Review of JCGS-22-045

"Eye Fitting Straight Lines in the Modern Era"

by Emily A. Robinson, Reka Howard, and Susan VanderPlas

Summary:

The authors present a study where human participants had to fit
straight lines through points in a scatterplot. On average,
the participants' fitted lines closely matched a principal axis line
and not the least squares regression line.

Overall, the article is well written. I have a series of minor comments, though - see below.

Specific minor comments:

p.3, l.11 (& more): your spelling of "scatter-plot" with the hyphen is unconventional;
simply use without hyphen (that will also match the 3 occurrences in your references)

p.3, l.32: use past tense when referring to published past work, i.e., "focused" here
p.3, l.37: -> "Cleveland (1993) provided"
(& more)

p.3, l.32: "viewers ability" -> "viewers' ability"

p.3 or p.6, bottom: add some references from the late 1980s/early 1990s that are
related to the visual assessment of structural changes in time series visualizations;
this reference comes to mind first (although different sources cite it differently):
Unwin, A.R., and Wills, G. (1988) “Eyeballing Time Series,” in Proceedings of the
1988 ASA Statistical Computing Section, 263-268.
A google scholar search for
"Eyeballing Time Series"
results in a few related references.

p.4, l.26 (& more): use consistent capitalization here:
"Wilkinson’s Grammar of Graphics (Wilkinson 2013). The grammar of graphics";
I would always capitalize it as "Grammar of Graphics" as a proper name

p.6, l.42: use single quotes for `You Draw It` as in the abstract

p.7, top: be specific and indicate in which of the sections of your paper

each of these points is being addressed, in other words, provide a specific overview what can be found in Sections 2 - 5 of your paper (and also mention the supplementaty materials in 1 or 2 sentences)

p.7, l.34: you had 35 participants and got 119 plots; later (p.10, l.38) you state that each particpant had to evaluate 4 plots; provide this information here immediately; can you summarize why there are 21 plots missing, e.g., some plots were incomplete, some participants were dropping out after just 1 or 2 plots, etc.

p.7, l.51 & p.17, l.27 & l.32: "here" is meaningless for printed materials; list the full URLs (but still make them clickable)

p.8, l43: provide reference for the r2d3 R package

p.8, l.53: "R statistical software" -> "R software environment for statistical computing and graphics" (based on https://www.r-project.org/); also add the typical reference for R

p.8, l.55: "i = 1, ...N" -> "i = 1, ..., N,"

p.9, top: y_x-bar in Table 1 and beta_0 in (1) are not properly defined / used; are they the same?

p.9, l.25-37: can you further describe these four models with some more details and extend the table, e.g., list the domains in the table as well (and not only in the text); also indicate how many points were used in each scatterplot (e.g., was this random or fixed?; plot V in Fig 2 seems to have much fewer points than the other three); do the 4 letters have a certain meaning?

p.10, l.38-39: I suppose each participant got one plot of type S, F, V, N ? - say so

p.10-p.11: use PCA or PC and then use these consistently; if "principal axis" is the full term, I would even use PA as abbreviation as PCA is a widely used abbreviation for principal component analysis and could confuse readers here; if you switch to PA, also adjust the main text below

p.11, l.35 & l.48: be consistent, e.g., "increment" vs. "increments" and missing specification of k in the 2nd part

p.12, l.50: it is not clear to me what you mean by "constraining the fit to a linear trend", even after reading the following part; provide some additional explanations

p.13, l.26: keep the same order of F, S, V, N as before, i.e., S F V N from Table 1 to avoid confusing the reader

p.14, Fig 5: this uses even another order (F N S V); stay with the same order (S F V N from Table 1)
in all consecutive models and figures to avoid confusing the reader
(same for Fig. 6)

p.14, l.28: use one single Wood reference for the R package and the most important one that describes the method; leave out the three other Wood references here

p.14, bottom - p.15, top: this model is very similar to the previous one; simply state y_i,j,k,drawn etc. are the same as for model (2) and only specify what is new/different here, e.g., the s_i

p.16, Discussion:
Add some references from cognitive/human movement sciences that human arm movement is a complex task.
Drawing a straight line is not as easy as it sounds. Could this lead to the large residuals when x approaches 20 ?!? Here are some candidate articles (based on the abstracts). Do some further reading and find additional related references.
https://doi.org/10.1007/BF00241501
https://doi.org/10.1145/2820619.2820633

p.17, Future work: I worked through the 12 plots at
https://emily-robinson.shinyapps.io/you-draw-it-validation-applet/
and had considerable problems to draw a straight line with a mouse, even when I intended to do so. Similarly, I fail in the classroom when I try to add a regression line to points sketched out on a blackboard. My best solution is to visually estimate the point of means (x-bar, y-bar), use a long ruler, and rotate it so that it goes through the point of means and most of the points in the scatterplot.

This leads to a modified version of this study:
Give the participants a horizontal line segment at the bottom of the graph and let them shift and rotate this line segement until they think they have found the best fit for the point cloud. This likely would remove some of the big errors we see in Figs 5 & 6 as x approaches 20.

A second option for future work that goes beyond Mosteller et al. (1981) is to create scatterplots with one (or multiple) extreme outliers. What would humans fit then? Still, the PCA line or rather a robst regression line that ignores the outliers (likely not the OLS line that may be totally off from a line that goes through most of the data). [Apparently, this will also depend on the instructions and the feedback that is provided in the training part of such a study.]

Neither of these has to be implemented in the current study, but listing

both options as natural extensions for the straight line assessment
seems to be worthwhile.

p.17-21, References:
- capitalize journal names, e.g., Psychological bulletin & IEEE transactions
  on visualization and computer graphics
- capitalize proper names, e.g., in obama's presidency
- for books, include the city/state or city/country, e.g., in Cleveland (1993)
- Deming (1943) is incomplete (is this a book or a journal article?)
- in Kosslyn & Kosslyn, spell out OUP (and indicate the city/state and not USA)
- check capitalization of nouns; if I am not mistaken, JCGS uses upper case letters for all nouns
[some of these apply to other references as well]