Thinking with your brain and with your body:

The neurobiology of decision making and implications for mental health and well being
Background
Assumptions: Humans

- That we make decisions with our brain
- That the body was made to carry the brain around
- That the “best” (ie, the most advantageous, for the particular context) decisions are made without emotion
- That the best decisions are based on logic and conscious deliberation

Does current neuroscience support these assumptions?
That emotion, or unconscious processes, should play a role in **legal decision making** is inimical to the **rule of law**

That is, that the rule of law **protects** from the arbitrary exercise of public power, as well as from the “**deployment of purely personal legal power**”
Propositions: The Law

- In this, it is envisaged that legal decisions are made, **based upon reason and logic**, in the absence any **personal “bias” or other unconscious processes**, including emotion.

- Does current neuroscience support these propositions?
In the past few decades, there has been an explosion of research investigating the processes involved in decision making, including its neurobiological underpinnings.

A major finding has been that unconscious processes, including biases (or predispositions) and emotions, are an important and integral part of deliberation, reasoning and final decision making.
For example, it is now well accepted in the cognitive psychology domain that there are two main systems that go to make up the decision-making process:

- **Firstly**, what has been referred to as a “**System 1**”, which has been associated with “**Intuition**” and **fast** and **unconscious** mental processing
- **Secondly**, a “**System 2**”, which has been associated with formal concepts of “**Reason**” and **slow** mental processing
The neurobiologists for their part, have gone some way to identifying the neurobiological networks that underpin these two decision making systems.

Additionally, they have found that one of the networks that underpins one of the systems (System 1) has its own rich network through the brain - which also extends to the outer reaches of the body.

Through this connection, it is now well recognised that visceral responses and bodily sensations play an integral and essential role in cognition in general, and decision making in particular.
Decision making ...

- The aspects of decision making most likely to be associated with such bodily responses and associated unconscious biases, are those decisions that relate to personal, social, or moral issues.

- Additionally, it is in decision making situations when these personal, social and moral issues are considered, that the decision maker is most likely to experience some degree of “emotional” response via bodily sensations.
In fact, **for these types** of decision, the role of **emotion** and **associated bodily responses** is said to be **essential** to the **integrity** of the decision making **process** itself.
Aims of presentation

1) Assist with understanding of the **neurobiology** of decision making

2) To understand how **bodily reactions and emotions** are essential to some forms of decision making

3) To raise the awareness that a **barrister’s decision making**, both professionally and personally, will be enhanced where the **barrister’s bodily state (and mental health)** have been given attention and care
Provides scientific references


The civil standard of proof and the “test” in *Briginshaw*:

Is there a neurobiological basis to being “comfortably satisfied”?

Hayley Bennett * and G.A. (Tony) Broe **
Neurobiologist and neurologist

World leader in research into the neurobiology of decision making
Daniel Kahneman (2011)

- Nobel prize winning cognitive neuroscientist
- Uses cognitive, as opposed to biological references – but these graft onto neurobiological templates
Robert Sapolsky is an American neuroendocrinologist. He is currently a professor of biology, and professor of neurology and neurological sciences, and neurosurgery, at Stanford University.
Neurobiology of decision making
Brain anatomy

- Frontal Lobe
- Parietal Lobe
- Occipital Lobe
- Temporal Lobe
- Lateral Sulcus
- Central Sulcus
- Brainstem
- Cerebellum
Brain anatomy: complex

Lateral surface

Medial surface
Functional anatomy: complex
Functional anatomy: complex
Neuronal functional: complex
Brain anatomy

- Frontal Lobe
- Parietal Lobe
- Occipital Lobe
- Temporal Lobe
- Lateral Sulcus
- Central Sulcus
- Brainstem
- Cerebellum
Prefrontal region
Dorsolateral & ventromedial
Knowledge of association between frontal lobe and “executive” function has been available since the mid 1800’s.

At that time, damage to a person’s frontal lobe was found to result in impairments in “executive” function, that is, in judgment, reasoning, problem solving, abstraction, decision making, and for the regulation of emotion and behaviour.

In recent decades, there has been an exponential increase in research demonstrating that within the frontal lobe, ventromedial and dorsolateral regions have particular importance in decision making processes.
Found that VM cortex is the:

- Source of seemingly **unconscious**, “automatic”, and “intuitive” decision-making
- Source of “hunches”
- Source of “gut feelings”
- Source of “alarm bells”
- Source of the awareness of whether a particular decision “feels right”
- Source of somatic (bodily) responses and brain-body associations
Ventromedial cortex ... 

- VM is the source of access to past experience of decision maker quickly and automatically.

- Studies have found that participation of the ventromedial cortex in decision making assists when there is:
  - Incomplete and uncertain factual basis
  - Uncertainty of consequences
Ventromedial cortex ...

