

Pivotor People Pontificate: Scott and Jamie Discuss Data Visualizations

Scott Chapman & Jamie Novotny
Enterprise Performance Strategies, Inc.

Scott.Chapman@EPStrategies.com

Jamie.Novotny@EPStrategies.com



Contact, Copyright, and Trademarks



Questions?

Send email to performance.questions@EPStrategies.com, or visit our website at <https://www.epstrategies.com> or <http://www.pivotor.com>.

Copyright Notice:

© Enterprise Performance Strategies, Inc. All rights reserved. No part of this material may be reproduced, distributed, stored in a retrieval system, transmitted, displayed, published or broadcast in any form or by any means, electronic, mechanical, photocopy, recording, or otherwise, without the prior written permission of Enterprise Performance Strategies. To obtain written permission please contact Enterprise Performance Strategies, Inc. Contact information can be obtained by visiting <http://www.epstrategies.com>.

Trademarks:

Enterprise Performance Strategies, Inc. presentation materials contain trademarks and registered trademarks of several companies.

The following are trademarks of Enterprise Performance Strategies, Inc.: **Health Check[®], Reductions[®], Pivotor[®]**

The following are trademarks of the International Business Machines Corporation in the United States and/or other countries: IBM[®], z/OS[®], zSeries[®], WebSphere[®], CICS[®], DB2[®], S390[®], WebSphere Application Server[®], and many others.

Other trademarks and registered trademarks may exist in this presentation

Abstract



At EPS we have years of experience helping people understand the performance of their z/OS systems, in part by visualizing the performance details that are stored in the SMF data. You probably won't be surprised to find that we're quite interested in data visualization as a discipline.

In this webinar, Scott and Jamie will explore the psychology behind data visualization, discuss some visualization best practices, ridicule examples of poor visualizations, and explain how Pivotor reports work to avoid obfuscation and promote understanding.

EPS: We do z/OS performance...



- Pivotor - Reporting and analysis software and services
 - Not just reporting, but analysis-based reporting based on our expertise
- Education and instruction
 - We have taught our z/OS performance workshops all over the world
- Consulting
 - Performance war rooms: concentrated, highly productive group discussions and analysis
- Information
 - We present around the world and participate in online forums

z/OS Performance workshops available



During these workshops you will be analyzing your own data!

- Essential z/OS Performance Tuning
 - Via Zoom, June 21-25, 2021
- WLM Performance and Re-evaluating Goals
 - Via Zoom, September 20-24, 2021
- Parallel Sysplex and z/OS Performance Tuning
 - Currently being taught...November 16-17, 2021
- 2022 Dates TBD
- Also... please make sure you are signed up for our free monthly z/OS educational webinars! Next round set to “drop” in February.

Who are we and why do we care?



- Jamie Novotny

- Interested in all things human behavior, socioemotional health, and brain development

