Narrative, emotion and mental states

Bringing uncertainty into neuroeconomics

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Challenge...

“...systematic warnings over more than a century in the case of finance and over thirty years in the case of equilibrium theory have been ignored and we have persisted with models which are both unsound theoretically and incompatible with the data.”

Kirman (2010)
Real World Decision Problems

Uncertainty...concerns events where it is not possible to define, or even imagine, all possible future outcomes, and to which probabilities cannot therefore be assigned.....A capitalist economy generates previously unimaginable ideas, new products and new technologies.. (p 127)

- Interviews with 52 fund managers controlling <$500 billion.
- Financial markets are markets in stories.
- How to become comfortably attached to an emotionally and financially salient relationship with uncertain rewards and punishments.
- Calculation + Emotion in a State of Mind

- How do companies design resilient infrastructure for the long term and how much to spend on it?
- How to prepare for and regulate autonomous vehicles.
- How to respond to Brexit.
- How much money should a firm spend on cyber security?
- How should firms and governments mitigate (or perhaps benefit from) the effects of changing weather and climate change?
- What regulations should be applied to restrict future technology?
- What will be the price of oil in 2025?
Risk and Radical Uncertainty

The world is complex, dynamic & interconnected.

- **Not stable** due to innovation we have not imagined.
- **Not knowable** because subject to unforeseen consequences from complex combinations of interdependent events.

Ex ante, agents cannot know what is the best thing to do because the outcomes of planned actions cannot be known, to any measurable extent.

Typical decision contexts are both **equivocal** (lacking a problem structure and **indeterminate** (lacking predictability) → Uncertain

Which gamble to take if:

With 30 red balls, rest black.

30 red balls and 60 others that are either black or yellow.

There might be other coloured balls.

You don’t know how many balls there are altogether.

You might find other objects in there too.
An Ecologically Valid Agent

“the task is to replace the global rationality of economic man with a kind of rational behavior that is compatible with the access to information and the computational capacities that are actually possessed by organisms, including man, in the kinds of environments in which such organisms exist.” (italics added).

Herbert Simon (1955)
Current restrictions of economic agents

- More or less optimal calculating machines managing “risk” not uncertainty – i.e. use probabilistic reasoning as if making small world decisions when they cannot.
- In Uncertainty probabilities are not available, in complexity they are not computable: “the brain needs strategies beyond Bayes’ rule to succeed in an uncertain social and physical environment” (Volz and Gigerenzer, 2012)
- More or less fully equipped with the (“correct”) information about the world and the impact of their actions on it.
- But in real worlds information has to be selected and its meaning constructed, through interpretive processes. The intelligent mind creates from experience using "generic coding systems that permit one to go beyond the data to new and possibly fruitful predictions" (Bruner, 1957, p. 234).
Cognition under uncertainty is not cognition under risk.
- Value-based statistical thinking is sufficient for making good decisions in well-defined or small world contexts of risk but under uncertainty (in “large” or “real” world contexts) probabilities are unknowable so that statistical thinking is no longer sufficient.
- At social, psychological and brain levels humans have learned to cope. **The brain relies on different processes for different contexts.**

Extend the capacities given to economic agents so that they reflect the cognitive, affective and social, capabilities human have evolved to work together to cope with uncertainty

Adaptive heuristics, emotion, narrative.
Unconscious inference by a simple rule

The brain (predicts, anticipates) a three-dimensional world and uses the shaded parts of the dots to guess (infer) in what direction of the third dimension they extend. To make a good guess between convex and concave perception it assumes:

1. Light comes from above (in relation to retinal coordinates). 2. There is only one source of light.

These two structures describe human (and mammalian) history, when the sun and the moon were the only sources of light, and only one operated at a time.

The brain exploits the assumed structures by using a simple rule of thumb: **If the shade is in the upper part then the dots recede into the surface; if the shade is in the lower part then the dots project up from the surface.**
### Ten Heuristics in the Adaptive Toolbox of Humans

