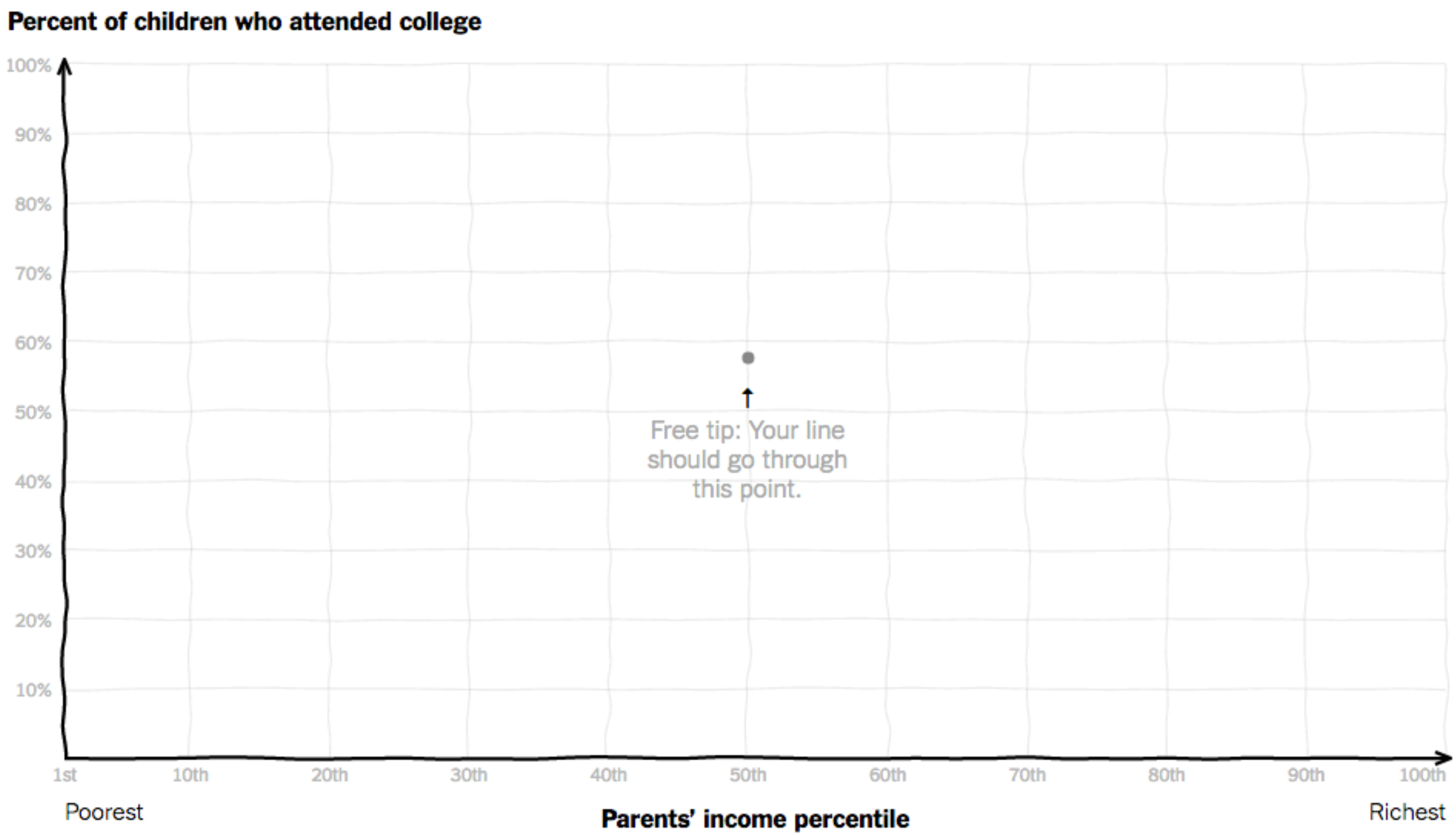
Expectation Visualization

Ian Wesley-Smith, Lovenoor Aulck, Yea-Seul Kim

“What if visualizations allowed people to draw their expectations of the data prior to viewing?”