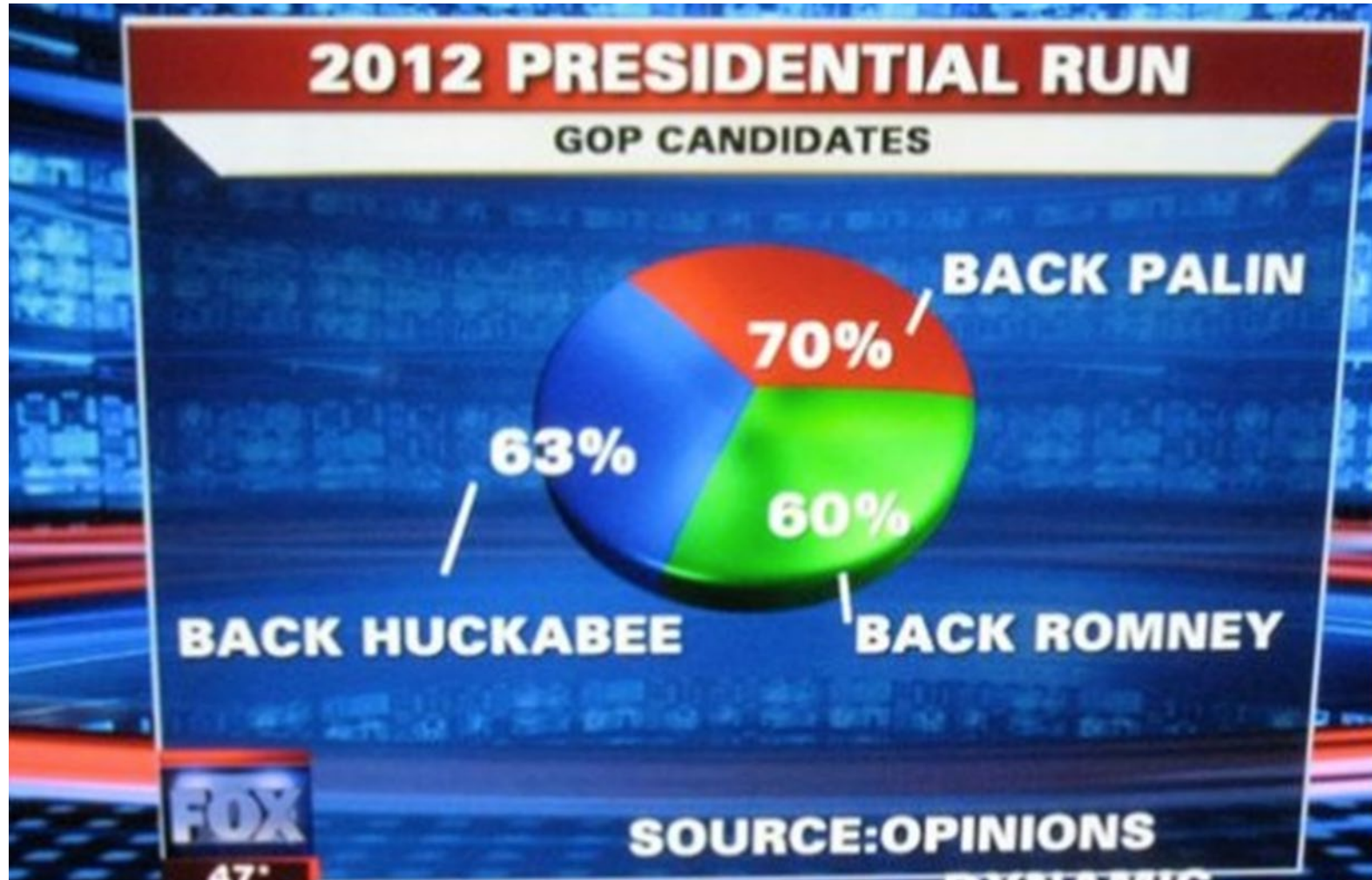
- Scott Chapman

- z/OS performance guy and data visualization junky



Bad Visualizations Can Be Painful

Good Visualizations Are Important

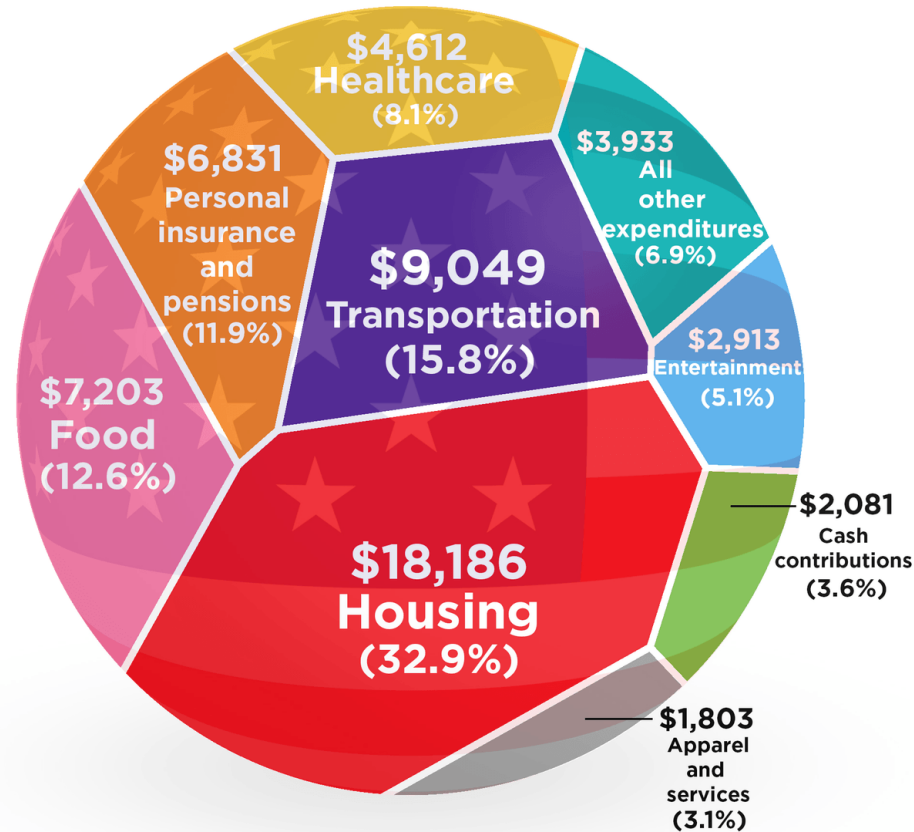


A pie chart adding up to 193%?!?

How to make an even worse pie chart



How Americans Spend Their Money



Average Income before taxes = \$74,664

Article and sources:

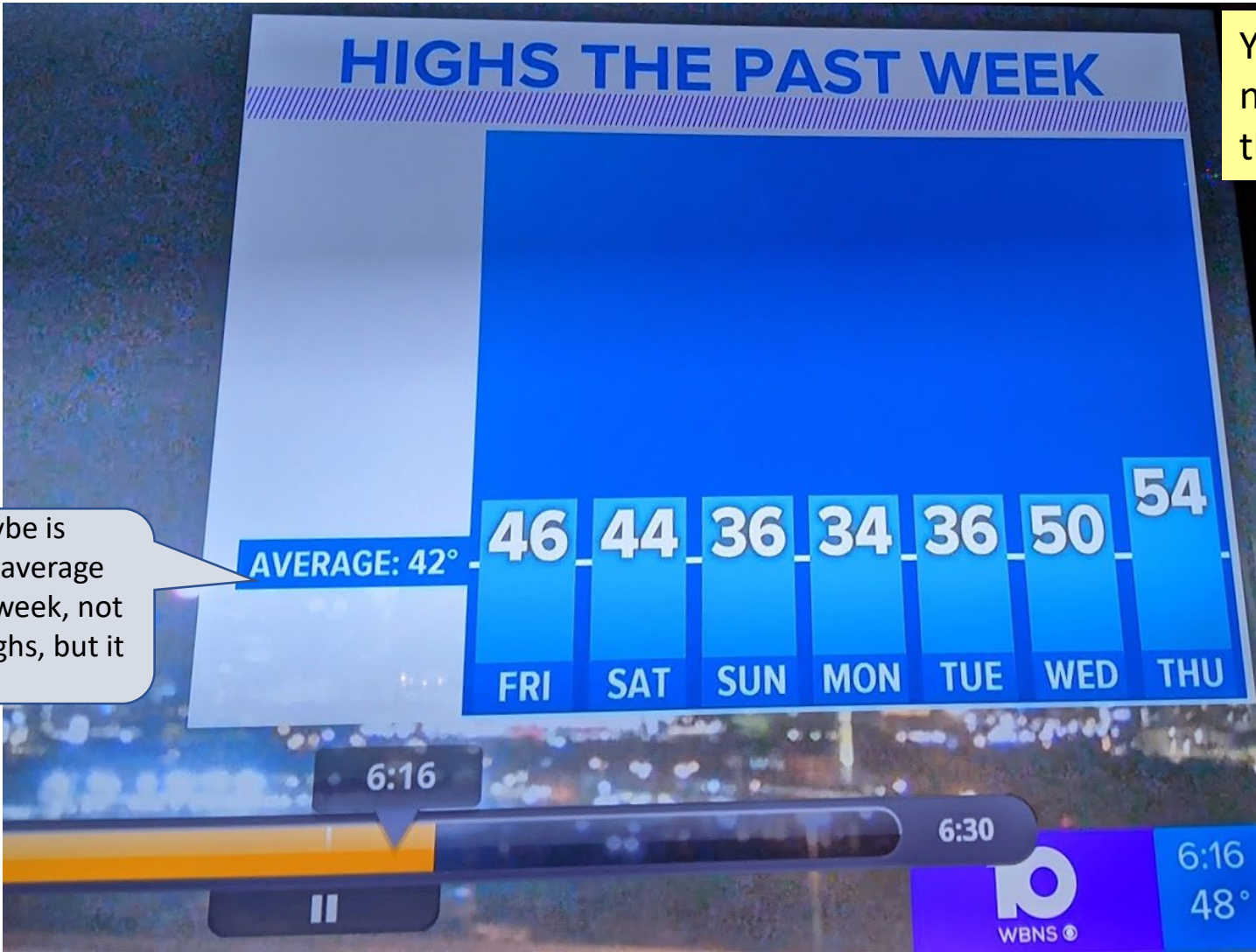
<https://howmuch.net/articles/how-americans-spend-their-money-2016>

<https://www.bls.gov/news.release/pdf/cesan.pdf>

Average Annual Expenditures = \$57,311

howmuch.net

Accuracy matters



This average maybe is supposed to be the average temperature for the week, not the average of the highs, but it is not clear.

Yes, I did pause the news just to capture this!

TV stations must have terrible software



INFORMACIÓN CORONAVIRUS MÁS ALTA DE TODA LA PANDEMIA. LA OCUPACIÓN



This chart isn't helping!

