A Comparison of Radial and Linear Charts for Visualizing Daily Patterns

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"Processing angles is more difficult than processing linear aspects." [Simkin and Hastie, Journal of the American Statistical Association, 1987]







"Radial graphs also have the potentially error-prone property that the reader's eyes must follow one of several concentric rings to map a data point to its value." [Goldberg and Helfman, SAGE Information Visualization 2011]









"Using polar rather than Cartesian coordinates has a pleasing aesthetic, while using space more efficiently." [Heer et al., Commun. ACM 2010]











"Mapping this circular behavior to a radial diagram is an intuitive concept and mirrors the data appropriately."

[Burch and Weiskopf, Springer Handbook of Human Centric Visualization 2019]



Radial Charts of Periodical Patterns







Radial Charts of Periodical Patterns





"The participants also reported to like the **clock metaphor**. Some suggested, however, to visualize only 12 hours at a time for a more intuitive encoding."







Clock Metaphor

9





Traffic Accidents







Traffic Accidents





Rose Chart







Rose Chart





Rose Chart





"Clock Charts"







Study Design













amazon mechanical turk





Do tired drivers have more accidents?

Many accidents happen in the morning rush hour





on the ride back home from work

Untargeted Analysis



Look at the visualization and try to understand the data!







Untargeted Analysis



Answer

Continue





Low-Level Tasks







Low-Level Tasks







Low-Level Tasks



Please estimate the value for the time interval marked by the orange arrow!









Visualizations of daily patterns using a clock-like layout can be interpreted more efficiently by untrained users than using alternative radial or linear charts.



Untargeted Analysis



Observation 1

Observation 2

There are a lot of accidents in the morning _ between 8 am and 10 am. Then again in the afternoon between 1 and 5 pm.

0.0 0.5 1.0 1.5 2.0 Number of Observations



Locate Maximum



Please click on the interval showing the maximum value!









accuracy

Locate Maximum

completion time





Locate Maximum Errors











Separating charts may attract much more attention to the first chart.





Locate Time



Please click on on the bar corresponding to the interval: 5 - 6 AM







accuracy

Locate Time

completion time





Locate Time Errors



Please click on on the bar corresponding to the interval: 5 - 6 AM



I found it very hard to read initially as I was trying to figure out if the 12pm on the left was for PM or AM, based on it stating AM in the center. This is very confusing.



Rose Charts













Separate rose charts are **difficult to follow**.



Locate Time







[Fuchs et al., ACM CHI 2013]









Locating an hour of a day is more efficient using a **continuous, labelled, linear bar chart**.



Read Value



Please estimate the value for the time interval marked by the orange arrow!





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accuracy

Read Value

completion time





Read Value Errors





It's pretty decent but I JUST noticed that each bar represents 20 accidents. Before I thought 1 bar = 1 accident because I didn't look closely enough







Users may not know **how to interpret the length of the bars** in rose charts.



Read Value Errors









Read Value









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Read Value











Separating radial charts may attract **attention to unimportant data points**.







It is **challenging** to read.















Clock Charts?







How to Visualize Daily Patterns?





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Thank you!



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