

Narrative Visualization to Describe and Assess Decision-Making

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ABSTRACT

The Visualizing Finance Lab (VFL) at Parsons The New School for Design has developed a methodology for creating and assessing “Narrative Visualizations” that depict the complexities of decision-making. “Narrative Visualizations” are not data visualizations; rather, they are illustrations, animations, cartoons and other pictorial media that use cultural, emotional, and behavioral cues and metaphors to communicate concepts and processes. Visual metaphors tend to communicate directly to intuitive understanding by using cultural and embodied cues, and might therefore influence intuition-based financial decisions. In a design class at Parsons, students created storytelling animations about a couple’s financial decisions. The student work was guided and assessed using VFL’s infoEmotion Matrix, which has broad applicability for design students and practitioners in describing and understanding the culturally-inflected decision processes of clients and designers.

Keywords: Narrative Visualization; Visual Metaphor; Emotion, Culture and Decisions; Decision-making Process, Design Education

Introduction

Founded in 2009, the Visualizing Finance Lab (VFL) grew out of experiments with “**drawing to learn**” exercises introduced to design students taking a financial management class as part of an undergraduate business program in Design + Management. Faculty noted that students consistently used character, facial expression, setting and other metaphorical devices to communicate and express their understanding of complex financial concepts. This is consistent with the frequent use of metaphors and an implied narrative in professional illustrations in the financial press and other venues. Intrigued by this reliance on the visual and metaphorical, the VFL has for the last several years investigated the links between these narrative visualizations and the conceptual and emotional interpretations they prompt. Drawing on two areas of scholarship—theories of metaphor and narrative, and recent insights in behavioral finance—that shed light on the cultural and emotional factors affecting individuals’ decisions in complex situations, the VFL has begun to explore both the effectiveness of these visualizations for general audiences, as well as their efficacy in the classroom. Noting recent work by O’Connor (1997), which highlights the role of narrative in managerial decision making, the students’ work can be seen to extend beyond the communication of concepts to examinations of decision-making processes. The VFL asserts that this use of narrative visualization to understand decision-making has broad applicability for various design disciplines, and highlights cultural factors that affect design decisions. The Visualizing Finance Lab presents here a methodology (the infoEmotion Matrix) for guiding and analyzing story-based visualizations created by design students or design professionals.

Narrative Visualization

The Visualizing Finance Lab uses the term “Narrative Visualization” to refer to narratively-rich pictorial illustrations commonly found in print and online publications. The storytelling properties embedded in these visualizations—as well as their frequent reliance on metaphor, character, emotion and setting to represent complex situations—differentiate them from data visualizations such as data-driven maps, diagrams and charts. To illustrate this differentiation, compare Figures 1 and 2 below.

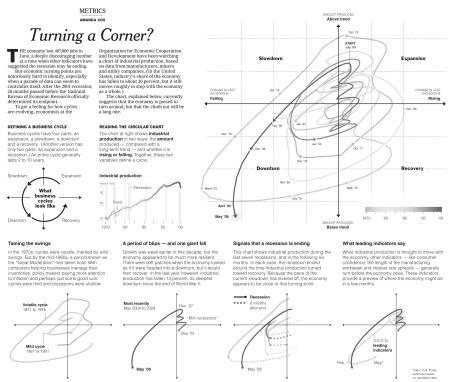


Figure 1

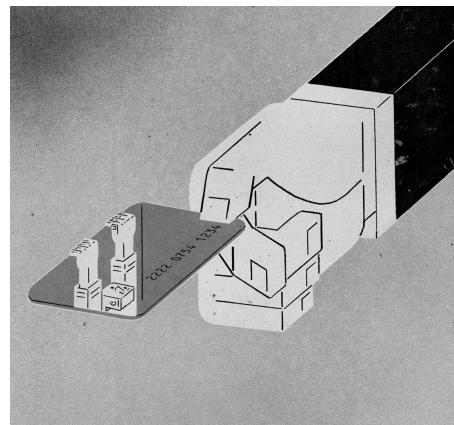


Figure 2

Figure 1 highlights the movement of data over time by mapping the trajectory and duration of industrial production and consumption cycles from 1970 to the present. Instead of pictorial illustration, it utilizes a Cartesian graphic convention for the display of its data, and has no apparent metaphorical content. In contrast, Figure 2 is rich in metaphorical and narrative content. Depicting a man hanging onto the edge of his credit card by his fingertips, the illustration accompanied an article highlighting the ways credit card fees are structured by banks to maximize the fees that a consumer is charged. The visual elements reinforce the consumer's financial vulnerability and peril. The posture of the man and the (red=danger) color of the credit card metaphorically connect a financial abyss with a physical abyss. The card/abyss in this visualization is proffered by an impersonal hand that represents the financial system as a rigid and oppressive machine. Compositional elements reinforce this impression with geometric lines and a contrast in scale between big man/big hand and little man.

