VISUALIZING FINANCE 1.0

Developing a Common Language

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The VFL Press, 2012

Published 2012
ISBN 978-1-62407-430-1

Cover photograph of Visualizing Finance Lab metaphor cards
by Sylvia Hardy

Book design, metaphor card design, symposium event photography
and layout by Aaron Fry. Layout assistance by Sylvia Hardy

This book has been composed in Rockwell and Century Gothic fonts.
Printed on Mohawk Superfine by Conveyor Arts
888 Newark Avenue, Studio 491, Jersey City, New Jersey 07306

Printed in the United States of America

Image credits: Alec Monopoly of the "Monopoly man" (Parker Brothers).
"Spinning dollar" graphic © Visualizing Finance Lab.

VISUALIZING FINANCE LAB

The Visualizing Finance Lab (VFL) is a group of academics, designers, and educators —based at Parsons The New School for Design—who work at the intersection of finance, education, and design. The VFL was founded to explore the relationships among theories of visual communication and metaphor, practices of visual communication in education and journalism, and the effects of these visual communications on financial understanding and financial decision-making.

The Visualizing Finance Lab's goals are to investigate

the nature of visual metaphors and how they help viewers to understand abstract concepts;

the possibilities for narrative and metaphorically-oriented visualizations to elicit emotional responses, in addition to fostering rational understandings;

whether narrative visualizations can enable individuals to internalize financial literacy in a way that helps them change their financial behaviors;

illustrators' and designers' processes of understanding and translating financial concepts to create effective visualizations.

We seek to apply the results of these investigations to

research and develop visual tools for financial literacy;

use these tools to promote financial empowerment, as well as social and institutional change;

assess the tools' effectiveness.

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Introduction

Visualizing Finance 1.0: Developing a Common Language was a one-day symposium within a six-day exhibit in the Arnold and Sheila Aronson Galleries at Parsons The New School for Design in New York City in late October 2010. The purpose of the symposium was to facilitate communication among designers, art directors, financial educators, financial institutions, and the public, and to explore the process by which financial illustrations are created for journalistic and educational purposes. The relationship between text and illustration in conveying financial information is under-theorized; too often visualizations are regarded as implicitly-understood accompaniments to the written word.

The exhibit presented an invited selection of illustrations by artists whose work has appeared in *The Economist*, *The New York Times*, and other prominent venues. The symposium was held in the exhibition gallery, so participants could refer to the illustrations around them while making observations. In the display space adjacent to the gallery were exhibited a video animation, several sketches from a professional financial planner and blogger, and examples of student visualizations from a Financial Management course at Parsons.

In the opening gallery talk participants analyzed the ways in which financial information is conveyed through metaphor and composition. In several instances, the illustrator/animator was present to describe the process of the work's creation. The panel discussion which followed included a financial literacy researcher, an economist, an art director, an illustrator, a video/new media designer, and a financial journalist. Conversation centered on the collaborative relationships among editor, writer, art director, and illustrator in the creation of a financial illustration, with some discussion about the interpretations and consequences of the images in the public sphere.

During the concluding workshop, attendees formed small heterogeneous groups of educators, financial professionals, and designers to develop sketches illustrating financial concepts. These were proposed by the guest facilitator: a financial planner and author. Participants used a set of vocabulary cards developed by the VFL as a vehicle for expressing their ideas. Each card listed a key term and image from one of three categories—financial concept, design principle, metaphor type—with an illustrative example on the reverse side (see card sample on cover).

This publication not only records the events of the symposium. It also contains a foundational essay that analyzes the role of metaphor in illustrations' effect on the reader/viewer's framing of important issues, and establishes some critical linkages with Behavioral Economics.

Carol Overby, Aaron Fry, Jennifer Wilson

Preface

Why Should Finance Be Visual?

By Marion Asnes

If visual expression is as old as human culture, so is economy, which at its foundation is the accumulation and distribution of limited resources—food, shelter and various goods and services. Today, in the urbanized global culture that unites much of the earth, economy is mediated by that abstraction we call finance—the creation and management of money, credit, assets, liabilities, investments, and multitudinous complex instruments that, together, constitute a technology that has empowered humanity to prosper, invent, and explore. Most people rarely pay much attention to this technology in itself. We do, however, pay attention to its effects on our own standard of living. In this sense, all finance is personal. As members of a free-market society, we assume responsibility for our financial well-being: we work and save, borrow, and spend. We are expected to fund essential life goals, such as acquiring a home, education, and retirement, via skillful use of consumer financial technology—investments, credit cards, and mortgages. And so, we must learn to wield these powerful tools effectively. They are difficult to master, and those who use them poorly risk grave consequences—as so many Americans learned in 2008, when thousands lost their homes, jobs, and retirement savings in the aftermath of the bursting real estate bubble. The resulting credit implosion continues to ripple through the world economy, as evidenced by this year's credit crisis in Europe. It has become distressingly obvious that we all need improved tools for understanding finance.

The most familiar tools for understanding finance are verbal and mathematical. At some point almost everyone has grabbed a brochure extolling some credit card or other. Numeracy—the ability to understand and work with math concepts—is an area where most Americans lack mastery. Take, for instance, percentages: you may know how to calculate a simple percentage like sales tax, but fall short when it comes to more complex calculations such as compound interest—let alone projections of probability and risk. The Visualizing Finance Lab has asked a daring question: why are we not more knowledgeable and sophisticated in our use of visual tools to communicate the complexities of finance? Humans are pattern finders; our eyes instantly recognize and compare big to small, or follow lines from beginning to end and note direction. Data visualization takes advantage of these powers, and has flowered with the Internet. Beyond the simple line graphs that once characterized financial news, we now have heat maps, interactive comparison charts and other data at the beck and call of anyone with an Internet connection. But visualization is more than the translation of mathematical relationships. It has a narrative power—even a mythmaking power—as ancient as humanity. I am referring, of course, to pictures; visual images command our attention and, when successful, are immediate and vivid transmitters of both information and emotion. To use the term Daniel Kahneman popularized in his 2011 book, *Thinking, Fast and Slow*, they activate the mind's emotional, instinct-based System 1, which "effortlessly originat[es] impressions and feelings that are the main sources of the explicit beliefs and deliberate choices of System 2" [page 21] – with System 2 representing the mind's more analytical and deliberative abilities. But illustrations don't stop there. They tend, in their composition, choice of imagery, and detail, to tell a story—one that steers viewers to more elaborate information that may appear as both numbers and words. The Visualizing Finance Lab chose to tie illustration to both System 1 and System 2 thinking, and analyze images in both contexts. Its first symposium, which took place in late October 2010, is captured in this book, which includes an edited transcript of the panel discussion, examples of the illustrations and data visualizations in an accompanying exhibition, and snippets of conversation engendered during a gallery talk with panelists and participants in the afternoon. The symposium ended with a workshop facilitated by Carl Richards, who is a financial professional, blogger, artist, and author of The Behavior Gap, an examination of how individuals sabotage their best financial intentions. Carl led us in an attempt to develop our own visual metaphors for financial terms, and his impressions of that effort are also recorded in this volume.

I attended the Visualizing Finance Lab's symposium as Carl's guest, and found myself becoming a participant—and eventually, a member of the Lab. The symposium took place just as I had resigned from a position as editor in chief of *Financial Planning*, a magazine for independent financial advisors. I had enjoyed a thirty-year career as a journalist and magazine editor specializing in personal finance, and one of the indelible lessons of that career was that all the explanations in the world were of limited effect unless you could make the audience focus on what you had to say—and the way to engage the audience was through vivid images that engaged them emotionally: evoking joy, fear, freedom, foreboding, anger, ambition, serenity, and other deep feelings. At the symposium, I was invited to join the panel discussion so I could describe the editorial process for assigning, evaluating, and editing financial images. Whereas editors and art directors in layout rooms everywhere discuss these issues in reference to individual images, there has been little academic attention to the nature of financial illustration as a body of work. I was thrilled and delighted that both academicians and artists were paying attention. Today, I no longer observe the financial world as a journalist; instead, I work within it, as the chief marketing officer for a financial services firm. In this role, as in my previous editorial career, imagery is as important as words and must partner with verbal communication. Most people assume that financial images refer rather nakedly to greed, which is far from the sole motivation for financial decisions. I look forward to working with the Lab as we analyze visual expression and develop effective ways to harness its power on behalf of citizen investors.

Gallery Talk

In the gallery talk participants assessed the effectiveness of each illustration in communicating a financial concept, and began to examine the interactions of economists, journalists, art directors, and illustrators in their process of creating visualizations that can deepen people's understandings of financial concepts.

Minh Uong:

I treat every illustration as if it's a billboard someone sees on the Long Island Expressway. If that image catches their attention, then I've done my job; if the reader flips right by it then I haven't done my job.

When I talked to my editor about what Collateralized Debt Obligations are, I found out that bankers come up with these bundles of trades that they don't understand themselves, and they're just hoping to pass the risk along to the next person. The image that came to my mind was just a big bundle of crap so I threw in all these turkeys and maybe even the kitchen sink. I went back to my arsenal of all the images I'd used in the past, and threw them together to make the bundle even more complex.

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"In Search of a Blue-Chip Bounty," Tim Robinson, *The New York Times*, October 8, 2006

Tim Robinson: This is from 2006, one of a long series on mutual funds in which I used a recurring image of arrows: sometimes positive, sometimes negative. My idea about the arrows came from the first piece, which occurred after a very bad quarter and I was thinking about Saint Sebastian—this very unfortunate fellow shot through with arrows. I related him to Joe Investor: someone who's basically uninformed but is trusting his money to mutual funds and hoping things go for the best.

In the image here things have been going well, but there's a cliff ahead and investors should be wary. This guy who's been carried away by his good fortune is headed for trouble, whereas the guy who falters anticipates the problem that is coming.

Tim Robinson:
(In this long series on mutual funds for *The New York Times*) I replayed the arrows idea (across each illustration) to get across to unsophisticated investors a gut level of "this is a good year, this is a bad year" very simply with facial expression or with a game of arrows' ups and downs.

Joanne Yoong:

There's no way for the person in this image to rationalize what's going on: there's a suggestion of victimization, when economic models fail to predict events.

This person could be a macroeconomist, not understanding what is beyond the surface that he thought was solid.

Lucas Bernard:

People in desperate situations tend to cling to certain popular clichés (or heuristics), but there can be danger in clinging to something that seems to make sense to us.

Aileen Heinberg
(Behavioral Scientist, Rand Corp):

In more emotionally-loaded situations individuals understand qualities rather than quantity and revert to rules of thumb. Illustration communicates very differently from a graph that would show a quantity.

"Where have all your savings gone?" Michael Morgenstern, *The Economist*, December 4, 2008

Marion Asnes: The black hole resonates on many compositional and symbolic levels, including the baby down the well. This human subject has no tool with which to grasp what has disappeared down the River Styx.

His attitude is one of despair and submission: a person who is not in control, like a 19th-century Dickens character. The emotional resonance is very profound.

Tim Robinson: Compositionally the hole doesn't open straight down; it's opening a void. There's an ambiguity of surface as thin crust rather than solid ground, just a shell, something that could be broken away.

George Washington is inside the bubble; there's a boundary between him and Mao and neither wants to get into the space of the other...

I see references to Warhol, to opium wars, to Chinese production, and to American waste

Audience comments:

The viewer intuitively knows that something's not right here...

Panel Discussion

Joanne Yoong, Associate Economist,
Financial Literacy Center, Rand Corporation

Jonathan Jarvis, Interaction and Media Designer

Lucas Bernard, Economist, The City University of New York

Marion Asnes, Editor-in-Chief, *Financial Planning* magazine (now Managing Director,
Chief Marketing Officer, Envestnet, Inc.)

Minh Uong, Art Director, *The New York Times*

Tim Robinson, Freelance Illustrator

Moderator:

Carol Overby (Co-director, Visualizing Finance Lab),
Assistant Professor, Finance and Accounting, Parsons
The New School for Design

The panel discussion in this symposium highlights factors that suggest that illustration and drawing can help to facilitate access to emotional aspects of financial understanding. These factors include

• That illustration is a primarily-emotional communication, as distinct from the primarily-informational communication of data visualization

• That "the emotional effect that people take from [an] image actually affects their decision making" (Joanne Yoong)

• That informational and emotional processes that allow illustrators to create their work are very important to the outcomes of this work

• That the editorial process typically aims to clarify narrative intent while modulating emotional intent

• That drawing is a different and potentially-efficient means of understanding and communicating difficult concepts (Jonathan Jarvis)

Moderator, Carol Overby: Panelists, please tell us how your work relates to the creation of visualizations, and to their effect on people's understandings of financial concepts.

Joanne Yoong: I'm an associate economist at the Rand Corporation. I work with a behavioral psychologist in the financial literacy sector at Rand; also in the Center for Financial and Economic Decision-Making. The Center brings together economists and behavioral scientists to understand what motivates ordinary people's decision making.

Minh Uong: I'm the art director for the New York Times business section. Every day I find it very challenging to illustrate stories—to think visually about them. I'm glad that I can use my background in illustration and apply it to financial understanding.

Jonathan Jarvis: I'm an art director at the Google Creative Lab, and run my own practice, called the New Mediators, which is about visualizing complex situations clearly. Often those are financial concepts, as in my animation "The Crisis of Credit Visualized."

Moderator: Jonathan became famous for this animation, which you can see out in the hall. Many of us have found it to be an excellent teaching tool for financial concepts.