*(Kruglianski and Gigerenzer, 2011)*

<table>
<thead>
<tr>
<th>Heuristic</th>
<th>Definition (Narrative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recognition heuristic</strong></td>
<td>If one of two alternatives is recognized, infer that it has the higher value on the criterion.</td>
</tr>
<tr>
<td><strong>Fluency heuristic</strong></td>
<td>If both alternatives are recognized but one is recognized faster, infer that it has the higher value on the criterion.</td>
</tr>
<tr>
<td><strong>Take-the-best</strong></td>
<td>To infer which of two alternatives has the higher value, (a) search through cues in order of validity, (b) stop search as soon as a cue discriminates, and (c) choose the alternative this cue favors.</td>
</tr>
<tr>
<td><strong>Tallying</strong></td>
<td>To estimate a criterion, do not estimate weights, but simply count the number of positive cues.</td>
</tr>
<tr>
<td><strong>Satisficing</strong></td>
<td>Search through alternatives, and choose the first one that exceeds your aspiration level.</td>
</tr>
<tr>
<td><strong>1/N; equality heuristic</strong></td>
<td>Allocate resources equally to each of N alternatives.</td>
</tr>
<tr>
<td><strong>Default heuristic</strong></td>
<td>If there is a default, do nothing.</td>
</tr>
<tr>
<td><strong>Tit-for-tat</strong></td>
<td>Cooperate first, and then imitate your partner’s last behavior.</td>
</tr>
<tr>
<td><strong>Imitate the majority</strong></td>
<td>Consider the majority of people in your peer group, and imitate their behavior.</td>
</tr>
<tr>
<td><strong>Imitate the successful</strong></td>
<td>Consider the most successful person, and imitate his or her behavior.</td>
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</tbody>
</table>

- **Heuristic**
  - Recognition heuristic: Goldstein & Gigerenzer (2002)
  - Fluency heuristic: Jacoby & Dallas (1981); Schooler & Hertwig (2005)
  - Tallying: Unit-weight linear model, Dawes, 1979
  - Satisficing: Simon (1955); Todd & Miller (1999)
  - **1/N; equality heuristic**: DeMiguel et al. (2009)
  - Default heuristic: Johnson & Goldstein (2003); Pichert & Katsikopoulos (2008)
  - Tit-for-tat: Axelrod (1984)
  - Imitate the majority: Boyd & Richerson (2005)
  - Imitate the successful: Boyd & Richerson (2005)
Types of investment opportunities fund managers identify

Table 1. Search rules for identifying opportunities used by 52 active fund managers.

1. Look for complex companies that are hard to understand and have received little market attention but which you can show are undervalued based on past performance.
2. Look for shares hit by possibly exaggerated rumours (e.g., of impending litigation or compensation pay-outs).
3. Look for companies sitting on “piles of cash” as they often find ways to return this cash to the shareholders while isolating losses in spin-offs.
4. Look for market-leading companies identified as likely to benefit substantially from regulatory change.
5. Look for companies in sectors in fast growing regions in which there will be a growing inability to meet their own level of demand (e.g., the need for gas supply to power stations).
6. Look for related demands (e.g., drilling, building pipelines, or importation of gas) and buy companies that provide these services.
7. Look for and evaluate the sentiment on management teams within companies.
8. Look for companies with strong regional market solutions that appear undervalued.
9. Look for low value companies (due to market perception) in sectors that do badly when interest rates rise.
10. Look for government/industry funding partnerships – often treated as off-balance sheet funding for governments.
11. Look for the typical “sound investment” that “ticks all the boxes” (new listing, big company, barrier to entry exist, good margins, free cash flow, good management, etc.).
Embodied cognition and the role of emotions

- Cognition is to do with how a person understands the world and acts in it.
- It is not free floating but embodied (instantiated).
- As a system it evolved out of “simpler” structures better to support action in specific situations, including social interaction.
  - It is “the outcome of interaction between perception, action, the body, the environment and other agents, typically during goal achievement” (Barsalou, 2008 p 619).
- Embodiment means that feelings (conscious emotions) play an organizing or metacognitive role in cognition.
  - Cognition is grounded in emotions that have an evolutionary purpose linked to maintaining homeostatic control.
- Significant advances recently in understanding fundamental relation between emotion and approach/avoidance motivation and behaviour at multiple levels from the primitive primary emotional system of the brain through learning processes to higher order cognitions (Panksepp, 2013; Rolls, 2013).
Emotion as an Evolved Approach-Avoidance Rule

The Brain can be conceived as an evolution of modular systems, evolved to solve complex problems in simple ways with redundancy (simplexity).

Emotions are states elicited by rewards and punishers which, therefore, play an adaptive role in goal, or what we can call behavioral rule, setting during action.

Emotional states are generated through activations in numerous brain networks including the Behavioral activation (BAS) and Behavioral Inhibition (BIS) systems, which influence approach and avoidance and are eventually perceived as feelings.

