
Issue #10 (closed): [REVIEW] [Accessibility] Gatherplots review

@domoritz on Sep 04, 2023 21:33: [opened]

@domoritz on Sep 04, 2023 21:33:

Perceivable

- [x] Contrast of all text and elements is sufficient. Geometries and large text must hav contrast against background. Regular text must have >4.5:1.
- [ ] Content has non-visual alternatives. All figures have alt text and videos have tran Equations are screen reader accessible.
- [ ] Font sizes for all texts are sufficiently large. Text must not be smaller than 9pt/12p Ideally only minor text is rendered at 9pt (e.g., axis labels) while all other text is larg
- [ ] The article works even if I could not perceive colors. Color should never be used a communicate meaning.
- [ ] The article can be navigated comfortably with a screen reader. There are no unne accessibility elements (e.g., axis ticks and labels) that clutter the screen reader exper

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Screen reader

- [x] VoiceOver on macOS
- [ ] VoiceOver on iOS
- [ ] NVDA on Windows
- [ ] JAWS on Windows
- [ ] Not tested with a screen reader (explain below why not)

Browser

- [x] Safari or other WebKit-based browser
- [ ] Chrome or other Chromium-based browser
- [ ] Firefox

Comments on Perceivable

All images should have alt texts that describe the content.

The font sizes of the figures is too small, especially on mobile. You can also consider maki figures responsive and change the layout (e.g. horizontal to vertical arrangement of chart the screen width changes.

> **Demonstration**
>
> Beyond the embedded demonstration in this article, you can also find a live demo of Gatherplots at https://gatherplot.firebaseapp.com/.

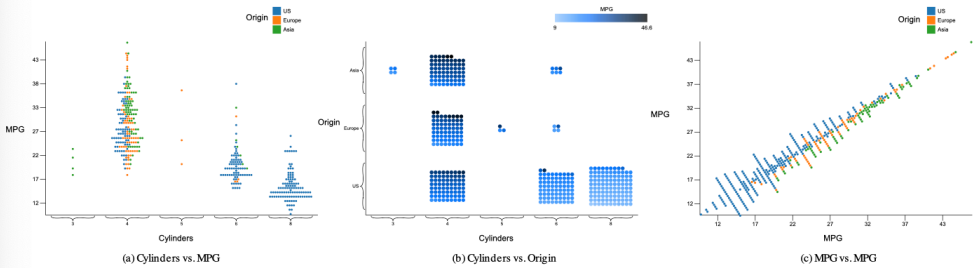
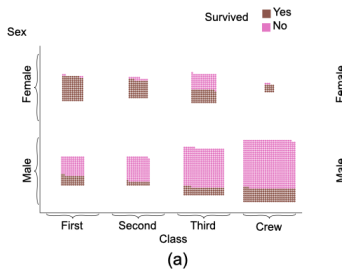


Figure 1: **Cars dataset.** Gatherplots showing a dataset related to cars, yielding overplotting in normal scatterplots. The gatherplot in (a) shows Cylinders (categorical) vs. MPG (continuous), highlighting the overall distribution of MPG values of cars with different cylinders. The brackets on the X-axis are used to indicate that the interval within the brackets represent the same value in the data. The gatherplot in (b) shows `Cylinders`

Right now, a lot of the figures rely on being able to differentiate colors. Try using differen in addition to color. For example, in figure 4a, you could use different shapes for survived survived.



