PTSD IN THE BAYESIAN BRAIN

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A TALK IN 4 PARTS

A puzzling epidemic, 1999 to 2016

The obvious solutions

Enter the Bayesian Brain

Into the future

PTSD and History

- Unlike most DSM disorders, PTSD includes a causal mechanism, a forensic potential, and a distinctive historical identity.
- Every DSM classification has a history, a chronology of efforts that were, at one time or another, intended to represent, explain, or influence the disorder's clinical phenomenology and epidemiology.
- PTSD is historical in an 'episodic' sense, described in Ian Hacking's book, *Mad Travelers: Reflections on the Reality of Transient Mental Illnesses* (1998).

History and Heterogeneity

- The history of psychogenic trauma spans 150 years, and comprises a series of episodes and epidemics.

- Each episode is shaped by social, cultural, economic, political, and professional interests, and concurrent developments in the biological and medical sciences.

- Syndromes – shellshock, PTSD, mild traumatic brain injury (mTBI), Gulf War Syndrome, second-generation Holocaust trauma – and subjectivities (victims' self-awareness and self-representations) proliferate

History and Heterogeneity

- One can imagine, but cannot find, a supervening version of the posttraumatic disorder – the sort predicated by Richard McNally's notion of 'bracket creep'.

- The Institute of Medicine endorsed a 'gold standard' for diagnosing PTSD (CAPS), but it is irregularly employed by VA diagnosticians.

- Disability rolls for PTSD
  - 1999:120,265 recipients @ $1.7 billion
  - 2004: 215,871 @ $4.3 billion
  - 2014: over 650,000 US veterans were receiving compensation for PTSD

- Concurrent expansion of the operational theater in the Middle East following the Gulf War and by invasions of Afghanistan and Iraq, adding two million veterans by 2015

A PUZZLING EPIDEMIC

US Veterans receiving disability compensation for all health problems increases **12%**

Veterans receiving compensation for service-connected PTSD increases **80%**

Most of the increase in PTSD is among veterans of the **Vietnam War, 1964 – 1975**

250,000 cases of "long-delayed onset PTSD"!

R.J. McNally and B.C. Frueh. 2013. Why are Iraq and Afghanistan War veterans seeking PTSD disability compensation at unprecedented rates? *Journal of Anxiety Disorders* 27: 520–526

Puzzling because –

The typical patient continues treatment sessions once he has received a disability rating for PTSD

Attendance continues while evidence of lack of efficacy accumulates – reflected in his increasing disability rating

Once the disability rating reaches 100%, most men stop attending treatment sessions

CONCURRENT CHANGES AT THE VA

- 1980 (DSM-III): stressors are limited to witnessing or experiencing traumatic events.
- 2010: the VA expands the range of stressors to include a victim's *fear or expectation* of an imminent trauma-level event.
- 2012: the requirement that claimants document physical proximity to stressors is set aside.
- 2012-2016: PTSD claims rise 60% to over 150,000 per annum;the approval rate increases from 55% to 74%

AN OBVIOUS SOLUTION TO THE PUZZLE

Labour economists and the US Government Accounting Office investigate

They discover the new disability claims are concentrated among veterans whose limited vocational skills have reduced their ability to make a decent living

The obvious solution = **malingering** accounts for a significant portion of the new applications

Fictitious and Factitious experiences

- **Malingering** = a *conscious deception* with the goal of acquiring some external reward
  - It includes invented symptoms, exaggerated real symptoms, misattribution of symptoms

- **Factitious experiences** (*cryptomnesia, source amnesia*)

A LANDMARK CASE OF FACTITIOUS MEMORY

A runaway team of horses bear down on Le-Log

He is carried unconscious to hospital

On awakening, he is amnesic, his legs are paralyzed and bruised

He recovers the memory of his traumatic experience

Eye-witnesses tell Charcot a different story

Charcot concludes: Le-log is a case of traumatic hysterical paralysis driven by **a *traumatic memory of the future***

DSM-5 would identify Le-log as a case of ‘factitious symptoms’

MALLEABLE MEMORIES

59 US veterans of the first Gulf War were interviewed:

One month after returning from theater of operations

Twenty-four months later

On the second occasion:

- 70% report at least one combat event not reported in the initial interview
- A majority of newly remembered experiences were "objectively described severe events," rather than "subjectively evaluated experiences."
- Most common **newly remembered events:** "bizarre disfiguration of bodies as a result of wounds", "seeing others killed or wounded," "extreme threat to your personal safety"

Southwick SM, Andrew Morgan III CA, Nicolaou AL, and Charney DS. 1997. Consistency of memory for combat-related traumatic events in veterans of Operation Desert Storm. *American Journal of Psychiatry* 154:173–177.

SOUTHWICK et al. EXPLAIN THE NEWLY REPORTED EXPERIENCES

In the interim, men view media accounts of the military actions they participated in, and have conversations with fellow veterans about their experiences

The men who became increasingly symptomatic in the interim unknowingly exaggerate their memory of trauma events as a way to understand or explain their emerging psychopathology

Similar findings are reported in a study of U.S. soldiers (n=460) who served in a peace-keeping mission in Somalia (Roemer et al. 1998); research on a second sample of veterans of the first Gulf War (King et al. 2000); and an epidemiological study of civilians (Hepp et al. 2006); and Englehard, I.M. and McNally, R.J. 2014. Metacognitive appraisal of memory inconsistency for traumatic events in Dutch veterans.