MUERTES NOTIFICADAS



Fuente: Ministerio de Sanidad

DIRECTO

Redacción 'laSexta Noticias'

EVOLUCIÓN DEL CORONAVIRUS EN ESPAÑA

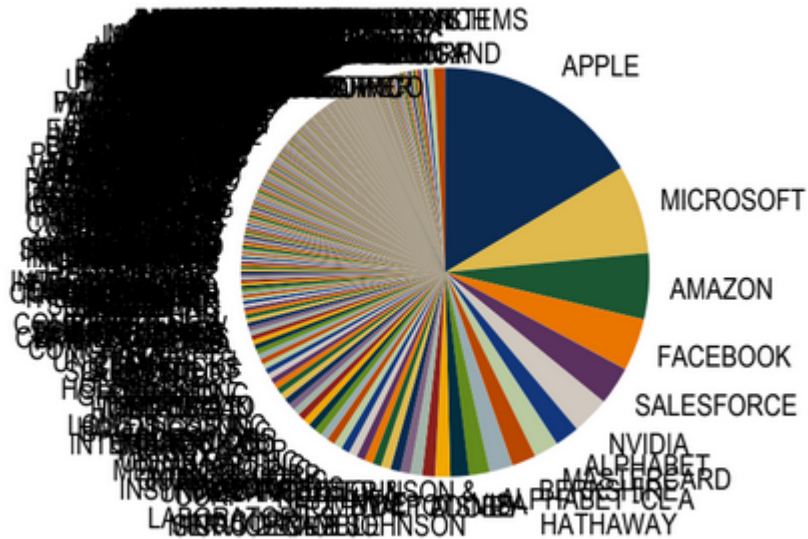
SANIDAD NOTIFICA 42.885 CASOS EN 24 HORAS, LA SEGUNDA CIFRA MÁS ALTA DE LA PANDEMIA



More series is not more better!



Chart 3: 10 stocks in S&P500 accounted for >50% of August 7.2% return



Source: BofA Global Investment Strategy, Bloomberg



For more such fun, see: <https://www.reddit.com/r/dataisugly/>

History and Psychology of Visualizations

History of Data Visualization & Perception



- Pre-17th century – Mapping and land markers
- 1800s – Early graphs and visuals consisted of geologic data, astronomy, medical data
- Later 1800s – early 1900s – featuring stats about health outbreaks, industrial revolution, medicine, and more
- 1912 – Gestalt School of Psychology early studies
- 1980s – Edward Tufte came out with *Visual Display of Quantitative Information*
 - Seen as “groundbreaking work” in the field of data visualization
- Data visualization has evolved and adapted since then, especially with the addition of software programs, interactive visualizations, and more

Gestalt Principles of Perception

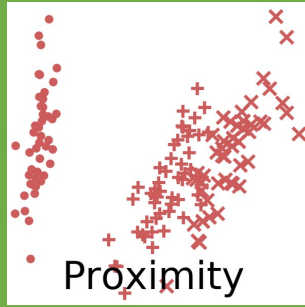


So, how do we effectively use data visualization?

- Identified by psychologists Max Wertheimer, Wolfgang Köhler, and Kurt Koffka, these “principles tell us that the human brain is hard-wired to identify patterns as a way to make sense of our world.” (3)
- Our brains create “structure by default”
- “The whole is greater than the sum of its parts”
- Evolved into ~8 laws/principles

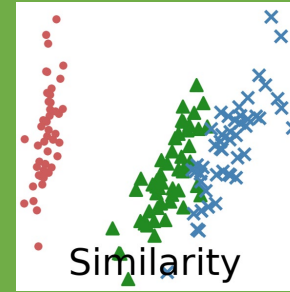
Proximity

Grouping is evident when items are close together, hinting a relationship



Similarity

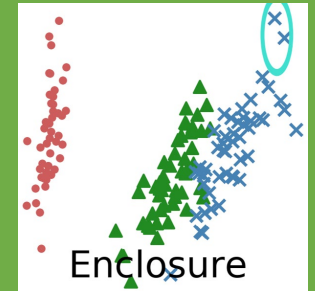
When similar characteristics or attributes are used (like color, shape, etc.), there is a grouping/relationship



Enclosure/Focal Point

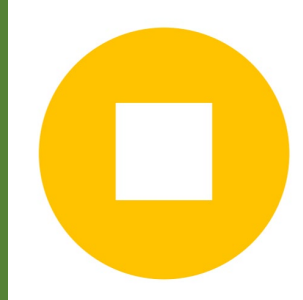
If something stands out, it is likely intentional

If multiple objects are in a visual enclosure, there is a relationship



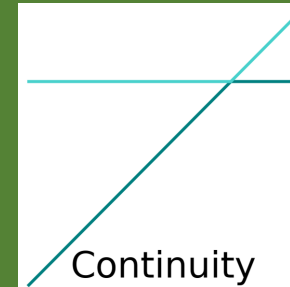
Figure/ground

Ease of switching from background/foreground to create a whole visual using contrast colors and size distinctions



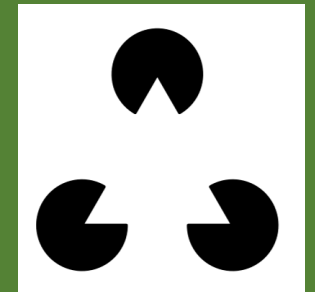
Continuity

When elements are in a line/curve, they are likely perceived as related as items that are not



Closure

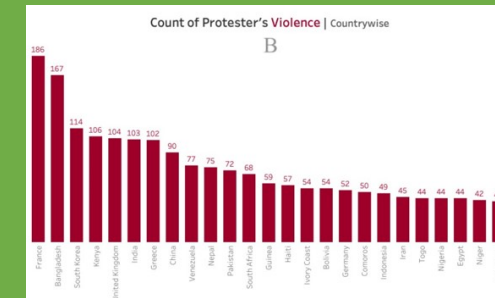
A complex arrangement of elements are perceived by the brain as one recognizable object



Simplicity

Ability to perceive something with minimum cognitive effort to avoid information overload

Photo sources: [O'Reilly](#), [Medium](#), [Design for Geeks](#)



Modern Visualization Recommendations

Determine your message first



- Your data tells a story—have a clear vision of that story
- Are you showing:
 - Value changes over time?
 - Ratios?
 - Comparisons to thresholds?
 - Relationships between changing values?
- What conclusion do you want your audience to come to?
 - If you find you have too much data, think about what really needs to be shown to support the intended conclusion
 - Consider highlighting data that supports the conclusion

Picking a chart: Values changing over time



- Classic Line chart

- Widely used and easily understood
- May be hard to find individual data values on the line
 - Consider adding data markers (carefully, can lead to cluttered chart)
 - Sometimes lines are clutter and removing the lines is better
- Wide variability between data points can lead to difficult to read chart
 - In Excel, consider using data markers only—no line

- Area chart

- Very similar to line chart, but with more “weight”

