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Torturing the Brain: On the folk psychology and folk neurobiology motivating 'enhanced and coercive interrogation techniques'

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On 16 April 2009, the US Department of Justice released legal memos detailing coercive interrogation techniques used with terrorism suspects during the Bush administration[1]. The release of these documents has fuelled international controversy over the use of so-called 'enhanced interrogation techniques' (including torture) to extract information from terrorist suspects, despite strong ethical and legal objections. The use of such techniques appears motivated by a folk psychology that is demonstrably incorrect. Solid scientific evidence on how repeated and extreme stress and pain affect memory and executive functions (such as planning or forming intentions) suggests these techniques are unlikely to do anything other than the opposite of that intended by coercive or 'enhanced' interrogation.

The released memos do not present in any detail the underlying neuropsychobiological model motivating the pro-torture or pro-coercion position; they do not discuss or reference the contemporary and relevant cognitive neuroscientific literature; and only mention the Diagnostic and Statistical Manual of the American Psychiatric Association in the context of psychiatric risk associated with torture. Although the memos mention consultations with psychologists and health professionals, the advice of these professionals has not been released and therefore cannot be assessed.

From reading the memos, the neuropsychobiological model seems to be the following: a person possesses information (by definition, this information is in their long-term memory - the enduring personal register of experience, events, and facts that lasts at least for minutes and may extend to decades); they intentionally withhold this information under questioning; applying certain non-verbal techniques (Box 1) over prolonged periods of time (press and other reports indicate up to six months or more) will facilitate release of this information from long-term memory by the captive. The memos do not fully articulate the mechanisms by which coercion makes captives reveal information they hold in memory. Nevertheless, they seem based on the idea that repeatedly inducing shock, stress, anxiety, disorientation and lack of control is more effective than standard interrogatory techniques in making suspects reveal information. Information retrieved from memory in this way is assumed to be reliable and veridical, as suspects will be motivated to end the interrogation by revealing this information. No supporting data for this model are provided; in fact, the model is utterly unsupported by scientific evidence.

Contemporary neuroscientific models of human memory and executive function are very different. The structural and functional integrity of the hippocampus and the prefrontal cortices, as well as regular sleep, are essential for normal memory function. The hippocampus and the prefrontal cortices are extensively inter-linked, each co-regulating the other. Recalling previously-learned information activates a wide variety of brain areas, but especially the prefrontal cortex and the hippocampus. Moreover, activity in prefrontal cortex is particularly associated with intentionally controlling access to, and retrieval of, memories. When these brain areas function improperly, both memory and executive functions (intention, planning, and regulation of behaviour) may be impaired.

Stress causes heightened excitability or arousal in the brain and body, a perception that present or future events will be very unpleasant combined with a lack of controllability over these events[2]. Experiencing stress causes release of stress hormones[3] (cortisol; catecholamines such as noradrenaline; Figure 1). Stress hormones provoke and control the 'fight or flight' response (the immediate and rapid preparation by body and brain for action in response to threat) which, if overly-prolonged, may result in compromised cognitive neurobiological function (and even tissue loss) in these brain regions. Both the hippocampus and the prefrontal cortex are particularly rich in receptors activated by stress hormones. Cortisol binds preferentially to glucocorticoid receptors in hippocampus and prefrontal cortex, increasing Ca^{++} access, and thus neuronal excitability[3, 4], which will compromise normal physiological functioning of neurons if it is sustained. Catecholamines modulate many sites in the brain (including hippocampus and prefrontal cortex), and have many effects, including provoking glucose release, and increasing blood pressure and heart rate. These responses are beneficial over the short-term, but cause long-term damage to the brain and body if this state of 'hyperarousal' is maintained over the long-term. Furthermore, the amygdale [5] (involved in the processing of fear- and threat-related stimuli), may become enlarged, creating a negative feedback loop amplifying the effects of subsequent stressful events. Finally, prolonged and sustained sleep deprivation, in part because it results in substantial increase in cortisol levels, has a deleterious effect on memory.