Tim Robinson: I'm a freelance illustrator who often deals with financial situations. It's fascinating to me to find out that there are so many people thinking about visualizing finance because as an illustrator, you sit alone in a room thinking about your problem, and sometimes you wonder whether the relationship between your drawing and the subject is relevant to anybody else.

Lucas Bernard: I teach business and economics at The City University of New York. We've been trying to discuss financial economics with people at many levels—college, MBA, and in business—for quite some time.

Moderator: These panelists are going to talk about the process of communicating financial concepts through illustration. The traditional method is for economists and financial professionals to begin by formulating an idea that they want to communicate to the public. Regarding that traditional process, let's explore how people like Joanne and Lucas conceptualize financial and economic concepts and begin to visualize the concepts in their own imaginations.

Joanne Yoong: We economists have a fundamental idea that a household maximizes its personal utility—subject to some kinds of constraints—and we derive implications for certain behaviors and for different settings. So when we think about risk, for example, we form all kinds of expectations about how people will behave under different scenarios. Our ideas about visualization are very often about mathematical graphs and financial visualization tools that have existed for many years. However, when we actually talk to ordinary people about a concept like risk, we find out they have a very amorphous idea about it: it's a cloud that hangs over their heads, not a mathematical concept that they can easily understand. What's really exciting about this meeting is bringing the concepts to ordinary people, and crossing the divides between mathematical/technical language, verbal language, and visual language.

Lucas Bernard: Economists still have a bit of a love affair with creating a scientific world with mathematical-type models, and went a little overboard with mathematization. One of the things I noticed about the illustrations in this room was that many are, in my view, static shots of states of affairs in the world. Visualizing finance is a broader concept than just describing such states of affairs, and involves the passage of time. And so it seems to me that one challenge is to incorporate the idea of the passage through time into a static image. Another is to incorporate multiple possibilities into a single picture.

Many financial concepts are complex, but not necessarily incomprehensible. It is perhaps easier for economists to think about those concepts in mathematical terms because that is the language we speak, but many of those concepts can be made clearer. We also have to remember that the range of financial awareness is quite broad. There are people who have no idea, but there are many, many, many people who work in finance and have some degree of knowledge.

Moderator: Let's turn to the designers and art director. How do you start to understand financial concepts?

Jonathan Jarvis: When I began the sketches of what eventually became "The Crisis of Credit Visualized" I was in my studio listening to National Public Radio. And I heard the term "subprime mortgage" for perhaps the 500th time. I realized I didn't actually know what it meant no matter how many times I'd heard it, so I looked up "subprime mortgage" online. I found "it's lower than prime mortgage" and I snowballed down this fascinating path of financial terminology. I began drawing maps of where the mortgage goes: from the originator to the banks and eventual investors, just getting into it. After two weeks I was answering my friends' questions about subprime mortgages. And I took a step back, and as a designer thought "well now I can explain this to everyone who pretty much has no clue, who is like I was two weeks ago." The drawings grew into my graduate thesis and then into a video that has become very popular.

Moderator: So do you think that naivete about concepts can be really useful? How do you even begin to talk to experts about the concepts they want to convey?

Tim Robinson: There's a difference between a visualization that completely explains sub-prime mortgages, and a picture that's just a gag. First of all, when you're doing a video, you have hundreds of images, so you can explain a lot. What I do, with a single image, works on the level of a much more common way to look at these things: I'm looking for the joke. Or I'm looking for that dark sensation. These are two very different reasons to use illustration.

Moderator: So, information and emotion. Which ties to what Joanne is working on.

Tim Robinson: Right, yeah. I don't see any emotional graphs. And I don't see a lot of really truly informative spot illustration or cover illustration. Maybe I'm wrong but I see them as two different things. And if I were called upon to disseminate some really technical information, I would be fired.

Moderator: Minh, you deal with both of these.

Minh Uong: Tim and I have different approaches to concepting finance, and the combination of tools we use. For example, I had to illustrate the ten-year anniversary of the merger of Citibank and Travelers, an insurance company—a very big, big deal at the time. And they said that the merger was going to drive up all the stock of Citibank, but after ten years Citibank stock dropped to something like—I don't know—99 cents or something.

Moderator: Where did you get your information for the illustration?

Minh Uong: I talked to the writer. As a visual, I wanted to do something with the Travelers umbrella itself. Citibank now incorporates the umbrella in their logo—that's where you see that red swoosh above their logo. We had brought in an infographic person to track the past ten years of how well or how not so well that stock did after the merger. But my thing was, even though we had the statistics on the page, I had to have something to really drive the reader to the story. So I went out and bought a red umbrella. And I sliced it up. And managed to fold it in a way that looked like the Travelers umbrella—only torn to pieces. And then we photographed the torn umbrella, and that was the visual anchor for that story.

Moderator: So you took the Travelers symbol and performed a symbolic action on the object. and then transformed that into a visual statement.

Minh Uong: Because the idea of the piece was that it was a disaster of a merger.

Moderator: So it sounds to me like you took on the role of the general public, the viewer. You heard from the writer what happened, and you had an emotional response. You also pulled from your own metaphorical library, and then worked with the illustrator's compositional vocabulary in order to put the visual together.

Minh Uong: Yes.

Moderator: Whoa, a lot of steps.

Minh Uong: Yeah, it's fun.

Moderator: Was there a point where the communication was breaking down? Lucas and Joanne should come back and talk about how they can translate, but the person we're missing today is the financial journalist who processes this information. Marion Asnes should join us.

Marion Asnes (off camera): Is there room?

Moderator: Sure, come on up, and tell us a little about yourself. We told everyone this was going to be an informal conference.

Marion Asnes: I've spent nearly 30 years writing, editing and speaking about personal finance: most recently as editor-in-chief of a magazine for financial advisors called Financial Planning and before that as senior editor at Money magazine. I have just accepted a position as chief marketing officer at a financial services firm called Envestnet. As a magazine editor and now as a marketer, I have to be fluent in both the technical language of finance and the emotional, metaphorical, and compositional languages of design and illustration.

Lucas Bernard: I'd like to interject that I think we're getting a little confused about the difference between financial news, and financial concepts. This is something that affects illustration in the sense that they are very different things. When you talk about Citibank and whatever happened, that's financial news. But when you talk about what is a credit derivative, what is a mortgage-backed security, this is a serious financial concept, and there are aspects of it that can be understood, and illustrators can play a role in that.

Moderator: We may be proposing that even in financial news, the illustrator can get across financial concepts. Marion, what do you think?

Marion Asnes: Illustration can and should translate concepts as well as news. In addition, one of the things Minh's work shows is that, over time, art directors become very sophisticated about financial concepts almost through osmosis, and illustrators do too. You've all become more educated, and that's very important. Essentially, illustration is emotive and emotion has a very powerful purpose in journalism. As an editor you're thinking about illustration as a visualization that's going to get the reader to stop flipping pages and pay attention, because we're all distracted now. The way you get people to pay attention in our world is with an arresting visual image. Ideally, the image should also communicate a vital concept in a lightning way, through metaphor. So to go back to Minh's Travelers umbrella, it works: It's dramatic enough to get you to focus, and you understand the message instantly—this was a disaster. Now, as a reader, you're hooked, and you'll take time to absorb the information in the story. Or so we hope.

Part of the reason we're in financial trouble today as individuals and as a nation is that people don't take the time to understand the concepts and use them to make wise personal and political decisions. So once your attention is engaged, you do need that second level of thinking and information transfer. A lot of that has come through graphics, which provide much more complex information and that have a different level of intellectual decisions behind them. But both illustration and graphics are extremely valuable.

Joanne Yoong: Part of what we're hearing is the dichotomy in some of our language between data visualization and illustration. And the images as an explorative tool and the role of emotion in these things. I also want to say that I have seen some very emotional graphs.

Moderator: But you're an economist.

Joanne Yoong: That's true. Maybe that says something about me but you know what they say, that there's lies, damned lies, and statistics. Part of the lies are the visual lies that people tell with graphs. People who do data visualization use elements like scale, comparison, and what kinds of axes they choose: exponential, logarithmic scale, linear scale. These choices have a real effect on what viewers get out of a very basic graph. So in some sense I think that we differentiate between the image as a quote and the image as an exploratory tool. And I think that when we pass one off as the other, that's when we get into trouble.

Marion Asnes: I could add one thing to second that: when we are in the office talking about stock charts we call them fever lines.

Moderator: Minh, I was really struck with the way you described this process—from the theorist or the expert, to the writer, to the art director, to the illustrator. I wonder if our illustrators could say something about whether it's important to have art direction in this lineup, or whether they're able to talk directly to a writer, or whether they can go directly to theorists. Jonathan, you partly answered this so maybe Tim has something.

Tim Robinson: Well, it's newspaper work, so it's often very quick turnaround. I don't generally get anything more than the article and a discussion with the art director. I can't recall a single instance of a conversation with the writer of the story. These could be political stories, or economic stories, or financial stories, but that's just not how it works. They call you, you speak to the art director, you get copy, and you have a deadline. I think most illustrators work alone so mostly we're speaking to art directors. In Minh's case, he's both.

Moderator: So when you have questions about the content, who do you ask?

Tim Robinson: Uh, my wife (laughter) who does happen to work in the finance industry and has a better understanding than I do. But I'm supposed to be hopefully a little light-hearted or funny about this. And she doesn't think any of it is very funny. So I think it's important to know what's expected of you, and they're generally not asking me to explain the financial concepts that Lucas is talking about. They're asking me for a snapshot, so I need to digest this particular article—not its substructure—and identify what the article is saying. It's all there in the lead paragraph if the story is written well, and I think an illustration should somehow pander to the lead and then hopefully to the headline.

Moderator: As Marion represents the journalists, let's hear from her and then go back to Minh.

Marion Asnes: I want to talk about the other side of that process. I'll sit with the art director and we'll have conversations about what the story is about. I try to explain the main ideas that will jump out of the story. Then when the sketches come in, I will go through them and give some more direction like, "Make the little guy even littler, because in this piece he's overwhelmed." When I think it's not working at all, I'll either talk to the art director or write a memo that the art director forwards to the illustrator, explaining the story and what I need the illustration to do. This is just the reality of media. The relationship is between the illustrator and the art director, so the art director manages the communication.

Minh Uong: Well, in my situation the editors and the writers are right there, so I can walk over and talk to them about an article that they want me to illustrate. But usually writers have about 100 words to sell the theme to me. It's up to me to come up with an image that sums up the gist of the story, because as Tim said, you can't illustrate the whole story. It's just, what is this story about? For example, with Citibank, it's about the merger being a disaster and that's what I have to show. In a way, sometimes talking to the writer is more confusing. I prefer to have them give me only a paragraph or two and say, "come up with a visual for this," because there's one image; you can't show everything. Except that one (points to "Bundle Ball" image off-screen) where I did actually show everything.

Moderator: So there's one more layer of communication that you're adding here: distilling the article itself into one or two paragraphs to communicate to the art director and the illustrators. One of the questions that we're looking at in our research lab is whether we can develop a vocabulary to assist communication across the layers between finance and illustration. So I'd like to ask each of you, what kind of language barriers do you find when you try to communicate all the way from expert to illustrator? Minh, you have layers of translators and have nailed the problem to some extent, so we'll start with the economists for examples of communication problems.

Lucas Bernard: I have some thoughts on this because a lot of financial stuff concerns issues of risk, and necessarily statistical and probabilistic thinking. Maybe you've seen Nassim Taleb's books *Fooled By Randomness* (2001) and *The Black Swan* (2007). There's been a lot of discussion in recent years on what is actually meant by statistical and probabilistic thoughts. I find that in my class, when trying to explain concepts like confidence intervals or value at risk, students don't understand because they have very naïve ideas of statistical and probabilistic reasoning. And sometimes the concepts can be made much clearer with illustrations or sort of common-sense descriptions that might be verbal. But I think that a lot that can be done along the lines of making statistical and probabilistic thoughts and expressions more common knowledge to the average person.

Marion Asnes: I would say that the one barrier people have to get over is their own resistance to foreign information. I think it's kind of trendy to say "I don't know anything about money," but money is an essential element in the lives of everyone in modern society. And all of us can understand more than we thought, if we choose to think about it creatively and intelligently. For example, I was at a conference recently where economists and investment managers were trying new ways of mapping out Monte Carlo simulations that take into account fat tail. The jargon I just spoke is a very fancy way of re-examining the likelihood that specific investments will be successful. Since 2008, experts are revisiting these calculations, which underestimated how often terrible things happen in the markets. So these experts asked, "how can we recalculate risk and make the answer more meaningful?" There were a lot of equations that made me think, "now I have to go to remedial math camp." But I just had to listen and look at the graphs. Eventually I was able to make some sense of what they were doing. All of us have to be willing to take ourselves to that more open place, to say I will risk investing that little bit of extra effort to figure it all out. Once you do that, you do get very compelling ideas that can generate great images. We've all been trained to think, "this is incomprehensible so I'm not even going to bother," but it's not as hard as we all think.

Moderator: Tim, when it comes to translation vocabulary we know you have your wife as a private translator. But what other instances have you found of problems with communication and vocabulary or of ways to overcome them?

Tim Robinson: Well I was thinking that the mediators, and the really essential decision-makers, are the art directors. It's their decision, who they're going to call to make an image. If they have something very serious to impart, they're not going to call someone outrageously silly like Elwood Smith; they're going to call someone whose images have a history of steering people to the serious. So I won't really ever have breakdowns in communication with art directors, because if they're good at their jobs they know how to talk to artists. And if you're a reasonable illustrator you know how to listen and put your ego aside when you hear "That first illustration missed the mark—and by the way so did the second one." And so you just proceed until you come up with something that the art directors can wrap their heads around and take to the editors.