- Column chart

- Can combine the ideas of both line and area charts
- Also allows you to more easily recognize the interval that is being reported

Picking a chart: Ratios and Comparisons



- Beware the pie chart!
 - More difficult to perceive differences between angles than length
 - If more than a few slices, labeling becomes difficult
- Consider bar (or column) charts
 - Bar length makes differences easier to perceive
 - Consider ordering the observations intelligently
 - Can effectively display many more values
- Heat maps for large quantities of data
 - Can be difficult to interpret details
 - Work best when interactive with tool tips or click-through to details

Colors



- Use white as your background for your chart
- Consider intensities of a single color for data ranges
- Use less saturated colors
 - Reserve vivid colors for highlighting particular data points
 - Consider gray scale for most data, reserving color for highlights
- Use different colors with similar intensities to denote categories of data
- Color blindness is common!
 - Red-green: 7-10%
 - Yellow-blue: 6%
 - Free check tool available at vischeck.com
 - Phone apps available too, just hold your phone up to the screen to see what it might look like for a color blind person



Chart Junk



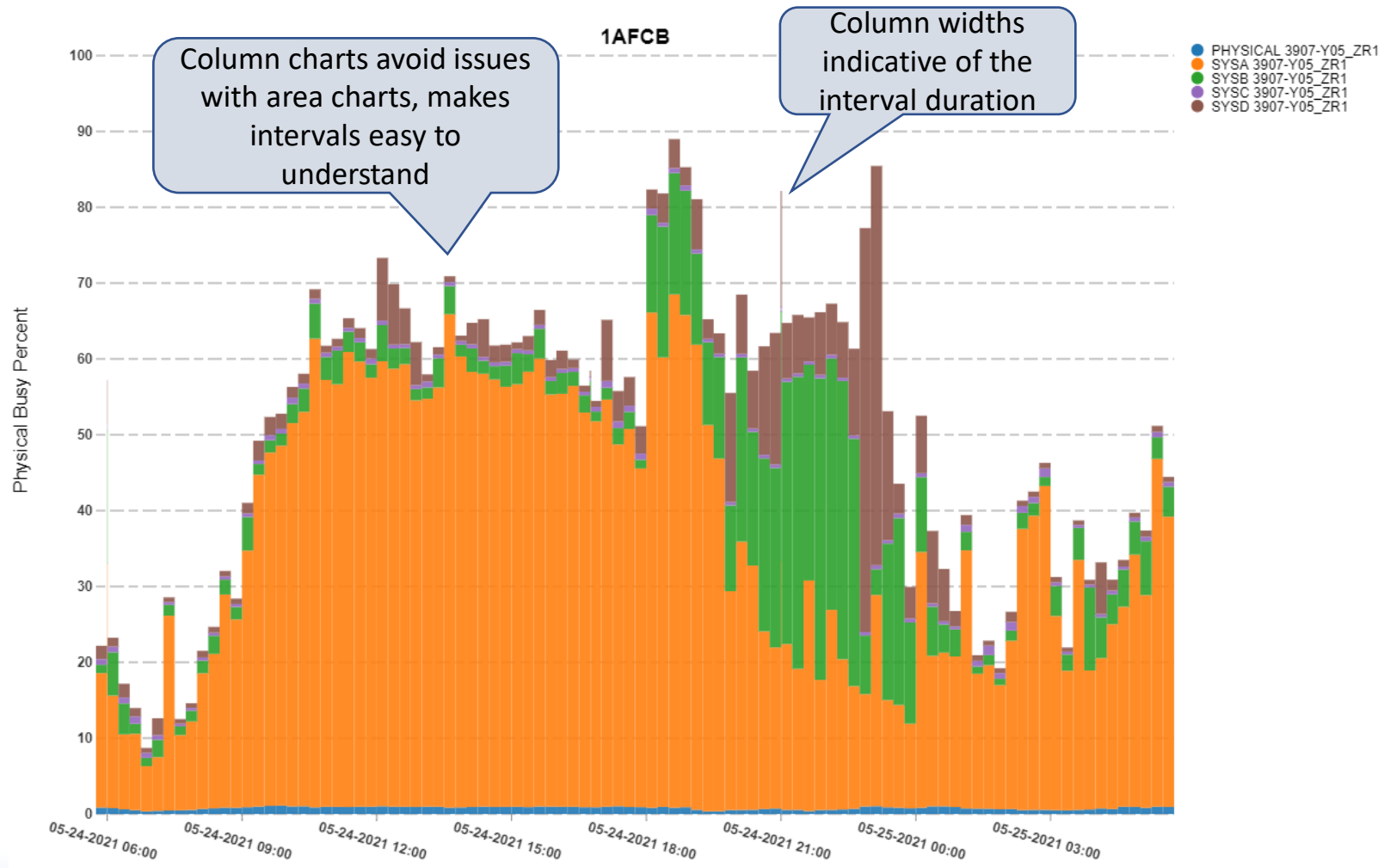
- Don't include what's not needed!
- Don't let visual effects distract the reader from the story of your data
 - Unless obfuscation *is* the goal
- 3-D effects are often overused and unnecessary
- Avoid unnecessary gradients, icons, and backgrounds
 - Sometimes a background indicating thresholds may be ok
- Grid lines don't need to be dark
- Y-axis should almost always start at zero