Percent of children who attended college
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
Free tip: Your line should go through this point.
1st
10th
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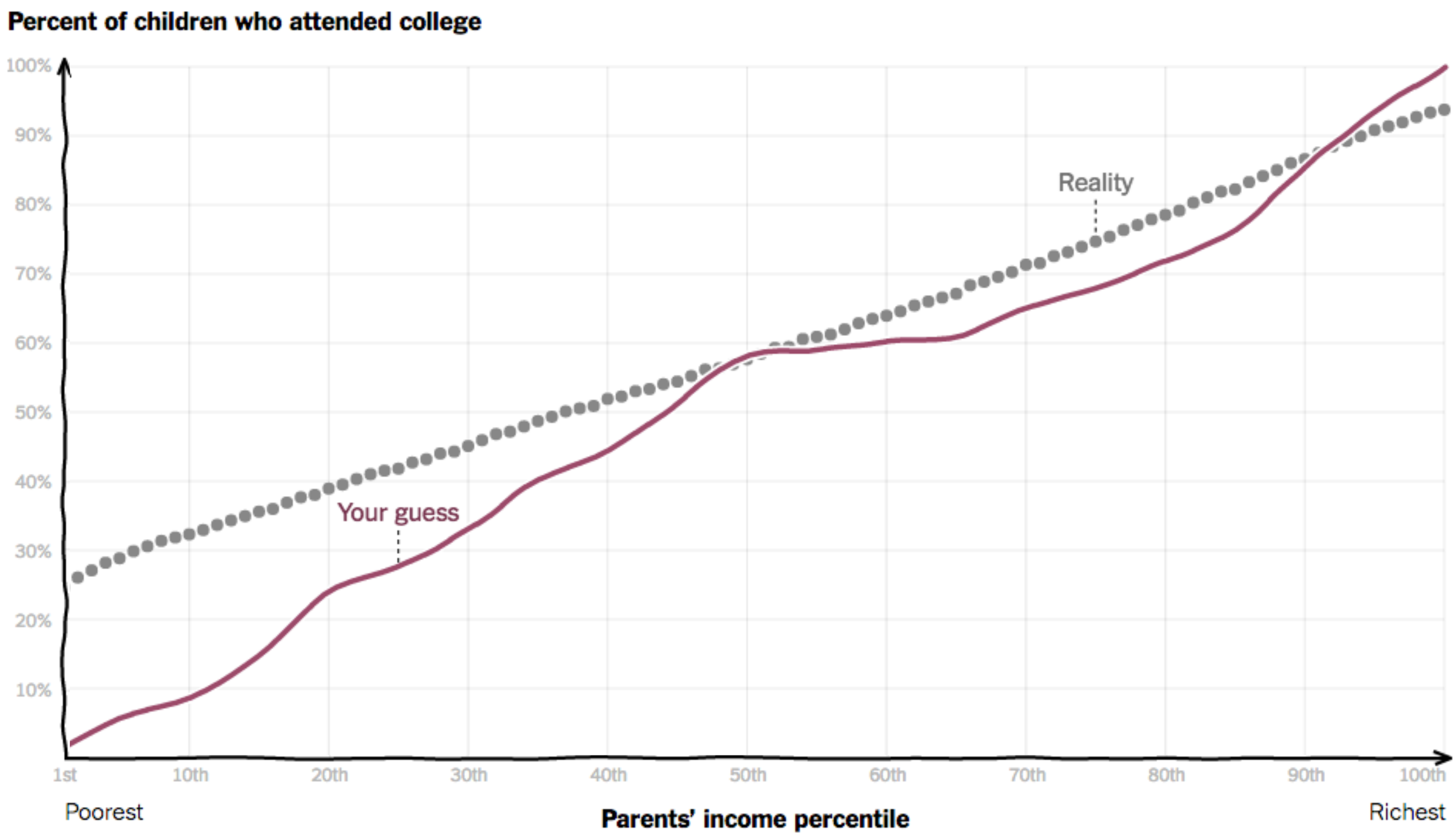
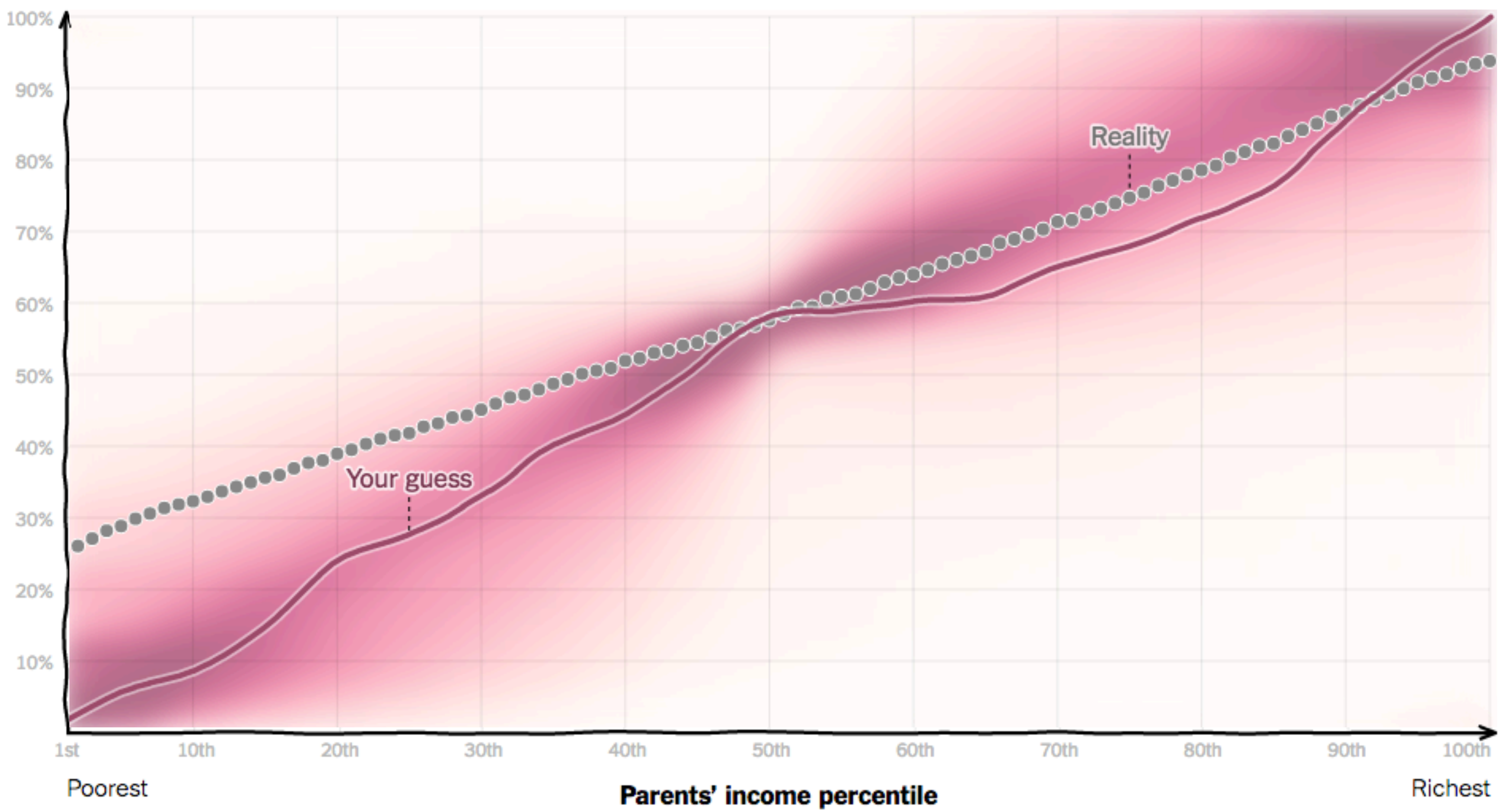
30th
40th
50th
60th
70th
80th
90th
100th
Poorest
Parents’ income percentile
Richest