Moderator: So what both you and Marion have said is that you should be willing to listen, and learn, and be wrong, and try again.

Tim Robinson: Oh, absolutely. There's no way you're going to hit the mark every time you scribble down a notion. No way.

Moderator: Jonathan, what can you tell us about communication and vocabulary and how you get through to people. You must have gone to some experts for feedback.

Jonathan Jarvis: Oh yeah, absolutely. I have a similar situation: my brother is an investment banker, my roommate, my friend. But I take Lucas's point of defining vocabulary. There's a big difference between financial news and financial concepts, and there's also a big difference between a hook image, and an information graphic. An information graphic is really the writing—it's the content. You can differentiate between what you choose to record and what you choose not to record. And it gets really interesting when you combine the hook and information roles: when the art director or the illustrator isn't being asked to do something they're the one initiating the questions. So when I go to economists and bankers, my job as an illustrator is to distill that information into language that anyone can understand. And I think that in a lot of information graphics, the icons—houses, people, however you decide to visualize mortgages—can just be replaced with mathematical symbols and you have pretty much the same thing. But the illustrator's job is to do a bit of interpretation and to simplify.

Moderator: I want to come back later to this idea of the illustrator and the art director being the ones to initiate the project, but first I'd like Minh to talk to us about the communication and vocabulary issue, because Tim has already told us that you art directors are the heroes.

Minh Uong: I'm no hero. All of my experience as an art director at the Village Voice was about learning which artists to assign to which stories. I get a story and pass it on to the illustrator, but before I do that, I pick the style of illustrators out there that I think would be right for the piece. Like Tim said, I'm not going to go find a comical artist for a very heavy piece on violence in America. So that's the first thing, to pick the right person for the job, and then to bring out the best in that person who's being used for the article. Then I become a mediator between the sketch and getting it approved by the editor, and if the editor doesn't like the concept, I have to go back to the illustrator and tell him or her that they didn't get it or its not what we're looking

The process of drawing itself is a powerful learning tool, but acquires a sort of hyper-efficiency when it creates a tangible visualization that's useful for everyone.

for. So I think I'm in the middle. I think I understand what its like to be an illustrator. And also I'm this person behind the scenes, who satisfies the editor. Actually you guys, the readers, have the ultimate say, but I have to satisfy my editor to have him approve the concept.

Audience Member 1: As someone who does research and visualization for my work, I find that it's not until I start to draw that I really start to understand the numbers. And that process has been very useful not only in making sure I really understand this information but also that I understand it well enough to explain it to someone else. But instead of explaining it verbally I do it through my data visualizations. I noticed out in the hallway there are examples of classwork in which students were asked to draw concepts from economics or finance as a way of demonstrating their own insights. I'd be curious to hear if other people have that experience.

Jonathan Jarvis: I would completely agree. In fact, it's the story I drew—the lifespan of a mortgage—that made me finally understand it. And it's one thing to do it as a learning tool. But it's interesting that when you do this process that's useful for yourself, you create something tangible that's useful for everybody. So it's this kind of hyper-efficiency, if you can work in a way that's a manifestation of a process that might normally get thrown away. You can imagine an artist designing a poster, with that wonderful process of trying things, erasing, trying again…. If you had a video of the whole process, maybe you'd time-lapse it because it takes so long, but it's a beautiful thing in itself, watching somebody work. And so if you're talking about finance, there might be an artifact that we usually throw away, but maybe if you can work in a neat and orderly way, or maybe if you're visualizing data, and you're being accurate along the way, that's kind of both processes in one.

Marion Asnes: A lot of things that we think would be easy to explain verbally, in a kind of linear verbal narrative, are actually much more effective if they're shown as a shape. If you're looking at the weather over the past fifty years, you don't want to look at a table of average temperatures, you want to see the chart for an instantaneous grasp of a great deal of complex data. We are visual pattern-finding animals. That's how we found fruit and ran away from tigers. It makes sense that we would be able to comprehend a great deal of data more effectively in that visual fashion. Words are not always the way.

Lucas Bernard: I'll add an example that is not exactly about data. When we look at mortgage-backed securities, we see investors taking some very complicated positions. Sometimes their choices are based on something called correlation between the defaultable assets, whatever they may be. To explain this concept mathematically is very complex, to explain it verbally is almost impossible, but there's a very cute illustration of a cat walking across a room filled with mousetraps. And by considering the difference between a young cat who still has all nine lives, or an old cat who has just a few left, you understand immediately the nature of the positions different investors are taking, and why they might prefer one position to another. So this illustration is better at conveying the concept than any other way. Now, how the illustrator produces this in some sort of systematic way, I have no idea, because I never would have thought up that illustration on my own. But it's very effective and it demonstrates the value of good illustration in explaining financial concepts.

Moderator: Let's hear from Joanne about communication and vocabulary, and then we'll open it up to questions.

Joanne Yoong: There are three points that I wanted to tie up. One is that, indeed, I think visual language is extremely important in describing economics in a very fundamental way. We know that the human brain is not hardwired to understand probability in verbal terms. So when we teach a basic game-theory class, we map all the different players and all the different strategies into a diagram. The mapping is a fundamental teaching tool. When we try to understand concepts of beta probability, we're thinking about conditional probability in different states of the world, and if we ask people to map out all the eventualities themselves they understand much better than if we tell people what those probabilities are. And this advantage of visualization isn't about not being an economist or a statistician, it's about being a human—the basic biology of the way our brains are made up. So that's one point.

The second point is that we fall into a trap: we assume that the complexity of the financial or economic world is going one way, to the world of visualization. Often economic models are oversimplified; they're stylized models, which a common-sense person will look at and say, "that's not realistic." Sometimes the problem is not about capturing the full complexity of the economic model, but about taking the very stylistic facts of the economic model and relating them to ordinary people in a context that makes sense. And also, to be fair, financial professionals or economists use shorthands that come from mathematics, but all specialists have shorthands that are very useful within their own disciplines—whether economics, statistics, comparative literature, or illustration—and I think it's imperative that we step back when we talk across disciplines and say "well, what is logic and reason and understanding and what about this shorthand makes it simpler to some people but more complicated to other people?"

And the third point is, when people are communicating—verbally or visually—it's imperative that they ask, "what are we using this for?" Are we communicating in terms of emotion? Are we trying to evoke emotion? Are we trying to manipulate emotion? And as a designer, I would think, that's the first thing you want to know—what am I going to be using this image for?

Moderator: Nice summary Joanne, and a nice segue into taking questions and comments. ...

Audience Member 2: I want to make a comment about where design education should be headed. You're all talking about illustration, but people are walking around now with iPads and iPhones. So it seems to me that people are not going to be looking for illustrations anymore; they're going to be looking for "You Tubes" that explain things, like the interactive work you did. And I can't imagine that magazines will continue to be as static as they've been; they're going to move toward short and understandable animated pieces. I go to YouTube anytime I want to understand almost anything now. And it's in one minute; you go on and someone has done this amazing animation and all of the sudden you're an educated person. So I'm just wondering, is this where design education should be headed?

Minh Uong: Yes, right. In the future, it will be more than just an article printed on a piece of paper, and you'll have multimedia in it so you can tap into all these links that are related to the story. But that still requires a piece of art to go with a certain story. So that won't change, probably. There will just be more links to everything else, so you'll finish that story a day later, rather than just reading for twenty minutes. So I think that's the part that you were addressing.

Jonathan Jarvis: Your comment reminds me of some dreams that I have. One, is that I can't wait for the day when I have an economics textbook in front of me and I can tap on the demand line and see the supply line vary. Also, YouTube is the second largest search engine in the world. People are searching to learn, not just to watch a cat play a keyboard. So it's definitely a trend.

When you make an animation, you first write it basically. Sometimes you're writing in words; the script to The Crisis of Credit video is half drawings and half words and that's how I put it together. And so it's just an article using a different form of language. It could still be printed, because when you're on the subway you're not going to be blasting your speakers and watching videos…so it might be easier to read it in that case.

Audience Member 3: I'd like to ask a question that turns the panel discussion a little bit on its head. We've been talking about taking content and then illustrating it in a way that enriches understanding of the content. But I'd love to hear about an incidence of visual content actually influencing the financial content, and whether it's possible to have more of that in the future from the creative and intelligent people who do visual work and see the world differently.

Lucas Bernard: Someone who teaches here at Parsons did photographic studies of time—of people moving through an airport. And I realized that when you look at the composite picture you see different paths but none of these paths took place at all. Embedded in the images were very subtle changes. If you were to look at the shadows, for example, you might be able to discern what happened. And I realized that this might be a good way to analyze a financial phenomenon. If you look at the whole mess carefully you might be able to see that the stuff you're looking for is actually encoded there.

Tim Robinson: If you're asking for personal experience, I've certainly never produced an image

that influences the writers to rethink what they're writing. But fine artists have definitely created imagery that makes people rethink the way they write about things because those images have made people reconsider their culture.

Joanne Yoong: I'd like to say that images do have a large effect on how people make financial decisions. If the image is part of a decision-making tool, the connection goes from image to behavior. The reason for information disclosure is that people believe that information affects financial behavior. Another stream of research that we've been doing with psychologists is that the emotional effect that people take from an image significantly affects their decision making. In behavioral finance they do this thing called framing, and in experiments a situation may be framed so that the last piece of information depicts hot or cold emotional states, which elicit very different responses—even my own responses are different. These effects might not last very long, but they may last long enough to influence a financial decision. We think that something called myopic loss aversion is very important to larger markets because when people see large short-term losses, as opposed to gains, they make very different choices. And so the images that can evoke panic may really affect behavior in a way that is very lasting; it's something that I think is very robust in our economy.

Minh Uong: There have been times when I've tried to run a interesting image but the editors shot it down. Once was during the financial crisis: a story about the total lack of confidence in the market, so I used the word "confidence" being flushed down the drain. The editors loved the image, but they said they couldn't run it because they had three stories all dealing with the same concept. I guess they could say it in three articles, but to say it in one image was too hot. Another time I showed a house upside-down, cracked on the ground, and they said no to that too. If it was up to me I would run it, but I guess The New York Times has certain limits.

Carl Richards: I have a file I call the Financial Pornography file, of images that make people want to make decisions that might turn out to be exactly the wrong decisions at exactly the wrong time. Remember the August 1979 Business Week cover, "The Death of Equities"? This was the classic, because when people saw the nose-diving stock certificate, it made them want to stay away from equities. However, by the time "The Rebirth of Equities" cover appeared in May 1983, the equity markets had risen nearly 60 percent. So I'm interested in how much you reflect about whether an illustration will influence people to do the wrong thing at the wrong time.

Tim Robinson: I've had the same experience as Minh: being told "no, as dark as this article is, you can't depict it that darkly." They always want me to bring in some angle of hope.

Carl Richards: If you look at 1999 and mid-2007, when the market was at its height, articles and images certainly supported buying. So journalism mirrors society's greed and fear.

Tim Robinson: I have a friend who's a very savvy investor and when he sees bleak articles and bleak imagery, he salivates, and is off to the market. So while I think that there will be

people who are influenced adversely, there's also a broad population that will recognize this as an opportunity.

Marion Asnes: Around the bottom of the market, Carl told me his clients wanted him to do "this safe guaranteed portfolio," while I believed that the market was so lousy that it had nowhere to go but up. I just started throwing my money aggressively into small caps, which are the riskiest stocks but tend to produce fat returns when the market recovers. So a lot of it depends on your audience: just as you always have to consider the source of your information, you also have to consider the recipient of your information.

Audience Member 4: I'd like to address a comment to Joanne because of her interest in financial literacy. Considering the power of images to persuade people, do you think that people who are less knowledgeable might be making more emotive decisions, while someone who is more knowledgeable is better able to act on and benefit from the opportunity of buying small caps, for example?

Joanne Yoong: Some of the work that we have done does suggest that those who are less financially literate are more susceptible in this kind of emotionally-charged situation. I don't think this phenomenon is specific to finance, I think it's something that the economic world sort of lives and breathes. But we often forget that images especially have power over people who don't really know what's going on. The problem is that this kind of influence is a very complex issue. Part of what we are trying to sell to policy makers is we can wield a kind of benevolent paternalism, to manipulate this image in a way that's going to help people make better decisions. But we don't always know what those best decisions are. Perhaps when Minh was working on that illustration, his editor thought it was a good time to steer people away from the market. I think we can't trust too much in our own discipline because I am an economist and oftentimes we don't have the right answer and other economists understand this. But many people don't. In some sense we already have an idea of what we need to do; however, the awareness that the images have power is something we need to maintain at a very fundamental level.

Mediator: That wraps it up for this portion. Let us thank our panelists.

Workshop

Carl Richards, Guest Workshop Facilitator

I always had this dream of taking really smart people from different disciplines, putting them in a room with no windows—I would shout "diversification," leave the room and come back an hour later to see what they came up with. The Workshop at the Visualizing Finance Symposium was like that. To introduce the workshop, I related the experience of the mother who asked her child why he didn't obey her when she told him to stay away from the corner. The child answered, "What's a corner?"

