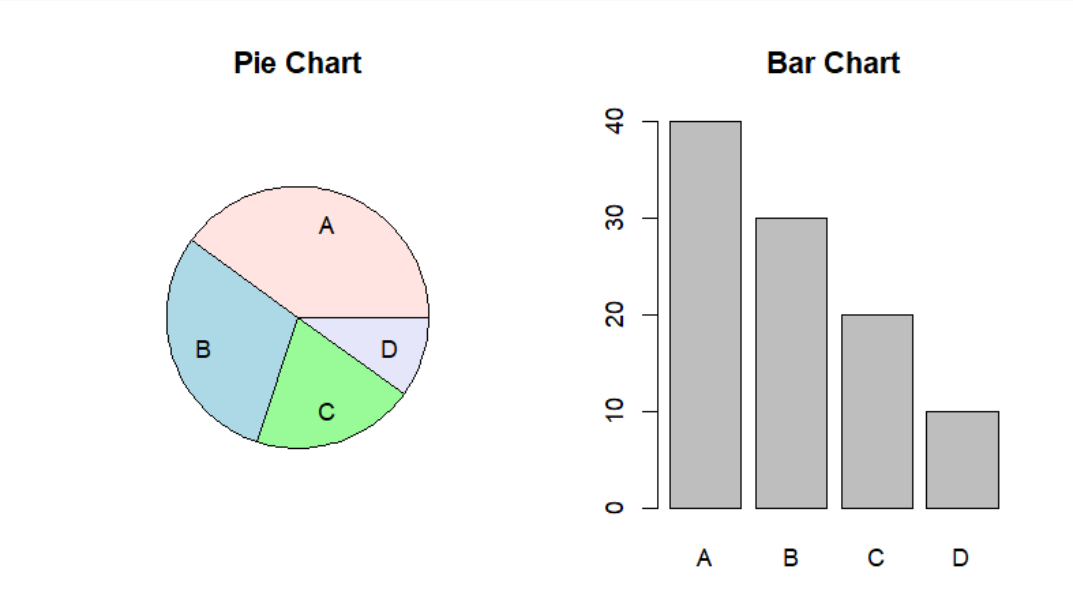
Introduction: Pie vs. Bar — A Century-Long Debate

- Pie and bar charts date back to Playfair (early 1800s).
- Pie charts often criticized as less accurate, yet remain widely used.
- This review explores:
  - Historical experiments and design
  - Task performance comparisons
  - Practical usefulness of each chart type

Motivation: Why Revisit Pie vs. Bar?

- Effective charts are essential for accurate communication of quantitative data.
- Bar charts consistently outperform pie charts in accuracy, speed, and clarity (based on early research).
- Yet, pie charts remain popular in media, business, and education.
  - This raises key questions:
  - Why do pie charts persist?
  - How do habits, aesthetics, or tradition influence chart selection?



The Dawn of Empirical Graphics

- Early JASA studies (1926–1930s) by Eells, von Huhn, and Croxton tested pie vs. bar charts for accuracy and speed.
- Tasks varied: Eells used part estimation; Croxton used ratio comparisons like A/B, $A + B = 1$
- Findings: No clear winner—results depended on task design; von Huhn and Croxton critiqued and refined earlier work.