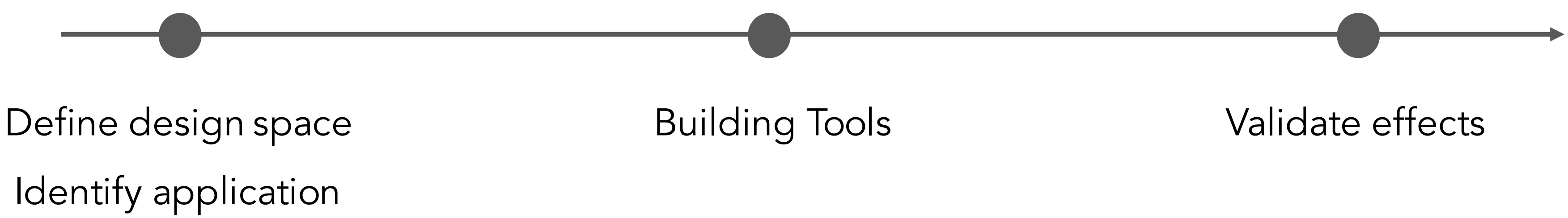


Percent of children who attended college
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
Reality
Your guess
1st
10th
20th
30th
40th
50th
60th
70th
80th
90th
100th
Poorest
Parents' income percentile
Richest

Percent of children who attended college



Process


Define design space
Identify application
Building Tools
Validate effects

User-driven Expectation Visualization: Opportunities for Personalized Feedback

Yea-Seul Kim and Jessica Hullman
University of Washington

Abstract

In this paper, we define and motivate Expectation Visualization, an interactive technique for soliciting, and presenting personalized feedback on, a user's expectation of the data. Expectation Visualization (EV) addresses the common challenge faced by designers of how to engage users with visualized data on a deeper level. We describe the design space of EV, including how it can be used for data encoded in marks and mark attributes, and describing forms of training and personalized feedback. We propose three specific applications where the benefits of EV may be particularly useful. We conclude with ideas for future research.

Keywords: Human-centered computing, Visualization, Information visualization.

1 Introduction

Traditionally interaction in visualization has been understood as user-driven manipulation of views of an existing data set: for example a user might select, sort, or filter a view [3]. Such interactions allow a user to generate views that are particularly relevant to him or her. As rich interactive visualizations become easier to author and more ubiquitous in media and other outlets, novel interactions, particularly those that make the data personally relevant to a user, are desired.

