



**On the behaviour of financial markets: People, systems and concepts**

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## **Behavioural Finance: A definition**

**There is an understanding in economics, and in finance, that stakeholders in a market, “on average, [.. the stakeholders] make unbiased decisions and maximise their self-interests” and that those who make “suboptimal decisions would be punished through poor outcomes”. The rewarding and punishing episodes make the stakeholders “would either learn to make better decisions or leave the marketplace”. The erroneous behaviour of the stakeholders, it is further assumed, is idiosyncratic of each stakeholder and there is little or no correlation between the errors of and that of the other – irrespective of spatial distances and time spans**

**Baker, H. Kent., and John R. Nofsinger. (2010). Behavioral Finance: An Overview. In (Eds.) H. Kent. Baker and John R. Nofsinger. *Behavioral Finance: Investors, Corporations, and Markets*. New Jersey: John Wiley & Sons, Inc. pp3-22.**

## Behavioural Finance: A definition

Behavioral finance argues that some financial phenomena can plausibly be understood using models in which some agents are not fully rational. The field has two building blocks: limits to arbitrage, which argues that it can be difficult for rational traders to undo the dislocations caused by less rational traders; and psychology, which catalogues the kinds of deviations from full rationality we might expect to see.

Barberis, N., and R Thaler (2003). A survey of behavioral finance. *Handbook of the Economics of Finance Vol 1, Part B.*, pp 1053-1128 .  
<https://www.sciencedirect.com/science/article/pii/S1574010203010276>.

## Behavioural Finance: A definition

### The *actors* in a financial market are:

- Traders and speculators**, who have particular and complex relations to what they understand to be the market;
- Inventors of market models and formulas**, that prove to be contested and fallible interpretations of economic reality rather than unproblematic representations;
- Designers of technology and risk assessment models**, which have normative choices and criteria at their hearts;
- Journalists who do not just write impassive financial news**, but play important roles in marketing financial products and creating space for speculation in everyday life;
- Regulators and policy makers**, create regulatory frameworks, develop financial and economic policies; technocrats, business people and government officials

de Goede, Marieke (2005). "Resocialising and Repoliticising Financial Markets: Contours of Social Studies of Finance". *Economic Sociology*, Vol. 6, No. 3 - July 2005

## Behaviour and Financial Markets: Kenneth Arrow 1972

From the time of Adam Smith's *Wealth of Nations* in 1776, one recurrent theme of economic analysis has been the remarkable degree of coherence among the vast numbers of individual and seemingly separate decisions about the buying and selling of commodities. In everyday, normal experience, there is something of a balance between the amounts of goods and services that some individuals want to supply and the amounts that other, different individuals want to sell. Would-be buyers ordinarily count correctly on being able to carry out their intentions, and would-be sellers do not ordinarily find themselves producing great amounts of goods that they cannot sell.



"Kenneth J. Arrow - Prize Lecture: General Economic Equilibrium: Purpose, Analytic Techniques, Collective Choice". Nobelprize.org. Nobel Media AB 2013. Web. 10 Nov 2013.  
<[http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/1972/arrow-lecture.html](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1972/arrow-lecture.html)>

## Behaviour and Financial Markets: Louis Bachelier 1870-1946

**Bachelier's Equation: Calculating the price of the Napoleonic era *perpetual* bonds issued by the French government. First attempt to include interest rates into the calculation of securities and a discussion of *risk* through the notion of random changes in the prices introduced by Louis Bachelier (1870-1946). Bachelier borrowed concepts from heat conduction (Fourier), statistical mechanics (Gauss), and the experimental reports about *Brownian motion*.**

Read, Colin. (2013). *The Efficient Market Hypothesis: Bachelier, Samuelson, Fama, Ross, Tobin, Shiller*. Basingstoke: Palgrave Macmillian

## Behaviour and Financial Markets: Louis Bachelier 1870-1946

Let  $p$  be the present value of the bond (with a nominal value of one unit of a currency),  $r$  is the interest payment on the bond,  $r^*$  is the current market interest rate

$$p = \int_0^{\infty} r e^{-rt} dt = \frac{r}{r^*}$$

Default risk for the bonds at time  $T$  in the future:

$$p = \int_0^T r e^{-rt} dt = \frac{r}{r^*} (1 - e^{-rT})$$

If the bond holder expects a liquidation payment of a fraction  $k$  of a bond of a nominal value of unity:

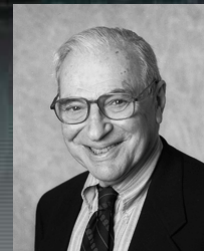
$$p = \frac{r}{r^*} (1 - e^{-rT}) + k e^{-rT}$$

Read, Colin. (2013). *The Efficient Market Hypothesis: Bachelier, Samuelson, Fama, Ross, Tobin, Shiller*. Basingstoke: Palgrave Macmillan

## Behaviour and Financial Markets: Herbert Simon 1978

human behavior in business firms constitutes a highly interesting body of empirical phenomena that calls out for explanation as do all bodies of phenomena.

The classical theories of economic decision making and of the business firm make very specific testable predictions about the concrete behavior of decision-making agents. Behavioral theories make quite different predictions. Since these predictions can be tested directly by observation, either theory (or both) may be falsified as readily when such predictions fail as when predictions about aggregate phenomena are in error. (pp 346-347)



[http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/1978/simon-lecture.html](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1978/simon-lecture.html)

## Behaviour and Financial Markets: Robert Merton 1997

The special sphere of finance within economics is the study of economic resources, both spatially and across time, in uncertain environment.

.. uncertain environment. To capture the influence of time and uncertainty requires sophisticated mathematical and computational tools.



"Robert C. Merton - Prize Lecture: Applications of Option-Pricing Theory: Twenty-Five Years Later". Nobelprize.org. Nobel Media AB 2013. Web. 10 Nov 2013.  
<[http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/1997/merton-lecture.html](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1997/merton-lecture.html)>

## Behaviour and Financial Markets: Vernon Smith 2002

Historically, a recurrent theme in economics is that the values to which people respond are not confined to those one would expect based on the narrowly defined canons of rationality.



[http://nobelprize.org/nobel\\_prizes/economics/laureates/2002/smith-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/2002/smith-lecture.pdf)

## Behaviour and Financial Markets: Daniel Kahneman 2002

intuitive judgments occupy a position – perhaps corresponding to evolutionary history – between the automatic operations of perception and the deliberate operations of reasoning.

psychology of intuitive beliefs and choices →  
heuristics of judgment, risky choice, and framing effects.

[http://www.nobelprize.org/nobel\\_prizes/economic-sciences/laureates/2002/kahneman-lecture.html](http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2002/kahneman-lecture.html)



## Behaviour and Financial Markets: Irrationality or Creativity

Many of the things we think about, actions we take, the way we react to stimuli, generate a feeling or subjective experience, for example, an emotion, or a mood.

The generic term used in the 20th century psychology and philosophy literature to denote such an emotion or mood is an old, Middle English (14th century), word *affect*.



# Preamble

## Defining Rationality

1. The quality or condition of possessing reason; the ability to exercise reason.
2. The fact or condition of being based on, or in accordance with, reason or rationalism.
3. As a count noun: a rational or reasonable view, practice
4. The tendency to regard everything from a purely rational point of view.

Oxford English Dictionary (2010)

# Defining Rationality

Domain	Definition
Literature	The tendency to regard everything from a purely rational point of view.
Mathematics	The property of a number or quantity of being rational: A set of numbers is called a domain of rationality when the sums, differences, products, and quotients of any numbers in the set always yield as results numbers belonging to the set.
Philosophy	The quality or condition of possessing reason; the ability to exercise reason.
Psychology	The fact or condition of being based on, or in accordance with, reason or rationalism

Oxford English Dictionary (2010)

## Defining Rationality: The genesis of the term *rationalism*

Year	Domain	Definition
1732	<b>Theology</b>	The <b>practice of treating reason</b> as the ultimate authority in religion; (also) the practice of explaining supernatural or miraculous events on a rational basis
1782	<b>Moral Philosophy</b>	The <b>doctrine or belief</b> that reason should be the only guiding principle in life, obviating the need for reliance on, or adherence to, any form of religious belief.
1797	<b>Philosophical Analysis</b>	The <b>doctrine or theory</b> that emphasizes the role of reason in knowledge, or claims that reason rather than sense experience is the foundation of certainty in knowledge
1915	<b>Economics</b>	The <b>principle or practice</b> of using reasoning and calculation as a basis for analysis, planning, etc., esp. in social and economic organization.
1918	<b>Architecture</b>	A <b>theory or style</b> based on the application of rationalist principles to architecture, characterized by a rejection of ornament and an emphasis on geometrical simplicity and functionalism

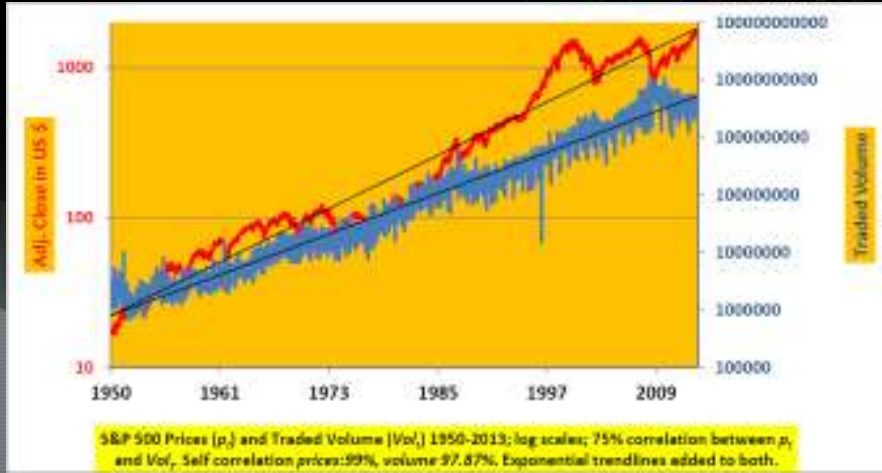
## Behaviour and Financial Markets

So what am I going to talk to you for the next 2.5 days?

