
1.1 main point of the paper as the authors see it. Erika
The key point of the paper is the confirmation of what we are already intuitively aware of: that changing the angle of display, affects our ability to accurately perceive data. In other words, it is easier to see the big picture from above than at the same level. They add to this confirmation by quantifying the error, and determining which visualization techniques are better suited for oblique table views (as compared with vertical angles). (ie. Choose length and angle over area and slope; position is up/down/lateral distance dependent...)

As a further note, switching between display angles for judging differences (ie. mixed displays: vert & hori) was not as error prone as only using flat tabletop displays. (Possibly surprising, given comparing across different angles of orientation). As such, it can be used as a mitigation technique when not limited to a horizontal display.

Additionally, the author hypothesized mitigation techniques for displaying data, backing them up with evidence from their results, but did not present explicit experimental evidence. (eg. choose bar graphs over line graphs or point plots; include referencing contextual data, such as the lines behind the data).

1.2 main point of the paper as you as a reader see it. Nicole
- Some critics

  - I personally had difficulties understanding the experiment setup (I had to go after Cleveland & McGill reference to understand it better). Also, there are minor details that you have to assume, because they are not explicitly stated. I'd love to see an example on how did the subjects evaluate some variable.

  - The validity of the experiments could be questioned: 12 participants evaluating with 4 variables each, makes 6 users for each variable. With this little, the 'perception intelligence' of an individual may have a great effect on the results, which is noticeable by their large error variance.

- Some good points

  - One good thing that this paper brought to me, as a reader, was the insight of having to deal with perception issues on tabletop. It is something that is very obvious as soon as you realize it, but could be overlooked, because we have a
tendency for visually compensating it within our brain.

- This is one of those situations that, after reading the experiment results, you feel that it makes sense (and it is even a little too obvious). We wouldn't need an experiment to realize, for instance, that the perception of 'slope' will be off because of the perspective of the table. But it is useful that 'a priority/preference order' was suggested. It all depends on what additional visual cues are going to be useful to your application in the end, but it gives us a good idea on how we could start improving perception issues: when we detect that there are perception issues, but don't really know how we are supposed to fix them.

1.3 How this paper applies to moving this research forward and to our research – Mahmudul Hasan

- To attribute any of the findings of this paper to an underlying cause, we can come up with some hypotheses and set up further studies.
- Similar studies can be performed to evaluate viewers’ perception of graphical elements at multiple vertical display orientations, on very large displays, or on volumetric displays.
- The effects of rotation of the graphical elements around the axis perpendicular to the display surface could be an important addition to this study.
- A perception prediction model that takes into account all the variables related to display conditions would be very beneficial to the designers.
- We can evaluate how the viewing duration affects the accuracy of perception.

Whether providing additional contextual information would improve the perception of the graphical elements can be examined.

1.4 Notes: combine 1, 2, and 3 with comments from the class discussion and your thoughts. Carmen

Perception of Elementary Graphical Elements in Tabletop and Multi-surface Environments

Main point as author sees it:
-as a person changes angle, things become harder or easier to see

-quantifying what we can or canít see as angle changes

-experiments! Establish common things to look at.

-suggest choosing length and angle over area and slope

-position sometimes good, sometimes bad, depends on distance

-horizontal vs. Vertical look: just as many errors, if not fewer, in recognizing

-techniques for mitigating problem areas: line graphs, bar graphs, make it easier

Main point as reader sees it:

-difficulty understanding experiment setup. More details needed.

-large variance in experiment. Suspicious?

-more people, better results, perhaps
-people have tendency to compensate things in perception.

-how should we start correcting perspective?

Reader Perspective, how to continue:

-does every participant have equal ability to compare visual elements?

-should we keep track of the ability people have? Maybe another study

-suggestion from authors is opening up a new issue, raising questions

-we can come up with hypotheses from results, set up further studies. More research needed

-good to have quantitative account of userís perception

-not looking at speed. Previous research says ability only determines speed. Demographic is not relevant.

-perceptual research more than comsci

-ideas from psychology on perception, applying to tabletops, is beneficial

-controlled study, best choice.
-what is the application for this, still? Where is the serious need?

Three most interesting things:

Confirmed distortion in change of perspective.
Different visual elements have different errors
Lack of killer app, to prove concept.
Effect of changing proj geo on int of 3d orientation on tt

Perspective proj: A single proj point doesnít work for all viewing
Readerís take

Main thing from background section
In depth on issues in 3d on tables
Some good suggestions, not concrete guidelines
How does it relate to research?

Most impactful of the three
Multiple users on a table gets it wrong if the projection is not right
It was helpful how they choose the setup so that everyone had a good view
Background was helpful for people without graphics background
It proposed an open problem for other setups that can provide more insight than the examples.

Discussion

Parallel projection is not the ultimate solution, it may be a good one.

It might not always be desired that everyone in the group needs similar view, someone might need a better view.

Problem with split area is, it leaves little space for the group.

In collaborative situation, splitting the view makes it more like distributed.

It can be a little difficult to keep everyone on the same loop with split areas.

How do people work together? Working simultaneously or integrating from time to time?

Example where 3d on table may be useful.

Architecture

Surgical practices

Engineering

Games

Modeling

Any part of the biological system can be modeled.

Apart from the one presented, three other experiments resulted in a better perception with a neutral projection point.

Another study may unfold if the effects of projection/perspective is same or different when there is a context.

Thinking beyond existing technology, which kind of 3D can be used?

Augmented reality
It would be interesting if the augmented reality is above the surface instead of below the table.

The ability to grab and perform normal gesture requires 3D objects above the table.

3 main points

Projection matters when presenting 3D on tabletops

Usually parallel is better than perspective

Future studies can explore the impact of projection with context