One form of "personalized" interaction that researchers have argued for is the manipulation by the user of internal (mental) representations as he or she makes sense of visualized data [10]. Relating an external visualization to one's internal representation, or mental model, can lead to better comprehension of gaps in one's knowledge [4][13]. For example mentally animating a set of small multiples showing a physics process, or comparing the small multiples to an internal representation, can lead to deeper understanding of the process [6].

Prompting users to engage in self-explanation, the process by which users explain its concept or example to themselves, may be useful as a means of guiding a user to compare internal representations to an external visualization [1]. As a form of prediction, self-explaining stimulates greater engagement with the topic. For example, it has been proposed that a system might prompt more active processing of data by asking a user to guess the direction of the trend prior to viewing the data [7].

In most examples studied in psychology [4][6][13], the benefits of self-explaining and internal visualizations come only after considerable cognitive work on the part of the user, who must mentally imagine the difference between their internal representation and the external visualization. In this work, we consider a new possibility: What if visualizations allowed people to draw their expectations of the data prior to viewing? Seeing the data along with the expectation provides a form of personalized feedback, as it renders this gap between expectation and fact explicit. The act of drawing maintains a user's engagement, while the visual representation of the expectation against the result allows more detailed observations than may be possible through mental visualization alone.

In this paper, we define Expectation Visualization (EV), an interactive technique for soliciting and presenting personalized feedback on a user's expectations of the data. Expectation Visualization (EV) addresses the common challenge faced by designers of how to engage users with visualized data on a deeper level. In the rest of the paper, we describe the design space of EV including how EV could be applied to common visualization tasks and visual encodings. We propose specific types of applications in which the cognitive benefits of EV could be useful. We conclude by offering ideas for future work.

2 Expectation Visualization Design Space

We use a recent New York Times interactive graphic to motivate the design space of EV. We define the design space according to tasks and visual encodings. We discuss forms of training and presentation of personalized feedback.

2.1 Predicting Marks

We begin our characterization of the design space for EV by considering a recent New York Times graphic of this technique (Fig. 1). The interface presents a XY plot without any data shown, however the axes are labeled as *Parent's income percentile* and *Percent of children who attend college*. The user is encouraged to draw their guess for each income level in the chart (Fig. 1a). In the accompanying text, definitions of various visual trends are provided to help users to relate the graphical representation to their expectations (e.g., or). After the user is done drawing the line, the true trend is presented as an overlay on the chart showing the user's expectation (Fig. 1c). Statistics describing how the user's guess compares to those of other users are presented in text below the chart.

In this example, the user's mental model is represented by a trend line. Two continuous variables are being considered, so a simple labeled XY plot is sufficient for the drawing interface. However other visual encodings and data types require different drawing interactions and interfaces. We envision how EV can be applied to other tasks and encodings in Table 1.

2.2 Extension to Mark Attributes

Visualizations are composed of marks (e.g., a bar in a bar chart, a circle in a scatterplot) and mark attributes (e.g., size, shape, color). While the above example provides interactive support for visualizing one's expectations by adding marks, it may also be possible to support interactive prediction of a variable, which will be encoded as a mark attribute. For example in a choropleth map, a user brush on color to predict the trend in a region for a continuous variable. In these examples, marks are presented and the user interacts to add value expectations (Table 2).