As illustrated in Figure 2, narrative visualization is distinguished from data visualization in its reliance on visual metaphor to represent both informational and emotional content.

Metaphor and Framing

While symbols, iconography and personification have long been part of the illustrator's toolkit, narrative visualizations frequently draw on *conceptual* metaphors both to explain content and to frame an argument. This use of metaphor accords with current linguistic and cognitive-science understanding of the way metaphors function, stemming from Conceptual Metaphor Theory (CMT). CMT grew out of seminal work by George Lakoff and Mark Johnson who asserted that metaphors are primarily a product of experiences and perceptions about the world rather than a product of language. In *Metaphors We Live By* (Lakoff and Johnson, 1980), they argue that metaphors structure the way individuals think, and that our most primary metaphorical understandings have their origin in physical experience. They analyze families of metaphorical associations around concepts such as "life is a journey" and "argument is war" to demonstrate how these metaphorical phrases both shape and are shaped by the way humans conceptualize different aspects of their lives. Of particular relevance to financial illustrations is the conceptual metaphor "up is good" and "down is bad" (which they suggest stems from our association of illness with lying down). These associations are reinforced by the conventions of w3 graphical or schematic depictions of data.

The metaphors used in narrative visualizations thus do more than provide convenient visual symbols to illustrate abstract concepts. They draw upon and reinforce existing conceptual frameworks. The use of the credit card to represent a potential financial/physical abyss in Figure 2 is made more powerful by the conceptual (and experiential) association of "falling" with "danger" and individuals' associating being "deep" in debt with insecurity or peril. These associations

encourage the viewer to adopt the implied framing (“credit is dangerous”), and ultimately influence both the way the viewer thinks about personal credit and the way he/she subsequently behaves.

The ability of metaphors to create a “frame” is further demonstrated by comparing two narrative visualizations of the same subject: the “bail-out” of the federal mortgage associations, Fannie Mae and Freddie Mac by US taxpayers. In Figure 3, Fannie and Freddie are depicted as the arms of a drowning man needing to be saved (“thrown a lifeline”) by taxpayers.



Figure 3



Figure 4

In Figure 4, the taxpayer (the boat) is represented not as empowered rescuer, but hapless victim imminently threatened by an overweight Fannie Mae, while an equally overweight Freddie Mac passively waits to be rescued from the roof of one of many “underwater” houses. While neither visualization explicitly points to a conclusion, the choice of metaphor in each case implicitly frames how the viewer should regard the bailout decision.

Behavioral Finance and Decisions (System 1 and System 2 Thinking)

The assumption that humans are influenced by the framing implicit in metaphors is supported by recent insights in the fields of cognitive psychology and behavioral economics. Over the last several decades these disciplines have experienced a major shift away from a rational agent view of human decision-making toward a theory that recognizes the dominance of intuition and rules of thumb in the decision-making process. Herbert Simon’s theory of bounded rationality (Simon, 1972) asserts that the decision-making capacity of individuals is limited by the information available, limits on their cognitive capacity, and the amount of time they have to make a decision. Because of these limits, the individual relies on rules of thumb—rules that are based sometimes on experience and sometimes on intuition. Simon calls the decision-maker a “satisficer,” one whose decisions meet a satisfactory or acceptable threshold rather than an optimal one. Faced with a complex situation, incomplete information, and cognitive and time limitations, the individual may thus make decisions or take courses of action that are mostly correct or correct most of the time, but that are also prone to cognitive bias.

Tversky and Kahneman (1979, 1981) identified several of the rules of thumb (heuristics) that are repeatedly and consistently employed by individuals making decisions involving risk. The biases implicit in these rules of thumb cause us to overestimate the probability of some events while underestimating others; to pursue a losing course of action, for example because we’ve already invested in it; or to view prices relatively (in terms of a discounted value) rather than as absolute value, to use another example.