Feelings constantly interact with attention, perception, memory and cognition at different brain levels.
Actors can ‘supplement’ and support reasonable calculation with something emotional... ‘animal spirits’, and so put aside thoughts ‘of ultimate loss ... as a healthy man puts aside the expectation of death’ (Keynes 1936, p162).

i.e. the ambivalent emotions generated by thoughts of loss or gain aroused by the need for action, in the face of limited information about potential rewards and harms, trigger the behavioural inhibition system and generate anxiety due to potential goal conflicts.

In the short-term, anxiety is functional, activating search and vigilance. As it is an aversive state so there will be strong motivation quickly to resolve the goal conflict that is generating anxiety, whether though emotion-focused defence and coping mechanisms which downplay the conflict, or though problem-focused approaches which seek to resolve it
Narratives provide meaning in chaos

- Cognition, is more than the processing of pre-coded information units along the lines of mechanical computation.

- **Information is given meaning** in the context where it is found and used, often influenced by the motives of those who create it.
  - A potentially paradigm-disturbing point about decision-making in radical uncertainty is that in such a context we simply can’t know which bits of information (or even which causal models) that we have to hand will actually be useful in future.

- Narrative is a cognitive process to provide meaning in context. It allows us efficiently to construct the everyday meaning of events and happenings along with their causal implications.
  - Bruner (1990): the narrative framing of meaning provides a typical means of constructing the world without which we would be left “lost in a murk of chaotic experience”
A fundamental mode of mental organization.

- Resting on two crucial changes from ape mind to human: the ability to understand others’ inner states and the drive to express one’s own states. (Tomasello, Carpenter, Call, Behne, and Moll (2005))

- In inner speech, the human mind constructs a narrative of experience, a running verbal commentary on the body’s activities (e.g., Gazzaniga, 2000) which, to be fully effective needs conscious processing. (Baumeister and Masiacampo (2010),

- Conscious narratives are stories about the world and our experience of it - building on crucial forms of sequential thought: multiword speech, logical sense, and causal plausibility.
Animal Spirits

Actors ‘supplement’ and support reasonable calculation with ‘animal spirits’ to put aside thoughts ‘of ultimate loss ... as a healthy man puts aside the expectation of death’ .. [if] the animal spirits are dimmed and the spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die;—though fears of loss may have a basis no more reasonable than hopes of profit had before. (Keynes 1936, p162)
Conviction Narrative Theory (CNT): Foundations

• **Coping**: Economic actors manage to act in radical uncertainty.

• **With what consequences** for the way they co-ordinate when their decisions are aggregated?

• **Intuition**: perceived uncertainty in context stimulates (through social perception) the behavioral activation system (BAS) and the behavioral inhibition system (BIS)?

• **Thesis**: Agents adopt conviction narratives (*thought* accurate and *felt* true) subjectively capable of supporting action because *they cognitively and affectively manage* the anticipation of both *gain and loss* associated with its uncertain consequences.

• **Conviction narratives are grounded in four functions of narrative.**
Four Functions of Conviction narratives

1. **Identify opportunities** for action by fitting subjective patterns to types with implicit causal implications.
   - Rules, adaptive heuristics, repertoires, etc. Eg. Company hit by rumour; benefitting from regulation, growth of China, etc. (Prospective brain – Schachter et al 2008)

2. **Facilitate forming pictures of future outcomes** of alternate actions and their subjective impact.
   - Simulations “running” the outcomes.

3. **Because cognition is embodied establish attachment** to a **preferred narrative** which allows enough sense of confidence and accuracy to support action (approach) despite uncertainty potentially creating avoidance.
   - Create subjective confidence building from socially available narratives attached to *via happenings in brain systems integrating BAS and BIS systems*.

4. **Facilitate communication and collaboration** (Teamwork).
   - Provide rationale
In CNT cognition and emotion combine to facilitate action....

Simplified Dual Process Decision-Making Model

- Deliberative Processes (S2)
- Automatic (inc. Emotional) Processes (S1)

CNT Unified process Decision-Making Model

- Deliberative Processes
- Emotional Processes
- Conviction Narratives (Approach less Avoidance)
- Action
CNT - selecting and supporting action under (radical) uncertainty

Reproduced from Tuckett and Nikolic, 2017
“... the ability of human actors to draw on feelings of conviction provides an advantage unavailable to a computer generating only scenarios. While a computationally competent outside observer may be unable to identify secure grounds to support a particular narrative of the future in radical uncertainty and so to commit to a particular decision, a human decision-maker can feel sufficient conviction to act.”