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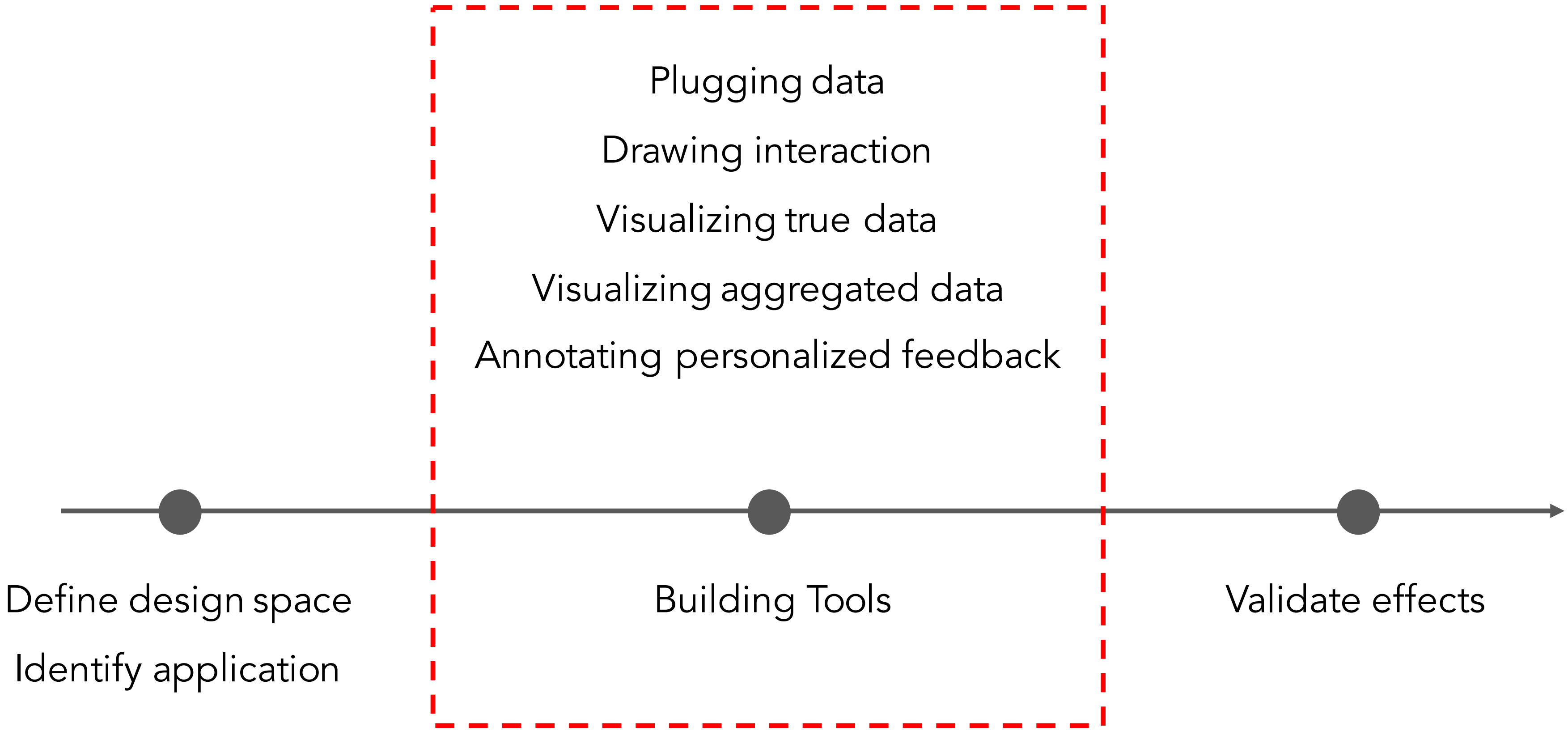
Described the design space of EV