More recent research has framed humans' reliance on heuristics to inform decision-making, in terms of a "two systems" model, first postulated by psychologists Keith Stanovich and Richard West (Stanovich and West, 2000), and developed subsequently by several scholars (c.f. Wim De Neys, 2006, Kahneman, 2011). In his book *Thinking, Fast and Slow* Daniel Kahneman (2011) defines and contrasts System 1 and System 2 thinking in a table, adapted here as Table 1:

System 1	System 2
Intuitive fast automatic effortless <i>without voluntary control</i> System 1 is particularly good at comparing, averaging, identifying surprises from normal expectations, gauging intensity levels of attributes, and representing sets (of data) as prototypes and norms.	Analytical slow careful effortful <i>requires high degree of voluntary control</i> System 2 is particularly good at computational tasks: sums, correlations and statistical tasks. It catches inconsistencies and anomalies in System 1 thinking, but will only be deployed when System 1 thinking encounters a problem it thinks it can't solve.

Table 1

System 2 (slow) thinking is analytical: it requires a careful consideration of details, and an ability to work through and rationally weigh all available options. System 1 (fast) thinking is based on heuristics and on intuitive understanding of situations. When faced with new information, System 1 thinking creates a fast holistic picture of the situation, often using metaphors (whether verbal, conceptual or visual) to inform a rapid sizing up. It is not surprising, for example, that political rhetoric is metaphor-lade. System 1 frequently uses metaphorical framing to guide the individual's interpretation of the situation and subsequent actions.

"(we) gravitate toward the least demanding course of action (because) in the economy of action, effort is a cost, and the acquisition of skill is driven by the balance of benefits and costs. Laziness is built deep into our nature"¹

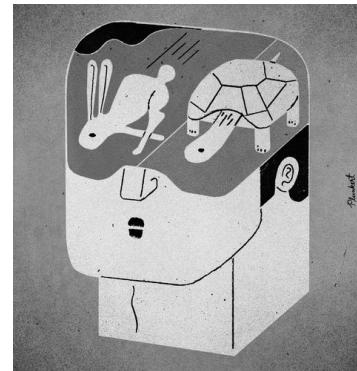


Figure 5

The differences between System 1 and System 2 thinking are illustrated by the metaphor-based narrative visualization in Figure 5. The proverbial hare represents System 1 (intuitive, fast) and the tortoise represents System 2 (analytical, slow)

¹ Kahneman 2011, p.35

Cognitive biases occur when System 2 thinking is overridden by System 1 thinking (usually without the decision-maker being aware of it). The cognitive bias toward less effortful thinking is illustrated by the viewer's response to Figure 3. System 1 thinking encourages the viewer to conclude that the cost of bailing out Fannie Mae and Freddie Mac imperils public finances; a System 2 analysis of the same event might reason that the total cost of the bailout was \$187 billion (or 31% of total Federal outflows)³, that the Fed may eventually recoup some of the money it spent, and that the situation might be more nuanced than the illustration suggests.

This analysis suggests the Achilles heel of System 1-fueled visualization: its vulnerability to hyperbole and inaccuracy. This vulnerability exists, however, precisely because narrative visualizations lend themselves so well to this kind of intuitive and holistic interpretation. Their reliance on conceptual metaphors, the (often) overt framing, and the presence of a narrative itself, all accord with the way humans naturally engage with financial and other complex decisions.

Narrative Visualization in a Design Class

The Visualizing Finance Lab applied these theories of visual metaphor and decision-making in a class project with second-year undergraduate students in 2012, developing and testing a methodology for the creation of narrative visualizations in scholarly and professional contexts. The pedagogical purpose of the course was the teaching of "narrative visualization": a difficult task given the complexity of interpretations and analyses demanded by narrative visualizations. Teams of students created short animations or videos depicting the culturally-inflected story of a couple's financial concerns, behaviors, and decisions (similar to Kahneman's "System 1" thinking). The animation also presented financial concepts and data (necessary for "System 2" thinking).

Students were provided with a videotaped role-play exercise, from which they developed a script and storyboard. The role-play originated at The City University of New York's financial-counseling course for community leaders. The counseling course was created and taught by professor and community activist Joyce Moy as part of a curriculum designed to be culturally sensitive and to address commonly-occurring problems in underserved populations. The story involves a couple who are planning to marry, but are concerned that the groom's very-low credit score will damage the bride's excellent credit history. The groom's credit problems were caused by his father and carry cultural, emotional and familial weight. The couple considers several plans of action, each decision reflective of the financial, legal, cultural and familial factors involved.