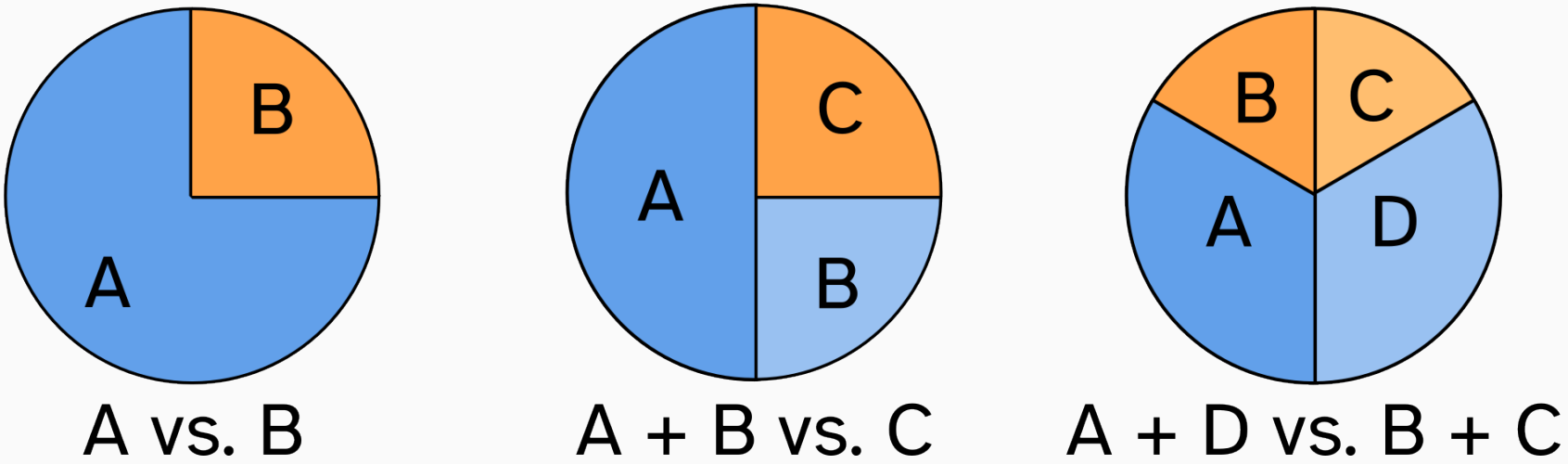


Figure 2: *Examples of comparison tasks used in graphical perception studies*

Modern Experimental Graphics

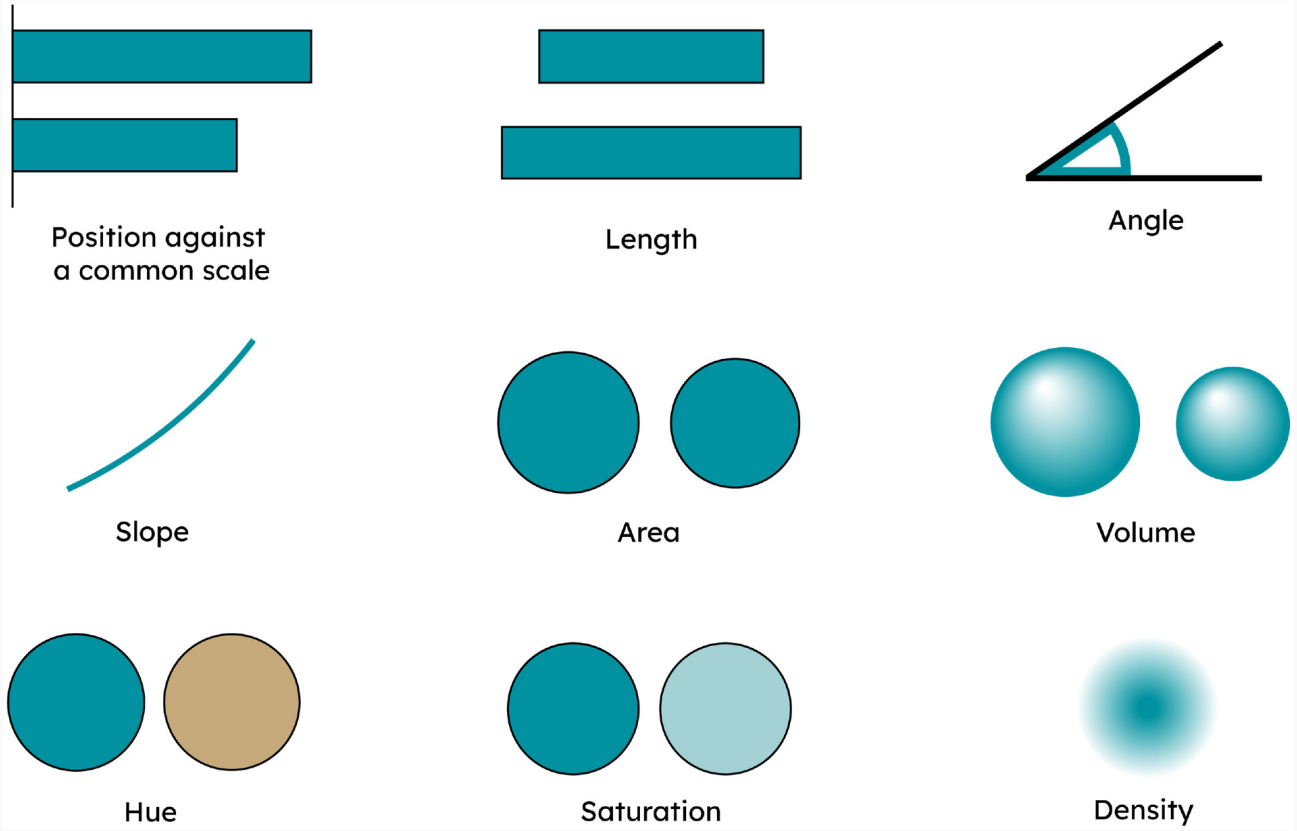


Figure 3: *Visual encodings ordered by perceptual accuracy, as proposed by Cleveland and McGill*

- The first six activities are listed according to Cleveland and McGill's accuracy tests. Assumed to be far less accurate than the others.