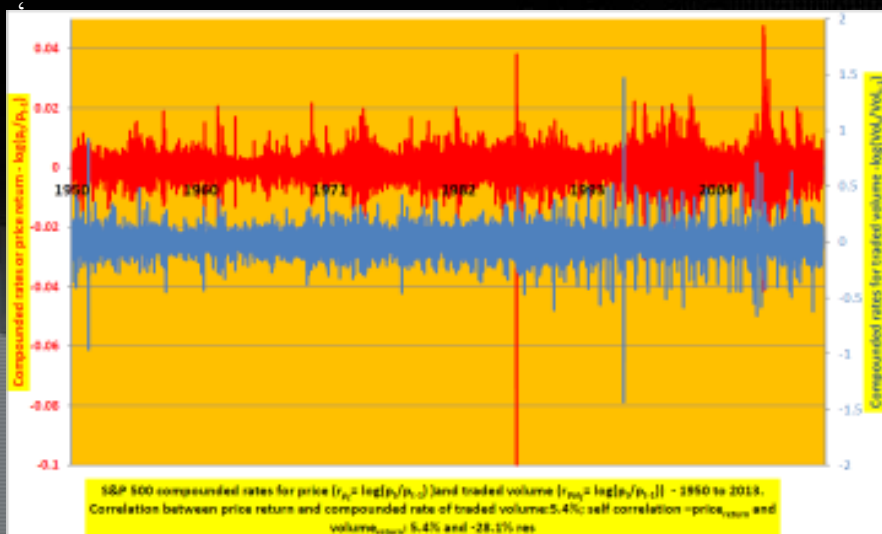
1. Introduction & Terminology
2. Fluctuations in the Financial Markets
3. Prospect Theory
4. Herd Behaviour
5. Volatility and Sentiment



## Behaviour and Financial Markets: What happens in a market?



## Behaviour and Financial Markets: What happens in a market?

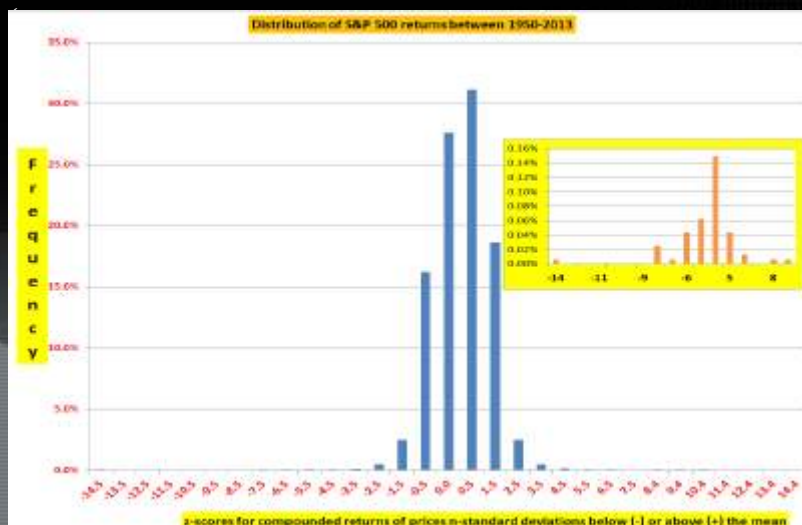


## Behaviour and Financial Markets: What happens in a market?

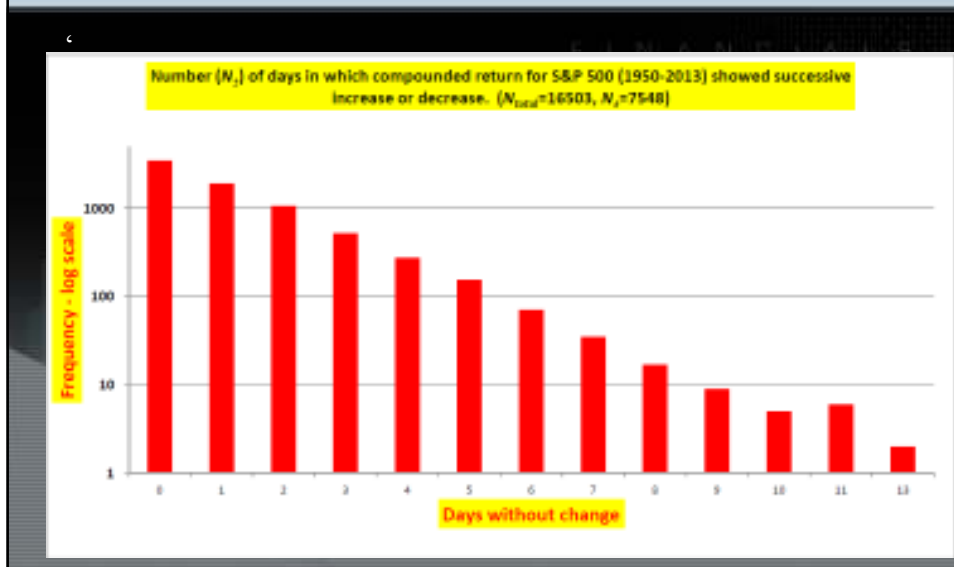
S&P 500 Prices and Traded Volume, and the compounded rates between  
1950-2013

	Average	Std. Dev	Skewness	Kurtosis
Prices	433	491	1.03	-0.52
Volume	7.04E+08	1.39E+09	2.56	6.70
<b>Compounded Rates</b>				
Price Return	0.013%	0.42%	-1.03	27.66
Volume Return	0.022%	8.4%	-0.05	17.13

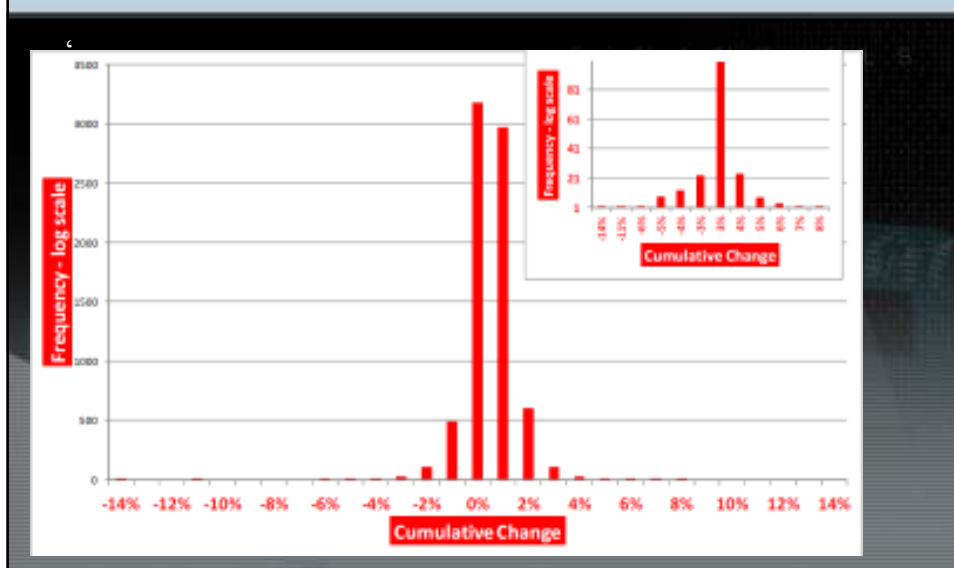
## Behaviour and Financial Markets: What happens in a market?



## Behaviour and Financial Markets: What happens in a market?



## Behaviour and Financial Markets: What happens in a market?



## Behaviour and Financial Markets: Cyclical Behaviour

Galbraith (1958/1998:38) suggested that over the last 400 years successive downturns, or ‘deep trouble’, in the financial markets, have been described by terms that help to ‘soften the connotation of deep trouble’; 17<sup>th</sup> century *financial mania* was replaced by the softer *financial/market bubble* (18<sup>th</sup> century), which, in turn, was replaced by *market panics* (19<sup>th</sup> century). The 20<sup>th</sup> century begat *market crash* and, and then we have had the borrowing from the physics of wave-like behaviour terms including *economic depression* and *economic recession*.

The 21<sup>st</sup> century downturn (c. 2008) was so severe that the softer terms like *credit squeeze/freeze* gave way to *credit crunch*. It does not mean that the older, ‘harsher’ terms disappear – ‘banking panic’, a technical term used in the 1960’s, has resurfaced in the research literature

## Behaviour and Financial Markets: Earnings announcements and efficient markets

‘Stock prices rose (fell) when firms reported earnings that were higher (lower) than expected by a simple time series model. . . . [A]ccounting earnings, however, are considerably delayed reports of financial and include accruals, which can be viewed as a noisy measure of the cash flows that provide the foundation of most valuation models in finance’ (Baker and Nofsinger 2010:29) .