- VM is associated with the processing of emotional information
  - In particular, is **essential** when processing information of a **personal, social, or moral** nature

- VM is part of a **rich network** of connections to the other parts of the brain, as well as to the **farther reaches of the body**
This **brain-body connection** of one of the main networks that allows for the **experiencing of emotion**

- Within this system, the experience of “**emotion**” is associated with changes to the visceral and musculo-skeletal states of the body.

- These changes can be measured experimentally by changes in **heart rate** (pulse), **blood pressure**, **respiration rate**, **skin conductance** (sweating), etc.

- Examples: anger, disgust, fear
These somatic changes may be experienced (or not)

In this, when the emotions and their physiological changes are of a **sufficient magnitude**, the emotions may be “felt” (ie, consciously perceived)

When **not** of a **sufficient magnitude**, ventromedial function and its associated physiological changes to the body, may **not be consciously** recognised, but **will still occur** and may still participate in cognition (at a non-conscious level)
Definitions

“Emotion”
- A collection of changes occurring in both brain and body, usually prompted by a particular mental context

“Feeling”
- The perception of those changes
Iowa Gambling Task:
Experimental task illustrating role of ventromedial cortex in decision making
Bechara A, Damasio H, Tranel D, and Damasio A

Results first published in *Cerebral Cortex, 1997* – but have since been replicated

**Accepted wisdom**: “Deciding advantageously in a complex situation is thought to require **overt reasoning** on declarative knowledge, namely, on facts pertaining to premises, options for action, and outcomes of actions that embody the pertinent previous experience”

**Study hypothesis**: “Overt reasoning is **preceded** by a **nonconscious biasing** step that uses neural systems other than those that support declarative knowledge”
Iowa Gambling Task

- **4 decks of cards**: A, B, C, and D

- Each card in each deck either wins the subject a sum of money or costs them some

- **Task:**
  - Subjects told:
  - *Play so that you lose the least amount of money, and win the most*
  - *Turn over one card at a time, from any deck*
Experimental condition:

Cards stacked:

- A and B decks are disadvantageous:
  - Rewards high, but losses higher

- C and D are advantageous:
  - Rewards not so high, but losses less
Iowa Gambling Task

Experimental conditions:

- Two groups: “Normal” control subjects and “Ventromedial” impaired subjects
- Subjects are monitored for skin conductance response (SCR): sweaty palms
- Subjects asked at various intervals: *Tell me all you know about what is going on in this game*
Results: Normal subjects began to choose advantageously before they realised what strategy worked best, whereas ventromedial subjects continued to choose disadvantageously even after they knew the correct strategy.

Moreover: Normal subjects began to generate “anticipatory” SCRs whenever they pondered a choice that turned out to be risky, before they knew explicitly that it was a risky choice.
Experimental observations:

- All subjects commenced by sampling cards from all decks

- Usually by **card 10:**
  - Normal subjects began to generate anticipatory SCRs to decks A and B
    - All indicated they had no idea of what was going on: “Pre-hunch” period
By about **card 50:**

- All normals began to express a “hunch” that decks A and B were riskier, and generated anticipatory SCRs whenever they pondered a choice from decks A or B
  - “Hunch” period
By card 80:

Many normal subjects expressed knowledge about why, in the long run, decks A and B were bad, and C and D were good:

- “Conceptual” period (70%)
Ventromedial subjects:

Subjects with ventromedial lesions did not develop the anticipatory SCRs, although some eventually articulated the observation that the choices they were making were risky.
Experimenters concluded:

“In normal individuals, nonconscious biases guide behaviour before conscious knowledge does. Without the help of such biases, overt knowledge may be insufficient to ensure advantageous behaviour”
Primary neural substrate for **attention** and “**working memory**”

Working memory is the “**short term**” memory system that allows **attention** to be paid to a **number of pieces** of information **at once**, for a limited amount of time.

Whilst in working memory, this information may then be **evaluated, compared and contrasted**, and **manipulated**.

May hold and integrate information from **multiple sources**, as well as incorporating and orchestrating this **new knowledge** with **previously learned and stored information**.
Dorsolateral function is typically a **conscious** process, and can **actively draw on** information from a wide variety of sources.

Dorsolateral function more **classically related** to traditional concepts of **deliberation and judgment**.

Operation may appear **technical and mechanical**.
Stages of decision making

- Earliest processing mediated by ventromedial cortex
  - May be conscious or non-conscious
  - Processing will operate rapidly and apparently automatically
  - Is able to, consciously or non-consciously, access relevant and related past experience
  - Is able to process and access emotional information as it relates to personal, social, and moral issues – which tends to have high emotional salience
Stages of decision making

- **On its own**, ventromedial is:
  
  - Able to arrive at a **preliminary “decision”** which may be felt as a “hunch” or “gut feeling”

- Preferences **towards or against** particular options will be linked to particular **bodily reactions**, via the somatic and emotional connections from the ventromedial cortex **to the body**

- In doing this, information is sorted and prioritised for later processing by the dorsolateral cortex
Stages of decision making