³ As reported by ProPublica: Journalism for the Public Interest
<http://projects.propublica.org/bailout/main/summary>.

In their time-based narrative visualizations of this financial drama, the students were required to identify and incorporate various content elements and visualization elements, as follows:

Content Elements

Financial Content Elements:

- Data and Information: numbers, facts
- Concepts: legal information, standard practices, time value of money, etc.

Behavioral Content Elements:

- Consequences: emotional and financial
- Negotiation: strategies, skills, methods, and decision processes
- Ethics: personal moral considerations
- Culture: community expectations, norms, and understandings
- Emotion: subjective and personal factors such as opinions, loyalties, relationships

Visualization Elements

- Graphs/maps
- Text: on-screen text/data
- Dialog: also monolog or verbal explication, through characters or voiceover
- Setting: background, objects, and props
- Character: personifications, archetypes, metaphors
- Body language: shown by character(s)
- Facial expression: shown by character(s)
- Tone of voice: through character(s) and/or voiceover

Members of the Visualizing Finance Lab organized these elements into the **infoEmotion Matrix** to guide and assess student work and to highlight the System 2 (rational) vs System 1 (intuitive) aspects of understanding and decision-making. The elements in the matrix roughly proceed left-to-right and top-to-bottom from System 2 (rational) to System 1 (intuitive).

infoEmotion Matrix

Content element	Visualization element								
	Graphs/ Maps	Text	Dialog	Setting	Character	Body language	Facial expression	Tone of voice	
Financial: data									
Financial: information									
Financial: concepts									
Behavioral: consequences									
Behavioral: decision processes									
Behavioral: negotiation									
Behavioral: ethics									
Behavioral: culture									
Behavioral: emotion									

As currently configured, the infoEmotion Matrix is not designed specifically to assess student work: there has been no expectation that student projects use every Visualization Element to illustrate every Content Element. Rather, the matrix is meant as a framework to encourage students (and others) to think about the visualization tools available and their possible uses in depicting factual information, as well as more-complex contextual aspects.

The following images from one student animation demonstrate this use of the infoEmotion Matrix. Each dominant Visualization Element is listed on the left side of the caption, and accompanied by the Content Element(s) it portrays:



Figure 5

Text	data; concepts (540) consequences; emotion ("Oh No")
Setting	culture
Character; Body language	concepts; consequences (vampire) ethics, culture (white dress)
Facial expression	consequences; emotion (frown, wide eyes)

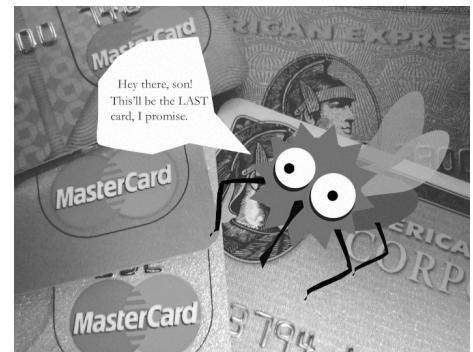


Figure 6

Text	decision; ethics ("this'll be the last")
Setting	Information; concepts; consequences (multiple credit cards)
Character	Consequences; decision processes; ethics (mosquito)

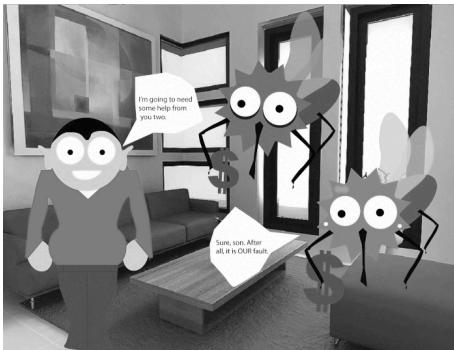


Figure 7

Text; Dialog	consequences; ethics ("our fault") negotiation ("need some help")
Character	consequences (mosquito)
Body language	decision processes; emotion (squared shoulders)
Facial expression	negotiation; emotion (smile, wide eyes)