The market response to the earnings announcement is usually sharp and lasts for months.

The *efficient market hypothesis* has had difficulty in dealing with this (above suspicion) anomaly.

Baker, H. Kent. , and John R. Nofsinger. (Eds.) (2010). *Behavioral Finance: Investors, Corporations and Markets*. Hoboken, N.J.: John Wiley and Sons, Inc.

## Behaviour and Financial Markets

Experimental economists have reported mixed results on rationality: people are often better (e.g. in two-person anonymous interactions), in agreement with (e.g. in flow supply and demand markets), or worse (e.g. in asset trading), in achieving gains for themselves and others than is predicted by rational analysis.

Patterns in these contradictions and confirmations provide important clues to the implicit rules or norms that people may follow, and can motivate new theoretical hypotheses for examination in both the field and the laboratory.

[http://nobelprize.org/nobel\\_prizes/economics/laureates/2002/smith-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/2002/smith-lecture.pdf)

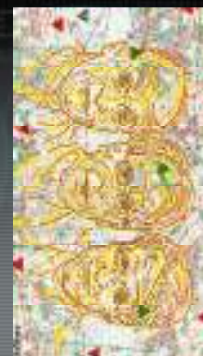
## Behaviour and Financial Markets: Rational, Irrational &?

THE “prize in economic sciences in memory of Alfred Nobel”, as it is officially known, sometimes struggles to command the same respect as its counterparts.

This year’s winners appeared to reinforce doubts about the prize’s standing. One, Eugene Fama of Chicago, is known for his ardent belief in the efficiency of markets: he declined to renew his subscription to this newspaper after tiring of its incessant warning about bubbles, the very existence of which he denies. Robert Shiller from Yale, in contrast, is known for his prescient warnings of bubbles, in technology stocks in the 1990s and in housing in the 2000s.

Lars Hansen developed what has since become a very influential statistical technique known as “generalised method of moments estimation”

<http://www.economist.com/news/finance-and-economics/21588059-nobel-prize-economics-reveals-how-little-we-know-about-behaviour>



## Information Asymmetry in Financial Trading

Information invariably comprises an element of surprise.

Information flows when there is an asymmetry – the writer knows more than the reader/listener.

The providers of information can present information that blends facts and opinion.

It is important to understand the attitude of the writer and how the attitude is expressed.

## Information Asymmetry: Noise Traders and Informed

Assume that there are two kinds of traders only in a market: informed traders and noise traders. The noise trader fails to ascertain the true value of an asset and relies on guesswork, heuristics, imitation of the informed trader, or prayer. The noise trader *mispri*ces and the informed trader should see this as an opportunity to create a margin through arbitrage. This arbitrage is not always possible and worse still the informed tries to follow the noise trader.

Traders		Noise	
		Pessimistic	Optimistic
Informed	Pessimistic	Herding	Short-sell
	Optimistic	Buy	Herding

## Impact of News on Prices and Traded Volume

- News Effects
  - I: News Announcements Matter, and Quickly;
  - II: Announcement Timing Matters
  - III: Volatility Adjusts to News Gradually
  - IV: Pure Announcement Effects are Present in Volatility
  - **V: Announcement Effects are Asymmetric – Responses Vary with the Sign of the News;**
  - VI: The effect on traded volume persists longer than on prices.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Vega, C. (2002). *Micro effects of macro announcements: Real time price discovery in foreign exchange*. National Bureau of Economic Research Working Paper 8959, <http://www.nber.org/papers/w8959>

## Affect, Emotion and Mood

### Differentiation of Meaning and Affect Dimensions and Scales

AFFECT CATEGORY	SCALE/VALUES
Putting a qualitative value on entities	<b>Positive/Negative</b>
Showing how the depth or shallowness of affect	<b>Strong/Weak</b>
Indicating the persistence of affect	<b>Active/Passive</b>
Implying a moral judgement	<b>Virtue/Vice</b>

## Sentiment Analysis

***Sentiment analysis: a systematic, computer-based analysis of written text and speech excerpts, for determining the attitude of the author or speaker respectively in relation to a specific topic.***

Khurshid Ahmad (2011) (Ed.) *Affective Computing and Sentiment Analysis: Metaphor, Ontology, Affect and Terminology*. Heidelberg: Springer.

## Sentiment Analysis

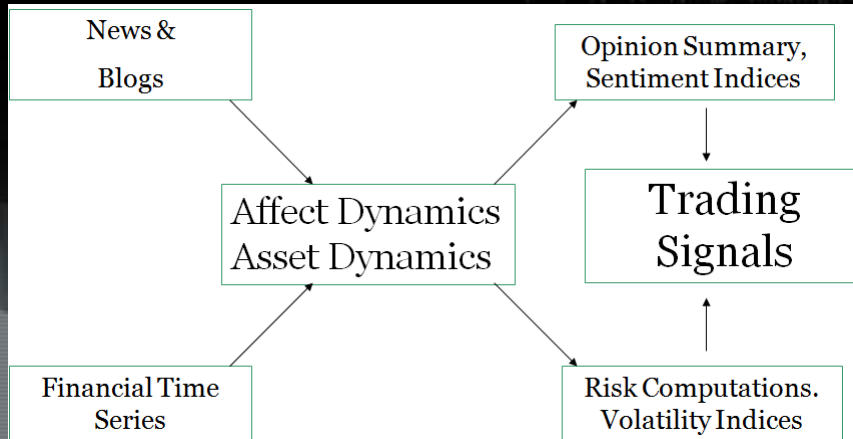
**Sentiment analysis systems were used first by political scientists to understand the orientation of political parties – through an analysis of party manifestos**

**Scholars in economics and finance have used opinion columns in financial newspapers to estimate the impact of opinions and opinion makers on prices and traded volumes of equities**

Khurshid Ahmad (2011) (Ed.) *Affective Computing and Sentiment Analysis: Metaphor, Ontology, Affect and Terminology*. Heidelberg: Springer.



# Sentiment Analysis



## Existing terminology/ontology resources

Ontological commitments of a new term – *dark liquidity pools*

**dark liquidity pools** Secretive actions conducted by large brokerages to make transactions outside of the markets so that the trades will not adversely affect the price of large sections of stock. Institutional investors commonly use dark liquidity pools as a method of concealing their investors or investments. Because the prices of these transactions are concealed, investors are typically able to receive a lower price.

<http://www.investorwords.com/>

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## Existing terminology/ontology resources

Ontological commitments of a new term – *dark liquidity pools*

http://www.investorwords.com/

<b>Action</b>	The <u>price movement</u> and <u>volume</u> of a <u>stock</u> or overall <u>market</u> .
<b>brokerage</b>	Used interchangeably with <u>broker</u> when referring to a <u>firm</u> rather than an <u>individual</u> . <b>also called</b> <u>brokerage house</u> or <u>brokerage firm</u> .
<b>transactions</b>	(a) An <u>agreement</u> between a <u>buyer</u> and a <u>seller</u> to <u>exchange</u> an <u>asset</u> for <u>payment</u> . (b) In <u>accounting</u> , any <u>event</u> or <u>condition</u> recorded in the book of <u>accounts</u> .
<b>market</b>	A public place where <u>buyers</u> and <u>sellers</u> make <u>transactions</u> , directly or <u>via intermediaries</u> . Also sometimes <u>means</u> the <u>stock market</u> .
<b>trades</b>	(a) A <u>transaction</u> of a <u>security</u> or <u>commodity</u> . (b) The <u>exchange</u> of <u>products</u> and/or <u>services</u> without the use of <u>money</u> . <b>also called</b> <u>barter</u> .
<b>price</b>	<u>Cost</u> , usually expressed in <u>monetary terms</u> .

Patent being applied for the CIO

## Regulatory Change & The Text Deluge

A selection of key sources of compliance and regulatory documents; most have a digital 'press room' and RSS feed

	<b>Financial Industry Regulatory Authority</b> is an regulator for all securities firms doing business in the USA.
	The <b>U.S. Securities and Exchange Commission</b> protects investors, maintains markets, and facilitates capital formation.
	The <b>Commodity Futures Trading Commission</b> has the mandate to regulate commodity futures and option markets in the USA.
	<b>National Futures Association (NFA)</b> is the industry-wide, self-regulatory organization for the U.S. futures industry.
	<b>US Federal Reserve System</b> comprises a banking regulation division in addition to its other activities.
	The <b>Federal Deposit Insurance Corp.</b> , was created by to maintain stability and public confidence in the US financial system.
	The <b>Office of the US Comptroller of Currency</b> [...] supervises national banks & fed. savings assn. and US-based foreign banks.
	OFAC administers and enforces economic and trade sanctions based on US foreign policy and national security goals.
	The <b>Council</b> identifies threats to the financial stability of the USA; promotes market discipline; and responds to emerging risks.
	The mission of <b>CFPB</b> is to make markets for consumer financial products and services work for customers.
	<b>FBI</b> checks on criminal history record of employees of banks and related entities.