There is a vast literature on the effects of extreme stress on motivation, mood and memory, using both animals and humans. To briefly summarise a complex literature: chronic, prolonged and extreme stress: (i) inhibits long-term potentiation (LTP; the biological process believed to underlie memory formation in the brain) and facilitates long-term depression (the inverse of LTP)[2]; (ii) causes hippocampal atrophy and hence impairs learning in humans and animals[2-4, 6, 7]; (iv) is implicated in many neuropsychiatric disorders (especially

anxiety, depression and post- traumatic stress disorder[6]. Notably, repeated, chronic exposure to uncontrollable pain (e.g. electric shocks) causes many similar effects to those found under severe but non-painful stress.

A common argument in favour of torture is that it will reliably elicit veridical information from the captive's long-term memory, as asserted by many media commentators in the context of the 'ticking-time bomb' scenario or in the case of major, imminent threat in which lives may be saved. A pragmatic anti-torture argument is that it will not; that torture is as likely to elicit false as well as true information, and that separating the one from the other will be very difficult. It is difficult or impossible to determine during interrogation whether the information a suspect reveals is true: information presented by the captor to elicit responses during interrogation may inadvertently become part of the suspect's memory, especially since suspects are under extreme stress and are required to tell and retell the same events which may have happened over a period of years. Other factors exacerbate this problem. Confabulation, the pathological production of false memories, is a common consequence of frontal lobe disorders[8] and, as already noted, prolonged and extreme stress has a deleterious effect on frontal lobe function[4]. Thus, distinguishing between confabulations and what is true in the verbal statements of tortured suspects will be very difficult.

Extreme stress studies in Special Operations Soldiers[9] have found impaired visuo-spatial capacity and impaired recall of previously-learned information in stressed soldiers (who undergo stress, including food and sleep deprivation, during training modelled on the experiences of American prisoners-of-war). Brain imaging in persons previously subjected to severe torture suggests that abnormal patterns of activation are present in the frontal and temporal lobes, leading to deficits in verbal memory for the recall of traumatic events [10, 11]. A recent meta-analysis[12] of the relationship between pharmacologically-induced cortisol elevations (in the upper physiological range) concludes that it impairs memory retrieval in humans, as do psychosocial stress-induced cortisol elevations. On the other hand, mildly stressful events generally facilitate recall. The experience of capture, transport and subsequent challenging questioning would seem to be more than enough in making suspects reveal information.

In a torture situation, the captor and the captive have different motivations. The captor wants the captive to speak and reveal key information from long-term memory. The captive wants to escape the extreme stress while not revealing key information. In classical conditioning, circumstances signaling escape from stressful or noxious/aversive events are known as conditioned safety signals[13]. Here, the detainee's own words provide the safety signal: 'while I'm talking, I'm not being waterboarded'. The truth of what the detainee says does not provide the safety signal, just the fact that s/he is talking. In other words, speech acts signal periods of safety.

Equally, when the captive is talking, the captor's objective has been obtained. Finally, and presumably, subjecting a fellow human being to torture is very stressful for all but the most psychopathic. In fact, the historical literature[e.g., 14] is replete with accounts of alcohol or drug abuse by torturers. Thus, the fact that the captive is speaking also provides a safety signal to the captor; making the captive talk may become the end (not the truth of what the captive is revealing)—so long as the captive is talking the captor can avoid using torture.

Waterboarding is cited in the legal memoranda as causing elevations in blood carbon dioxide levels. Data on the effects of hypercapnia (increased blood carbon dioxide) or hypoxia (decreased blood oxygen) on brain function are not cited; nor are data on carbon dioxide narcosis (deep stupor or unconsciousness), which may be expected as a result of acute and repeated waterboarding. Brain imaging data suggest that hypercapnia and associated feelings of breathlessness (dyspnea) cause widespread increases in brain activity, including brain regions associated with stress and anxiety (amygdala, prefrontal cortex) and pain (periaqueductal gray)[15]. These data suggest that waterboarding in particular acts as a very severe and extreme stressor, with the potential to cause widespread stress-induced changes in the brain, especially when these are repeated frequently and intensively.