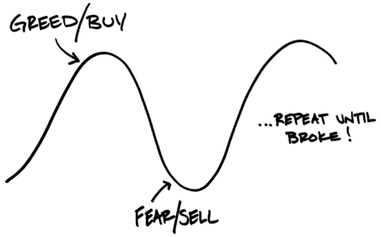
This failure to explain is a mistake we often make in financial services. The people who need to help individuals make sense of this world—whether a financial planner or other financial professional, an economist, journalist, or an academic—assume others know what they mean. We need a new framework for the discussion. Visualization is one route to that framework.

For the workshop, we organized the participants into teams with heterogeneous skills—drawing, journalism, scholarship—and we asked each team to illustrate a concept, such as diversification, leverage, or risk. The team chose one person to draw, but it couldn't be the self-described "artist." It was fascinating to see that, often, the people who were least comfortable drawing came up with the most explanatory images. Their discomfort with creating images pushed them to come up with simpler images. We had several constraints—limited tools, limited time, and in some cases, professed limited experience and ability—that worked to our benefit. By pushing to develop a new way of expressing these concepts we found new ways to understand. Serious economists and journalists found the perspective enlightening.

That's pretty impressive.

Carl Richards

Certified Financial Planner; founder of Prasada Capital Management; creator of the "Personal Finance on a Napkin" section in the "Bucks" blog, *The New York Times,* author of *The Behavior Gap,* 2012.



Carl Richards
"How Greed and Fear Kill Returns"

The New York Times, March 24, 2010

Exhibition

These illustrations were exhibited from October 20 to October 25, 2010 in the Arnold and Sheila Aronson Galleries, Sheila C. Johnson Design Center, Parsons The New School for Design. The exhibition pages showcase work not otherwise featured in this publication. For a complete list of works from the symposium exhibition refer to "Image Notes" on page 73.

Gary Neill
"Desperately seeking a cash cure"

The Economist
November 20, 2008

Belle Mellor
"Of froth and fundamentals: the real lesson from volatile commodity prices"

The Economist
October 9, 2008

Christopher Hitz
"Curtain Closer"

Forbes
March 29, 2010

Jonathan Jarvis
"The Crisis of Credit Visualized" (still)

crisisofcredit.com, 2009

Belle Mellor
"The IMF. Mission: possible"

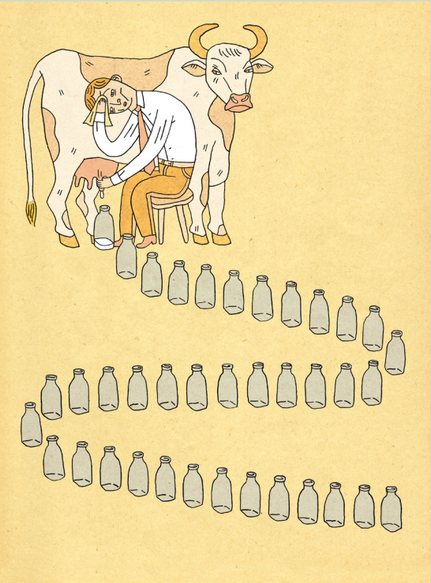
The Economist
April 8, 2009

Ian Whadcock
"Fixed-odds financial betting"

Investor's Chronicle
September 2008

Brett Ryder
"The data deluge"

The Economist
February 25, 2010



Nora Krug
"Odds and Ends"

The Deal
July 3, 2008

Narrative Visualization and Behavioral Economics: Metaphors, Frames, and their Influence on Financial Behavior

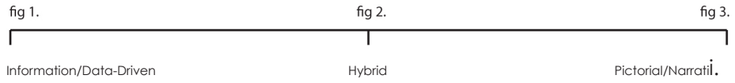
Abstract

We argue that illustrations depicting financial events such as those found in *The Economist* and other business journals are largely based on metaphors and, as such, access our emotional in addition to our conceptual understanding of the subjects illustrated. In addition to their potential to support understanding and retention of complex financial concepts, understanding through metaphors may affect our financial decisions, as suggested by recent insights in behavioral economics and cognitive neuroscience.

Drawing on Conceptual Metaphor Theory and research in multimodal analysis, we create a model and offer examples to explain how metaphors are articulated through the four domains of practice (discourse, design, production and distribution), as defined by Kress and Van Leeuwen. We discuss the ways in which metaphors frame understandings by simplifying and organizing concepts, while also investing them with rich emotional and culturally-freighted associations. We argue that metaphors, in all modes and domains of practice, create powerful interpretations because they seem to explain a situation as they frame it, thereby suggesting a range of possible responses to it. This idea in applied to the analysis of several recent financial visualizations. We discuss the basic tenets of behavioral economics, in particular Kahneman's recent work in two-system thinking, and the limits of human interpretive and decision-making capacity and apply these insights to suggest how the framing metaphors in financial illustrations may have the potential to affect viewers' understanding of the issues depicted, their emotional responses to them, and their subsequent actions.

Narrative Visualization and Metaphor

When the Visualizing Finance Lab formed in late 2009 to explore our shared interests in financial visualization, we adopted the term "narrative visualization" to refer to pictorial/narrative illustrations in the financial press. This seemed to be a useful phrase to allude to the story-telling properties of metaphorical devices found in these visualizations: devices that have historically been understood in written and oral rather than visual form. We later discovered that the term "narrative visualization" was being used by others to refer to storytelling with data-driven visualizations; these present, illuminate, supplement, or replace complex data sets and are commonly known as "information graphics" or "information visualizations" (Segel and Heer 2010; also Stanford VIS group http://vis.stanford.edu/). For the purpose of this essay we will identify the data-driven storytelling approach as the "Stanford definition" of narrative visualization, while characterizing visualizations that rely on emotionally and metaphorically influenced images as the "Parsons definition" of narrative visualization. We recognize the value of the "Stanford definition" frameworks for the analysis of data storytelling; however, their analysis does not emphasize the subjective and emotional experiences of the reader. Our "Parsons definition" focuses on the subjective/emotional dimension—a different but not mutually exclusive distinction. The "Stanford definition" addresses narrative devices, genres, strategies and structures in the presentation of data, asserting an authenticity and transparency implied by the more-quantitative techniques of data visualization (see Figure 1). In contrast, the "Parsons definition" examines the ways in which pictorial/metaphor-based visualizations trigger certain cognitive associations while suppressing others. In practice, financial illustrations lie somewhere along a continuum ranging from "pure" information/data-driven to "pure" pictorial/narrative, as exemplified by the three examples in Figures 1-3 below. Our interest is primarily in the pictorial/narrative orientation toward the right side of the continuum.



Information/Data-Driven. Figure 1 below exemplifies the movement of data over time. It maps the trajectory and duration of industrial production and consumption cycles from 1970 to the present, without readily apparent metaphorical content.

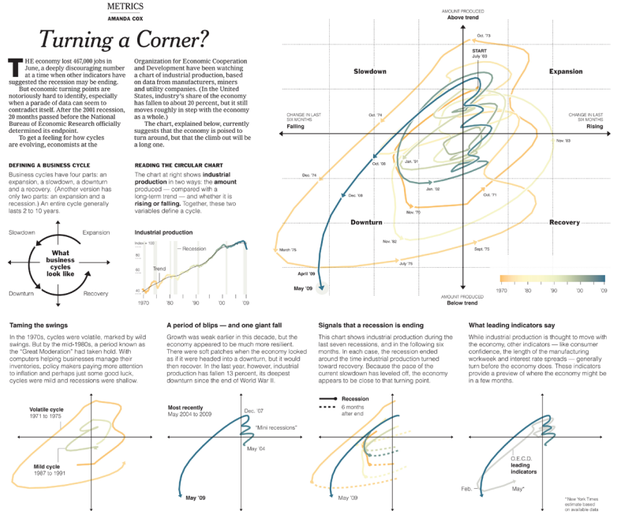


Figure 1. "Turning a Corner," Amanda Cox, *The New York Times*, July 5, 2009.

Hybrid. Figure 2 to the right illustrates how metaphors can be embedded as the interpretive engine of data visualization. This flow-chart plots the evolution of the 2008 financial crisis through two narratives, which develop over time. These narratives are composed of sequences of events that overlap chronologically: one fuels a speculative frenzy, the other results in financial crisis. Both sequences of events are framed by two overarching metaphorical associations:

color green = proceed/safe
ii. color red = stop/danger

As the sequence of events and actions accelerate, the background shifts from neutral, or possibly (clear) blue sky to green, and then from "blue sky" to red. Analysis of this image hints at an underlying tension between factual information (or data) and the subjectivity

Figure 2. "A Visual Guide to the Financial Crisis," *Mint.com*, November 13, 2008

The *Business Week* article accompanying the illustration (right), along with many related stories, led to widespread public outrage about the "$40 cup of coffee."

In 2011 Bank of America paid $410 million to settle a class-action suit filed against it (in one of more than sixty current suits against banks) over "$40 cup of coffee" practices in the computing of their overdraft fees.

of the metaphorical frame through which it is encoded, with the frame emerging as a form of master narrative that directs the complexity of the data in deterministic (some might claim, reductive) ways. The viewer reads this graphic top to bottom, the crisis being a descent or downward orientation. This visualization exemplifies a hybrid of presentational modes, mixing data visualization with implicit metaphorical content.

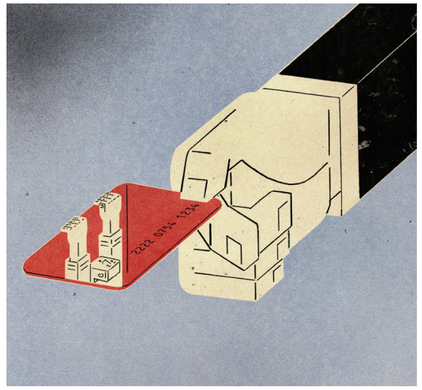


Figure 3. "Avoiding the Debit Card Trap," David Plunkett, *Business Week*, February 13, 2006

Pictorial/Narrative. Figure 3 above is rich in metaphorical content. This illustration shows a man hanging on to the edge of a credit card by his fingernails, a metaphor that can be understood in a very physical way. The rectangular shape of the card symbolizes an abyss, the color red is a socially understood metaphor (or sign) for danger. The card/abyss is proffered by an impersonal hand that represents the financial system as an oppressive and rigid machine. This impersonality is reinforced by the geometric mechanical line that outlines the shapes and the contrasting scale between the big man/big hand and small man/small hand. The article accompanying the piece explains how banks wait until the end of the business day to process all debit card transactions, rearranging their order to maximize the number of times that the customer is charged overdraft fees (see margin note on left). Figure 3 exemplifies the type of narrative visualization we are characterizing as the "Parsons definition" and that we describe in more detail in the following pages. Its narrative does not lie in the depiction of a linear sequence of events; rather, it appeals in

a very visceral way to our anxieties surrounding excessive debt, bank payments, and financial insecurity. The explicit use of metaphors is crucial to our understanding of how this image functions, because the primacy of its emotional content frames the financial content in ways that give rise to emotionally-determined interpretations and actions.

Psychologists in the cross-disciplinary field of Behavioral Economics have attempted to codify the ways our conceptual frameworks and emotional responses to money and risk affect our financial decision making at all levels and scales. Daniel Kahneman and Amos Tversky's early work on individuals' attitudes to risk and the influence of context on how they make decisions amounts to a serious challenge to classical economic theory and has, since the early 1970s, progressively influenced fields as diverse as medicine, law, political science, engineering, and environmental studies.

Using insights from Behavioral Economics, we assert that financial illustration can have a significant impact on opinion formation and decision-making. Therefore, understanding how visual and metaphorical resources are both activated and interpreted in financial illustration is essential to determining how these resources influence behavior. Awareness of their potential influence on behavior is, in turn, essential to improving financial communication, understanding, and literacy.

Discourse and Metaphor

Historically, metaphors have been understood as a feature of language and theorized within the disciplines of rhetoric and linguistics, the earliest recorded theory of metaphor being part of Aristotle's treatises on Rhetoric and Poetics. I. A. Richards (1936) provided a structural linguistic model that has proven useful for understanding metaphor in non-linguistic contexts. By the mid-twentieth century, metaphor theory expanded to include perspectives from philosophers, psychologists, linguists, and educators (Ortony 1974; Black, Searle, Shön 1979). These insights into the way metaphors affect the way we communicate, react to, and perceive the world, gave rise to Conceptual Metaphor Theory, or CMT (Lakoff and Johnson 1980), which asserts that metaphors structure the way we think, and that many metaphors have their origin in our physical experiences of the world.

In practice, it can be difficult to determine whether the associations suggested by a metaphor arise from sociocultural experiences, as suggested by language-based theories, or from physically-embodied experiences, as suggested by Conceptual Metaphor Theory (CMT). In "Avoiding the Debit Card Trap," Figure 3, do we equate excessive credit card debt with hanging over a precipice by one's nails because of evidence and stories that we have amassed showing that credit card debt can lead to financial ruin? Or is it because having high levels of debt gives rise to feelings of high anxiety and impending doom akin to those we would feel if we were literally poised to fall from a cliff?

Although there has been a longstanding study of symbol systems and pictorial imagery in art history, this rich consideration of visual metaphors has not been applied consistently to an analysis of other types of visual metaphor. Since the 1980s the emerging field of multimodal analysis has bridged this gap, providing a broader categorization and analysis of how visual metaphors operate within different contexts and media (Kennedy 1982, O'Halloran 1999, Forceville 1996, 2008, Jewitt 2009). Multimodality has developed as an umbrella term for research into communicative acts that, like many narrative illustrations, span at least two modes (Kress and van Leeuwen 2001). Within this broad field, a number of researchers (El Rafaie 2009, Forceville 2009, etc.) have studied multimodal metaphors as a subset of possible metaphorical acts within a wide spectrum of modes. Extensions of this work are being carried forward in the field of media studies, particularly in media theory and multimedia semiotics.