## Defining Rationality

Method	Techniques
<b>Systematic study of archives detailed observations</b>	Mathematical/ Statistical Models
<b>Elicitation Experiments</b>	Psychological/ Anthropological Experimentation
<b>Introspection or broad-based observation</b>	Logical Philosophical

## Defining Rationality

Method	Instances	Data Characteristics
Systematic study of archives detailed observations	Econometrics esp. asset dynamics	Large data sets of quantitative variables
Elicitation Experiments	Bounded Rationality & Prospect Theory	Case studies of exemplar behaviour
Introspection or broad-based observation	Wealth (re-) distribution; poverty alleviation	Limited historical data; narratives
	Expected Utility Models; Choquet/Sugeno Expected Utility;	Paradoxes in uncertainty management

## Risk: Behaviour and Rationality

Risk assessment is an integral part of modern finance theory and practice. Conventional or standard finance (with its  $\beta$ 's risk free assets) discounts impact of human behaviour whilst behavioural finance gives much prominence to human fallibility. (Baker and Nofsinger 2010).

Standard Finance	Behavioural Finance
Classical Decision Making	Decision Making Heuristics
Modern Portfolio Theory	Prospect Theory
Capital Asset Pricing Model Normative Decision Making (operations research)	Framing and Weighting of Chance Events
Omniscient Rationality	Bounded Rationality

## Behaviour and Financial Markets

**Long-Term Capital Management L.P. (LTCM)** was a hedge fund management firm that utilized absolute-return trading strategies, including fixed-income arbitrage, statistical arbitrage, and pairs trading, combined with high leverage.

Founded in 1994 and had annualised returns of over 40% until 1997. The firm, got entangled in the transformation of Russia from a controlled economy to a market-based economy, and was bailed-out after making losses of \$4.6Billion in 1998 by other institutions under the guidance of the US Federal Reserve

John Meriwether, formerly of Salomon Brothers, founded LCTM in 1994 and had the Economic Science Nobel Laureates (1997) Myron Scholes and Robert C. Merton on its Board of Directors.

[http://en.wikipedia.org/wiki/Long-Term\\_Capital\\_Management](http://en.wikipedia.org/wiki/Long-Term_Capital_Management)

## Behaviour and Financial Markets: LCTM a precursor

Long-Term Capital Management L.P. (LCTM) was a hedge fund management firm that utilized absolute-return trading strategies, including fixed-income arbitrage, statistical arbitrage, and pairs trading, combined with high leverage.

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**The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1997 was awarded jointly to Robert C. Merton (Right) and Myron S. Scholes (left) "for a new method to determine the value of derivatives"**



[http://nobelprize.org/nobel\\_prizes/economics/laureates/1997/](http://nobelprize.org/nobel_prizes/economics/laureates/1997/)

## Behaviour and Financial Markets: LCTM a precursor

APPLICATIONS OF OPTION-PRICING THEORY:  
TWENTY-FIVE YEARS LATER\*

Nobel Lecture, December 9, 1997

by

ROBERT C. MERTON

Graduate School of Business Administration, Harvard University, Boston, MA 02163, USA and Long-Term Capital Management, L.P., Greenwich, CT 06831, USA

New financial product and market designs, improved computer and telecommunications technology and advances in the theory of finance during the past quarter-century have led to dramatic and rapid changes in the structure of global financial markets and institutions. The scientific breakthroughs in financial modeling in this period both shaped and were shaped by the extraordinary flow of financial innovation which coincided with those changes. Thus, the publication of the option-pricing model in 1973 surely helped the development and growth of the listed options and over-the-counter (OTC) derivatives markets. But, the extraordinary growth and success of those markets just as surely stimulated further development and research focus on the derivative-security pricing models. To see this in perspective, consider some



[http://nobelprize.org/nobel\\_prizes/economics/laureates/1997/merton-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/1997/merton-lecture.pdf)

## Behaviour and Financial Markets: LCTM a precursor

### DERIVATIVES IN A DYNAMIC ENVIRONMENT

Nobel Lecture, December 9, 1997

by

MYRON S. SCHOLES

Graduate School of Business, Stanford University, Stanford, CA, USA and  
Long-Term Capital Management, L.P., One East Weaver Street, Greenwich,  
CT 06831-5146, USA

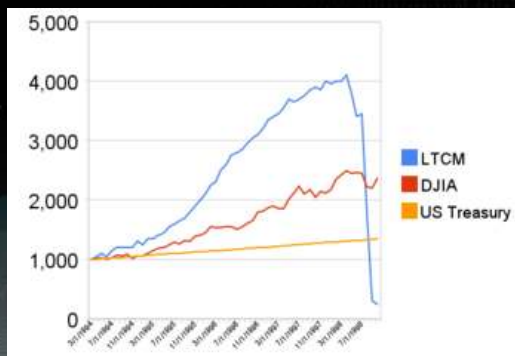
It is difficult to define financial derivatives in a dynamic environment. The purest among us might argue that any security is a derivative if its price dynamics depend on the dynamics of some other underlying asset or assets and time. This broad definition allows not only for what currently exists but also what new derivative instruments will be developed in the future with enhanced understanding and changing production costs. The popular press, however, tends to limit the definition to include financial options, futures and forward contracts either traded on an exchange or issued in the OTC industry. In the future they may come to be called financial products.



[http://nobelprize.org/nobel\\_prizes/economics/laureates/1997/scholes-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/1997/scholes-lecture.pdf)

## Behaviour and Financial Markets: LCTM a precursor

'LTCM's basic strategy was 'convergence' and 'relative-value' arbitrage: the exploitation of price differences that either must be temporary or have a high probability of being temporary. Typical were its many trades involving 'swaps': by the time of LTCM's crisis, its swap book consisted of some 10,000 swaps with a total notional value of \$1.25 trillion.' (MacKenzie 2003:354).



The value of \$1,000 invested in LTCM, the Dow Jones Industrial Average and invested monthly in U.S. Treasuries at constant maturity.

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380

## Behaviour and Financial Markets: LCTM a precursor

Hedge funds report their performance on a monthly basis. In August 1998, LCTM reported that 'it lost 44 per cent of its capital. However, though massive, and far greater than had seemed plausible on the basis of LCTM's risk model, this loss was not in itself catastrophic. LCTM still had 'working capital' of around \$4 billion [...] of which only \$2.1 billion was being used for financing positions [...]'. LCTM was, it seemed, a long way from being bankrupt. (Mackenzie 2003 : 365)

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380

## Behaviour and Financial Markets: LCTM a precursor

Realising that the long term (sic) potential of LCTM was good, John Merriwether decided to seek more funds from the hedge-fund investors. He sent a fax that comprised, amongst other items, the following: 'In August, many of them diverged at a speed and to an extent that had not been seen before. LCTM thus believes that it is prudent and opportunistic to increase the level of the Fund's capital to take full advantage of this unusually attractive environment.'

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380

## Behaviour and Financial Markets: LCTM a precursor

Meriwether's fax, intended to be private to LTCM's investors, became public almost instantly. Robert Merton, a fellow director, remarked: 'Five minutes after we sent our first letter . . . to our handful of shareholders, it was on the Internet'.

This was the first known casualty of the Internet! The *agencement*, the collective for stakeholders and machines, was visibly in operation – messages reaching untold millions, all imitating each other.

The outflows of capital resulting from unfavourable marks were particularly damaging in LTCM's index option positions, where they cost the fund around \$1 billion, nearly half of the September losses that pushed it to the brink of bankruptcy *ibid*:366)

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380

## Behaviour and Financial Markets: LCTM a precursor

Donald MacKenzie, University of Edinburgh, has analysed the LTCM's 1998 crisis using both qualitative, interview-based data and quantitative examination of price movements.

He suggests that 'the roots of the crisis lay in an unstable pattern of imitation that had developed in the markets within which LTCM operated. As the resulting 'superportfolio' began to unravel, arbitrageurs other than LTCM fled the market, even as arbitrage opportunities became more attractive, causing huge price movements against LTCM.

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380



## **Behaviour and Financial Markets: LCTM a precursor**

**Donald MacKenzie, University of Edinburgh has analysed the LTCM's 1998 crisis using both qualitative, interview-based data and quantitative examination of price movements.**

**According to MacKenzie, the collapse may have been caused because:**

- 1. Arbitrage is typically conducted by people often personally known to each other;**
- 2. the possibility and consequences of imitation;**
- 3. the limits on the capacity of arbitrage to close price discrepancies.**

Donald MacKenzie (2003). Long-Term Capital Management and the sociology of arbitrage. *Economy and Society*, Vol 32 (No. 3), pp 349-380

## **Behaviour and Financial Markets**

**Many contemporary scholars, and not only popular writers, have [...] argued that the standard socio-economic science model [..] requires, justifies and promotes selfish behavior**

[http://nobelprize.org/nobel\\_prizes/economics/laureates/2002/smith-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/2002/smith-lecture.pdf)

## Behaviour and Financial Markets

The study of the behaviour of stakeholders in financial markets attempts to understand why stakeholders do not behave in a 'rational' manner. The term stakeholders is a broad one comprising amongst others, investors, traders, speculators, reporters, technologists, theorists, and regulators.

## Behaviour and Financial Markets

Given that technology plays a major role in financial trading, we have to include machines in the 'assemblage' or *agencement* that is the collective stakeholders and machines.

Stakeholders may fail to update their beliefs correctly, sometimes machines in the *agencement* may fail them, stakeholders may act in a contrarian manner. Stakeholders sometimes appear risk averse in gainful situations and at others risk seeking in turbulent times

## The End of Rationality??

Information processing in financial trading shows phenomenon like super-additivity and subadditivity that has its correlates in neural processing systems.