Pivotor Prefers Column Charts



CEC Physical Machine CP Busy% by CEC Serial Number



Pivotor Avoids Chart Junk



User Interface elements limited to what is really needed

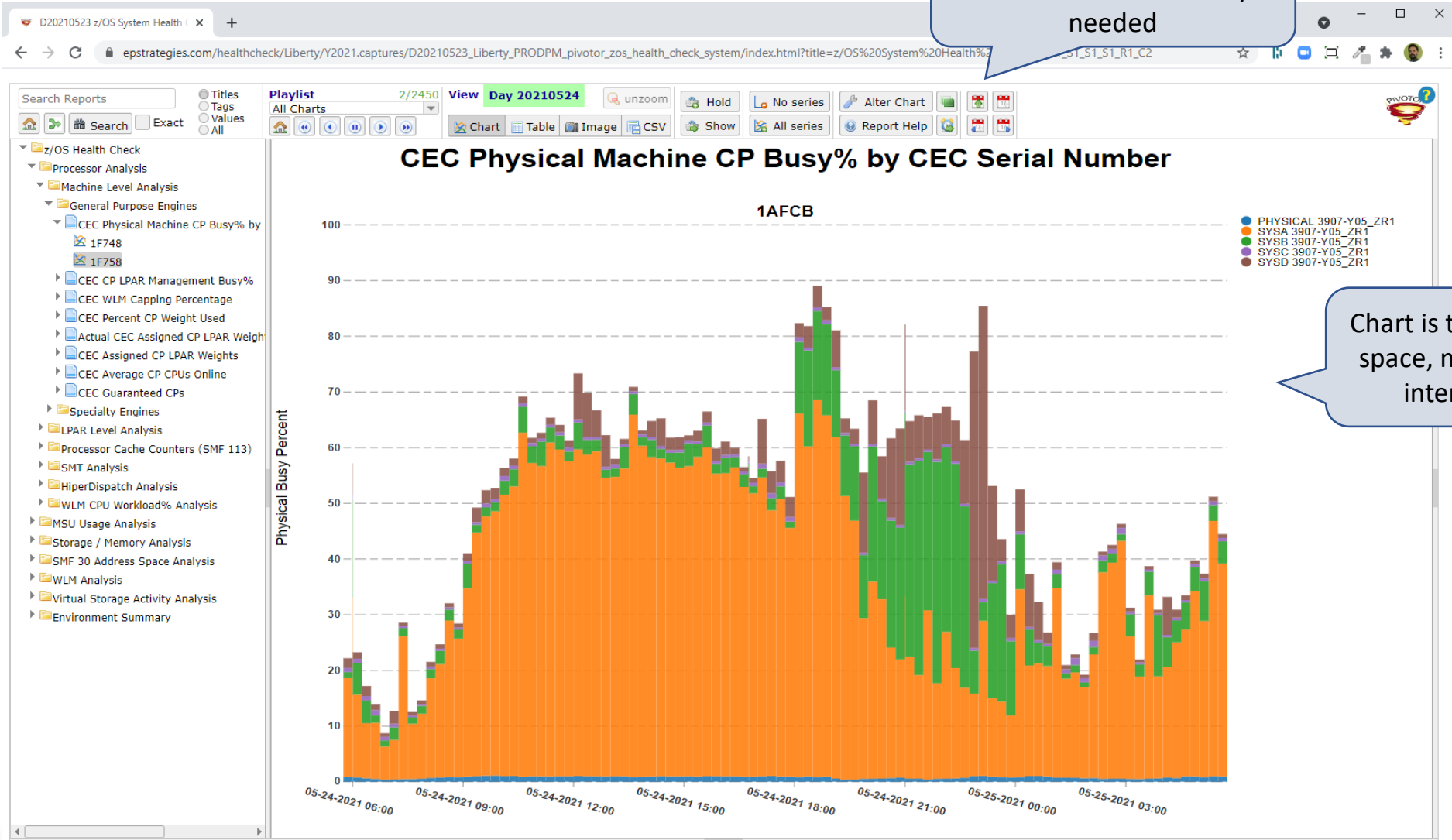
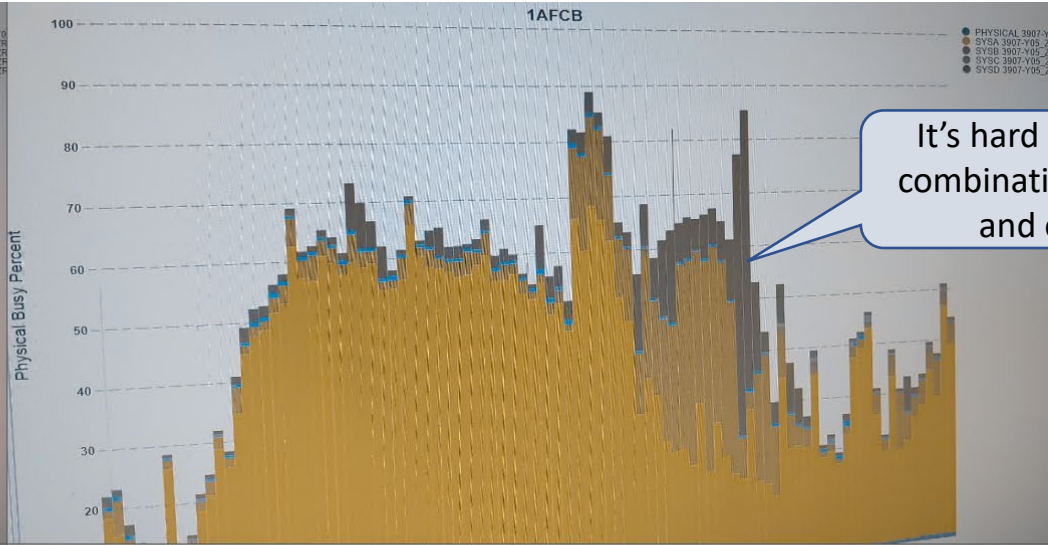
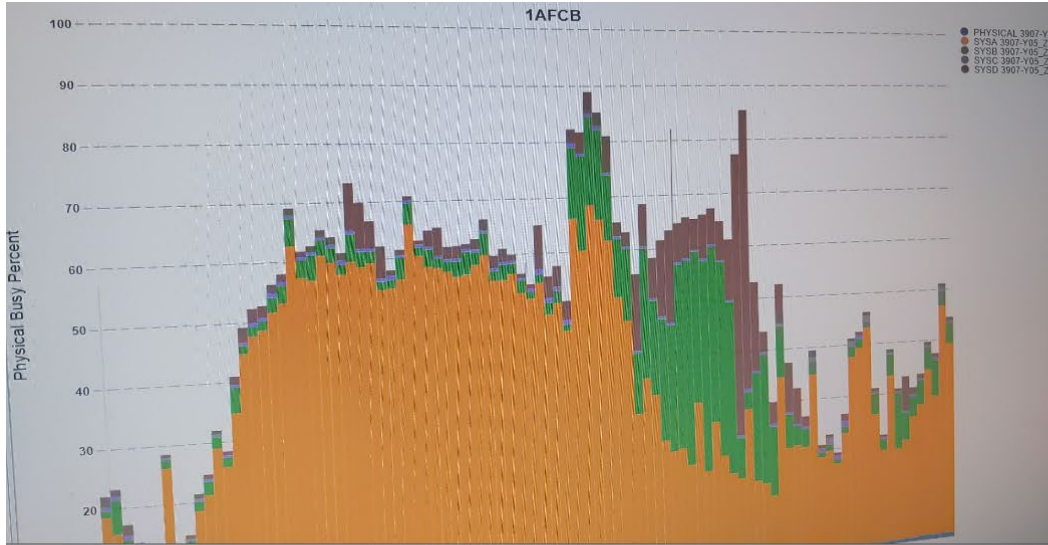
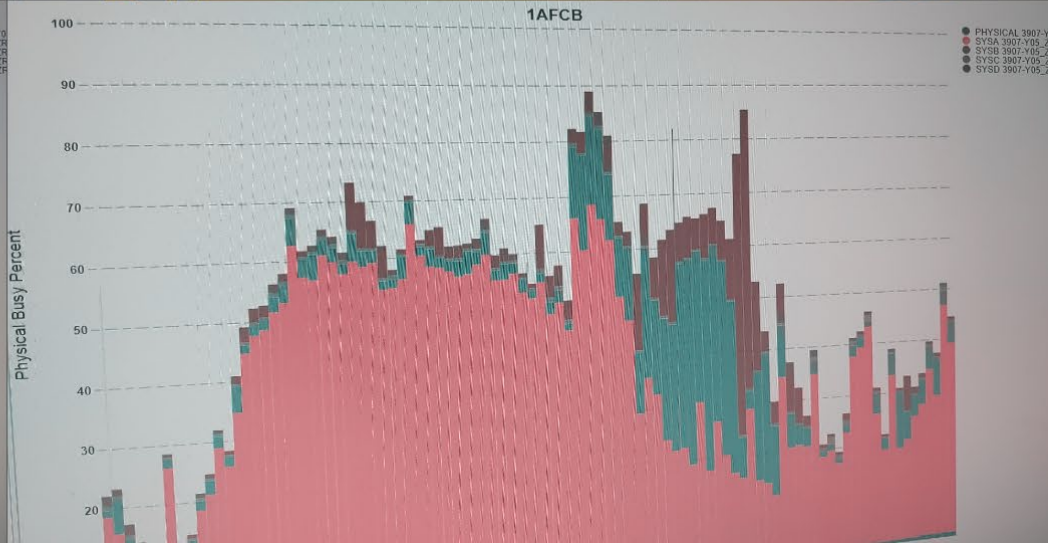
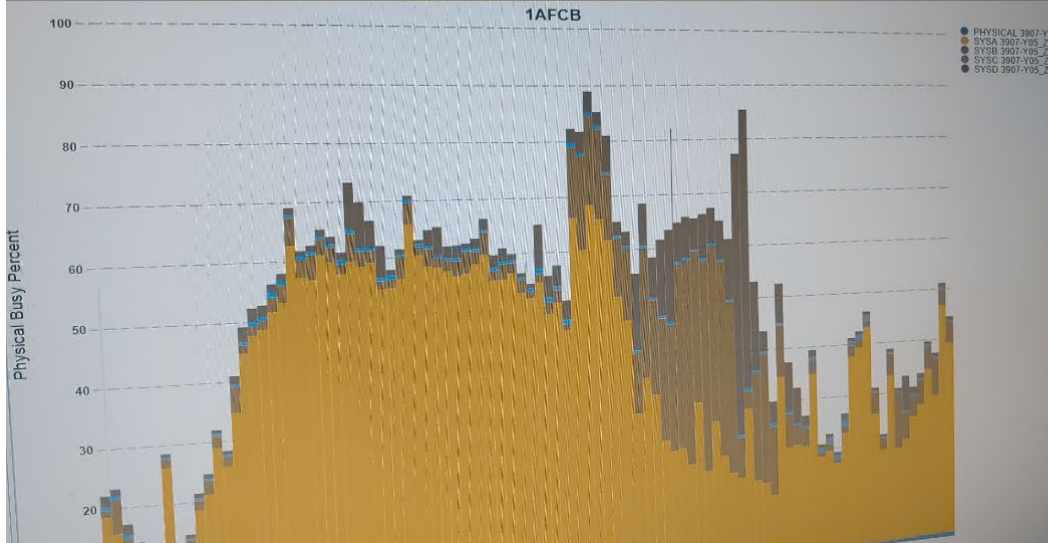