I noticed that the tooltips for references open when the VO cursor is over a reference and cursor goes into the tooltip. It clutters the VO experience so it feels like it should be differ @cscheid for Quarto

5 Evaluation

This study was designed to demonstrate the effectiveness of gatherplots, in particular its different layout modes with categorical vs. categorical variables. Crowdsourcing platforms have been widely used and have shown to be reliable platforms for evaluation studies [Paolacci, Chandler, and Ipeirotis (2010); Willett et al. (2013)]. Therefore, we conducted our experiment on Amazon Mechanic

Paolacci, Gabriele, Je
Experiments on An
5 (5): 411–19. https

Willett, Wesley, Shiry Ginosar, Avital Steinitz, Björn Hartmann, and Maneesh Agrawala. 2013. "Identifying Redundancy and Exposing Provenance in Crowdsourced Data Analysis." *IEEE Transactions on Visualization and Computer Graphics* 19 (12): 2198–2206. https://doi.org/10.1109/TVCG.2013.164.

general p
the study

Experimental Desig

Operable

- ☑ If there are interactive elements in the article, they can be operated with a keybo
- ☑ If there are interactive elements in the article, there are textual instructions for h them.
- ☑ When navigating over the article with a keyboard, the focus indicator is always v
- ☑ Interactions that work with a mouse also work on a touch screen.

Comments on Operable

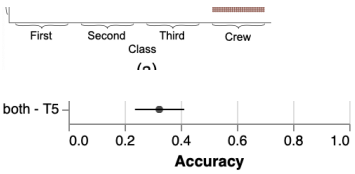
No interactive elements and focus seem to work as expected.

Understandable

- [x] All charts have a title and a description.
- [x] Changes in animated or interactive elements are easy to follow.
- [x] All axes have clear labels (either explicit or implicitly given the context).
- [x] There are legends for all charts that need them.

Comments on Understandable

The visual hierarchy of axis labels and axis titles could be improved. For example, increa font size of titles or make them bold. Some charts already use this style.



Robust

- [x] All buttons use the `button` tag.
- [x] Headings, paragraphs, and figures are tagged correctly.

Comments on Robust

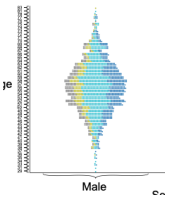
All good.

Assistive

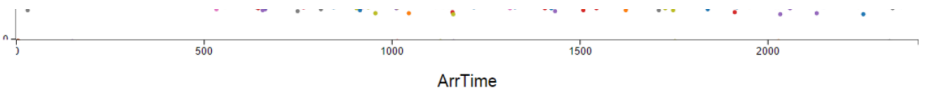
- [ ] The data density of all charts is appropriate. Use clustering or other data reductio techniques if elements compete for space but explain the method.
- [x] Navigation and interaction feels intuitive with all interaction methods (mouse, ke touch).
- [x] All visually apparent features and relationships are described.
- [ ] Formatting makes values human-readable. Use , or space to separate thousands. A numbers to the right. Use the smallest, appropriate number of significant digits.

Comments on Assistive

The density of labels is too high in some cases and the marks are very densely packed.



The formatting of some numbers could be improved.



Flexible

- ☐ The article is readable on a phone.
- ☑ The article can be zoomed and font-sizes change appropriately. The layout of the
not break when zooming in or changing the font size (e.g., using CMD + or CMD - on
- ☑ Long animations (if they exist) can be paused or stopped. Animations should be v
GIFs as they cannot be paused.
- ☐ Style and charts use a consistent and familiar design (fonts, colors, etc). Interactic
defaults should be consistent for all interactive elements.

Comments on Flexible

As mentioned before, the font sizes in figures are too small on phones.

I found it somewhat difficult to follow some of the charts because they use very different
styles (fonts, colors, font sizes, etc). This probably happened because the charts use differ
libraries. It would be good to use one familiar style. This would greatly improve understa

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ORCID

0000-0002-3110-1053

@domoritz on Sep 04, 2023 21:33:

[referenced from #Accessibility Review]

@cscheid on Sep 11, 2023 18:18:

thanks for the ping, @domoritz. I'll open a quarto issue to track.

@mjskay on Sep 12, 2023 00:12:

Thanks for this @domoritz!

I have some questions about some of the criteria and how we can make them work well.
@frankelavsky too since I think his opinion would be valuable.

My first thought is: it would be helpful to have a sense of what is critical or not. Perhaps a
distinction between "minimum requirements" versus "nice to have". Then we could give
rating like "F (fail) / B (pass) / A / A+" or something like that in an infobox at the top of the
When I look at Chartability, I see some issues listed as "critical", maybe that's a starting p
establishing such levels?