This shift in focus toward nonlinguistic forms of metaphor is a natural consequence of Conceptual Metaphor Theory (CMT), for if CMT's primary assertion that metaphors are bound up in thought processes is correct, then this interaction should extend to ideas expressed in ways other than the verbal. Indeed as Forceville (2009) remarks, research in multimodal metaphors redresses two major weakness of CMT: its reliance on linguistic evidence, leading to the conclusion that conceptual metaphors are an artifact of language rather than thought; and the possibility that crucial aspects of metaphorical acts will be missed by focusing only on metaphors in language.

Forceville defines multimodal metaphors as metaphors that are expressed through more than one mode. While some narrative visualizations we examine are multimodal, others are monomodal, lying solely in the pictorial realm. A number of researchers have analyzed metaphors in narrative visualizations in specific fields including advertising (Urios-Aparisi 2009), corporate branding (Koller 2009), emotions represented through Japanese manga (Shinohara and Matsunaka 2009), and in political cartoons (El Rafaie 2003, 2009). Recently, Bounegru and Forceville (2011) have researched recurrent metaphorical themes, such as natural disasters, in editorial cartoons of the current financial crisis.

To understand more completely the pivotal and multi-faceted role that metaphors can play in narrative visualizations, consider the example to the right. In this magazine cover, a financial bubble is depicted metaphorically as a gigantic bubble-gum bubble being blown by a young Chinese woman. A "correct" interpretation of this image depends on the viewer differentiating between those qualities of the bubble and of the young woman that are relevant and those that are not. Relevant interpretations may include the impermanence and fragility of bubble gum bubbles and, by implication, financial bubbles. Somewhat less relevant interpretations may include the fact that bubble gum is candysweet and seductive—and that it is a child's food, implying that those who buy into the bubble are unsophisticated or impulsive. Finally, very marginal interpretations may focus on the age and gender of the bubble-blower as the principal agent of inflation (of the Chinese economy).

In the diagram below, we visualize an analysis adapted from John Searle's (1979) interpretation of the empahsis and suppression of certain metaphorical associations in Romeo's famous utterance "Juliet is the sun."

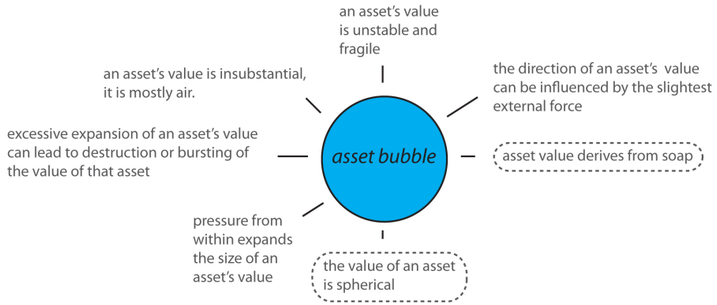


Figure 4. "The China Bubble," Joe Zeff Design, *Time*, October 31, 2011

Searle uses this to demonstrate the way that metaphors delimit certain associative possibilities: associations that are emphasized appear below as unbounded text; while associations that are suppressed by this metaphor are bounded by a dashed border. Here we apply this to the asset bubble metaphor. In Figure 4 (opposite), the combination of words and text cements the association of bubblegum bubble with financial bubble, creating a multimodal metaphor. The illustration draws from and reinforces a socially understood gestalt about financial bubbles. Moreover, the metaphor is constituted from a complex web of associations made up of both sociocultural experiences (children play with bubbles) and our physically embodied experiences with them (bubbles inflate, deflate and burst).

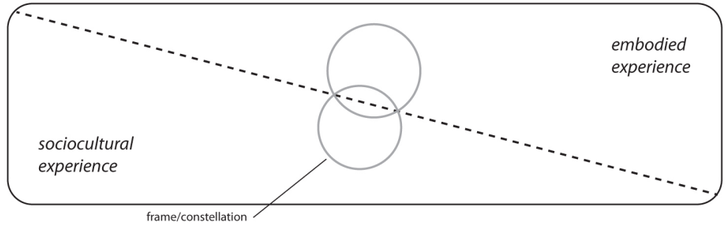
Metaphors such as this can also activate unintended associations. Donald Shön (1979) explores the impact of these in the framing of public policy debate. An example he offers is the metaphorical phrase "urban blight" which then suggests that "blight" should be viewed as an aspect of a wider "social pathology." This, in turn, defines the horizon of possibilities for "curing" a (social) "ill." He asserts that this conceptual shift occurs through a process of both frame setting and frame restructuring. In a more elaborated argument, Shön and Rein (1994) argue that real situations are often complex, vague, ambiguous, and indeterminate; in order to make sense of any situation one must select certain features and relations as the most salient characteristics of that situation. These features allow one to create a story explaining the situation. They refer to the process of selecting certain features as "naming and framing." Derived from a complex ambiguous situation, each story places the features it has selected within the frame of a particular context. These underlying contexts are the story's generative metaphors. Examples of these generative metaphors include the metaphors of disease and health, of sin and redemption, and of natural processes versus unnatural interference. Framing is necessary to make a complex and problematic situation intelligible. While frames enhance our capacity to make sense of a given situation, there are many situations that can be framed in varying, mutually incompatible, yet equally compelling, ways.

Frames simplify and organize concepts, while investing them with rich emotional and culturally-freighted associations. Metaphors, whether visual or multimodal, are powerful framing devices because

they seem to explain a situation as they frame it, thereby suggesting a range of possible responses to it. This is of particular interest to psychologists and behavioral economists who are concerned with the effects of framing on individual decision-making.

Frames and Metaphorical Constellations, a Model

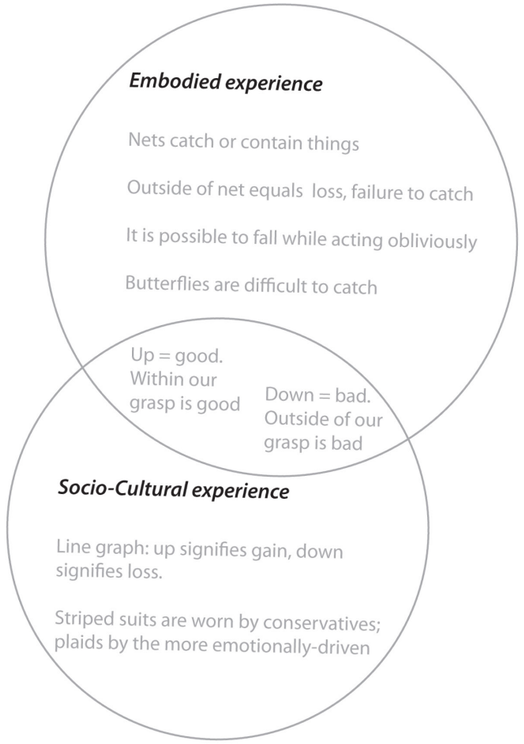
To clarify the context in which metaphorical framing occurs, we propose the following model, in which a given metaphor draws together concepts within a space that integrates both embodied and socio-cultural experiences. This single "field of experience" reconciles the "objectivist" or language-oriented theories of metaphor with the "embodied" or experientially-based theories.



We assert that metaphors are built from a clustering of associations across this experiential space. The metaphor acts as a frame (delimiting certain associations) while also simultaneously (generatively) drawing together (or re-combining) other asociations to create a constellation.

To demonstrate how this simultaneous frame/constellation functions, we consider the illustration on the right that appeared in *The New York Times* on October 8, 2006 as part of a quarterly report about mutual funds. The subject of this illustration is investors' relationships to the financial concepts of risk and reward. Two personifications of mutual fund investors approach the edge of a cliff. One is cautiously poised on the edge while the other is rushing happily and obliviously toward the precipice. Each figure holds a butterfly net containing a graph charting the performance of his respective mutual fund, or perhaps belief in future performance of it. The actions of the men's bodies and the directions of their gazes are interpreted by the viewer as metaphors for their behavior as investors. The man in the background appears cautious, wary of a sudden drop; his eyes

Figure 5. "In Search of a Blue-Chip Bounty."
Tim Robinson, *The New York Times*, October 8, 2006



Butterfly net frame/constellation from "In Search of a Blue-Chip Bounty," Tim Robinson (see Figure 5)

are fixed on the "downside" risk of falling into the ravine. In contrast, the man in the foreground appears reckless and his gaze is upward, riveted on a graph that depicts ever-increasing gains. There are layers of metaphor embedded in this visualization: the suited men personifying investors, the ravine symbolizing financial ruin, etc. However, we focus our analysis principally on the metaphorical associations drawn together by the central metaphor of the butterfly net. The diagram above, a close-up detail of the frame/constellation diagram embedded in the model on the opposite page, illustrates some of the associations that are drawn together by the metaphor of the butterfly net in Figure 5. Note how the associations are derived

from embodied and sociocultural experiences, and the associations that are relevant to both (depicted here as the overlapping zone in the diagram's center). In addition to the constellation elements, (e.g. nets catch or contain things—embodied), the frame/ constellation elicits associations (i.e. nets catch or contain thing; the net is a tool for catching things that are hard to catch; good investments must be pursued and captured. These particular associations are reinforced by the graphic element of the netting material that suggests graph paper. Combined with other metaphorical elements of the illustration (the physical actions and facial expressions of the suited men, the cliff edge), the images of the butterfly nets frame the insights that emerge in ways that simultaneously appeal both to our cultural and to our embodied understandings of gain and loss, caution and danger.

Multimodality

Analyses such as those in the two preceding diagrams address the metaphorical associations of the visual elements of the illustration. However, to understand more fully how the metaphors operate we must look beyond the formal aspects of the visualization to its context (its relationship to the associated article, its placement in *The New York Times*, the constitution and expectations of this readership, etc.). Kress and Van Leeuwen (1996, 2001) provide a framework for analysis of the communicative act across all types of media. Their multimodal framework encompasses the following four domains of practice (what the authors also term "strata"), which are the means of expression for the communication.[1]

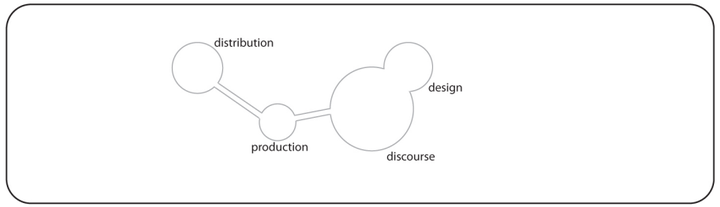
i. *Discourse* - or framing
Example: the "ethnic conflict" discourse of war

ii. *Design* - the structuring of resources within discourse
Example: a thriller in a setting of ethnic conflict

iii. *Production* - the organization of the expression
Example: black and white silent film of a thriller in a setting of ethnic conflict

iv. *Distribution* - the transmission of the expression.
Example: a single-night-only large-screen projection of a thriller in a setting of ethnic conflict, in a public square in Sarajevo

According to Kress and Van Leeuwen, multimodal articulations occur when various semiotic resources or "modes" (e.g. color, words, sound, gesture, line, layout) are drawn together across these four domains of practice, at a particular time and social context, for a particular purpose: see following diagram.



Metaphorical acts are present within all four domains of practice, but may arguably be most closely associated with the domain of discourse. Kress and Van Leeuwen define discourse as a "set of interpretations, evaluative judgments, critical or justifying arguments and so on." They further claim "discourses are socially constructed knowledges of [some aspect of] reality.... By 'socially constructed' we mean that they have been developed in specific social contexts, and in ways that are appropriate to the interests of the social actors in these contexts."[2]

This description provides a clear point of intersection between "conceptual metaphors," as defined by Lakoff and Johnson, and the domain of "discourse," as defined by Kress and Van Leeuwen. Both are formulations of discursive framing, and both are constructed from a range of sociocultural and embodied experiences of the world. However, in order for the metaphor to be expressed it must be communicated through the four domains of practice. Multimodality, or specifically the domains of practice, can be viewed, then, as a modifying filter through which the metaphor must pass. It supports the metaphor's associative action across the embodied-sociocultural field. As an example, a given metaphor in a narrative visualization may be framed through discourse. Its metaphorical characteristics can then be expressed through its design which draws upon the modes of color, line weight, line style, degree of realism. Its metaphorical significance is then further modified through the domain of production (qualities of ink, or pixel presentation) and then through the domain of distribution in magazine, broadcast media and/or web for particular audience(s).

Returning to Robinson's "Butterfly Net" illustration (Figure 5) as a modal discussion, the following table offers a modal analysis that addresses each of the domains of practice in this work.