Chart is the majority of the space, making it easier to interpret the data

Pivotor Tries to Address Color Blindness



It's hard to find a perfect combination for everybody and every chart!



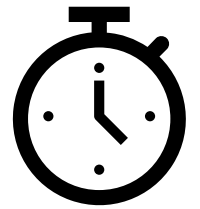
Feed your brain!

Data → Understanding

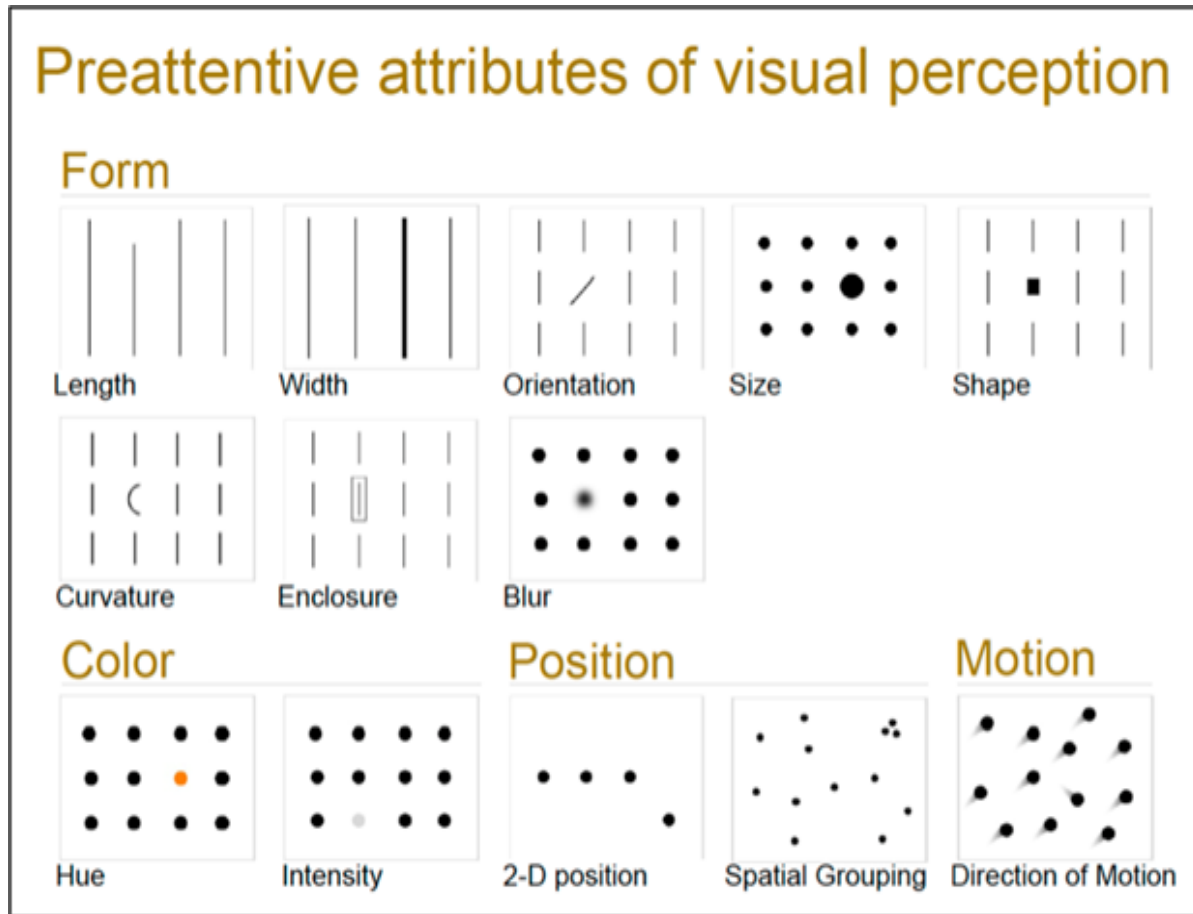
It takes “about 13 milliseconds for the brain to process an image”