Some other thoughts:

- This criterion strikes me as too strict: *The article works even if I could not perceive co
should never be used alone to communicate meaning.*

  This is a difficult criterion to have in a visualization journal, and when I look at Char
  is not listed as "critical" and comes with this qualification:

  > While this standard is very difficult for the field of data visualization to wrestle
  > there is also little research that explores effective strategies.

  It is a little difficult to say "solve this problem in your paper, but we don't know how'

imagine a number of cases where this criterion will difficult or impossible to be fulfi research on color, complex visualizations of multivariate data where other channels out, etc). I agree it is worth striving for, and for the paper at hand is probably easier than some others, but given the lack of existing good solutions it is a high bar to ask authors. Perhaps we can soften the language and/or make it a non-critical criterion (Chartability).

- I wonder about this comment:

  > The font sizes of the figures is too small, especially on mobile. You can also cons making the figures responsive and change the layout (e.g. horizontal to vertical arrangement of charts) when the screen width changes.

  Totally agree about desktop fonts being too small in several figures. I'm wondering w general advice we can give for folks on mobile --- responsive visualization will be ha impossible in many cases (e.g., screenshots of desktop VA systems, or people generat from static vis tools). For folks using static vis tools, it would be cool if there was a qu solution where they could provide alternate plots for the same chunk that could be s responsively (@cscheid?). However, I am wary of placing strict requirements that pe responsive vis tools, since the vast majority of such tools can't do that. So I also wond softer version of this criteria would be considered satisfied if the vis is readable on d and at least zoomable on mobile, even if not responsive?

- Lastly, because the description text is stripped when the review is generated, the hel to the Chartability sections visible on the review form are not available to authors to information. Maybe we could add links to the corresponding information in Chartab each checkbox item?

Thanks again for all of this!

@cscheid on Sep 12, 2023 02:50:

> For folks using static vis tools, it would be cool if there was a quarto solution where t could provide alternate plots for the same chunk that could be selected responsively (@cscheid?)

We'd love to do this, but it'll be a while until we can get a design going. There's a 1.4 featu lets you do something almost like what you want, but it would take multiple renders to g different outputs (specifically, you can now use https://quarto.org/docs/authoring/conditio with checks for arbitrary metadata key-value pairs). Do note, critically, that this is not *res* But I'd love to figure out a solution for you folks.

@nickelm on Feb 27, 2024 23:41:

I have just pushed changes addressing this accessibility review: https://github.com/journalovi/2023-park-gatherplots/issues/6. Here follows the revision response itself. Pleas know if some other format is expected for this!

> All images should have alt texts that describe the content.

I have improved the alt-text for all of the images in the article.

> The font sizes of the figures is too small, especially on mobile. You can also consider making the figures responsive and change the layout (e.g. horizontal to vertical arrangement of charts) when the screen width changes.

I have tried to make the images responsive by turning on the `fig-responsive` setting in format as well as splitting compound images into component pieces so that they can be b displayed on mobile.

However, I have chosen **not** to modify images drawn from the Gatherplot implementatio means that some of the labels, such as in Figure 1, are kept in their original size. Given th interactive article is primarily intended to be viewed online, it should be possible to see i full size.

> Right now, a lot of the figures rely on being able to differentiate colors. Try using different shapes in addition to color. For example, in figure 4a, you could use differe shapes for survived and not survived.

While I appreciate this feedback, this functionality would require modifying the visualiza is thus not part of any of the Gatherplot implementations. I leave such features for future

> The visual hierarchy of axis labels and axis titles could be improved. For example, increase the font size of titles or make them bold. Some charts already use this style.

As discussed above, I have chosen to not modify the original images from our Gatherplot implementation.

> The density of labels is too high in some cases and the marks are very densely packe

See above; we have chosen not to edit the visualization images but rather to make them l

> As mentioned before, the font sizes in figures are too small on phones.