Modern Experimental Graphics (Cont.)

- Spence & Lewandowsky (1991): Compared A vs. B+C using bar, pie, and table; measured accuracy and speed.
- Peterson (1954): Evaluated 8 chart types for part-whole accuracy; found format matters.
- Simkin & Hastie (1987): Bars better for comparisons; pies better for proportions.
- Skau & Kosara (2016): Pie distortions reduce accuracy; arc cues work best.
- Hill (2025): Bars best for ranking; pies/donuts strong in simple proportion tasks.

Experimental Description

Label	Citation	Comparison	Question	Measure	Participants	Preference
A-exp1	Eells (1926)	$\frac{A}{(A+B+\cdots)}$	Estimate each segment	Accuracy, Preference	97	Pie
A-exp2	Croxton (1927)	$\frac{A}{(A+B)}$	Estimate percentage values	Accuracy	807	Pie
B-exp1	Von Huhn (1927)	$\frac{A}{B}$	What is B if A is 1?	Accuracy	287	Bar
B-exp2	Spence (1991)	A, A+B, etc.	Which part is largest?	Accuracy, Speed	Varied (Online)	Bar
C-exp1	Petersen (1954)	$\frac{A}{(A+B)}$	Estimate proportion	Accuracy	86	Bar
D-exp1	Cleveland (1986)	$\frac{A}{(A+B)}$	What % is this of the standard?	Accuracy	127	Bar
E-exp1	Simkin & Hastie (1987)	$\frac{A}{B}$ & $\frac{A}{(A+B)}$	Compare or estimate	Accuracy, Time	200	Pie (for $\frac{A}{(A+B)}$)
F-exp1	Skau & Kosara (2016)	$\frac{A}{(A+B)}$	What % is the blue part?	Accuracy	100	Pie
G-exp1	Hill (2025)	Ranking, A vs B, A+B	Rank or estimate	Accuracy	42	Bar