The interaction in decision making in economics and finance shows that decision makers (DM) may be using non-additive probability measures (Zhang 2002), and appears to involve issues like co-monotonicity of different acts the DMs perform (Chateauneuf, Grabisch and Rico 2008);

There are indications that mental accounting is used that may be related to subitization –visual enumeration- which has its neural correlates and evolutionary traits

Chateauneuf, A., Grabisch, M., and Rico A. (2008). 'Modeling attitudes towards uncertainty through the use of Sugeno integral. *Journal of Mathematical Economics*. Vol 44, pp 1084-1089

Zhang, J. (2002). Subjective ambiguity, expected utility and Choquet expected utility. *Economic Theory*. Vol 20, pp 159-181

## The End of Rationality??

**The key role played by human interaction in financial markets, contrarian and herd behaviour shown by (large) sections of the trading community, and the ever present information asymmetry, between traders, brokers and (regulatory) institutions, has led to an emphasis on the role of affect in financial trading.**

## The End of Rationality??

Affect is a superordinate term for feelings, sentiments and emotion. Affect is used for an act that will lead to change or will impress other persons (mind) and make them act. Affect includes evaluation of feeling/emotion/emotional response (negative/positive), strength or weakness of such feelings, and the role played by stakeholders who exhibit or cause emotional response – actively/passively. There is another human moral/ethical dimensions associated with affect which are acts of virtuousness or viciousness.

## The End of Rationality??

Financial trading systems usually facilitate a fundamental analysis (assets, profits/losses etc), and/or technical analysis (share price movements). There is a third type systems that are emerging and are called *sentiment* analysis systems.

Sentiment Analysis systems typically evaluate feelings/emotions from published formal (e.g. newspapers, regulatory newsletters) and informal (blogs, inter/intra organisational e-mails) sources of news and views.

# The End of Rationality??

Sentiment Analysis systems are amongst the more expensive retail information services offered by financial information services providers like Reuters and Dow Jones



# The End of Rationality??

Sentiment Analysis systems are amongst the more expensive retail information services offered by financial information services providers like Reuters and Dow Jones



## Behaviour and Financial Markets

So what am I going to talk to you for the next 2.5 days?

1. I will look at the episodic behaviour of the markets and try and understand why economic cycles show unexpected spikes
2. I will introduce you to three major thinkers in Decision Sciences, with special reference to economics and finance, especially, Herbert Simon, Daniel Kahneman, Amos Tversky, and Vernon Smith;
3. I will introduce you to the notion that whenever people interact they use a mixture of public and private data that is processed into personal information.

## Behaviour and Financial Markets

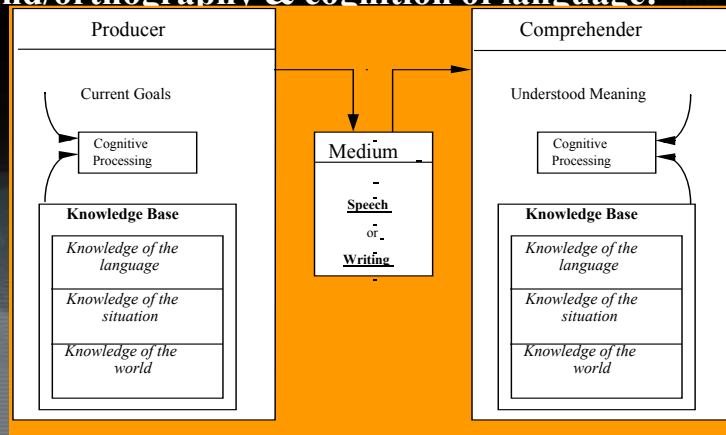
What you see/hear/touch is what you get? Perception of sound/orthography & cognition of language!

- Language can be viewed as 'a communicative process based on knowledge. Generally when humans use language, the producer and comprehender are processing information, making use of their knowledge of the language and of the topics of conversation. Language is a process of communication between intelligent active processors, in which both the producer and the comprehender(s) perform complex cognitive tasks.

Winograd, Terry. (1983). *Language as a Cognitive Process*. Wokingham: Addison-Wesley Inc.,

# Behaviour and Financial Markets

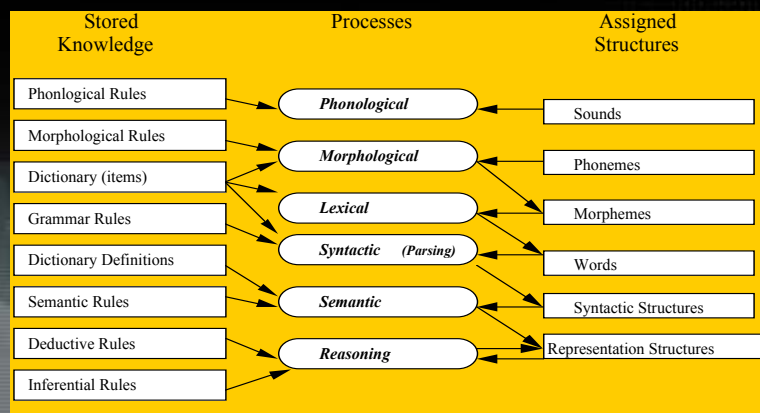
What you see/hear/touch is what you get? Perception of sound/orthography & cognition of language!



Winograd, Terry. (1983). *Language as a Cognitive Process*. Wokingham: Addison-Wesley Inc.,

# Behaviour and Financial Markets

What you see/hear/touch is what you get? Perception of sound/orthography & cognition of language!



Winograd, Terry. (1983). *Language as a Cognitive Process*. Wokingham: Addison-Wesley Inc.,

## Behaviour and Financial Markets

What you see/hear/touch is what you get? Perception of sound & cognition of music!

- There are two **COMPATIBLE** 'conceptions' of music (Bigand 1993:233): one stressing the complexity of musical stimuli (**PERCEPTUAL**) and the other stressing its symbolic dimension (**COGNITIVE**)

McAdams, Stephen., & Bigand, Emmanuel (Eds.) (1993). *Thinking in Sound - The Cognitive Psychology of Human Audition*. Oxford: Clarendon Press.

## Behaviour and Financial Markets

What you see/hear/touch is what you get? Perception of sound & cognition of music!

- According to the **information processing** [...] approach to psychology, the link between the perceptual qualities of the sound source, its abstract representation in memory, its identity, and the various meanings or associations it has with other objects in the listener's environment are hypothesized to result from a **multi-stage process**.

McAdams, Stephen., & Bigand, Emmanuel (Eds.) (1993). *Thinking in Sound - The Cognitive Psychology of Human Audition*. Oxford: Clarendon Press.



## Behaviour and Financial Markets

**What you see/hear/touch is what you get? Perception of sound & cognition of music!**

- The notion of recognition suggests that whatever an agent hears at a given time, it should correspond in some way to something that has already been heard in the past, as when a voice on the telephone, [...] or a piece of music on the radio, are recognised.

McAdams, Stephen., & Bigand, Emmanuel (Eds.) (1993). *Thinking in Sound - The Cognitive Psychology of Human Audition*. Oxford: Clarendon Press.

## Behaviour and Financial Markets

**What you see/hear/touch is what you get? Perception of sound & cognition of music!**

**Any intended input, any idea, image, fact, knowledge, and so on, counts as information in cognitive psychology (COG PSY).  
Processing in COG PSY usually means moving towards some GOAL by going through a series of STAGES or a SEQUENCE of acts.**

## The End of Rationality??

The limits of the so-called rational approach to problem solving, monitoring and prediction have been demonstrated recently in a number of areas of human endeavour. The evidence of this limitation is particularly vivid in two diverse areas – image retrieval using purely visual features and financial decision making using efficient market hypothesis.

Oxford English Dictionary (2010)

## The End of Rationality??

**An area where there is evidence of *bounded rationality* is the manner in which news, rumours and blogs about financial markets appear to change the (numerical) value of attributes associated with the assets bought and sold in the market, e.g. prices and volumes of shares or currency traded. The rationalist approach is to discount the news altogether and focus on prices/volumes (→ the efficient market hypothesis.)**

## The End of Rationality??

But the news in general, and the linguistic, ontological and metaphorical description of the assets in particular, especially the *sentiment* about the market, has a profound effect on the market and is deemed responsible for the major booms and busts.

## The End of Rationality??

Human beings have the propensity to choose radically different solutions to the same problem if the problem is expressed or framed differently. The facial gestures of the stakeholders in the market plays a key role in 'framing' news and blogs.

Expert traders and regulators make judicious choices in aggregating linguistic, numerical and gestural information

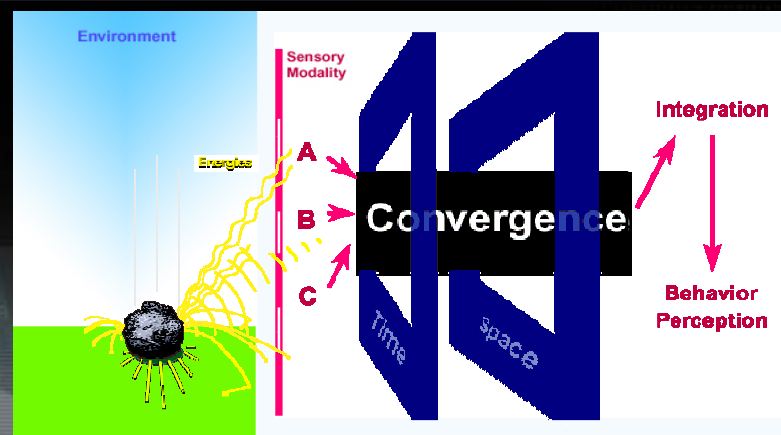
# Behaviour and Financial Markets

Behavioural models include questions about the role of theories in financial trading. Theories sometimes become the basis of practice (e.g. *efficient market hypothesis*) and indeed entire new trading systems emerge based on a theory (*hedge funds*).