I have tried to address font sizes to the extent possible.

> I found it somewhat difficult to follow some of the charts because they use very diffe visual styles (fonts, colors, font sizes, etc). This probably happened because the chart different libraries. It would be good to use one familiar style. This would greatly imp understandability.

This is a fair point. Unfortunately, we are presenting results from both our old Gatherplo implementation (no longer accessible), Observable Plot, and our own new Gatherplot implementation. They all provide slightly different functionality that I want to demonstra article.

I hope I have addressed all of the concerns, but I am happy to iterate on any issues that st persist.

@domoritz on Feb 29, 2024 17:41:

Thanks for the updates. These are great and I agree that it doesn't make sense to change t figures for the old implementation.

I found three issues that need to be fixed.

First, the issue with tooltips @cscheid commented on in https://github.com/journalovi/202 gatherplots/issues/10#issuecomment-1675190237 still exists and it making it almost impo navigate the document with a screen reader. This needs to be fixed in quarto but until it i suggest disabling tooltips for references.

Second, it's great that you broke up the images but the threshold for wrapping should be Can you set a minimum image size? See how the images get super small on a narrow scre

Data Collection

We conducted a crowdsourced user study on Amazon Mechanical Turk involving participants drawn from the general population. We collected completion time, accuracy, and confidence for five different retrieval, ranking, and comparison tasks under four conditions: scatterplots with jittering, gatherplots with absolute mode, gatherplots with normalized mode, and gatherplots with a toggle to switch between absolute and normalized mode.

Data Analysis

Data collected from the crowdsourced survey were analyzed with respect to the accuracy (correct or incorrect), time spent, and confidence of estimation. Based on our hypotheses, we analyzed the different modes of layout for each type of question: retrieve value, absolute value task, and relative value task.

Analysis Results

Gatherplots outperform jittering for accuracy as well as for the subjective confidence measure.

Implementation

We implemented a web-based demonstration of Gatherplots using D3 and Firebase, as well as using Observable JS in this article.

Demonstration

Beyond the embedded demonstration in this article, you can also find a live demo of Gatherplots at https://gatherplot.firebaseapp.com/.

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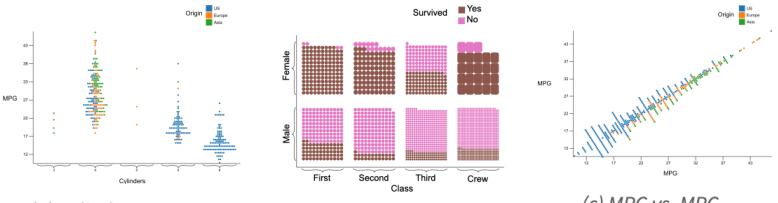

(a) Cylinders vs. MPG. (b) Cylinders vs. Origin. (c) MPG vs. MPG.

Figure 1: **Cars dataset.** Gatherplots showing a dataset related to cars, yielding overplotting in normal scatterplots. The gatherplot in 1 (a) shows Cylinders (categorical) vs. MPG (continuous), highlighting the overall distribution of MPG values of cars with different cylinders. The brackets on the X-axis are used to indicate that the interval within the brackets represent the same value in the data. The gatherplot in 1 (b) shows `Cylinders` (categorical) vs. `Origin` (categorical), partitioning the graphical axes into intervals and packing points into groups for each interval. In 1 (c), both X-axis and Y-axis show the same continuous variable (MPG). All these cases would have caused overplotting for a scatterplot, resulting in dot-shaped or line-shaped point patterns where individual points cannot be identified.