Figure 4: *Summary of Experimental Studies on Chart Perception*

Accuracy of Charts

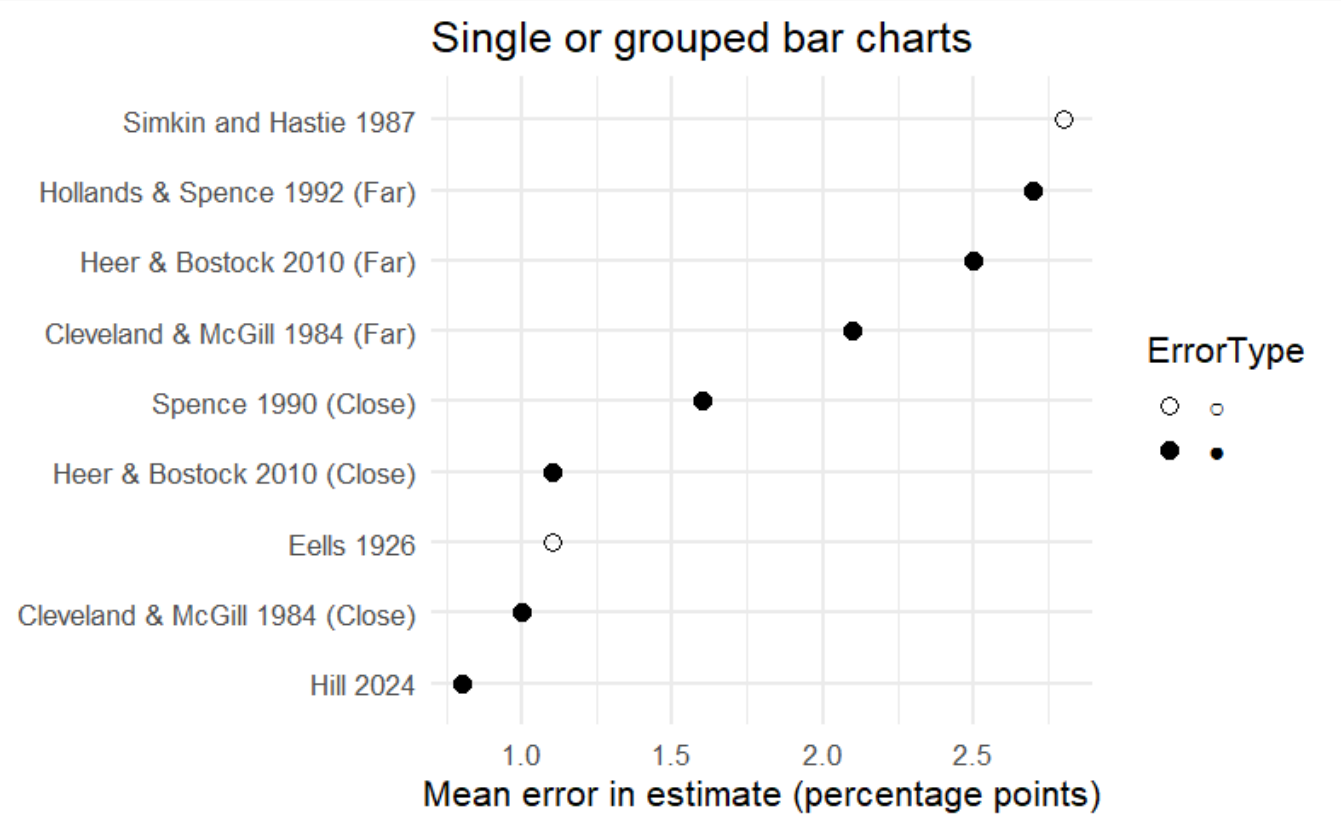


Figure 5: *Accuracy of Bar Chart By Task Type*

- Filled dots indicate studies that reported standard errors; hollow dots did not
- Hill (2024) showed the lowest estimation error, indicating the highest accuracy among all studies.
- Studies with Close bar alignment performed better than those with Far bar placement

Accuracy of Charts (Cont.)

- Heer & Bostock (2010) showed the lowest error, indicating better accuracy with segmented bars.
- Older studies had higher error rates and often lacked standard error reporting (hollow points).

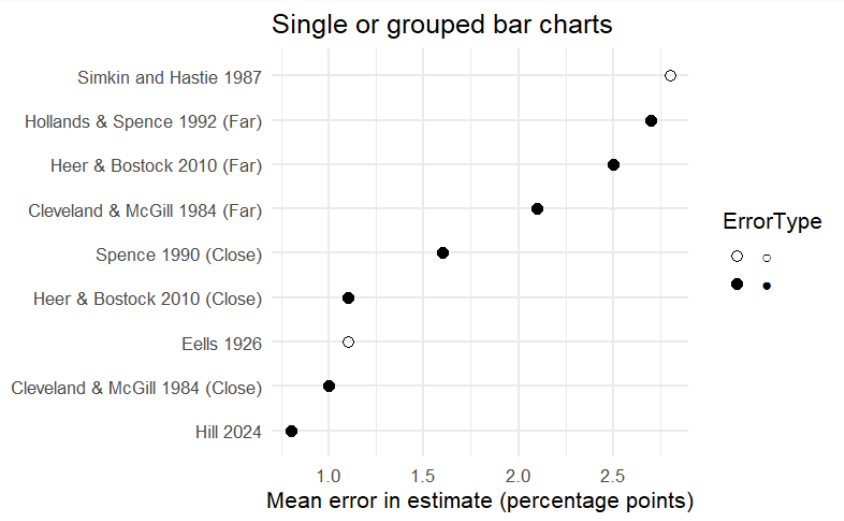


Figure 6: *Accuracy of Bar Chart By Task Type*

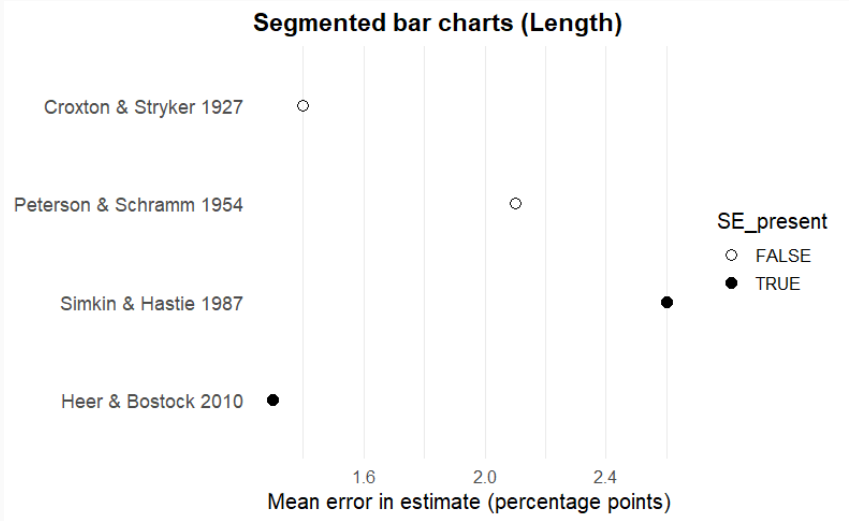


Figure 7: *Accuracy of Bar Chart By Task Type*

Accuracy of Charts (Cont.)