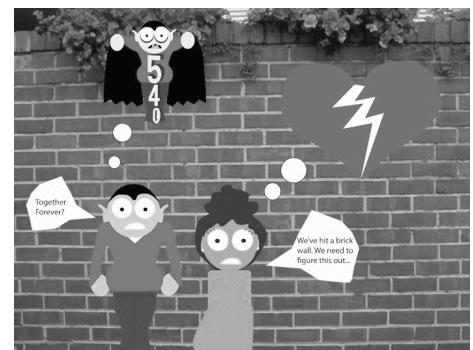


Figure 8

Text; Dialog	consequences; decision processes; negotiation ("together forever"; "need to figure this out")
Setting	consequences; negotiation (brick wall) consequences; emotion (broken heart)
Body Language	consequences; negotiation; emotion (stiff, distant)
Facial expression	decision processes; consequences; emotion (frown, wide eyes)

Benefits of Narrative Visualization for Students and Professionals

The student exercise and the infoEmotion Matrix were designed to help students practice specific design skills, but also to facilitate their learning of basic financial concepts and to address decision-making in the context of narrative visualization. As mentioned in the introduction, the Visualizing Finance Lab's interest in narrative visualization grew out of experiments in learning-by-drawing exercises. The use of drawing as a means to learn and reinforce abstract concepts is well researched in the scientific education literature (c.f. the Picturing to Learn project, Ainsworth, and Prain and Tytler, 2011, Anning 1999). <http://www.felicefrankel.com/felice-frankel-educational-program/image-and-meaning/>. It has not been researched as thoroughly in other disciplines.

Nevertheless, many of the qualities that characterize scientific thinking (abstract concepts, relationships between ideas, dynamic processes) are equally characteristic in these other fields. The VFL has conducted preliminary research that suggests that students' learning in business classes is improved when drawing exercises are incorporated (Overby, forthcoming).

The Narrative Visualization class at Parsons in 2012 incorporated several Learning Outcomes:

- deep/intuitive understanding of specialized disciplinary concepts (in this case financial) through drawing and visualization
- awareness of the role and impact of emotional and cultural factors
- understanding of decision processes through storytelling
- learning of the skills of visual storytelling
- acquisition of design and visualization skills

The Visualizing Finance Lab members believe that these Learning Outcomes, in combination with the infoEmotion Matrix, can be applicable within design education and for practicing designers who are concerned with the quality of decision-making within their own practices and in their relationships with clients. For example, Narrative Visualizations can expand the architectural or interior designers' skills beyond drawing the experience of the space, to drawing the experience of interactions with clients. Authors Bolland, Collopy, Lyytinen and Yoo (2007) argue for a "design attitude" toward decision-making, paraphrasing Herbert Simon (1977) who states that there are three essential aspects of "decision-making: intelligence, design, and choice" which are inescapably intertwined and important. The authors note that "the institutionalized study of management decision-making has reduced these three into a single aspect, that of choice" (2007).

Other management scholars, notably Ellen O'Connor (1997), support the importance of narrative storytelling in managerial decisions. O'Connor asserts that organizational decision theory, and the research that supports it, depend largely on narrative: "to discover how anything happens in an organization, we ask people to tell us stories."⁴ She compares traits in narrative (as a form of human understanding) to heuristics in decision theory, and further notes that attention to narrative allows us to study meaning and meaning-making processes in decision-making. In this context O'Connor is referring to the role of narratives in organizational action, with stories "constituting a force in themselves regardless of the "facts" (O'Connor, on Roe, 1994). She invokes sociologists' research to assert that narrative is a conversation about the self in interaction with other selves, and that "metaphors for cognitive processes can be seen in frames (O'Connor on Lakoff and Johnson 1980, Lakoff and Turner 1989) structures (Mandler 1984) maps (Fiol and Huff, 1992) and scripts (Gioia, 1986, 1992)."

Conclusion

Narrative visualizations provide rich metaphorical framings of situations that are complex and multifaceted. In contrast to the explanatory power of data visualizations (which provide information from which analysis-based decisions can be made), these narrative visualizations open a space in which an individual can see him/herself making decisions, in conversation with others, under the imperfect conditions that Herbert Simon (1972) informs us are the stuff of human decision-making in the world. Members of The Visualizing Finance Lab agree that narratives have a cognitive force in themselves (regardless of facts), and that narratives present information in a manner that supports the heuristics and frames that humans use to understand situations rapidly and intuitively. The infoEmotion Matrix provides a framework for both the development and the assessment of these Narrative Visualizations.

⁴ O'Connor (1997), p: 304-323

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September 2013

Forthcoming in initial issue of *Mobility and Design*, Lebanese American University School of Architecture and Design and University of Montreal Faculty of Environmental Design