Visual Analytics, Flocking and Design Processes

Michael Cumming BArch PhD mcumming@ocadu.ca

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Summary of Talk

Version 1

- Visual Analytics often involve Big Data Sets
- Big Data Sets usually involve Distributed Action
- Distributed Action usually results in Emergent Patterns

Version 2

- Greg van Alstyne's talk last week mentioned Herbert Simon
- Herbert Simon was a great influence on my work
- Herbert Simon's (and my) work may connect obliquely with Visual Analytics

Introduction

My background

- Architectural practice (mostly in Toronto and Europe)
- Academia (Computational design / Computer-aided design)
- Ambitious City (Support for bottom-up urban design)
- MGDS-PET project at DFI / OCADU (wearable devices to support transmedia narratives)

My Research Interests

Distribution of Design Processes

- Should design processes be distributed, with less centralization?
- If more people worked on complex design problems, would the results improve?
- Can the ideas of open source software development be applied to design in general?

One Definition of Visual Analytics

> *Visual analytics combines automated analysis techniques with interactive visualizations for an effective understanding, reasoning and decision making on the basis of very large and complex data sets.*

(Keim et al., 2008)

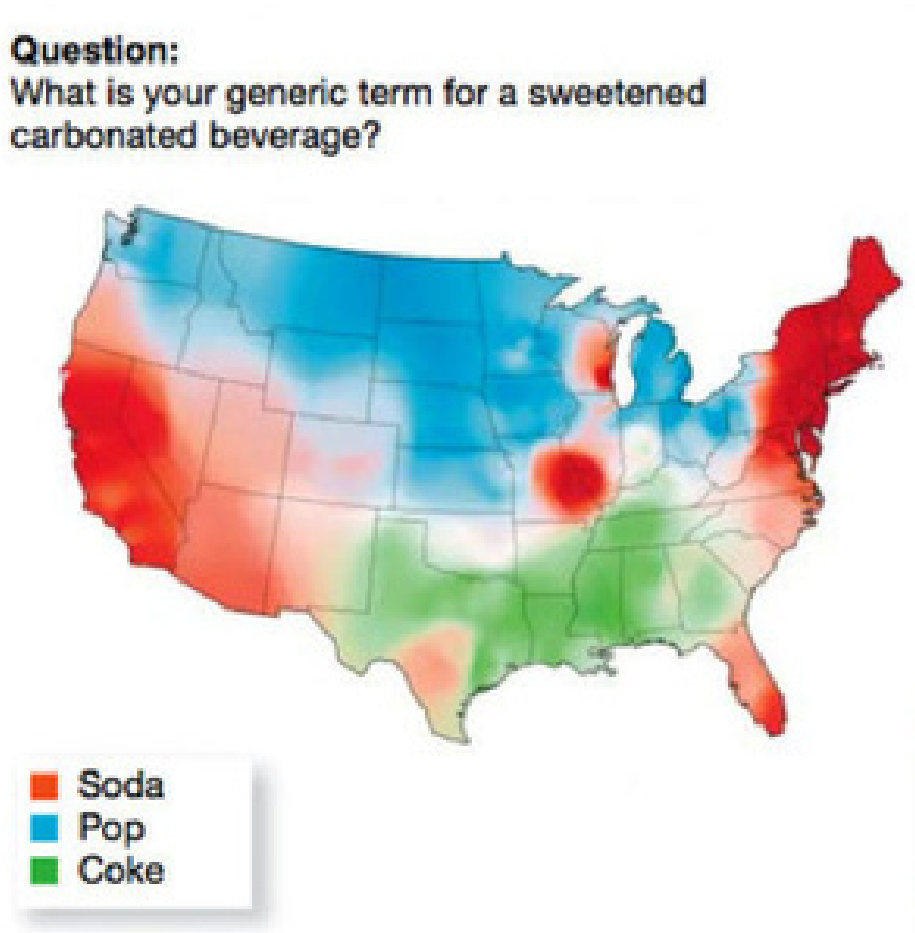


Figure 1 : Carbonated Beverage Linguistic Data

Visual Analytics as an Industrial Technique

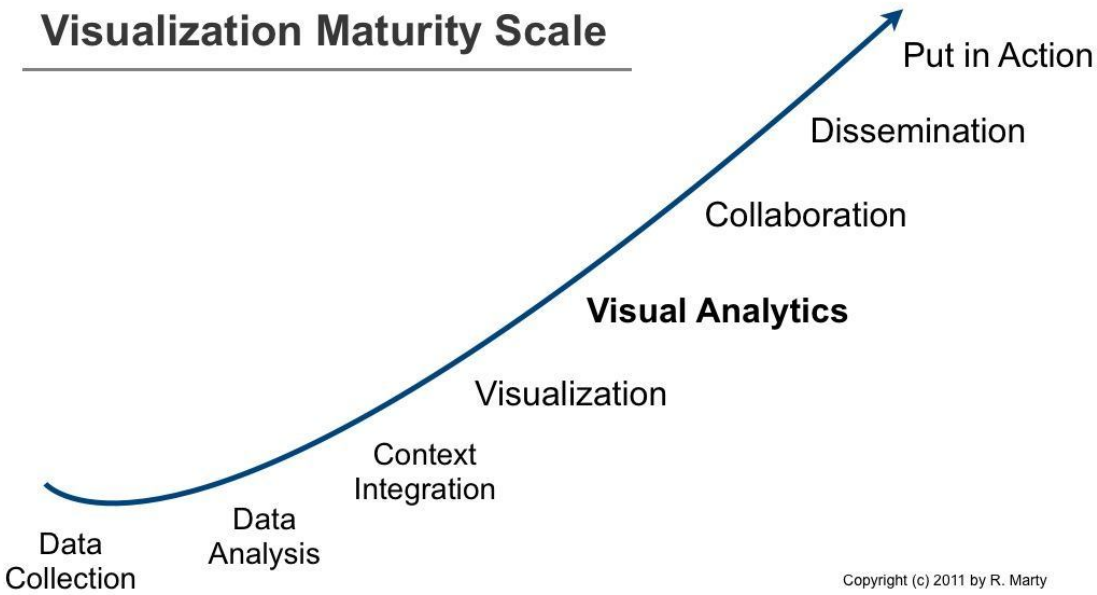


Figure 2 : Visual Analytics as one step in many data transformations.

(Marty, 2012)

Large Data Sets and Distributed Activities

Large Data Sets are often generated by distributed activities:

- Animals going about their business
- People interacting with each other
- Particles and waves in nature
- Diseases and viruses in a population
- Users on the Internet, etc.

Distributed Activities Commonalities

What do distributed activities have in common?

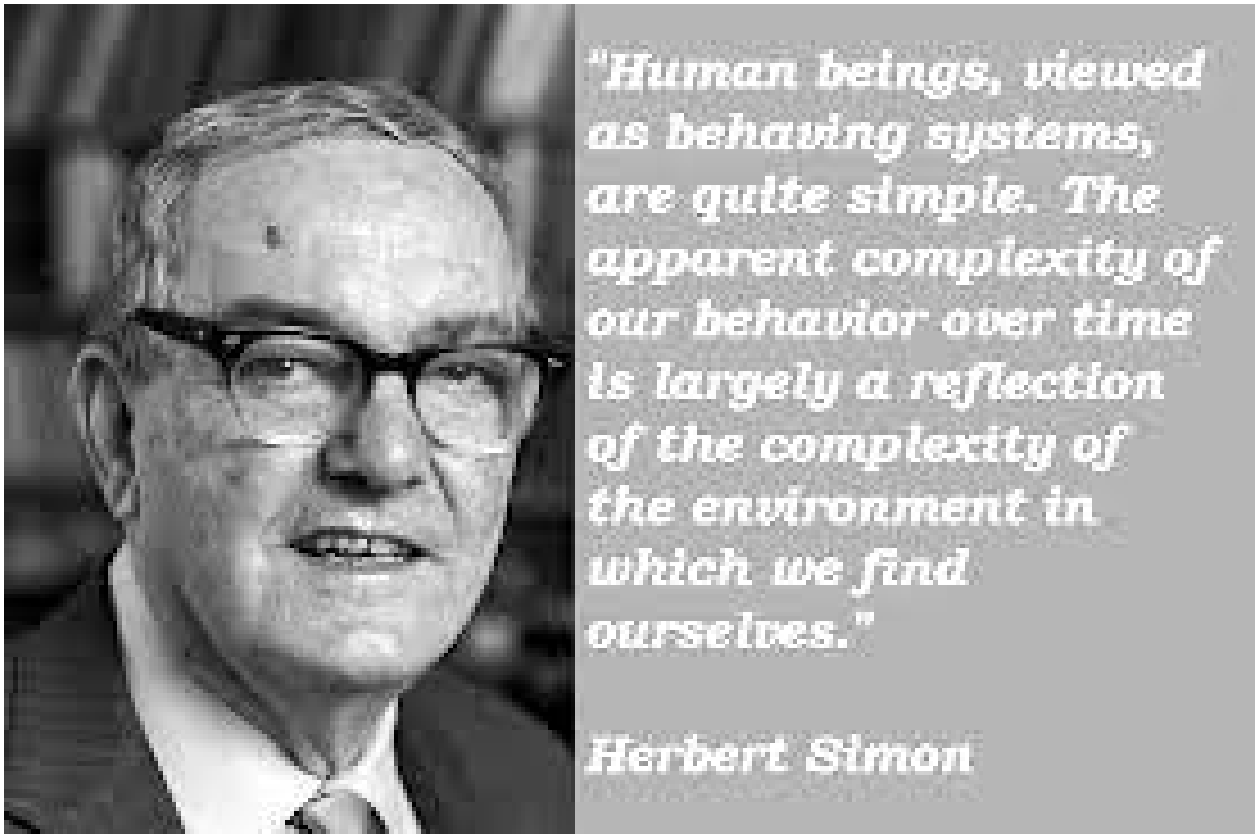
- Lack of central control
- Coordination between independent agents
- Independent goal-seeking
- Emergent effects