- Pie charts perform well for part-to-whole tasks, with low error (1–3%).
- Segment comparisons are harder, showing higher errors (4–6%).
- Recent studies show improved accuracy with better design.

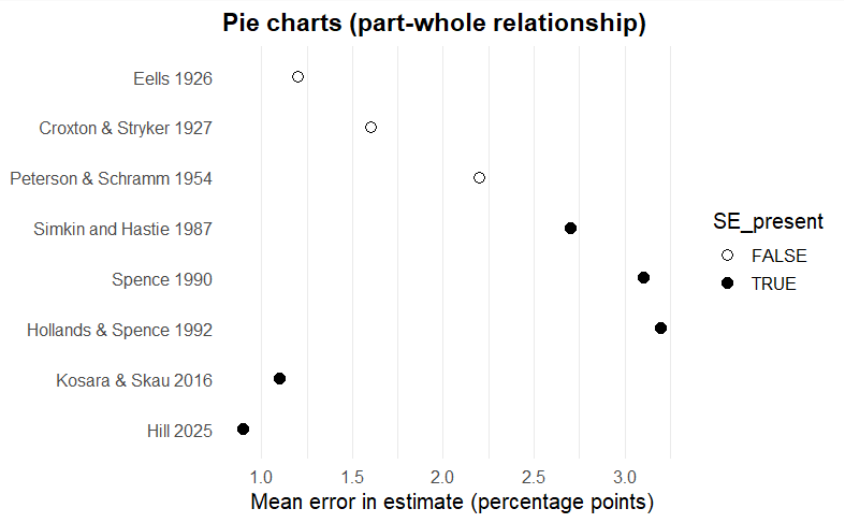


Figure 8: *Accuracy of Pie Chart By Task Type*

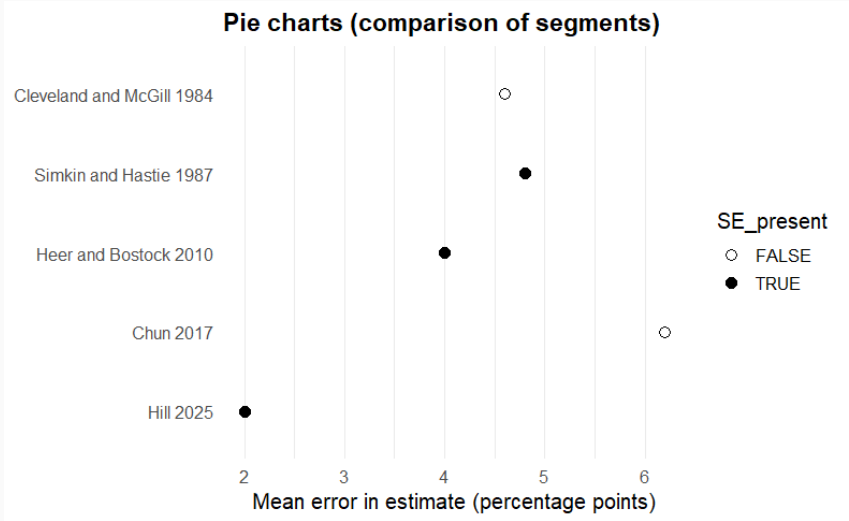


Figure 9: *Accuracy of Pie Chart By Task Type*

Result

- Bar charts excel in comparison and ranking tasks — faster, more accurate, and user-preferred.
- Pie charts perform well in part-to-whole and grouped estimation tasks, aligning with intuitive reasoning.
- Task matters: Bar > Pie for A vs B; Pie > Bar for $A/(A+B)$; mixed results for A vs $B+C$, $A+B$ vs $C+D$

Conclusion

Conclusion

There is no universal winner. The most effective chart type depends on the specific judgment or task.

- Both chart types remain widely used across science, business, and social sciences.
- The effectiveness of a chart depends on:
  - the task (comparison, estimation, ranking),
  - perceptual features (angle, length, position),
  - and visual design elements (adjacency, clarity).
- Pie charts are generally better for conveying part-to-whole relationships.
- Bar charts are superior for comparing magnitudes and identifying rankings.

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Thank You

Questions?