1 Introduction

Scatterplots—one of the most common types of statistical graphics [Cleveland and McGill (1988); Elmqvist, Dragicevic, and Fekete (2008); Utts (1996)]—are often used to visualize two continuous variables using visual marks mapped to a two-dimensional Cartesian space, where the color, size, and shape of the marks can represent additional dimensions. It can also be used for exploring multidimensional datasets in the form of scatterplot matrices (SPLOM), where all the possible combinations of axes are presented in table form. However, scatterplots are so-called *overlapping visualizations* [Fekete and Plaisant (2002)] in that the visual marks representing individual

Lastly, the screen reader experience for the plot charts is too noisy. Try navigating the do and you will find that all tick marks are navigated. Axes should be described in one AX el per axis or skipped and described in the description. Also, each mark in the scatterplot b

own accessibility element. It's probably best to group them so that one can skip over the g
reduce noise. See the last comment in the perceivable block at the top: "The article can be
navigated comfortably with a screen reader. There are no unnecessary accessibility elem
axis ticks and labels) that clutter the screen reader experience."

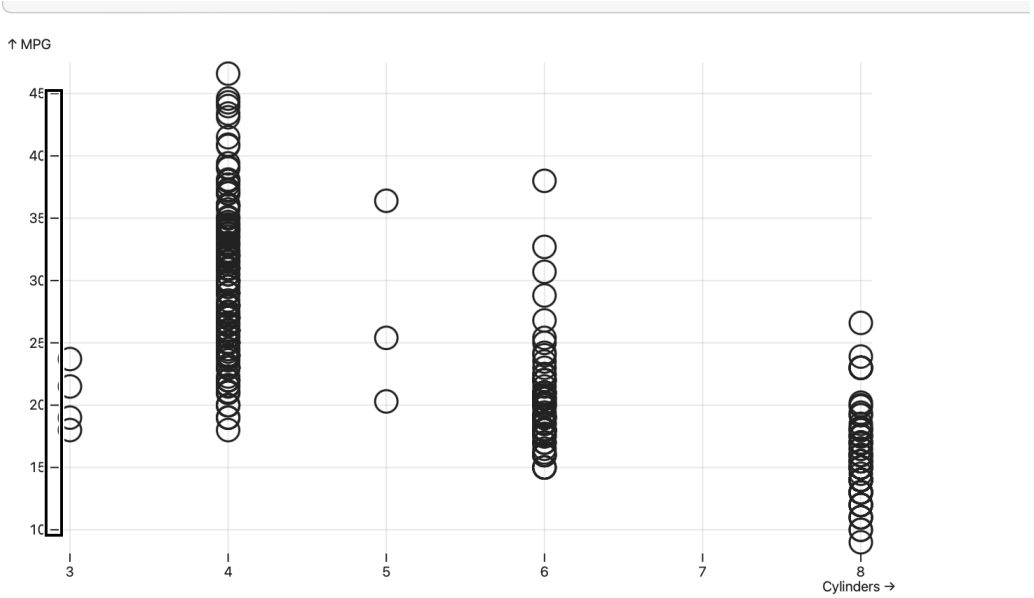

Figure 2: **Scatterplot problems.** Interactive scatterplot visualizing a car dataset with one continuous variable `MPG` a
categorical variable `Cylinders` showing limitations of scatterplots when plotting categorical variables on one or b

@cscheid on Feb 29, 2024 17:44:

> First, the issue with tooltips @cscheid commented on in https://github.com/journalovi/2023-park-gatherplots/issues/10#issuecomment-1675190237 still exists an making it almost impossible to navigate the document with a screen reader.

Can we have a followup about this at https://github.com/quarto-dev/quarto-cli/issues/650

@nickelm on Mar 25, 2024 08:22:

> Thanks for the updates. These are great and I agree that it doesn't make sense to cha the figures for the old implementation. I found three issues that need to be fixed.
>
> First, the issue with tooltips @cscheid commented on in #10 (comment) still exists ar making it almost impossible to navigate the document with a screen reader. This nee be fixed in quarto but until it is, I would suggest disabling tooltips for references.

I have disabled the tooltips for now. For the record, this is done by adding the following o the HTML format block:

```
citations-hover: false footnotes-hover: false crossrefs-hover: false
```

> Second, it's great that you broke up the images but the threshold for wrapping shoul lower. Can you set a minimum image size? See how the images get super small on a narrow screen.