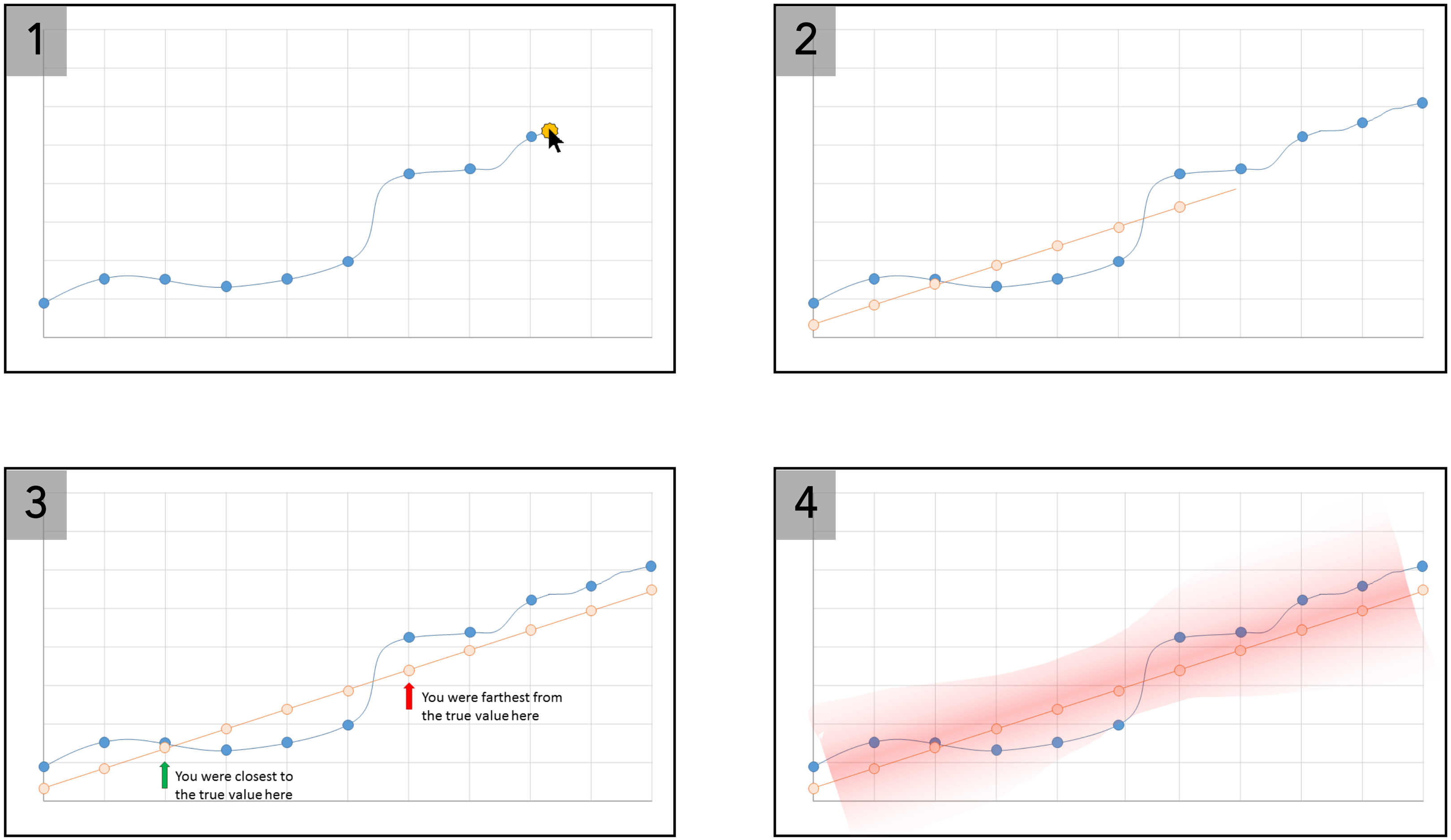
Proposed applications

Suggested ideas for future research.

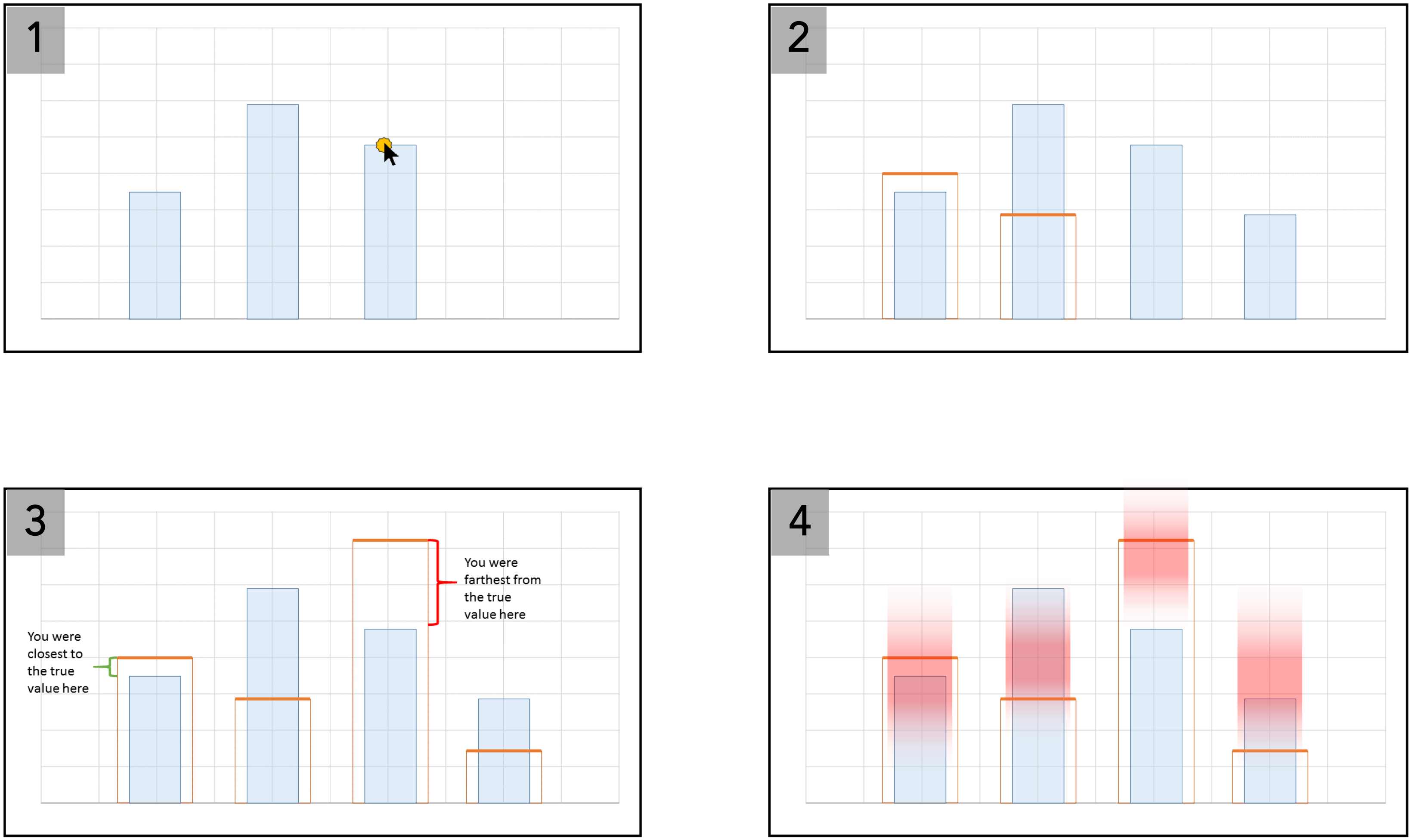
Scope


Plugging data
Drawing interaction
Visualizing true data
Visualizing aggregated data
Annotating personalized feedback
Define design space
Identify application
Building Tools
Validate effects