	Modal Description	Domain of Practice
i.	The background sky is very hastily rendered, cueing us to pay closer attention to the line graphs primarily, and the figures secondarily through the devices of focal plane (achieved through level of detail) and color saturation.	*Design*
ii.	The imperfectly ruled graph paper inside of the nets evokes cheap math exercise books at school, and of the struggle to create graphs and charts.	*Design/Discourse*
iii.	The men's faces are highly stylized and not remotely naturalistic (see placement of facial features), but they remain recognizable. In this way we see the illustrator borrowing from the visual vernacular, and emotional hyperbole, of classic cartoons.	*Design/Discourse*
iv.	Dry pastel with assured line work was used extensively in American art direction of the 1950s and early 1960s, and the men are attired in a manner appropriate to this era, the illustration has a vaguely "retro" look. A reader could take this to mean that there is an essentially eternal, or at least historical, quality about investor response to risk and reward or, less probably, that mutual funds first gained widespread popularity in the 1950s.	*Production*
v.	*The New York Times* is a daily newspaper covering a wide range of topics for a general readership; and therefore both the subject matter and writing style of its financial stories is mainstream and accessible to a lay reader.	*Distribution*

Metaphors are generative in the sense that they are capable of creating entirely unprecedented constellations that in turn lead to new perceptions, explanations, and configurations. The early twentieth century "avant-garde" proposed just such a radical cultural reframing, the moment becoming an occasion both for the generation of fresh metaphors and for the cultural space that allowed for their interpretation. In his poem "Les Chants de Maldoror," Comte de Lautréamont famously inspired Andre Breton and his fellow Surrealists with his line "As beautiful as… the random encounter between an umbrella and a sewing machine upon a dissecting-table,"[3] this single line spoke to them of the possibility of new metaphorical associations. The Surrealists' use of collage in both literary and visual works was an expression of these associations.

The visual and metaphorical techniques of Surrealism, Dada, and Constructivism—the juxtaposition of seemingly unrelated images and materials to create unsettling new associations and emotions—has had a profound influence on visual communication during the century that followed.

Figure 6. "Two Children are Threatened by a Nightingale," Max Ernst, 1924

Figure 6 maintains the modalities of traditional Western portraiture or landscape painting. The framed panel uses the picture-as-window device with single vanishing-point perspective and local color, all features that we expect from centuries of Western figurative painting. However, the expected constellation of embodied-sociocultural associations is reconfigured: for example the nightingale, a bird traditionally associated with poetry (or poetic muse) in this tradition, becomes a creature that menaces two children.

In the 2010 touring exhibition *Surrealism and Graphic Design*, design writer and critic Rick Poyner explored the profound influence of surrealist visual techniques on visual communication across posters, prints, books, magazines, record sleeves, and typefaces from the 1930s to the present.

Poyner found numerous instances in which surrealism's jarring juxtapositions, uncanny and psychologically provocative combinations of image, material and sound, and even the anti-establishment shock value of its provocations (sexual and otherwise) created a new pictorial space which cultural movements have since occupied.

Figure 7. Otto, "A special report on banking in emerging markets," *The Economist*, May 13, 2010

Elements of surrealist collage technique can be seen in Figure 7. This visualization, which accompanied an article about banking in emerging markets, superimposes images of a lotus flower, a factory, green geckos, and engravings of currency. The fragments of currency act as smoke emanating from the factory smokestacks while at the same time completing the image of the lotus. Through these new juxtapositions, the lotus, a traditional symbol of purity and birth (and an immediate visual reference to Asia) becomes metaphorically associated with industrial production and its positive (productivity), questionable (capitalistic), and negative (pollution) consequences.

The metaphors underlying Figure 7, like those in most collages, lie primarily within the Domain of Discourse. However, collage was not the only technique employed by artists in the early 20th century to create new associations within domains of practice. When Marcel Duchamp introduced a urinal into a museum as the new work of art entitled *Fountain* (Figure 9) under the pseudonym "R. Mutt"

he proposed that the artist does not need personally to make the object, and that anything can be art if she says it is, and if the supporting institution (museum) also supports the credibility of this claim. Therefore, under these terms, even a manufactured object with aject associations (a urinal) can be reframed as art.

Figure 8. Marcel Duchamp, Fountain, 1917

A straightforward metaphorical reading of the urinal/fountain in the museum is that the fountains of antiquity have been replaced by urinals in the age of mass production. Analyzing this in terms of Domains of Practice, Duchamp introduces metaphorical shifts in the Domain of Production (the artist Duchamp/Mutt assumes the role that society customarily assigns to factory workers as "authors" of the urinal). He also introduces metaphorical shifts in the Domain of Distribution (the museum as arbiter of taste replaces the functionary role of public restrooms): we are not going to a public restroom to use a urinal, we are going to a museum to look at art.

In the twenty-first century, modal shifts and new combinations of associations within and across all domains of practice (discourse, design, production, and distribution) continue to proliferate through the constant creation of new forms of media, social discourse, and its articulations. The book you are reading is one such example in which we are attempting to shift from a traditional conference proceedings by "collaging" academic writing, exhibition catalog, and symposium transcript in print and online forms and by using new methodologies for soliciting peer review. We argue that such modal and domain shifts create new multimodal metaphors that are as powerful in creating new meanings as traditional metaphorical operations in language. Indeed these new media platforms sometimes use names that reflect these metaphorical shifts: the blog as conflation of (world-wide) web and log (book).

A refreshed metaphor:

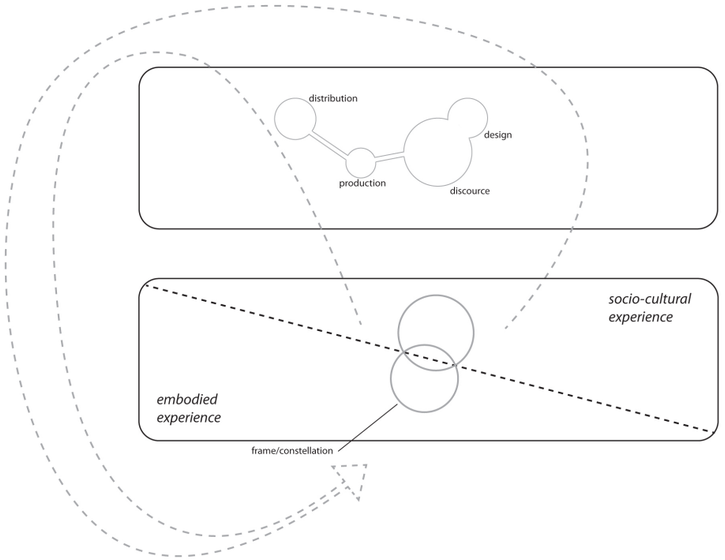
New York environmentalist Jay Westerveld first coined the term "greenwashing" in a 1986 essay regarding the hotel industry's practice of placing placards in each room promoting reuse of towels ostensibly to "save the environment." Westerveld noted that, in most cases, the actual objective of this "green campaign" on the part of many hoteliers was, increased profit, as cost savings realized through reuse were not shared with consumers.

Greenwashing could be considered a new metaphor that conflates two existing ones: "green," a frame/constellation that may include ideas such as nature, growth, new life, organic etc. with the metaphor of "white-washing," the act of covering a dirty surface with white paint, or of superficially concealing one's true intentions.

Repackaging and Reframing

An important function that metaphors play is creating new meanings and associations through the reframing of old ones. The expression "old wine in new bottles" metaphorically expresses this idea in which an old idea (cliché) is "repackaged." We can model this cycle by visualizing metaphors originating out of the field of embodied-sociocultural experience (page 50) and articulated through the multimodal field of the four domains of practice (diagram page 53).

As representations circulate in the world, within what Kostelnick and Hassett (2003) term a "discourse community," they pass into cultural usage and are eventually reincorporated (or co-opted) back into the experiential-sociocultural field. This process creates a "feedback loop" as the metaphor becomes one of many associations in the experiential-sociocultural field to be refreshed (or extended by new metaphors) and then "composted," (disintegrating for reaggregation into future constellations), or, alternately "dying" (by becoming implicitly understood). The model on the following page integrates the operations of embodied-sociocultural association-making that we have discussed, it illustrates the frame/constellation of a metaphor as it is articulated through the domains of practice and circulated through this feedback loop.



The term "dead" metaphor in linguistics refers to a metaphor that is essentially a victim of its own success. The metaphor has become so widely used that it has lost its metaphorical import: it is stale, and as such becomes a feature of normal language, examples include the terms "world-wide web" or "flower bed." Once a metaphor has died, it becomes part of the field of embodied-sociocultural experience, and hence has potential to be reused by new metaphors that "piggyback" on it through re-combinations of metaphorical association, or through modal shifts.

The history of the asset bubble provides a good example of this phenomenon. Originating at the time of the 1711–1720 British South Sea Bubble, one of the earliest modern financial crises, the bubble metaphor indicated that the prices of the stock were inflated (itself a metaphor for over-valuation) and therefore fragile. The metaphor was created from a rich frame/constellation of associations including the (embodied) idea that the basis of the stock value expansion was nothing but air, and therefore vulnerable to a sudden burst.

Figure 9. South Sea Bubble playing card, Thomas Bowles, London, 1720

Figure 10. "The new tech bubble," Jon Berkeley, *The Economist*, May 12, 2011

Figure 10 mounts a second definition of bubble onto the first one: the bubble surrounding and isolating the individual, derives from isolation tents (or bubbles) used to protect or quarantine people with either contagious medical conditions or immune disorders. This illustration also references the numerous instances in which bubbles are inflating, floating or being threatened with bursting.

An early depiction of the South Sea Bubble and its aftermath is shown in Figure 9 to the left. It is interesting to note that, typical of contemporaneous images, this illustration does not in fact depict a bubble but instead shows individuals tumbling into the ocean. The bodies are falling from a mast, alluding to the South Sea naval trade; they also appear as leaves falling from a tree, alluding to leaves of paper, or banknotes. The image engages the commonly-used wade/plunge/swim/sink/float/underwater financial metaphor. The caption that accompanies the visualization states that, "headlong fools plunge into the south sea waters," while the sly long-heads (wise investors) "wade with caution." We conclude from this that the bubble metaphor may have originated in writing or speech and subsequently been expressed and re-articulated both verbally and visually. Of note also is the mode of distribution as part of a set of playing cards, the meta-metaphor being that financial speculation is a game, specifically a game of chance.

In the centuries since the British South Sea Bubble, the bubble metaphor has "died" or been reincorporated into our common field of experience so that more complex identifications can now be built upon it effortlessly without the need to explain first what bubble means. The China Bubble (Figure 4) is a recent example as is Figure 10 (left). In the next section, we examine how the power of metaphor to frame interpretations has an effect on real financial behaviors, decisions, and actions.

Behavioral Economics, an Overview

In the early 1970s the underlying tenets of Behavioral Economics were derived from insights gained through a series of clinical psychological experiments about judgment and decision-making. Over the past forty years the field has gained momentum, in academia and in the culture at large, in response to a growing recognition that people do not act in the ways predicted by the existing model of economics. Those existing (Neoclassical) theories of microeconomics are based on implicit assumptions that people have unlimited information, resources, time and know-how to make optimal, or "rational-choice" economic decisions. The Neoclassical model assumes that individuals have well-defined "utility functions" that accurately reflect their preferences, and that individuals' actions are conducted in such a way as to optimize these utility functions. In other words, when

confronted with simple or complex situations, people will act in their own best interest, after weighing all possible alternatives. Herbert Simon (1957) suggested that when faced with complex situations, people make a number of simplifying assumptions first, before searching for optimal choice from among those remaining. He is credited with coining the term "bounded rationality" to describe the limitations that individuals face when making decisions, and his observations have subsequently been explored and verified experimentally by both economists and cognitive and behavioral psychologists.

Psychologists Amos Tversky and Daniel Kahneman (1974) studied peoples' systematic biases in the way they estimate probabilities and make choices. These biases include misunderstandings about the importance of sample size, the basic rules of probability, (including overestimating the impact of rare events), and a tendency to underestimate the magnitude of quantities they cannot easily envision. In "Prospect Theory: An Analysis of Decision Under Risk" (1979), they focused on how systematic biases affect the choices individuals make when selecting among several options. "People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting value to simpler judgmental operations. . . ." These biases, some of which had been previously noted, included the observation that people prefer smaller but certain gains over the uncertain possibility of larger gains, while also preferring a gamble on larger losses rather than face a smaller assured loss. They found also that people tend to make decisions based on perceived gains and losses relative to a fixed reference point, such as their current wealth, rather than on the final level of wealth resulting from their choices. In his 2011 book *Thinking, Fast and Slow* (275), Kahneman illustrates this idea in the following way:

Today Jack and Jill each have a wealth of 5 million.
Yesterday Jack had 1 million and Jill had 9 million.
Are they equally happy? (Do they have the same utility?)

Standard utility theory predicts that since Jack and Jill have the same wealth, they should be equally happy. However, experiments demonstrate that individuals in Jack's situation are likely to be much happier than those in Jill's, and that their appetite for future financial dealings will be determined not by their current utility (of 5 million

In a series of similar experiments using a keep-lose dynamic, Tversky and Kahneman tested the effect of emotional framing on decision-making in a number of contexts. In one variation of a set of experiments carried out by Tversky at Harvard Medical School, physician participants were given two sets of data about two possible treatments for lung cancer: surgery or radiation. The five-year survival rates favor surgery, but it is riskier than radiation in the short term. The first group read information framed in terms of survival rates, the second group framed in terms of mortality:

i. The one-month survival rate for surgery is 90%.

ii. There is 10% mortality in the first month.

84% of surgeons in group i chose surgery compared to 50% of surgeons in group ii.

Clearly, although both statements provided the same information, the framing of the risks had a large impact on how the individuals responded to this information, regardless of their training.[4]

each) but much more by the recent changes in their wealth relative to the "reference point" of their wealth the day before. Another factor that looms large in decision-making is the way that choices are made within what Tversky and Kahneman term a "frame effect." In their 1981 paper, Tversky and Kahneman describe an experiment in which individuals were asked to select one of two choices in two hypothetical scenarios, or problems.