The proposed use of phobic stimuli (insects) underscores the unsophisticated folk psychological model underpinning coercive interrogation. Chronic controlled exposure to phobic stimuli is known as 'flooding therapy' and is among the most effective methods applied under Cognitive-Behaviour Therapy (CBT) to treat phobias. Repeated and non-threatening exposure to a phobic stimulus usually results in individuals no longer being afraid of these stimuli.

In sum, coercive interrogations involving extreme stress are unlikely, given our current cognitive neurobiological knowledge, to facilitate the release of veridical information from long-term memory. On the contrary, these techniques cause severe, repeated and prolonged stress, which compromises brain tissue supporting memory and executive function. The fact that the detrimental effects of these techniques on the brain are not visible to the naked eye makes them no less real.

Box 1. CIA techniques formerly used with terrorist suspects¹

- *Attention grasp*: "...grasping the individual with both hands...on each side of the collar opening, in a controlled and quick motion. In the same motion...the individual is drawn toward the interrogator.";

- *Facial hold*: "...to hold the head immobile. One open palm is placed on either side of the individual's face."
- *Facial slap*: "...the interrogator slaps the individual's face with fingers slightly spread. The hand makes contact with the area directly between the tip of the individual's chin and the bottom of the corresponding earlobe...to induce shock, surprise, and/or humiliation".
- *Walling*: " ...The individual is placed with his heels touching the wall. The interrogator pulls the individual forward and then quickly and firmly pushes the individual into the wall. It is the individual's shoulder blades that hit the wall...the head and neck are supported with a rolled hood or towel...to help prevent whiplash...the false wall is...constructed to create a loud sound when the individual hits it...[to induce]...further shock and surprise...";
- *Wall standing*: "...is used to induce muscle fatigue. The individual stands four to five feet from a wall, with his feet spread approximately to shoulder width...His fingers support all of his body weight. The individual is not permitted to move or reposition his hands or feet."
- *Stress positions*: "... sitting on the floor with legs extended straight out in front of him with his arms raised above his head"; "kneeling on the floor while leaning back at a 45-degree angle".
- *Cramped confinement*: Placing the individual in a small box in darkness for up to two hours; in a larger box for up to 18 hours.
- *Sleep deprivation*: "is to reduce the individual's ability to think on his feet and, through the discomfort associated with lack of sleep [to a maximum of 11 days], to motivate him to co-operate".
- *Insect placed in a confinement box*: "You (the CIA interrogator) would like to place Zubaydah [suspected Al-Qaeda terrorist] in a cramped confinement box with an insect...he appears to have a fear of insects."
- *Waterboarding*: "...the individual is bound securely on an inclined bench...The individual's feet are generally elevated. A cloth is placed over the forehead and eyes. Water is...applied to the cloth in a controlled manner...air now is slightly restricted for 20 to 40 seconds due to...the cloth...increas[ing]...carbon dioxide level[s] in the individual's blood. This increase in the carbon dioxide level stimulates increased efforts to breathe. This effort plus the cloth produces the perception of "suffocation and incipient panic," i.e., the perception of drowning..."

Substantially more extreme techniques involving extensive physical and mental abuse have been employed by totalitarian regimes (e.g.[14]).

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Figure Legends

Figure 1. The stress response is controlled by the hypothalamic-pituitary-adrenal (HPA) axis. Behavioural stress (e.g., uncontrollable electric shocks, extended physical restraint or confinement) and/or systemic stress (e.g., anoxia; infection; sustained sleep deprivation) triggers the release of corticotropin-releasing hormone (CRH) from the hypothalamus into the portal circulation to the anterior pituitary, which releases adrenocorticotrophic releasing hormone (ACTH) into the bloodstream, causing substantial and sustained stress hormone (cortisol) release from the adrenal cortices and catecholamines from the adrenal medulla (the adrenal glands are located on the kidneys in the body trunk). The acute and chronic stress response includes 'fight or flight' initiation, mobilization of energy stores, decreases in reflex thresholds, and increases respiratory rate, muscle tension and gastric motility²⁻⁶.