Theories are developed with a (number of) assumptions by the theorists. Theories are revised regularly and some assumptions are found wanting.

Theories are refined incrementally and in some instances there is a paradigm shift of revolutionary proportions.

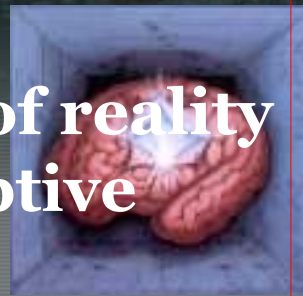
## A multi-sensory world



**Multisensory Processing**

## A multi-sensory world

**Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.**



## A multi-sensory world

**Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.**



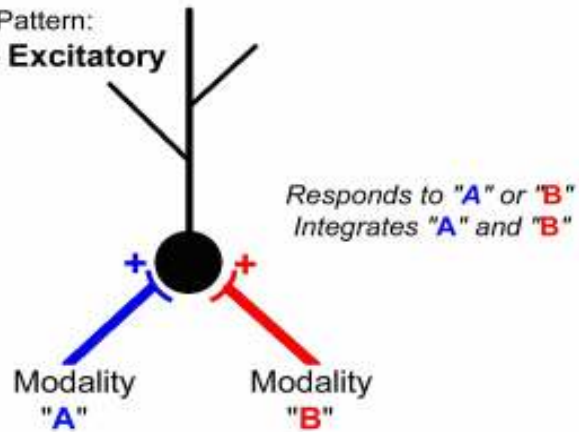
Multisensory  
Enhancement

# A multi-sensory world

Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.

Convergence Pattern:

**Excitatory - Excitatory**

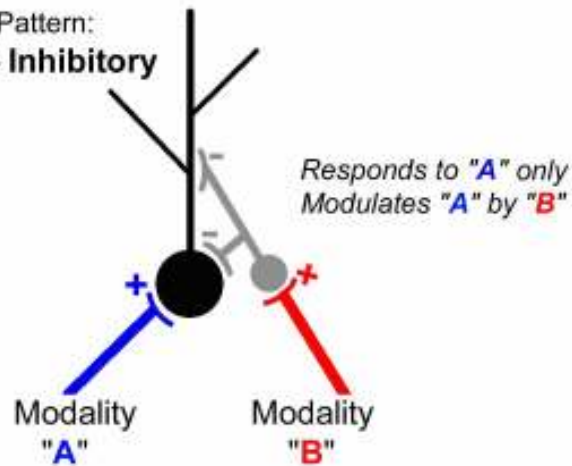


# A multi-sensory world

Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.

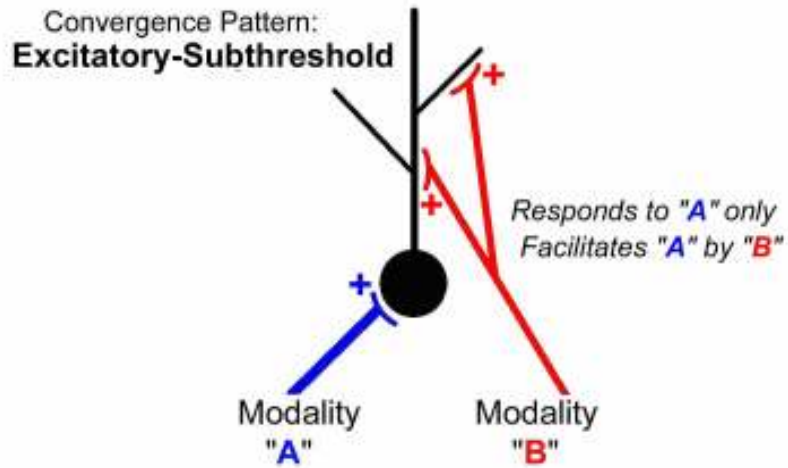
Convergence Pattern:

**Excitatory - Inhibitory**



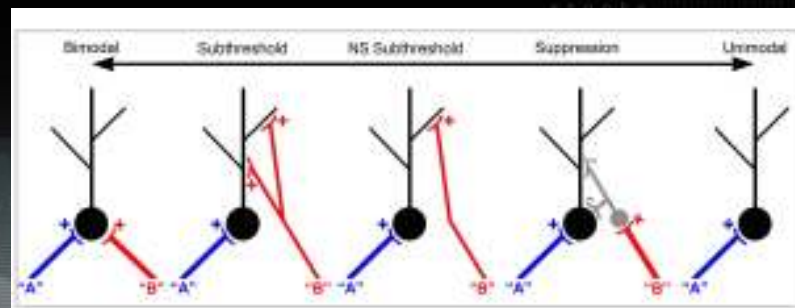
# A multi-sensory world

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# A multi-sensory world

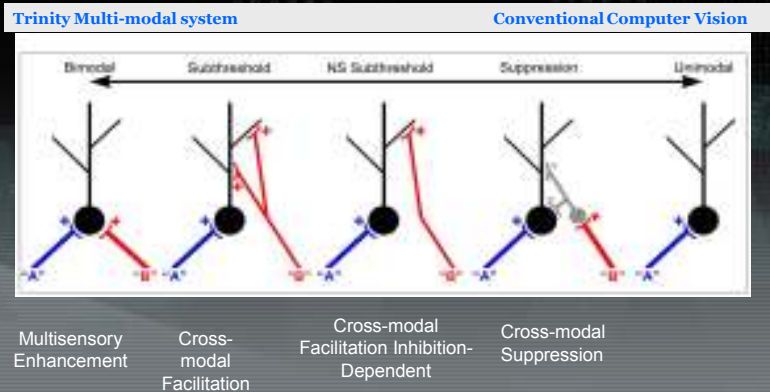
Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.



Multisensory Enhancement      Cross-modal Facilitation      Cross-modal Facilitation Inhibition-Dependent      Cross-modal Suppression

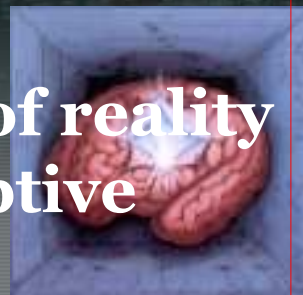
## A multi-sensory world

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## A multi-sensory world

**Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.**





# Behaviour and Financial Markets – The Euphoria

The New York Times  
Wednesday, March 25, 2009

Archives

**FINDS PROPAGANDA IN PROSPERITY TALK; Economist of Industrial Conference Board Warns Advertisers on Inflation. FORESEES PROBLEMS AHEAD Depression in Basic Industries Is Real, He Says, Despite Gain From Investments. Points to Boom Psychology. Fluctuation Less Acute.**

January 4, 1929, Friday  
Section: Steamships and Tours, Page 61, 649 words

E-MAIL

There seems to be no basis in production, wages or consumers' purchasing power to account for the vast increase in banking credits and other financial activities of the present time, according to Virgil Jordan, chief economist of the National Industrial ... [END OF FIRST PARAGRAPH]

**EUROPEAN CURRENCY CALLED STABLE NOW; In General, 1928 Closed Period of Violent Fluctuations, Says Commerce Department. EFFECT TIGHTENED TRADE But Financing is on Firmer Basis-- Marked Trend Seen Toward Combinations in Industry. Trend Toward Industrial Mergers. French Trade Deficit Noted.**

Special to The New York Times  
January 10, 1929, Thursday  
Page 3, 728 words

E-MAIL

WASHINGTON, Jan. 9.--Progress by Europe toward currency stabilization was emphasized today by the Department of Commerce in a review of European industrial and commercial conditions in 1928, prepared by R. M. Stephenson and the

The film of the 1929 Crash

<http://www.youtube.com/watch?v=iLNDPntfNFw>

# Behaviour and Financial Markets – The Euphoria

The New York Times  
Wednesday, March 25, 2009

Archives

**FOREIGN EXCHANGE; Sterling Rallies; London Turned It Higher Over Night on Buying Orders--Continental Dull. CLOSING RATES. FOREIGN BOND AVERAGES. BUDAPEST STOCK EXCHANGE. VIENNA STOCK EXCHANGE.**

September 1, 1929, Sunday  
Section: Second News Section, Page N12, 1472 words

E-MAIL

Sterling turned up a good fraction from Friday's minimum rate for the last three years in yesterday's trading, cables selling as high as \$4.84 7/8, soon after the start, with a final at \$4.84 13-16, an overnight gain of 3-16 cents.