Complexity and Distributed Activities

When you watch an ant follow a tortuous path across a beach, you might say, "How complicated!" Well, the ant is just trying to go home, and it's got to climb over little sand dunes and around twigs. Its path is generally pointed toward its goal, and its maneuvers are simple, local responses to its environment. To simulate an ant, you don't have to simulate that wiggly path, just the way it responds to obstacles.

(Stewart, 1994) (Simon, 1996)

Herbert Simon, 1916-2001



(Simon, 1996)

Figure 4 : Pioneering researcher in Artificial Intelligence, Herbert Simon.

Ants and People

Figure 5 : Ant-People Descend on Washington, DC.

(Beaton, 2009)

Flocking Birds

Figure 6 : Flocking red-winged blackbirds over Mattamuskeet Lake in Hyde County, North Carolina (photo by Guy Livesay, 1992)

Flocking Rules

Basic models of flocking behaviour are controlled by three simple rules:

1. Cohesion: steer towards average position of neighbours (long range attraction)
2. Alignment: steer towards average heading of neighbours
3. Separation: avoid crowding neighbours (short range repulsion)

(Reynolds, 1987)

Flocking Birds: Reynold's Boid Algorithm

(a) Cohesion (b) Alignment (c) Separation

Figure 7 : Boid Rules by Reynolds

(APRK, 2014)

Complex Patterns and Generating Mechanisms

Question

Do patterns that look complex or organic always involve simpler, lower-level interactions? [flocking birds / like ants on a beach]

Question

Does Visual Analytics study emergent, organic patterns, or the simpler behaviours that may have created them?

Collaborative Design as a type of Distributed Activity

Design is usually done collaboratively.

Why do people collaborate in design?

- Design problems may be too difficult for single designers
- Participation required from diverse stakeholders
- Demands for a range of technical expertise
- Need for diversity of perspective
- Requirements for local participation; local knowledge

In order to be able to solve most complex design problems, you need *many minds*.

Coordination Theory, Distributed AI and Collaborative Design

Three reasons why the actions of multiple agents need to be coordinated: (Jennings, 1996)

1. Because there are dependencies between agents' actions
2. Because there is a need to meet global constraints, and
3. Because no one individual has sufficient competence, resources, or information to solve the entire problem.