Problem 1: You have been given $1000 and asked to choose between
(a) a 50% chance of gaining an additional $1000
(b) an additional $500

Problem 2: You have been given $2000 and asked to choose between
(c) a 50% chance of losing $1000
(d) losing a sure $500 [5]

The large majority of individuals chose (b) in Problem 1 and (c) in Scenario 2, however, a close look at the wording of the problems shows that options (a) and (b) yield identical outcomes, as do options (c) and (d). This confirms Tversky and Kahneman's observations that people prefer certain gains and seek to avoid certain losses but it also reveals that loss avoidance decreases when they feel weathier or when their financial "reference point" shifts. In this case, reference point is the state that gains and losses are measured in relation to. Reference point can also be likened to context, and to frame. Thus individuals' choices are affected by the way these choices are framed via the shift (between the two example problems) of the reference point.

To account for such biases, Tversky and Kahneman proposed a formal model "prospect theory" (1979) to explain how individuals make decisions from among discrete choices. The first stage (editing) involves the application of several principles or heuristics including simplifying (rounding dollar amounts), combining (conflating similar choices), cancelling (removing common elements from each option) and eliminating (discarding options clearly less optimal, or "dominated" by other options). The second stage involves deciding from among the edited options based on a value function—a mathematical modification of the Neoclassical utility function that accounts for the observed biases.

In the early 1980s, the economist Richard Thaler, working with Tversky and Kahneman, applied their notion of heuristics to a more systematic critique of current economic theory, and suggested a number of characteristics of economic behavior that could be tested empirically. Economists and psychologists have continued to theorize and test the way heuristic principles, framing, emotion and other factors affect peoples' decisions. Recently, for example, Roy Baumeister (2008) argued that individuals have a limited amount of self-regulation or will power available to them at a given time, which must be replenished before it can be called on again. This phenomenon, which he terms "ego depletion," attempts to explain why people often make prudent financial decisions regarding expensive purchases, while spending unnecessary money on smaller items. This point, which can also account for one's failure to stick to plans, is reiterated by Joanne Yoong in her (2010)[6] discussion of the effects of financial education on financial behavior.

Metaphor, Framing and Heuristics

What do metaphorical framings share with heuristics? As an adjective "heuristic" is often used to describe an entity that aids understanding of another entity. Heuristics are often viewed as "rules of thumb," principles that allow us to apply certain mental models to unfamiliar or complex situations. In this sense metaphors and stories can be seen as heuristic in that they are models for understanding the world. This assertion is supported by George Lakoff (2008) when he argues that framing has a neurological-cognitive basis that both metaphor and heuristics share. In *The Political Mind, Why You Can't Understand 21st-Century American Politics with an 18th-Century Brain*, Lakoff extends Conceptual Metaphor Theory through more recent neurocognitive insights, by stating that frames consist of "certain cognitive biases that are patterned in our brains through early exposure and/or repetition and reflect in-built aversions to cognitive load (or effortful thinking). The frame is activated when one thing reminds us of another thing which reminds us of another thing…"

Neurocognitive "heavy lifting" is largely absent from metaphor whether visual, semantic, or multi modal. Our intuitive comprehension of metaphors is, in fact, a perfect example of what Kahneman (2011) describes as System 1 thinking. The "two systems" approach to understanding cognition was first postulated by the psychologists

Keith Stanovich and Richard West (2000), and was later developed by other scholars, including Kahneman, who elaborates on it extensively in his 2011 book. In *Your Money and Your Brain: How the New Science of Neuroeconomics Can Make You Richer,* (2007), Jason Zweig decribes the two systems colorfully (and metaphorically) as "lizard brain" (System 1) and "mammal brain" (System 2). The key differences between System 1 and System 2 thinking can be summarized in the following way:

System 1	**System 2**
• Intuitive • Fast • Automatic • Effortless Without voluntary control	• Analytical • Slow • Careful • Effortful Requires high degree of voluntary control
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.	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 encounters a problem *it* thinks it can't solve.

Additionally and significantly, System 2 is lazy because thinking rationally is hard work. Effortful System 2 thinking tasks actually deplete glucose in the body, requiring us to replenish with sweets or other "pick-me-ups."[7] Kahneman states that "(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."[8]

Metaphors allow us to bypass System 2 thinking by mapping directly onto how we routinely engage with problems. In addition, the frame/constellation model of metaphorical association correlates strongly with what Kahneman terms associative coherence created by associative activation in System 1 thinking. Kahneman demonstrates this by the word combination: Bananas – Vomit.[9] "Ideas that have been evoked trigger many other ideas in a spreading cascade" (or constellation) of activity in your brain. Memories and emotions are evoked; sometimes you experience a physical effect (in this instance perhaps disgust and nausea). Psychologists see this as a nodal network "composed of many different types of links: causes to effects (virus – cold); things to properties (lime – green); things to categories (banana – fruit)." Neuroscientists have revealed that

this associative action occurring within the brain is complex and simultaneous. Thus when a metaphor is activated, its cluster of associations is mirrored physically by a web of neurocognitive connections that link in fairly predictable ways. We believe that visual metaphor, then, is the key to understanding the potential power of financial illustration for the following reasons:

i. By being visual, illustrative metaphors engage perceptual intuition. Color, texture, the angle of a gaze, the tilt of a head, all offer very subtle, yet unmistakable cues that are understood at the very instant they are perceived. To repeat, System 1 thinking is primordial: it will instantly detect a sharp look, a change in the environment, or a subtle variation in tone of voice. It does this extremely quickly (often in a fraction of a second), and is therefore a cognitive function whose development is strongly related to survival reflexes.

ii. By being metaphorical, illustrations are low on new skill acquisition and investment. Conceptual Metaphor Theory demonstrates that people already have an available storehouse of embodied understandings of the world (the learning completed since childhood) and additionally have an equally vast repository of the sociocultural understandings gleaned from thousands of hours of listening to others, playing, interacting socially, watching television, acquiring language, and schooling. By activating associtive memory, metaphors allow us to access what we have already learned (with considerable effort) and to bring together these elements more effortlessly in new configurations and contexts.

Frame-Setting/Frame-Shifting

As Tversky and Kahneman assert, our reliance on frames to interpret and make decisions is both significant and empirically verifiable because when the frame shifts, so do our decisions. In "The Framing of Decisions and the Psychology of Choice" (1981), they compare the consequences of a conceptual frame shift with the changes in visual apperception that are dependent on perspective. "Veridical perception requires that the relative height of two neighboring mountains, say, should not reverse with changes of vantage point. Similarly, rational choice requires that the preference between options should not reverse with changes of frame. Because of imperfections of human perception and decision, however, changes of perspective often reverse the relative apparent size of objects

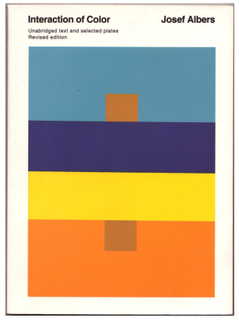


Figure 11. "Interaction of Color," Joseph Albers, 1963

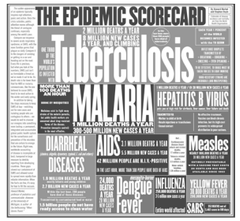


Figure 12. "The Epidemic Scorecard," Stephen Doyle and Howard Markel, *The New York Times,* April 30, 2003

This is a graphical comparison of the number of deaths due to the 2003 SARS epidemic relative to other diseases. It provides a good illustration of the "lie factor." Featured in Edward Tufte's blog on May 1, 2003, the contributing reader criticized *The New York Times's* "Epidemic Scorecard," stating that "a quick glance at the graph gives one the impression that the size of each epidemic's rectangle is relative to the number of deaths (or cases) associated with that disease." He continues, "a closer look reveals that there's apparently no such relation: Denge Fever, with 24,000 deaths a year, is about twice the size as Influenza, with 250,000 deaths a year. Tuberculosis and Diarrheal Diseases have about the same number of deaths, but

and the relative desirability of options." They note that once individuals discover that these visually-determined perspective shifts can create ambiguity about the relative height of mountains, these same individuals often reconsider their original assessments. Whether financial decisions can be similarly reassessed is another question; particularly since, as Tversky and Kahneman note, there are no measurable standards in such cases (as with the actual height of mountains). This phenomenon can be described by the metaphorical phrase "it depends on your point of view."

The power of visual images to frame our visual perception and interpretation has long been explored by artists and art historians. In his book *Interaction of Color,* Bauhaus artist and educator Joseph Albers described the results of his color experiments conducted over the decades of his career in the studio and the classroom. The cover of the book (Figure 11) presents a frame-shift experiment in which the color context around each block of brown influences and alters the way the brain processes its hue. The two brown squares are identical (in terms of pigment) but appear different in hue, intensity and tone because of the influence of the surrounding colors as the whole is perceived and processed by the brain. The image thus echos the process of cognitive framing of metaphors and associative activations, through the single mode of color.

The effects of framing are frequently seen in data visualizations when compositional choices about scale and organization play upon viewers' cognitive shortcuts. Edward Tufte, in his pioneering work on data visualization, *The Visual Display of Quantitative Information* (1983), champions the principles of graphic transparency, data accuracy and integrity (both graphically and ethically). Drawing on examples from many sources, Tufte describes graphic distortion (either deliberate or unintended) as the "lie factor" in information graphics. Common techniques of graphic distortion include manipulations of data intervals along the X and Y axes (which stretch or compress the graphical space), reframings of data to circumvent easy comparison (i.e. occurrences per day contrasted with total occurrences), and inaccurate visual correspondence between quantity, area and/or volume.
The tension between accuracy and visual appeal illustrated in Figure 12 underscores the nebulous role that such graphics play in journalism where they function somewhere on the spectrum between data visualization and narrative illustration. The journalist

or editor wishes to make compelling and engaging graphics that, ideally, do not sacrifice accuracy. Good information graphics facilitate System 2 thinking by allowing us to process information quickly (in a glance) by engaging System 1. The precise danger of this of course is that these graphics are engaging a cognitive system that needs no encouragement to leap to conclusions, so data accuracy is critical.

The blog reader's comments in the right margin highlight the type of data distortion in which quantities are represented (inaccurately) as areas. Thus the framing of the content has altered, not only in terms of relative sizes but also through use of type which serves to undercut further the, already nonexistent, size-to-number of cases-to-mortality correlations. This is further compounded through its direct conflict with the heading-subheading-body graphical hierarchy that structures information legibly and predictably for readers of *The New York Times*.

System 1 performs the task of correlating area to quantity efficiently: it rapidly identifies a visual system, distinguishes and compares features of it, and looks for intensities, averages, outliers, etc. However rapid, System 1 thinking is not capable of determining precise quantities. Developing a more accurate understanding of this graphic, for example, requires System 2 thinking (as well as a ruler and pen and paper) to measure the various areas and to compute and compare ratios. All of this analysis requires time and work, and the very nature of a scorecard—referenced in the title in Figure 12 as a metaphor for the card that people take to baseball games to keep a record of the action—suggests that this is a rapid and straightforward cognitive operation. In fact, it is neither rapid nor straightforward.

System 1 Thinking and Metaphor

In *Thinking, Fast and Slow*, Kahneman discusses the ability of System 1 to make rapid comparative judgments (e.g. larger/smaller; ugly/beautiful; before/after), as well as its sensitivity to the degrees of intensity of an attribute. "An underlying scale of intensity allows matching across diverse dimensions. If crimes were colors, murder would be a deeper shade of red. If crimes were expressed as music, mass murder would be played fortissimo while accumulating unpaid parking tickets would be a faint pianissimo."[11] Note that in his

TB is about 1/3 larger. All of which undercuts the point they're trying to make about SARS relative to these other diseases: SARS, with 353 deaths, is given about 1/2 the space as Yellow Fever which has 100 times as many deaths. (Or 50 times, if you annualize SARS.)"[10]

description of System1 thinking, Kahneman uses multimodal (color and sound) metaphors.

Kahneman's language is wonderfully accessible here because we recognize certain constellations of association from decades of exposure to Hollywood films and to the advertising industry (as well as to the leifmotifs of Wagner). How many horror movies have we seen in which the ax murderer's deed is prefigured by cues in the sound track? System 1's ability to make efficient comparisons and judgments among disparate elements can either be leveraged effectively or undermined. We can see how such effortless (visual) facilitation has (in Figure 12) become effortful (in terms of accurate data interpretation), contradictory, and unintentionally misleading. This evidence points to the fact that metaphorically and multimodally enabled System 1 thinking is enormously powerful in the right hands. Also, it is easily prone to errors of design which lead to errors of interpretation and, as Kahneman has pointed out, to further errors in judgment and decision-making.

Consider the two narrative visualizations in Figures 13 and 14. These illustrations have a common subject—that of US taxpayers' "recue" of the federal mortgage associations, Fannie Mae and Freddie Mac—but the conceptual framing for each visualization is quite different.

Figure 13. "Bailout," Joel Barbee, September 7, 2008

In Figure 13 (above) Fannie and Freddie are depicted as the arms of a drowning man needing to be saved (thrown a lifeline) by taxpayers. In this illustration, the taxpayer is the rescuer "bailing out" the insolvent Freddie Mac and Fannie Mae; The text in the first,

Figure 14. Bailout cartoon, Heng Kim Song, 2009

"we need a bigger boat," conforms to the Neoclassical model of logical decision-making in that it makes an essentially rational appeal for more capitalization. In contrast, Figure 14, above, positions the taxpayer not as empowered rescuer, but as hapless victim. The taxpayer (shown as a boat) is imminently threatened by Fannie Mae (overweight individual), with Freddie Mac, equally overweight, passively waiting to be rescued from the roof of one of numerous "underwater" houses.