**MARKETS IN LONDON, PARIS AND BERLIN; Traders on English Exchange Still Uneasy Over the Monetary Outlook. BOOM IN FRENCH STOCKS Brokers Unable to Fill Heavy Inflow of Orders--Rally in Berlin After Declines. London Closing Prices. Prices Soar in Paris. Paris Closing Prices. General Decline on Berlin Mart.**

Special Cable to THE NEW YORK TIMES  
September 3, 1929, Tuesday  
Section: Business & Finance, Page 46, 961 words

E-MAIL

LONDON, Sept. 2.--The stock markets were still uneasy today over the monetary outlook, with renewed signs of dullness among the gilt-edge issues. The funding loan declined 1/8 to 84 5/8 and the others declined similarly, with the victory loan at 90 as the outstanding exception. [END OF FIRST PARAGRAPH]

**STOCK TRADING SETS RECORD FOR AUGUST; 95,704,890 Shares Sold on the Stock Exchange, Against 67,703,588 Year Ago. BOND TOTAL \$258,455,000 Shows Decline of \$45,804,950 From Previous Month and Gain of \$77,116,500 Over 1928. Bond Dealings for Month.**

September 1, 1929, Sunday  
Section: Second News Section, Page N6, 656 words

E-MAIL

Trading on the New York Stock Exchange last month was the heaviest of any August on record, and the third largest month this year. Sales totaled 95,704,890 shares, compared with 93,378,690 shares in July, and 67,703,588 shares the same month a year ago. [END OF FIRST PARAGRAPH]

**FINANCIAL MARKETS; Many Sharp Advances in Stocks, Some Declines--Call Money Holds at 9%.**

September 4, 1929, Wednesday  
Section: Business & Finance, Page 41, 596 words

E-MAIL

September began in the stock market yesterday, as it is rather apt to do, with a show of speculative enthusiasm, expressed by numerous advances of 5 to 9 points. [END OF FIRST PARAGRAPH]

# Behaviour and Financial Markets – The Melancholy

The New York Times  
Wednesday, March 25, 2009

Archives

**CITY BANK EXPANSION DENIED AS STOCK RISES; Mitchell Declares None of the Rumors Has Any Basis-- Shares Up 24 Points.**

September 5, 1929, Thursday  
Section: Business & Finance; Page 41, 297 words

E-MAIL

Strength in shares of the National City Bank which yesterday gained 24 points in trading in the over-the-counter market, closing the day at a quotation of \$459 bid, \$463 asked ... [ END OF FIRST PARAGRAPH ]

**BABSON PREDICTS 'CRASH' IN STOCKS; Says Wise Investors Will Pay Up loans and Avoid Merging Trading. FISHER VIEW IS OPPOSITE Declares No Big Recession in Market Is Due, Because inventions Are Adding to Wealth. Tells of Declining Stocks. Fears Stampede to Save Profits. Fisher Denies Crash Is Due. Sees Dividend Returns Increasing.**

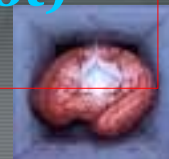
Special to The New York Times  
September 6, 1929, Friday  
Page 12, 959 words

E-MAIL

BOSTON, Mass., Sept. 5.--Wise investors will pay up their loans and avoid margin speculation at this time because a "crash" of the stock market is inevitable. Roger Babson, statistician, said today before the sixteenth National Business Conference at Babson Park, Wellesley. [ END OF FIRST PARAGRAPH ]

## A multi-sensory world

**Our brain, and perhaps that of a collective of people, generates its own projections of a given 'reality': accentuating, (censuring, ignoring) what we (do not) want to see/hear/know**



# Behaviour and Financial Markets – The Prophecy

The New York Times  
Wednesday, March 25, 2009

Archives

STOCK PRICES BREAK ON DARK PROPHECY; Drop in Hectic Last Hour as Babson's Prediction of a Big Slump Is Printed. FOLLOWS 19-DAY ADVANCE 'Stale' Market and Fear of Rise in Brokers' Loans Also Are Factors in Sudden Decline. Caught Off Balance. STOCK PRICES BREAK ON DARK PROPHECY Change Comes Suddenly.

September 6, 1929, Friday  
Page 1, 1470 words

 E-MAIL

Out of a clear sky a storm of selling broke on the Stock Exchange yesterday afternoon and in one hour wiped out millions of dollars in the open market value of securities of all sorts. [ END OF FIRST PARAGRAPH ]

# Behaviour and Financial Markets – The Confusion

The New York Times  
Wednesday, March 25, 2009

Archives

FINANCIAL MARKETS; Recovery in Stocks, After Thursday's Break--Call Money Goes to 6%.

September 7, 1929, Saturday  
Section: Business & Finance, Page 24, 629 words

 E-MAIL

Following the somewhat violent decline of the day before, the stock market reversed its movement yesterday, recovering much though as a rule by no means all of Thursday's losses. Transactions were again larger than the recent average. [ END OF FIRST PARAGRAPH ]

**How to Read the Full Article**

## Behaviour and Financial Markets – The Confusion

The New York Times  
Wednesday, March 25, 2009

Archives

### TREASURY FINANCING TO RELIEVE CREDIT; Extra Funds Are Expected to Be Available at End of Week Through Over-Draft.

September 8, 1929, Sunday  
Section: Second News Section, Page N7, 765 words

E-MAIL

## Behaviour and Financial Markets – The Confusion

The New York Times  
Wednesday, March 25, 2009

Archives

### TENDENCY DOWNWARD ON THE BERLIN BOERSE; General Depression Offset in Part by Brief Rally as Market Closes.

Special Cable to THE NEW YORK TIMES.  
September 8, 1929, Sunday  
Section: Second News Section, Page N13, 542 words

E-MAIL

### FINANCIAL MARKETS; Stocks Move Irregularly With Both Advances and Declines --Sterling Unchanged.

September 8, 1929, Sunday  
Section: Second News Section, Page N9, 713 words

E-MAIL

The general repurchasing movement which on Friday's stock market followed the previous day's break was not repeated yesterday. A good deal of promiscuous bidding-up of prices occurred again, but it was not as a ... [ END OF FIRST PARAGRAPH ]

# Behaviour and Financial Markets – The Confusion

The New York Times  
Wednesday, March 25, 2009

Archives

**TENDENCY DOWNWARD ON THE BERLIN BOERSE;**  
General Depression Offset in Part by Brief Rally as Market Closes.

Special Cable to THE NEW YORK TIMES.  
September 8, 1929, Sunday  
Section: Second News Section, Page N13, 542 words

[E-MAIL](#)

**FINANCIAL MARKETS; Last Week's Reaction in Stocks and the Talk of a Future "Crash."**

September 9, 1929, Monday  
Section: Business & Finance, Page 38, 717 words

[E-MAIL](#)

The action of last week's stock market, first in wavering undecidedly after its three weeks' rapid rise, then breaking suddenly and violently, and following this by irregular recovery, repeated the experience of many previous occasions.  
[ END OF FIRST PARAGRAPH ]

# Behaviour and Financial Markets – The Melancholy

The New York Times  
Wednesday, March 25, 2009

Archives

**BANKS' DEALS DRAW NATION'S ATTENTION;** Merger of National City With Corn Exchange Chief of New Developments. **OTHER MOVES IMPORTANT** Subsidiaries for Bank of the Manhattan Company and the Chatham Phenix. **GREAT SYSTEMS FORECAST** Bankers Consider Legalization of Establishment of Nation-Wide Chains of Branches.

September 22, 1929, Sunday  
Section: Second News Section, Page N7, 1122 words

[E-MAIL](#)

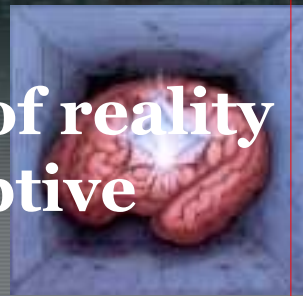
**ANXIETY IN LONDON OVER HATRY INCIDENT;** Collapse in Shares Hits Public, Sensational Developments Upset the Market.

Special Cable to THE NEW YORK TIMES.  
September 23, 1929, Monday  
Section: Business & Finance, Page 44, 200 words

[E-MAIL](#)

## A multi-sensory world

**Multisensory Processing is an emergent property of the brain that distorts the neural representation of reality to generate adaptive behaviors.**



## Behaviour and Financial Markets – The Farce

The New York Times  
Wednesday, March 25, 2009

Archives

SEEK TO WIND UP 4 HATRY COMPANIES; Creditors, Following Investigation Into British Crash, File Compulsory Petitions. INVESTORS ARE NERVOUS London Prices Sag--Exchange Delays Hatry Settlement--Broker Defaulted at Liverpool.

Special Cable to THE NEW YORK TIMES.  
September 24, 1929, Tuesday  
Page 9, 402 words

E-MAIL

LONDON, Sept. 23.--Reverberations continued through the British financial world today as a result of the crash of the Photomaton Parent Corporation and other companies controlled by Clarence C. Hatry. Hatry and three associates are now held without bail at Brixton prison charged with fraud involving more than \$1,000,000, and trading in securities of his companies has been suspended. [ END OF FIRST PARAGRAPH ]

# Behaviour and Financial Markets – The Tragedy

The New York Times  
Wednesday, March 25, 2009

Archives



# Behaviour and Financial Markets – The Rationalist Riposte

## Traditional Finance Theory Criticism

Theoretical behavioural models are somewhat ad hoc and designed to explain specific stylised facts

Empirical work is plagued by data-mining (that is, if researchers set out to find deviations from rational pricing by running numerous regressions, ultimately they will be successful).

Behavioural finance presents no unified theory unlike expected utility maximisation using rational beliefs.