Collaborative design has Centralized and Distributed aspects

Centralized aspects

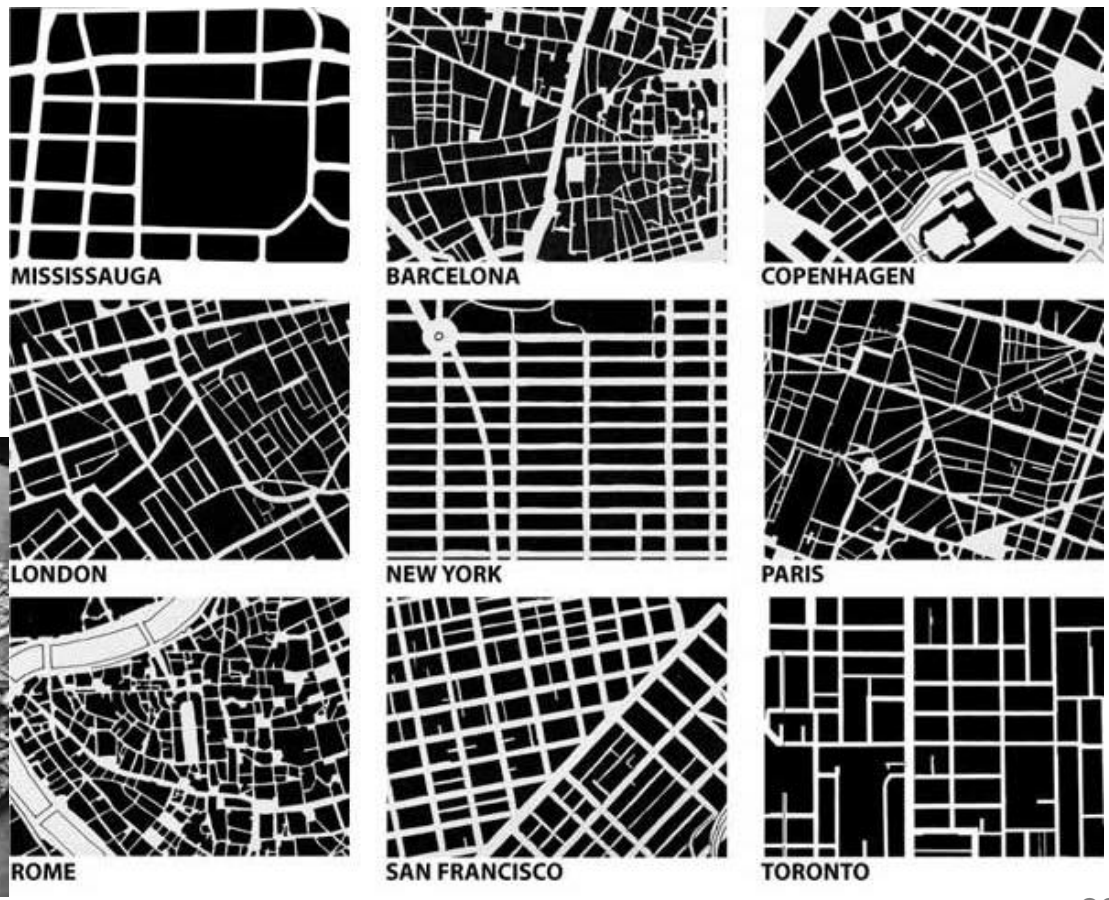
- Strong design concepts
- Team identity; common purpose; common ground
- Global attributes of the completed artifact
- Total cost

Distributed aspects

- Multiple agents, multiple types of expertise, different points of view
- Stakeholders‘ opinions and experiences
- Proprietary information

Examples: Centralized Design of Cities

Figure 8 : Plan Voisin; Centralized and Distributed City Planning



Examples: Distributed Design of Cities

Figure 9 : Santander, Spain; Toronto Laneway

Flocking Rules for Collaborative Designers?

Boid rules for designers working together in collaborative teams?

1. Cohesion: steer towards average position of your design collaborators (don‘t go too far astray from your collaborators)
2. Alignment: steer towards average heading of your design collaborators (pay attention to where others are going)
3. Separation: avoid crowding your collaborators (let them do their jobs)

Conclusions

- When you have complex, emergent patterns one compact way to understand them is through the algorithms that may have generated them (as with boids).
- Many things that appear to be designed top-down are often unintentional, emergent and dependent on distributed action.

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Thanks for attending!

Michael Cumming
mcumming@ocadu.ca
michael@ambitiouscity.com