Problem
Can we develop a tool that allows a user to fluidly and precisely specify a data visualization without coding? There is currently no tool that serves as a middle ground between those that allow rapid generation but can be somewhat restrictive with respect to layout specifics (Excel and Tableau) and toolkits that are flexible, expressive, and customizable, but require the user to know how to code (for example, D3 and OpenGL).

Motivation
This tool aims to be a graphical construction environment for D3 data visualizations. The target audience is anyone who desires greater control over data visualization they create and wants to share their work, but doesn’t know how to code. Journalists and bloggers benefit from the fact that the tool runs in the browser and the D3 visualizations it creates are easily integrated into webpages.

Creating a data graphic is a process that involves a dizzying number of decisions. The mapping of data to visual properties of marks, color schemes, annotations, layout, and other factors need to be considered to create a successful data visualization. Supporting thoughtful consideration and precise, intuitive control of these factors is a challenging problem.

Approach
This tool is designed to offer an intuitive interface to new users, while allowing the precision that more experienced users require. We employ a drag and drop interface for the creation of new marks as well as for the association of data columns with visual properties of the marks.

The system combines several basic visual interaction elements to allow a user to create a data graphic.

Mark: A set of graphical elements that correspond to data elements. Their visual properties can be mapped to data values. Marks include Rectangles, Arcs, Text, Axes, and Scatter Points.

Column: A set of values of the same type, one per data element.

Anchor: A visual indicator of a possible point of attachment of one element to another. They are shown or hidden based on context.

Menu: A list of options that appears on a Mark and allows for the association of data Columns with visual properties (height, x position, fill color, etc.) of Marks.

Property Editor: A list of options and input elements that allows for precise control of the style of Marks.

Interactions
Interactions with and between the visual elements specify different aspects of the visualization.

Drag and Drop Mark onto Work Area: Creates a new mark at drop point.

Drag Mark: Reposition Mark group and attached elements.

Drag Mark Edges: Scale Mark group and attached elements.

Drag Column: Show relevant Mark Menus of visual properties attached to their parent marks.

Drag and Drop Column onto Mark: Assign that column to selected visual parameter with the chosen scale.

Drag and Drop Column onto Label Anchor: Create labels for each element in a group using the value of that column.

Drag and Drop Axis Mark onto Axis Anchor: Attach an axis to that mark group and set it based on the group’s scale.

Click on Mark: Select Mark to activate the property editor.

Results
Bar graphs of medals by country and by continent

Pie charts of select countries by 2011 GDP and by population

Future Work
The goal of this system is to test and demonstrate the potential of different interactions to create data graphics. Once the basic interaction techniques are settled, the system would require features such as an undo history and a way to export finished graphics. Also, more map-able properties for existing marks could allow for greater expressiveness.

Stacked bar charts could be created by combining two bar marks or binding properties of one mark to a property of another mark, these mark–mark interactions would allow for combinatorial expressiveness similar to Tableau.

While D3 makes adding animation and interaction to graph elements easy for its users, there is a need for graphical tools to allow users to specify interactions and animations without the need for code.