- Visual representations can be better than text in a table since our brain can process visual communication easily and quicker → seeing is handled by visual cortex
- Thinking/cognition is handled by cerebral cortex, slower, and requiring more conscious thinking
- Variations in neural activity due to gender, age, various diagnoses can lead to differences into the brain’s processing of speed, efficiency, colors, motion, fine detail, and more
- Emotions influence what certain statistics mean to us individually, how we are feeling when reviewing data, and subsequently how we respond to them
- Attention spans are changing, highlighting the importance for a quickly understood display of data and information



Pre-attentive vs. Attentive Processing



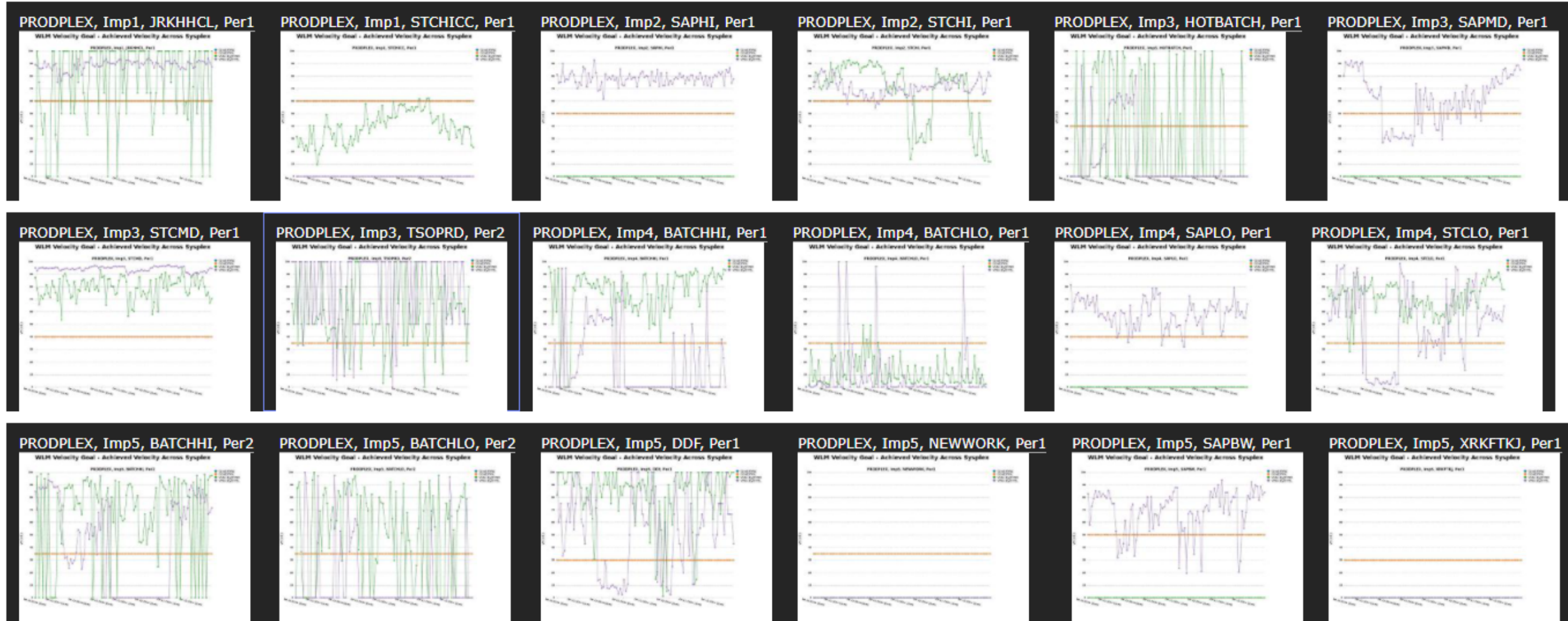
- Pre-attentive processing includes basic attributes and identifiers
- Attentive processing takes place once pre-attentive processing has been done (about 10 milliseconds), for more complete analysis, to show trends or patterns
- Quick processing = data visualizations are smart option