A CONVENTIONAL CLINICAL PERSPECTIVE

‘Storage and Retrieval’ conception of memory

A traumatic memory = an indelible object

Common metaphors: dvd, flashback, indelible inscription and retrieval

Memory provides a veridical object for forensic purposes: a dichotomous epistemological standard

AN ALTERNATIVE PERSPECTIVE

1932 - Memory = *an active process*
Fredrick Bartlett. *Remembering* (1932)

Advent of functional neuroimaging - traumatic memories are products of a common memory system – *the remembering-imagination system*

Fictitious, factitious, retroactive memories can metamorphose into embodied traumatic memory: it becomes difficult, even impossible to distinguish among these different kinds

MEMORIES OF THE FUTURE

A conventional clinical perspective –

‘Memories of the future’ are *an aberrant sub-type* of autobiographical and episodic memories

An emergent rival vision of the brain –

Memories of the future are *pervasive* and a characteristic feature of our brain – the *Bayesian or Helmholtzian brain*

THE BAYESIAN BRAIN AND MEMORY

- The brain is a self-adjusting inference machine
- Every memory is a malleable probabilistic prediction
- Every memory ***of* the past** is a memory ***for* the future**
- The brain is never at rest: detecting and minimizing prediction errors via
  - retrospective changes in salience
  - active intervention
  - changes in sampling sensory input

AN EPISTEMOLOGY OF THE FUTURE

- To say that memory is a constructive process, and that psychologists have turned their research efforts to the study of suggestibility, misinformation, and distortion is not [to] say that accuracy in memory has suddenly been shown by science to be impossible or unlikely. There is no reason to think that 'constructed memories' must be false. [The] forensic dangers of constructive processes … should not lead us simply to equate construction with error, or malleability with unreliability, since veridical memories too are constructed.
- (Sutton J. 2016. Memory, *Stanford Encyclopedia of Philosophy* EN Zalta, ed. URL = <http://plato.stanford.edu/archives/sum2016/entries/memory/>. Accessed on-line11 July 2016.)

DISCOVERY OF THE DEFAULT MODE NETWORK

One naively assumes: energy consumption increases when the brain is ‘at work’ (engaged in stimulus-bound, goal-directed activity)

In reality: energy consumption increases when the brain is apparently idle, a.k.a. ‘the resting state’ or ‘default mode’

In the ‘default mode’, the brain attends to internal neuronal traffic and ‘idle’ activities that include mind-wandering, stimulus-free thought, autobiographical recollection, self-referential processing

MEMORY AND IMAGINATION IN THE BAYESIAN BRAIN

"Empirical findings and evolving theoretical frameworks explain how ***a common neural system supports our recollection of times past, imagination, and our attempts to predict the future***."

S.L. Mullally and E.A. Maguire. 2014. Memory, Imagination, and Predicting the Future: A Common Brain Mechanism? *The Neuroscientist* 20: 220–234.

"Memory is not just a readout. It is a tool that's used by the brain to bring past experience to bear when thinking about future situations. In fact, ***memory and imagination involve virtually identical mental processes; both rely on a specific system known as the "default network""***.

D.L. Schacter et al. 2012. The future of memory: remembering, imagining, and the brain. *Neuron* 76: 677-694.

THE HUMAN BRAIN CONNECTOME

- The Human Brain Connectome Project
  - Glasser MF, Coalson TS, Robinson EC, Hacker CD, Harwell J, Yacoub E, Ugurbil K, Andersson J, Beckmann CF, Jenkinson M, Smith SM, Van Essen DC. 2016. A multi-modal parcellation of human cerebral cortex. *Nature* 18933
- ‘Intrinsic Connectivity Networks’ = stable, distributed constellations of neurons constituted and integrated in the brain via *connectivity* between anatomical regions and distributed networks

- Three ICNs have been mapped so far:
  - a **default mode network**
  - a **central executive network** (contributing to the maintenance and manipulation of information, and decision-making)
  - a **salience network** that supports monitoring of salient cognitive, homeostatic, or emotional events
- "Salience processing is not necessarily accessible to conscious awareness; the integration of visceral and autonomic stimuli, and homeostatic functions of the brain can influence what is perceived to be salient. In other instances, salience processing can be dependent on top-down attention and cognitive control processes that are focused on the execution of goal-directed behaviours" (Uddin 2015: 55).

- Research by Sripada et al. 2012 identified disrupted equilibrium between DMN and SN.
- The finding would help to explain hypervigilance and hyperarousal in patients with PTSD [1] and disrupted equilibrium between ‘salience detection’ and ‘internally focused thought’, i.e. circumstances associated with PTSD pathophysiology [2].
- A consequence of trauma or a vulnerability factor for the onset of PTSD?

- [1] = effective connectivity [2] = functional connectivity