Tuckett & Nikolic, 2017
Relative Sentiment – Methodology

• Wok with Rickard Nyman, Robert Elliot Smith and Sujit Kapadia (BoE)

• Relative Sentiment Shifts
  • Theoretically motivated (and validated) word dictionaries are used
    • Excitement ~ 150 words, Anxiety ~ 150 words
    • Relative sentiment metric = (# excitement - # anxiety) / # characters
      • Simplicity → more robust to data source, reduced complexity

• Excitement/Anxiety word samples
  • Amaze, amazed, amazes, amazing, attract, attracted, attraction, etc.
  • Anxiety, anxious, avoid, avoids, bother, bothers, bothered, etc.

• Bootstrap confidence intervals
  • Sample new weights for each word (weights sum to ~ 150)
  • Get a new sentiment point, repeat to get a distribution
  • Extract confidence intervals from the distribution
Animal Spirits in three economies (cycles shaded). Identifying Shifts through RSS.

### RSS & Eight Economies: Unusual Shifts in 2007

Table II Cross-Sectional Comparisons of RSS Shifts in 2007 and 2008

*Number of standard deviations from the mean value over the period 2003Q2 through 2007Q2; US, UK, Germany, France, Spain, Sweden, Canada and Ireland*

<table>
<thead>
<tr>
<th>Country</th>
<th>2007Q1</th>
<th>2007Q2</th>
<th>2007Q3</th>
<th>2007Q4</th>
<th>2008Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>-0.31</td>
<td>-0.91</td>
<td>-4.37</td>
<td>-3.54</td>
<td>-4.42</td>
</tr>
<tr>
<td>UK</td>
<td>0.28</td>
<td>-2.11</td>
<td>-6.52</td>
<td>-5.33</td>
<td>-6.33</td>
</tr>
<tr>
<td>Germany</td>
<td>-0.13</td>
<td>-0.12</td>
<td>-3.16</td>
<td>-1.84</td>
<td>-3.65</td>
</tr>
<tr>
<td>France</td>
<td>1.22</td>
<td>0.03</td>
<td>-2.59</td>
<td>-2.63</td>
<td>-4.38</td>
</tr>
<tr>
<td>Spain</td>
<td>-0.28</td>
<td>-2.56</td>
<td>-2.48</td>
<td>-2.09</td>
<td>-2.28</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.27</td>
<td>-0.47</td>
<td>-0.76</td>
<td>-2.44</td>
<td>-3.20</td>
</tr>
<tr>
<td>Canada</td>
<td>-0.24</td>
<td>0.18</td>
<td>-1.91</td>
<td>-3.05</td>
<td>-4.06</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.76</td>
<td>-3.21</td>
<td>-1.37</td>
<td>-1.31</td>
<td>-2.09</td>
</tr>
</tbody>
</table>

*Note: 2 standard deviation moves in bold*
Vector Auto Regression (VAR)

The impulse response of RSS on Industrial Production for the US, UK, and Canada remains evident more than twelve months out. For the US and UK, employment is similarly affected. For the UK also an effect on the FTSE,
In CNT, all decisions made under uncertainty necessarily require (ex ante) conviction narratives.

How is conviction is generated?

Under uncertainty we can expect from an outside view that most narratives would contain some grounds for feeling approach and some for avoidance → inside anxiety repelling techniques can be used to diminish avoidance. Or inside excitement amplifying techniques can create an attachment to a idealised Phantastic object.

“Divided state” (D⁺) – is a situation in which certain topics or situations exhibit an unusual lack of balance – either avoidance (anxiety) or approach excitement seem internally to diminish or disappear.

We think only what we can tolerate to feel, things not tolerated are not seen.

A group or market in D⁺ exhibits groupthink.
Updating in $D^S$ and $I^S$ Mental States

- New Congruent Feeling Information Elements
- New Incongruent Feeling Information Elements

Prior Narrative Prediction

Approach versus Avoidance Appraisal of New Data Elements

Updated Narrative Prediction

New Congruent Feeling Information Elements

New Incongruent Feeling Information Elements
RSS in Liquidity Articles (in Reuters)
Decision-making processes under uncertainty different to those under risk.

In uncertain contexts, evidence from contexts framed as risk may be unreliable.

Under uncertainty humans able to draw on evolved capacities such as adaptive heuristics, emotion and narrative to cope, rather effectively.

Set out CNT. Narratives managing approach and reward systems support the conviction to act as human agents cope with the challenges of uncertainty.

Because the aggregate economy is produced by many economic agents trying to develop the conviction to through narratives, economic equilibrium can become fragile, unstable and subject to groupthink.

RSS measured shifts in the narratives circulating in the economy tracked through time may carry information for anticipating break points or “phase transitions”.

Conclusion
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References to CNT and RSS