Dual Processing Theory

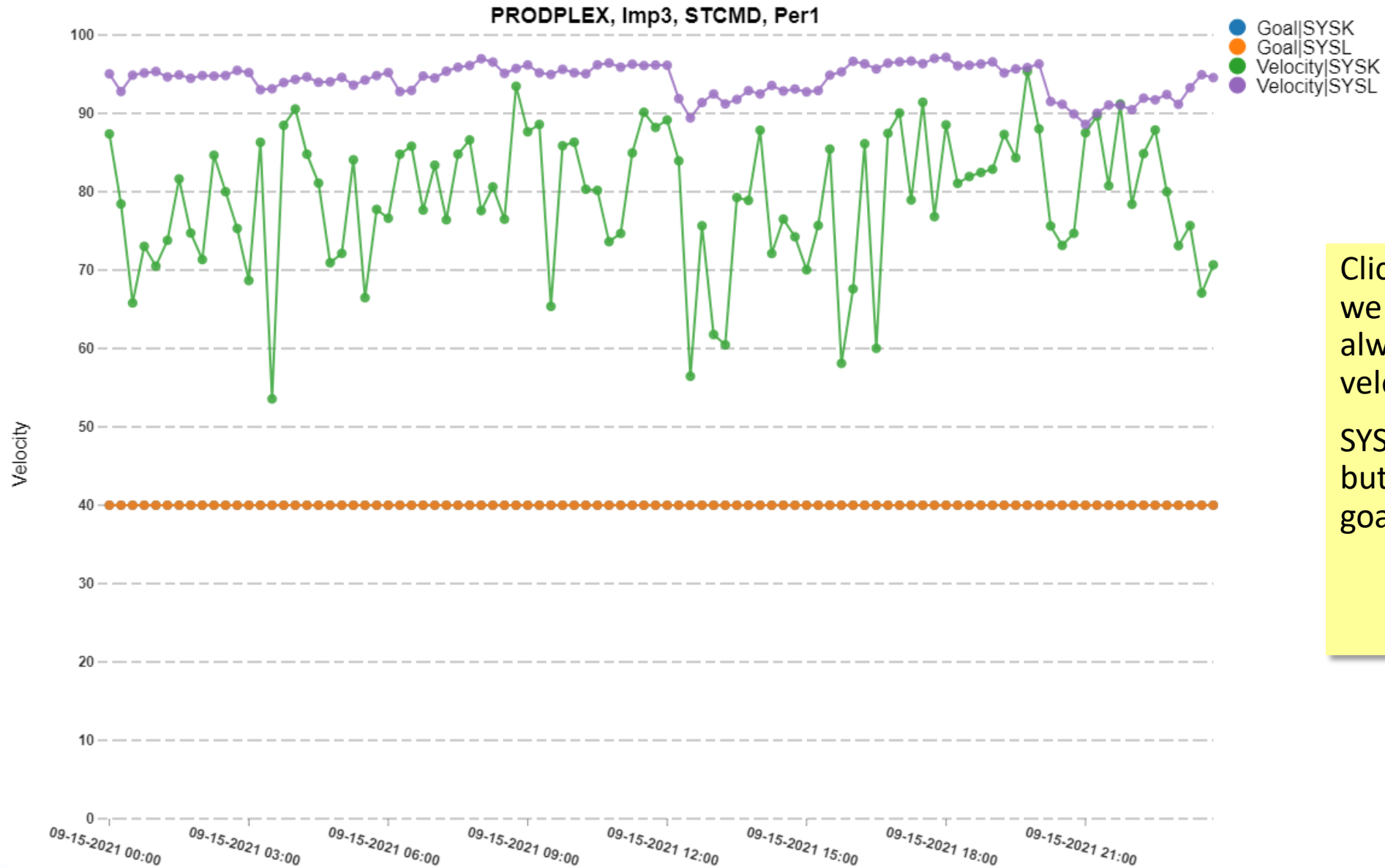


- Theory that thinking is categorized into 2 systems/types
 - System 1 – fast, instinctual, decision-making, autonomous
 - Often comes from emotions, visual processing, “immediate grasp of complex info”
 - System 2 – slow, rational, working memory, not autonomous, requires cognitive stimulation

WLM Velocity Goal - Achieved Velocity Across Sysplex



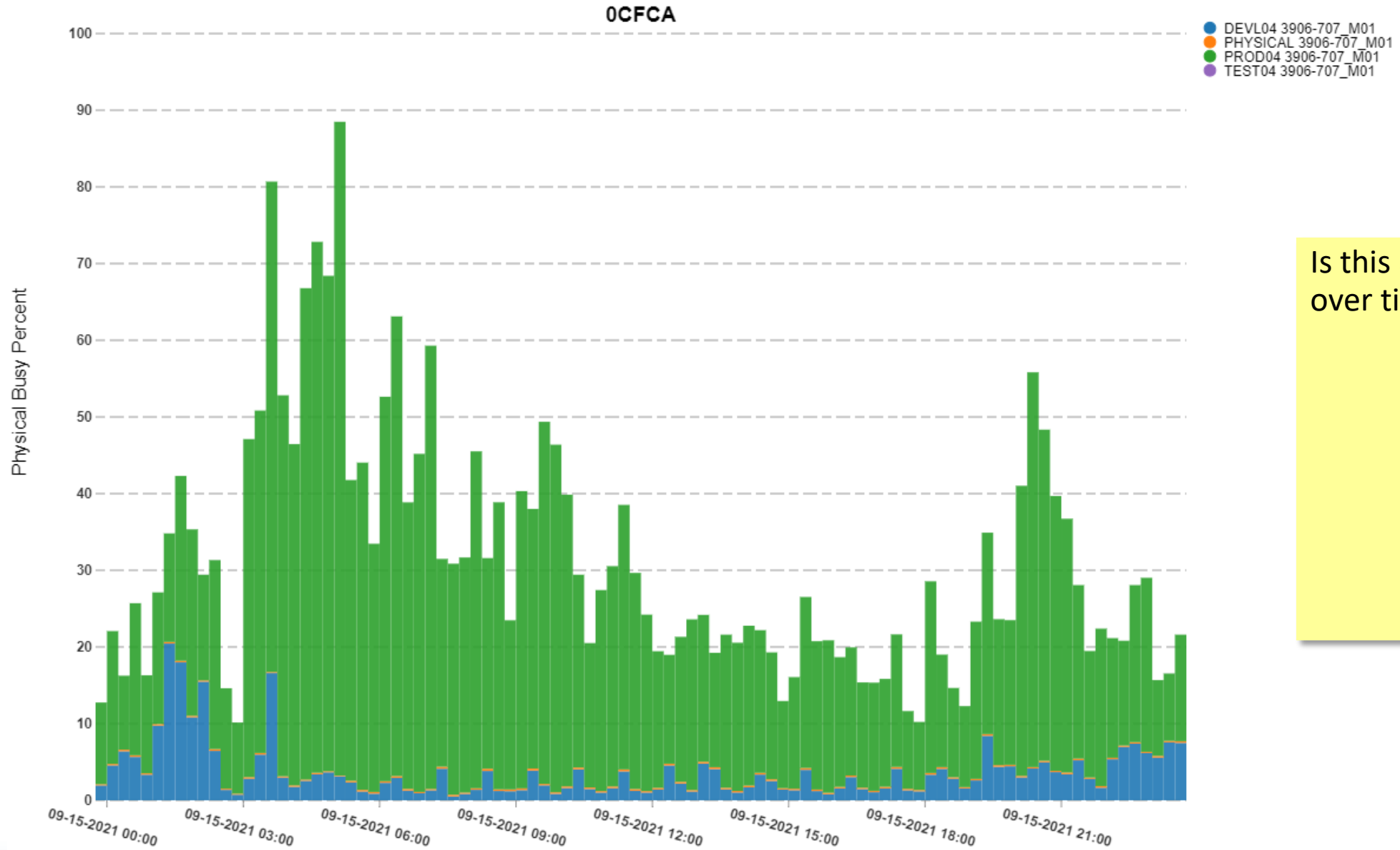
WLM Velocity Goal - Achieved Velocity Across Sysplex



Clicking into that chart we see that SYSL is always achieving a velocity above 90.

SYSK is more variable, but always above its goal.

CEC Physical Machine zIIP Busy%



Is this a common pattern over time?

Final Thoughts: SMF Visualization

This has been a different webinar...



- Normally we're sharing something interesting about z/OS performance
- Hopefully today you found something interesting about data visualization
- Data visualization is an important performance topic
 - We think a good bit about this when creating new Pivotor reports
 - Poor visualization choices can hide problems
- If you're a Pivotor customer maybe you understand why some Pivotor things are the way they are now
- If you're making your own charts, maybe we've given you some new things to think about
- And if you just wish you had good visualizations of your z/OS performance: maybe we should talk! 😊



Questions / Discussion?

Sources



- 1 - <https://medium.com/vizzuality-blog/making-impactful-visualisations-using-psychology-797a6f0807ea>
- 2 - <https://treehousetechgroup.com/the-psychology-behind-data-visualization/>
- 3 - <https://www.empiricaldata.org/dataladyblog/6-lessons-from-human-psychology-for-effective-data-visualization>
- 4 - <https://www.washington.edu/news/2018/08/16/men-and-women-show-surprising-differences-in-seeing-motion/>
- 5 - <https://www.nationalgeographic.com/culture/article/120907-men-women-see-differently-science-health-vision-sex>
- More: <https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/data-visualization-for-human-perception>
- <https://medium.com/nightingale/how-to-apply-gestalt-psychology-principles-in-data-visualization-6242f4f1a3de>
- <https://www.dundas.com/resources/blogs/introduction-to-business-intelligence/brief-history-data-visualization>