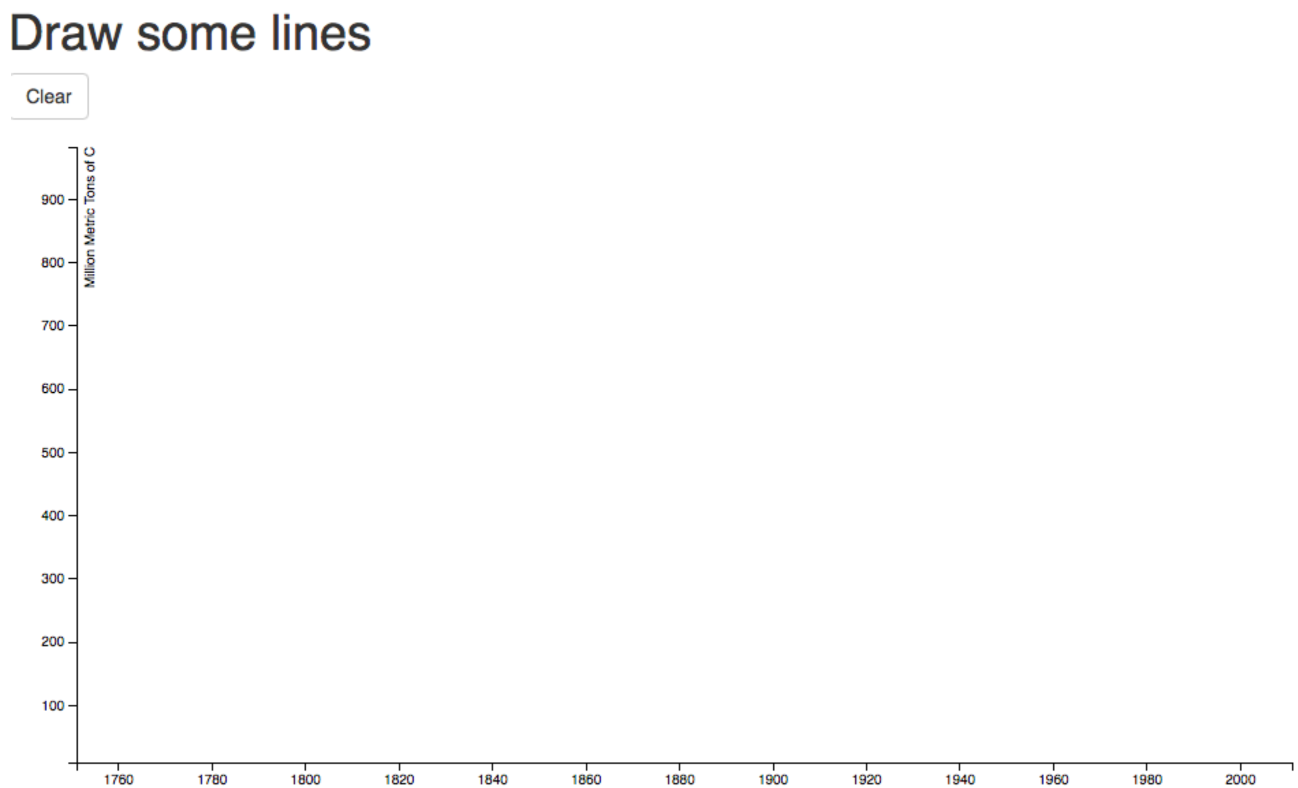
Storyboard – Line Chart



Storyboard – Bar Chart



Prototype


Draw some lines
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Million Metric Tons of C
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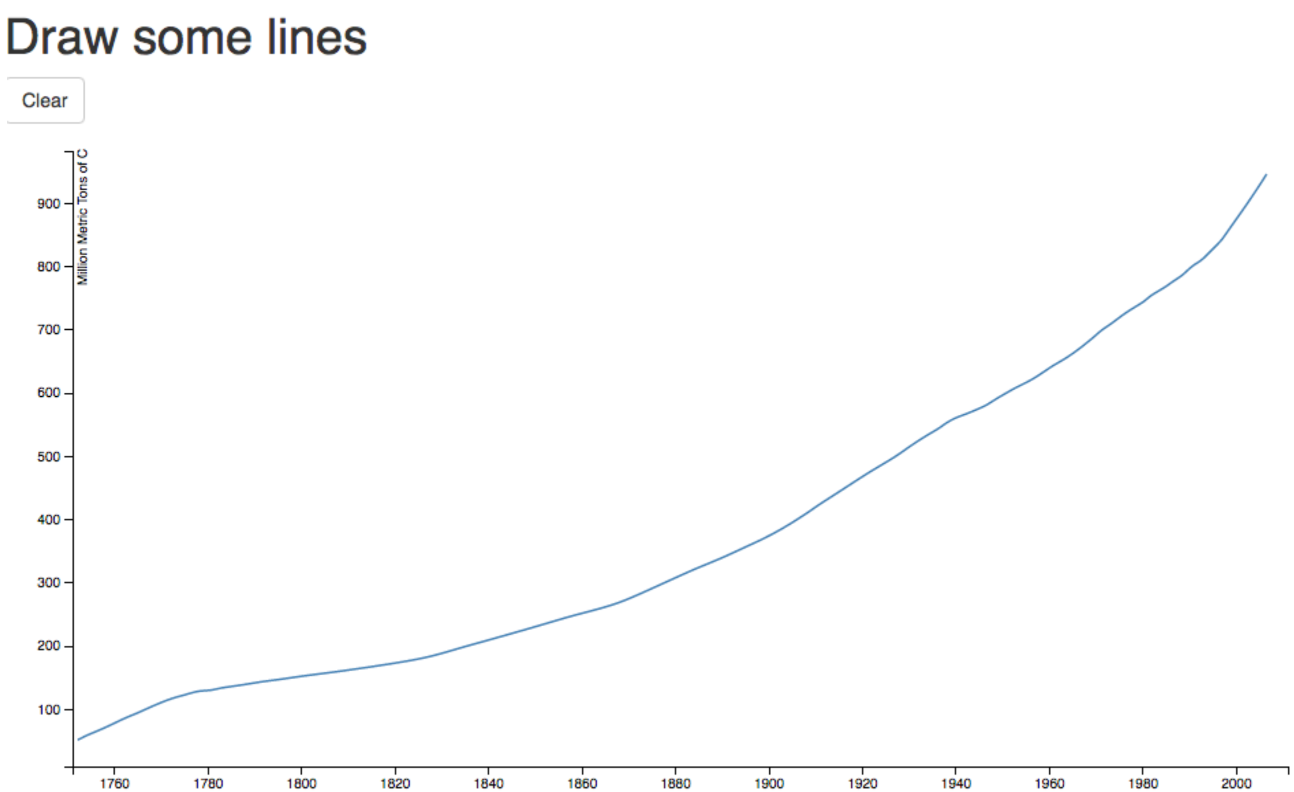