Of essence in the frame shift between the two images is how these agencies are understood. In the first illustration the reference point for Freddie Mac and Fannie Mae is represented by hands of a vulnerable man in urgent need of rescue; in the second they are seen as perhaps equally in need of rescue, but undeserving of it, putting their own survival selfishly and recklessly ahead of that of both the underwater homeowners and the US taxpayer.

In Figure 13 Fannie and Freddie are most at risk, in Figure 14, the US taxpayers are most threatened. The metaphorical associations underscored in each illustration diverge along familiar political lines and remind us of a point raised by George Lakoff in his book *The Political Mind*, in which he discusses how the US Republican Party's conflation of the words "tax" and "relief" (initially introduced to the political lexicon during the Reagan administration and now used normatively by both parties) has led to an implicit understanding that taxation is an affliction or oppression that the taxpayer needs relief from, rather than as a means of developing stronger public institutions and services.[12] In Figure 14, the reader is encouraged

to frame the reckless behavior of these lending agencies as the harbinger of inevitably disastrous consequences rather than posing the question, for the viewer, about what form a "bigger boat" might take.

Conclusion

The ideas presented above draw from many sources. We would argue, however, that there is a close link between the uses of metaphor in narrative visualizations and the effects of heuristics and framing in behavioral economics, and that much deeper attention needs to be paid to how visual metaphors are used, how they activate associative networks in our brains, and the consequences of this in the realms of personal finance and public policy at the national and global levels.

Sunstein and Thaler (2008)[13], Tversky and Kahneman and others have argued that when there is a deliberate manipulation of frame, the choice of frame becomes an ethical consideration and that this is frequently inseparable from an economic one. Naturally not all of the frames available to us are cynical traps intended to limit our ability to think. The main problem is that frequently these frames are all we have access to, a phenomenon that Kahneman calls WYSIATI (what you see is all that is). Our innate bias toward ideas that are easily available (to hand), or visible (visualizable) to us, combined with the laziness of System 2 thinking in monitoring our interpretations and decisions, means that visual metaphors—particularly, but not exclusively in the financial realm—can wield enormous influence on decision-making at all levels.

Illustration is a populist medium, so it is appropriate to cite a populist example of a plea against financial ignorance. *The Buried Life* is a group of four young men with a sizable television, web and blog following. In their blog, *The Buried Life* list "20 Things I Should Have Known at (age) 20." Number 1 is as follows: "The world is trying to keep you stupid. From bank fees to interest rates to miracle diets, people who are not educated are easier to get money from and easier to lead. Educate yourself as much as possible for wealth, independence, and happiness."

This is sound advice indeed, but what does "educate yourself" mean exactly? And why are we so uneducable in the ways that

rationalists may have wished? Clearly it is important to understand that the frames available—and the frames likely to be chosen—are not based only on economic motivations, but are dependent on factors that are extra-rational and fundamentally psychological and emotional. So, is the world trying to keep us stupid, or do individuals carry some responsibility for this? Lakoff contends that people tend to substitute more-accessible frames for more-accurate but less-accessible frames. This means that framing (using heuristics) is an activity that is informed by natural aversion to the demands of System 2 thinking, but one that is also deeply enmeshed in associative and metaphorical thinking. As Aristotle asserted, metaphors are undoubtedly available for manipulation but, viewed in a more positive light, they can also serve as powerful interpretive devices. Metaphors are never value-neutral in their import, but they are in their functional state. They can be activated to serve worthy or unworthy goals with equal effectiveness.

We assert that metaphorically-driven framing achieves two ends:

i. reduction of complexity, enabling rapid intake of complex information (the information visualization agenda);

and

ii. facilitation for the "reader" to connect emotionally with the subject (in effect activating the 98% of the brain devoted to System 1 processing). Whether this is used for positive social change or for destructive purposes remains an open question. We contend that the utility of visual metaphor lies in its ability to allow the reader to process information rapidly and then to adopt a point of view or plan of action in relation to this information.

In "Why Metaphors are Necessary and Not Just Nice" (1975), Andrew Ortony asserts that experiences of the world lie on a "continuity," which the discreteness of any symbol system, but particularly language, is unable to capture fully. Metaphors help to bridge the gap in two ways: through their compactness—their ability to express ideas inexpressible in literal language—and through their vividness, which arises from their closeness to the mental image we conjure up when comprehending speech.

This notion of vividness is echoed and extended in Kahneman's analysis of the factors that affect our understanding of uncertain outcomes. Kahneman contends that a "rich and vivid representation of an outcome, whether or not it is emotional, reduces sensitivity to probability in the evaluation of a an uncertain prospect (or a gamble)." To illustrate this point he uses the following example:

i. 21% chance to receive $59 next Monday.

ii. 21% chance to receive a large blue cardboard envelope containing $59 next Monday morning.[13]

In terms of mathematical probability, an individual is far less likely to receive a large blue cardboard envelope with the cash than to simply receive the money (in any form). And what bearing does the envelope have on the receipt of the money anyway? In this experiment, the System 2 thinking required to recognize this was swamped by the vivid associations conjured up by the description in description ii. Again here we see the Aristotalian duality of metaphor, as a powerful agent equally available for good (education/agency) as for evil (manipulation for profiteering or political advantage).

If metaphorically rich language affects our ability to interpret situations and to make choices, how much more effective is rich and metaphorical illustration? Metaphorically-based narrative visualization, by offering vivid and emotionally-resonant representations of complex phenomena, encourages individuals to respond emotionally and to reframe their ideas. If metaphors and visual images can frame discourse, influence decisions, and motivate action, it is vital that we identify, analyze, and critique the modalities and metaphors that are constantly at work in the financial press, in the realm of advertising, and in financial literacy materials and programs. In doing so, we will develop a more complete picture of the processes underlying individuals' financial decision-making and behaviors, and gain insights into how these might be improved.

Aaron Fry and Jennifer Wilson

Notes

Page	Note	
52	1	Four domains of practice: Kress, G and Van Leeuwen, T. 2001. *Multimodal Discourse: The Modes and Media of Contemporary Communication.* London: Arnold: 4.
53	2	"discourses are socially constructed… in these contexts.": Kress, G and Van Leeuwen, T. 2001. *Multimodal Discourse: The Modes and Media of Contemporary Communication. London:* Arnold: 5.
54	3	"As beautiful as… the random encounter…": Comte de Lautréamont, 1868-9. *Les Chants de Maldoror,* Paris, Blanchetière: 263.
60	4	"The one-month survival rate…": Kahneman, D. 2011. *Thinking, Fast and Slow.* London: Penguin: 357.
61	5	"Scenario 1: You have been given $1000 and asked to choose between...": Kahneman, D. 2011. *Thinking, Fast and Slow*. London: Penguin: 280
62	6	Yoong, J. 2010. "Making Financial Education More Effective: Lessons from Behavioral Economics." OECD Presentation, www.oecd.org/dataoecd/47/62/45485586.pdf
63	7	"thinking tasks actually deplete glucose in the body... ": Gaillot, M, et al. 2007, "Self Control Relies on Glucose as a Limited Energy Source: Willpower is More Than a Metaphor." Journal of Personality and Social Psychology 92(2): 325-326
63	8	"(we) gravitate toward the least demanding course of action…": Kahneman, D. 2011. *Thinking, Fast and Slow.* London: Penguin: 35.
63	9	"Bananas—Vomit…": Kahneman, D. 2011. *Thinking, Fast and Slow.* London: Pengun: 51.
66	10	Tufte blog, http://www.edwardtufte.com/bboard
66	11	"An underlying scale of intensity allows matching…": Kahneman, D. 2011. *Thinking, Fast and Slow.* London: Penguin: 94.
68	12	"tax" and "relief": Lakoff, G. 2008. *The Political Mind, Why You Can't Understand 21st-Century American Politics with an 18th- Century Brain.* New York: Penguin: 234-5.
71	13	"21% chance to receive…": Kahneman, D. 2011. *Thinking Fast and Slow.* London: Penguin: 328.

Image Notes

All of the illustrations that were featured in he Visualizing Finance Lab symposium exhibition can be found on the following pages.

Page(s)	
44	"Turning a Corner?" Amanda Cox, *The New York Times*, July 5, 2009
38	"Of froth and fundamentals: the real lesson from volatile commodity prices," Belle Mellor, *The Economist,* October 9, 2008
40	"The IMF. Mission possible" Belle Mellor, *The Economist,* April 8, 2009
41	"The data deluge" Brett Ryder, *The Economist,* February 25, 2010
39	"Curtain Closer" Christopher Hitz, *Forbes,* March 29, 2010
45	"Avoiding the Debit Card Trap" David Plunkett, *Business Week,* February 13, 2006
14-15	"The U.S.-China Exchange Rate Squeeze" Erin Schell, *The New York Times*, September 18, 2010
38	"Desperately seeking a cash cure" Gary Neill, *The Economist,* November 20, 2008
40	"Fixed-odds financial betting" Ian Whadcock, *Investor's Chronicle,* September 2008
13, 40	"Where have all your savings gone?" Michael Morgenstern, *The Economist*, December 4, 2008
10-11	"Unbundling the Bets: Questions for the Banks That Put Together Complex Deals" Minh Uong, *The New York Times*, April 21, 2010
41	"Odds and Ends" Nora Krug, *The Deal,* July 3, 2008
55	"A special report on banking in emerging markets" Otto, *The Economist*, May 13, 2010
12, 50	"In Search of a Blue-Chip Bounty" Tim Robinson, *The New York Times,* October 8, 2006

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Acknowledgments

We are grateful to the School of Design Strategies (SDS), at Parsons The New School for Design for providing the financial support to stage the symposium and to publish this book. Particular thanks to Professor Miodrag Mitrasinovic, former SDS Dean, for his vision in establishing and fostering research labs within the School of Design Strategies at Parsons and for supporting this publication, and for his ongoing support of our work, and to Alison Mears, current SDS Dean for her continued support. We are also very grateful to Robin Campbell, Director of Operations in the School of Design Strategies, for her assistance with budgeting and planning for both the symposium and this book. Our thanks also to Radhika Subramaniam, Director/ Chief Curator of the Sheila C. Johnson Design Center at The New School, for her support and assistance in staging the symposium and to Daisy Chan, Assistant Director of the Galleries. Finally, we are tremendously grateful to Ashley Lane, student assistant, for her practical assistance with the symposium event and her assistance with the development of the Visualizing Finance Lab's professional network, and to Sylvia Hardy for her invaluable assistance with the layout of this book.

Our gratitude also goes to Ahmad Rashad and Ulrich Stark, graduate students at The New School, both of whom assisted with aspects of our positioning essay and in the development of related projects.

Postscript

In contrast to traditional academic proceedings, which typically bind together the papers presented at a symposium, this publication seeks to immerse the reader in the symposium event as originally experienced, that is, as a fusion of visual and verbal discourses. This book is intended both as assertion of the Visualizing Finance Lab's perspectives on the power of the visual, and as a means of broadening our potential audience and network to include professionals, educators, scholars and those, like us, who work across these domains.

Since the October 2010 symposium, the Visualizing Finance Lab has continued to research, develop, and promote narrative visualizations as tools for financial literacy and empowerment, working in three areas: financial literacy for underserved populations; undergraduate financial pedagogies; and explorations of metaphor and multimodal communication. Working closely with the participants in a financial-literacy counselor training course and with design students at Parsons The New School for Design, we have begun a practical exploration of narrative visualization's ability to elicit emotional responses and cultural cues in order to convey meaning and to affect financial behaviors. The design students created "story-telling" animations that capture role plays from the counselor training course, based on counselors' experiences with their clients in the community. The Lab has also piloted visual learning techniques in undergraduate finance courses—translation of text to sketch; drawing to learn; and creation of "comic strips" for visual story-telling—and begun to measure the effects of these techniques on student understanding. We continue to research and write about theories of metaphor and multimodality, and their intersections with behavioral economics. Lab members recently presented a synopsis of their position paper at the "Mediated Significations of Finance Seminar" at Aalto University's Media Factory in Helsinki, where the Visualizing Finance 1.0 Symposium gallery exhibit was also shown.
http://mediafactory.aalto.fi/?tag=m-s

Please join us in continuing the cross-disciplinary explorations that began with this first symposium. We heartily welcome input and proposals for collaboration from all of our colleagues: in education, journalism, financial literacy, financial practice, communications theory, design, illustration, behavioral economics, and multimedia.

Please e-mail us at **visualizingfinance@newschool.edu**

Visual literacy Financial literacy

VISUALIZING FINANCE LAB

Visualizing Finance Lab Members

Aaron Fry
Co-director, Visualizing Finance Lab
Associate Professor, Parsons The New School for Design

Carol Overby
Co-director, Visualizing Finance Lab
Assistant Professor, Parsons The New School for Design

Jennifer Wilson
Associate Professor, Eugene Lang College
The New School for Liberal Arts

Associate members

Heico Wesselius
Assistant Professor, Parsons The New School for Design

Jim Osman
Assistant Professor, Parsons The New School for Design

Marion Asnes
Editor-in-Chief, *Financial Planning* magazine
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ISBN 978-1-62407-430-1

The VFL Press, 2012

US $39.00