## Behavioural Finance Response

Behavioural models are based on how people actually behave based on extensive experimental evidence, and explain evidence better than traditional ones

Much empirical work has confirmed the evidence out-of-sample, both in terms of time-periods as well as cross-sectionally across different countries

Traditional risk-based theories do not appear to be strongly supported by the data.

Avanidhar Subrahmanyam (2007) Behavioural Finance: A Review and Synthesis. *European Financial Management*, Vol. 14, No. 1, 2007, 12–29

## Behaviour and Financial Markets

### – Do theories change and, if so, why?

The history of any discipline shows major changes in the discipline over a period of time. The underpinning theories in a discipline appear to change as well. In physics, we have moved from an indivisible atom (c. 1900) to a divisible atom (c. 1920) comprising elementary particles (protons and neutrons, c. 1935 ). The elementary particles, it turns out, are in themselves comprise quarks (c. 1970's) .....

There are two major theories of this change: First, new theories appear through a process of *iterative refinement* – a gradual process. Second, theories appear when suddenly anomalies in existing theories are discovered and are discarded.

## Behaviour and Financial Markets

### – Do theories change and, if so, why?

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# Behaviour and Financial Markets

Theories are refined incrementally and in some instances there is a paradigm shift of revolutionary proportions.

Term/ 'Concept'	Associated Proposition	
	Before	After
Perception	<i>In perceiving one sees</i>	
	beams coming from an object (Aristotle)	beams leaving the observer's eyes (Pythagoras)
Motion	<i>Objects move because of</i>	
	an in-built tendency to move (Aristotle)	something exerts 'attraction' (Galileo)
Solar Cycle	<i>Sunrise is caused by</i>	
	a rising Sun (Brahe)	a turning earth (Kepler)
Combustion	<i>Burning an object (say O) in air means</i>	
	The mass of O decreases by losing phlogiston to air (Prestley)	The mass of O increases by gaining oxygen from air (Lavoisier)

# Behaviour and Financial Markets

Theories are refined incrementally and in some instances there is a paradigm shift of revolutionary proportions.

Term/ 'Concept'	Before	After
	Photosynthesis	<i>Glucose<sup>o</sup> produced by plants during photosynthesis was</i>
Carbon combined with water to form carbohydrates (C <sub>6</sub> (H <sub>2</sub> O) <sub>6</sub> ) (Ingenhousz)		Hydrogen combines with Carbon dioxide to form carbohydrates ((C <sub>6</sub> H <sub>2</sub> O) <sub>6</sub> ) (Van Neil)
Ventilation	<i>Expiration (during breathing) is facilitated by</i>	
	expansion of chest as a consequence of heating (Galen)	contraction of chest as a consequence of higher pressure (Harvey)
Heartbeat	<i>Blood circulation is caused by</i>	
	an explosion during diastole of the heart (Descartes)	a compression during systole of the heart (Harvey)
Species	<i>The distinction between species is</i>	
	an absolute phenomenon that has been determined in the past (Linnaeus)	a contemporaneous phenomenon with borders between the species (Darwin)

## Iterative Refinement

Karl Popper tried to build a purely deductive approach to science [and econometrics]. For Popper 'all scientific discussions start with a problem ( $P_1$ ), to which we offer some sort of tentative solution – a *tentative theory* (TT); this theory is then criticized, in an attempt at error elimination (EE); and as in the case of dialectic, this process renews itself: the theory and its critical revision to new problems ( $P_2$ )' (Redman 1994:69).

$$P_1 \rightarrow TT \rightarrow EE \rightarrow P_2$$

It is possible, suggested Karl Popper, that science could start anywhere.

Popper has influenced the development of econometrics.



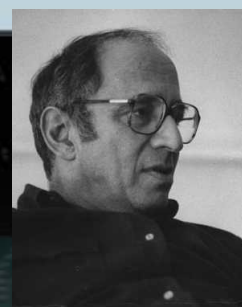
Austrian born philosopher and logician; held chair at LSE. Born 1902, died 1994.

Redman, Deborah, A. (1994). Karl Popper's Theory of Science and Econometrics: The Rise and Decline of Social Engineering. *Journal of Economic Issues*. Vol 28

## Paradigm Shifts:

What is paradigm shift anyway?

A research paradigm (Kuhn 1970) was defined originally by Kuhn to 'suggest that some accepted example of actual scientific practice - examples which include law, theory, application and instrumentation together - provide models from which spring particular coherent traditions of scientific research' (1970: 10).



American philosopher and sociologist of science; held chairs at Princeton and MIT. Born 1922, died 1996

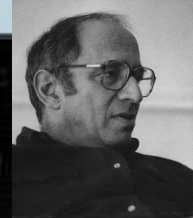
KUHN, T. S. (1970). *The Structure of Scientific Revolutions*. Chicago: Chicago Univ. Press.

## Paradigm Shifts:

What is paradigm shift anyway?

**Normal Science: science that is considered standard or normative; science that works within the prevailing paradigms of its time and uses generally accepted methods (*OED*);**

“Normal science’ means research firmly based upon one or more past scientific achievements [...] that some particular scientific community acknowledges for a time as supplying the foundation for its further practice.” (Kuhn 1970:10)



American philosopher and sociologist of science; held chairs at Princeton and MIT. Born 1922, died 1996

KUHN, T. S.(1970).*The Structure of Scientific Revolutions*. Chicago: Chicago Univ

## Paradigm Shifts:

What is paradigm shift anyway?

**Kuhn's attempt to revolutionise the philosophy of science by predicating a structure of scientific revolutions follows a research tradition that was operationalised by, amongst others, Ludwik Fleck. Fleck, a neo-Kantian scientist, attempted to argue that the *genesis and development of a scientific fact* (Fleck 1935/1979) involved 'thought styles' and 'thought collectives' that show sociological conditioning as vital to the consolidation of scientific facts.**

## Paradigm Shifts:

What is paradigm shift anyway?

**Fleck was aware of the developments in the atomic theory of matter (c. 1900-30) and commented that 'the concepts of the elements and of the atom can thus be constructed from historical factors as well from those of the thought collective. Such concepts are derived from the collective imagination.'** (1979:83).

## Paradigm Shifts:

What is paradigm shift anyway?

**Kuhn's position has shifted over the last quarter century and this has led him to argue that conceptual and linguistic change during scientific revolutions are amongst the key changes. During the last 10 years Kuhn has brought terms like *lexicon* and *lexical structure* into what has otherwise been an historical and sociological analysis of how science works and develops. Every scientific theory, according to Kuhn (1991), has its idiosyncratic structured taxonomic lexicon organised within a particular network whose links comprise structural relationships such as**

KUHN, T.S. (1991). 'The Road since *Structure*'. In (Eds.) A. Fine, M. Forbes and L. Wessels. *PSA 1990*, Vol. 2. East Lansing: Philosophy of Science Association.

Kuhn's 20 senses of the term *paradigm*. (Masterman, 1970: 61-6)

## Paradigm Shifts: What is paradigm shift anyway?

Orientation	Possible interpretations of the proposition: A paradigm is
Metaphysical	a successful metaphysical speculation (Kuhn 1970:2)
	a set of beliefs ( <i>ibid</i> :4)
	a myth ( <i>ibid</i> :17)
	a standard ( <i>ibid</i> :102)
	a map ( <i>ibid</i> :108)
	a new way of seeing things ( <i>ibid</i> :117-121)
	an organising principle governing perception ( <i>ibid</i> :120)
	something which determines a large area of reality ( <i>ibid</i> :128)

MASTERMAN, M. (1970) 'The Nature of a Paradigm'. In (Eds.) I. Lakatos and A. Musgrave. *Criticism and the Growth of Knowledge: Proceedings of the International Colloquium on the Philosophy of Science, London 1965 (Vol. 4)*. Cambridge: Cambridge Univ. Press. pp 59-89.

Kuhn's 20 senses of the term *paradigm*. (Masterman, 1970: 61-6)

## Paradigm Shifts: What is paradigm shift anyway?

Orientation	Possible interpretations of the proposition: A paradigm is
Constructural or Artefactual	(like) a textbook ( <i>ibid</i> :10)
	(like) an analogy ( <i>ibid</i> :14)
	a universally recognised scientific achievement ( <i>ibid</i> :21)
	a grammatical paradigm ( <i>ibid</i> :23)
	a conceptual and instrumental tools ( <i>ibid</i> :37, 76)
	a device or type of instrumentation ( <i>ibid</i> :59, 60)
	(like) a gestalt figure ( <i>ibid</i> :63)
	an anomalous pack ( <i>ibid</i> :85)

MASTERMAN, M. (1970) 'The Nature of a Paradigm'. In (Eds.) I. Lakatos and A. Musgrave. *Criticism and the Growth of Knowledge: Proceedings of the International Colloquium on the Philosophy of Science, London 1965 (Vol. 4)*. Cambridge: Cambridge Univ. Press. pp 59-89.

# Paradigm Shifts:

What is paradigm shift anyway? Players and others

F I N A N C I A L S

People	Knowledge		
	Mathematically Sophisticated?	Real World Experience?	Exemplars
Asset-back security traders	No	Yes	Investment Houses
Collateralised Debt Obligation Vendors	Yes	No	Consultancies; Banks
Regulators	No	No	Central Banks; Federal Reserve; FSA (RIP)
Clever Clog Academics	Yes	Yes	Louis Bachelier (1900); Beniot Mandelbrot (1960); Roubbani, Stiglitz, Shiller, Fama(yesterday)