Prototype



Draw some lines
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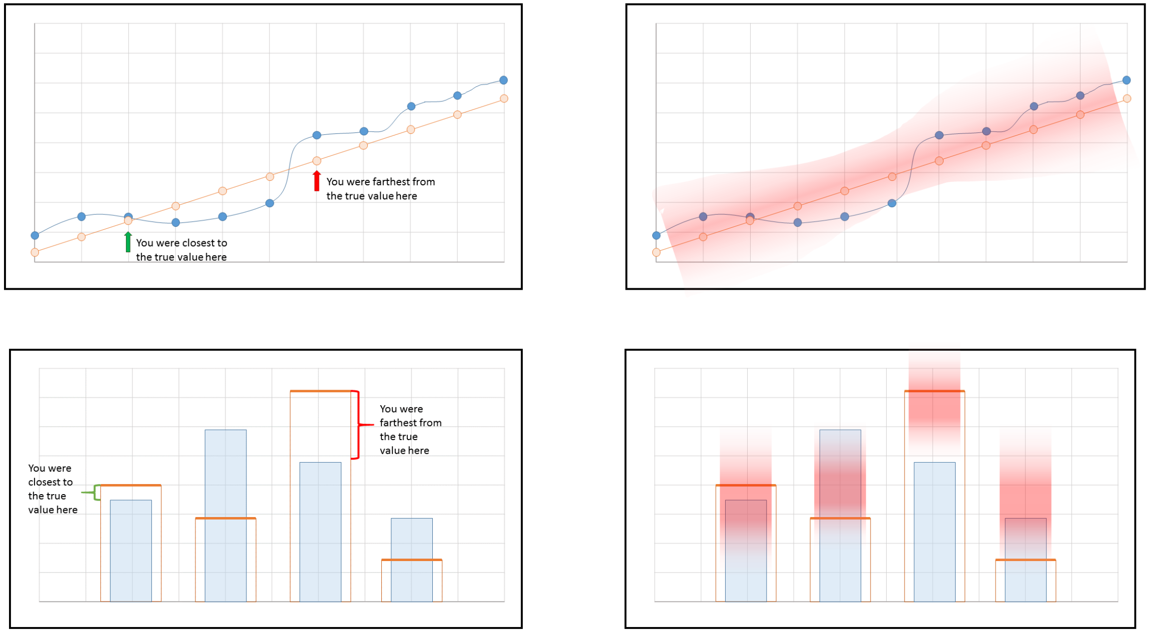
Questions



How to visualize aggregated data?

How to annotate personalized feedback?

Thank you!