There seems to be no easy way to do this and maintain responsiveness. For now, I have a min-width in a CSS class (.accessible-fig), but the responsive behavior no longer works. P how to achieve this are welcome, but at least the new version is easier to read.

The results in Figure 12 and 13 are still in three-column format, but if need be I can chan well.

> Lastly, the screen reader experience for the plot charts is too noisy. Try navigating th document and you will find that all tick marks are navigated. Axes should be descrik in one AX element per axis or skipped and described in the description. Also, each m in the scatterplot becomes its own accessibility element. It's probably best to group t so that one can skip over the group to reduce noise. See the last comment in the

> perceivable block at the top: "The article can be navigated comfortably with a screer reader. There are no unnecessary accessibility elements (e.g., axis ticks and labels) th clutter the screen reader experience."

Understood. This is an Observable Plot chart, however. I don't know how to change this sl reimplementing the scatterplot myself.

@domoritz on Apr 12, 2024 14:15:

> There seems to be no easy way to do this and maintain responsiveness. For now, I ha added a min-width in a CSS class (.accessible-fig), but the responsive behavior no lon works. Pointers on how to achieve this are welcome, but at least the new version is e to read.

I would suggest using css grid and change the number of columns based on the page widt a media query). Alternatively, you could use fixed width images so that the number of col changes based on the width as well.

> Understood. This is an Observable Plot chart, however. I don't know how to change t short of reimplementing the scatterplot myself.

Then I would say that we better hide the ax elements here and just rely on alt text until o plot improves.

@domoritz on Apr 12, 2024 14:51:

I sent a pull request to improve plot to generate better aria values for axes by default: htt github.com/observablehq/plot/pull/2018. You should still add custom aria for marks since doesn't do that automatically yet.

@mjskay on Apr 13, 2024 17:58:

Is there a simple solution here that doesn't require hacks around what quarto / observabl doing? I'd rather not require authors to implement a bunch of hacks around the systems using, as that adds a lot of additional burden on the author side. It seems like wasted effo spend a lot of time on hacks around accessibility issues that are likely to eventually be fix upstream --- since once they are fixed, we can just recompile the paper here.

To me this suggests not dropping down to custom CSS / HTML / etc to fix this, but to ask w reasonable short term fixes within the bounds of quarto / observable in expectation that this will be solved upstream in observable plot and/or quarto (which both seem receptive fixes?).

@mjskay on Apr 13, 2024 18:01:

(FWIW, Dom, I really appreciate the work you're doing to push us to be better --- I just wa balance that against author burden in expectation of upstream changes. Since we're not a traditional there-is-exactly-one-canonical-version-of-a-paper journal, getting it right here one-shot deal, but a process.)

@mjskay on Apr 13, 2024 18:06:

[referenced from #Import accessibility fixes back to the template]

@cscheid on Apr 13, 2024 18:40:

@mjskay It's also possible that whatever short term fixes we adopt over time can be inco to the Quarto template. (See the tooltip disabling above for a concrete case)

@mjskay on Apr 13, 2024 20:26:

@cscheid definitely! We can collect those changes here: https://github.com/journalovi/jov template-quarto/issues/12

@domoritz on Apr 13, 2024 21:41:

Absolutely. I think my fix that landed way faster than I expected is already good enough. we keep updating observable plot I think what we have now is good enough.

Hopefully I can make time to look into automatic aria descriptions for marks (similar to v already have out of the box in Vega-Lite) for Plot at some point as well.

I think that's what I love about living documents in e.g. jovi. We can make these improver the library levels and all documents that use the libraries can be updates to use the impr

@domoritz on Apr 13, 2024 21:42:

I think that concludes the review for this paper. I'll close the issue. Thanks everyone for t suggestions, comments, and making changes!

@domoritz on Apr 13, 2024 21:42:

[closed]

@mjskay on Apr 13, 2024 21:45:

awesome, thanks so much @domoritz!