- Later processing by the dorsolateral cortex
- Information becomes available for conscious dorsolateral deliberation

- Information from a variety of sources may be accessed:
  - Conscious access to past experience
  - New information recently acquired
  - Conscious awareness of emotion
Decision making in relation to personal, social, and moral issues:

- “acquired sociopathy”
- lack empathy and compassion
- “dispassionate”, “uninvolved”, detached”, “cold-blooded”

NOTE: General intelligence and knowledge of social and moral rules intact
Without ventromedial

- Decisions **slow and effortful**
- Need to **actively** interrogate memory systems for relevant experience
- Decisions **technical and mechanical**
- Decisions **unemotional**
- No **feelings** of being “right” or “wrong”
- As no **preliminary** “bias”, all alternative choices may appear of **equal weight** thus unable to make a decision
Without dorsolateral

- “Biased” decisions based only on previous experience
- Not able to integrate new information into factors to be considered
- Not able to hold complex information in mind, nor information from a number of sources, at once, to compare and consider
- Wholly emotional decisions may be unchecked for inappropriate bias and relevance
Without dorsolateral

- No “testing” against reason and logic
- Inability for the “testing” to over-ride a preset (based on ventromedial selection) emotionally and somatically favoured decision
The ideal decision making context is with participation of both the ventromedial and dorsolateral cortices.

In situations where personal, social, or moral issues are paramount, then ventromedial participation is required.

In other situations however, a decision made on a technical basis with only dorsolateral processing may be sufficient.
Implications for barristers making decisions
Decision making process

- Stages of decision making
  - 1) Ventromedial
  - 2) Dorsolateral
  - The decision itself
Rapid, automatic, “intuitive”, unconscious

Relies on previous learning: past experience

Emotional responses

Related bodily sensations

Legitimate preliminary “bias” or “prejudice”

Potential source of inappropriate bias

Gut feelings, hunches, alarm bells

Internal voice: “I’ve got a bad feeling about this”
Stage 2: Dorsolateral

- Slow, deliberative, conscious
- Able to take in new information from a variety of sources
- Scrutinise and “test” the results of ventromedial processes
- Able to assess for emotion and inappropriate bias, unsubstantiated suspicion, guesswork, hunches
- Able to over-ride a decision from the ventromedial
The decision itself

- The process moves from ventromedial (unconscious) processing, to, dorsolateral (conscious) processing

- The final decision will be based upon input from, and a balancing of that input, these two systems

- In this, need to enable and allow input from the ventromedial system: that is: not to block, or otherwise compromise access to that bodily information
The decision itself

- If access is blocked, or otherwise compromised, impaired decision making will result:
  - (see earlier, decisions made based only on dorsolateral information)

- The decision maker needs to address:
  - 1) Be aware this is an issue
  - 2) Do something about it: raise their awareness of bodily sensations, emotions, and hunches: *making the unconscious conscious, and available for participation in the decision making process*
Conclusion: Extension of neurobiological findings
In order to make a decision, the brain takes in information from:

1. the environment (via the senses)
2. the body proper (via the ventromedial cortex)

In this, the body proper has been described as a “sensing instrument”
Must be mindful: that we need to give the body – this “sensing instrument” – appropriate attention and care: that is, so as it can do the job it is built to do

1. The senses: It is uncontroversial, that the quality of information from the environment is maximised, if people “support” sense where needed: glasses, hearing aids

2. The body proper???
2. The body proper

Homeostasis refers to stability, balance, or equilibrium within a cell or the body. ... Homeostasis can be thought of as a **dynamic equilibrium** rather than a constant, unchanging state.

What we need to do is to:

- Be aware that there are factors that may derail homeostasis:
- That is, factors that dampen or numb bodily sensations, as they will also dampen or numb those sensations that assist decision making
What are these “factors”?

The following factors have the capacity to **derail homeostasis** (and numb sensation, and thus block access to valuable information) and thus have the potential to compromise decision making:

- Stress, anxiety, depression, other mental disorders
- Insomnia
- “Medications” used to deal with stress: Alcohol, drugs, food (over eating), etc

This is an uncontroversial list (I hope): most people will be aware of the physiological sequaele of these issues
Research findings have shown the following to support and enhance the integrity of the body proper, including being shown to be associated with better cognition and mental health:

- Appropriate diet
- Regular exercise
- Adequate sleep

In maximising the integrity of the body proper, its function as a “sensing instrument” for decision making is maximised: cognition is improved, as is mental health more generally.
Extend findings ... final

- Other research finding: only one third of people who have mental health problems seek advice from a professional
- Take home message:
- If struggling with stress, anxiety, and any other mental health issue (including any addiction), get help:
  - Find a therapist or other specialist
  - See a dietitian
  - Get a personal trainer
  - Join a gym, yoga class, etc

- This will enhance decision making, and more importantly, will enhance mental well being more broadly
One of my favourites is

- But each of us need to identify our own “blocks” to sensations, and find our own ways to remedy this