Decision making and mental capacity: resolving the Frontal Paradox.

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A young man was walking home one night when he spotted an older man crawling about on his knees under a streetlight. The young man asked him what he was doing.

*“I’m looking for my keys”* he answered.

So the young man got down on his knees to help him search for his keys, but after a while of fruitless searching, he asked the older man, *“Where did you drop your keys?”*

*“Over there”* replied the older man, pointing across the road.

Puzzled, the young man asked, *“So why are you searching for them here?”*

*“Because this is where the light is!”* came the reply.

**The riddle of the frontal lobe (Teuber, 1964)**

The excellent article by George and Gilbert (2018) in an earlier issue of *The Neuropsychologist* highlighted the relevance of the frontal lobe paradox for all professionals involved in assessing mental capacity. They wished to start a debate as to the way forward and this article is a response concerning the current inadequacy of formal neuropsychological assessments to address the frontal paradox. The anecdote at the top of this article was brought to mind recently during discussion with another senior neuropsychologist who disagreed with the author’s opinion that despite well preserved intellect, a certain young man lacked the capacity to manage his affairs. His counter-argument was that the client had performed well “on the best measures available.” Unwittingly he had summed up the current situation in neuropsychology: as clinicians we have psychometrically robust and well-standardised tools at our disposal, the problem is that they are not illuminating the real issues but we feel compelled to rely on them for our opinions, perhaps feeling that they are central to our identity as neuropsychologists and without the tools of our trade we lose the unique contribution we can make to mental capacity assessment.

Although executive functions and frontal lobe function are not synonymous, as George and Gilbert (2018) noted, damage to prefrontal cortical regions is considered to underpin the dissociation between knowing and doing which characterises the frontal paradox. Perhaps the best documented early case was EVR (Eslinger & Damasio, 1985) who underwent surgery for a frontal meningioma. On formal testing he obtained an IQ above 130, a Weschler Memory Quotient of 145 and high scores on executive tasks such as verbal fluency, the Cognitive Estimates Test and the Wisconsin Card Sorting Test. Yet EVR had significant deficits in everyday living but was, in light of his superior intelligence, regarded as malingering.

**Searching for the keys to capacity**

Burgess (1997) argued that it is difficult to assess executive functions using conventional neuropsychological tasks because executive operations rely on novelty and on other lower-order functions (task impurity) which leads to low process-behaviour correspondence. This argument carries weight but the crux of the present article is in the form of another explanation, which is that standard neuropsychological tests typically focus on one main prefrontal region, the dorsolateral prefrontal cortex (DLPFC), to the exclusion of other prefrontal areas likely to be at least equally but probably more relevant for decision making. Undoubtedly the focus on DLPFC has proved extremely fruitful over the years. A great deal more is known about the fractionation of the executive system, new clinical tests have been developed and psychologists are better informed than ever about executive functions, including the doggedly persistent frontal paradox which from time to time leads to calls for more ecologically valid assessment (Burgess et al., 2006).

The real problem though lies in the type of tasks that have been developed. The plain fact is that neuropsychologists have been beguiled by the DLPFC. For many neuropsychologists and others this is the origin of the dysexecutive syndrome and all that follows in terms of adaptive behaviour and mental capacity. In contrast, Stuss (2007) who considered this region responsible for ‘cognitive executive’ functions argued that it is only one of four functional categories of executive behaviour underpinned by prefrontal cortex. Yet this is where the light shines brightest so this is where we have focussed our efforts. However, this is not the primary prefrontal region involved in decision making of the kind we should be interested in if we are concerned with mental capacity and if we ever want to bridge the dissociation between knowing and doing (Wood and Worthington, 2017).

Elsewhere, research conducted by behavioural economists, cognitive psychologists and neuroscientists interested in decision making suggests a rather different path to follow. In the 1990s the new field of neureconomics came to characterise this interdisciplinary endeavour. Research into the neural basis of decision making increasingly emphasised the hitherto neglected role of orbitofrontal areas and especially ventromedial prefrontal cortex (VMPFC) in making choices (Glimcher, 2003). Constructs like working memory, thought to underpin decision making, were associated with dorsolateral regions and potentially separable from decision making processes in ventromedial areas (Bechara et al., 1998).

The basic research has been replicated time and again. The conclusions were startling, summarised by Damasio (2009): *“in two areas of social behaviour the defects were so evident that they practically required no special diagnostic tool; these areas were interpersonal relationships and, notably, decision making having to do with financial issues”* (p.209-210). In other words, exactly the kinds of issues we need to consider when evaluating mental capacity. Furthermore, *“patients with ventromedial prefrontal lesions had remarkably preserved intellect, as measured by conventional neuropsychological instruments, and an equally remarkable defect of emotional behaviour”* (p.210). One might also add that such cases may perform extremely well on conventional executive-type (i.e. dorsolateral) tests, as illustrated by EVR. Nor was EVR atypical: two of the three cases reported by Shallice and Burgess (1991), for instance, not only had IQ scores of 130 and 121 but also performed well on a range of executive tasks, including the modified Wisconsin, Stroop, Tower of London, Trail Making Test, verbal fluency, Cognitive Estimates and proverb interpretations.

This fits with other evidence from behavioural economics. For example, Baumeister (2003) asked why people make bad decisions that depart from rational self-interest, subsequently demonstrating that self-regulation is a limited capacity resource which is rapidly ‘spent’ under conditions of emotional arousal. Emotional appraisal of situations can be manipulated experimentally to influence decision making but it can also be affected directly by brain insults to the same effect. VMPFC is ideally placed anatomically to fulfil this central mediating role in decision making by virtue of links to limbic and other subcortical structures involved in analysing threat and appraising the emotional significance of events.

Evidence that impaired judgment and decision making is associated with emotional processing deficits is an invitation to neuropsychologists to eschew a purely cognitive model of decision making and recognise the need for a more holistic paradigm which takes account of emotional and motivational influences alongside working memory and other cognitive factors. Damasio’s somatic marker hypothesis was a response to this challenge, proposed as an explanation of how ordinarily decisions are determined by previous experience involving a coupling of outcome and emotional (somatic) state (Damasio et al., 1991). Choices would be made on the basis of a somatic signal to the brain representing the consequences of similar decisions in the past. This may not be consciously determined (thereby producing a ‘gut instinct’ element to decision making).

The so-called ‘cold’ (DLPFC) executive skills of logical, rational, problem solving which characterise many neuropsychological measures of executive function are in reality often undermined by the emotionally-driven ‘hot’ (VMPFC) executive processes that drive much of day to day decision-making. Whilst the Mental Capacity Act embodies the classical economic notion of a rational thinking mind weighing information in the balance, psychology and neuroscience may be moving in another direction. Conscious deliberation is a serial processing task which may be inadequate for more complex decisions, evidence suggesting that deliberation-without-attention may optimise outcomes (Dijksteruis et al., 2006), perhaps better reflecting the somatic-emotional-cognitive triad of decision making.



Figure 1. The neuropsychological triad underpinning complex decision making

Despite some empirical support (Carter and Pasqualini, 2004) the somatic marker notion as an explanatory hypothesis has been subject to a range of criticisms and may well prove inadequate. Yet the link between emotional-somatic states, learning and decision making in the brain is robust (Dalgleish, 2004) and one that clinical neuropsychologists cannot afford to ignore. There is now a wealth of research into decision making and VMPFC which has huge potential for the way neuropsychologists undertake structured mental capacity evaluations in future. For example, whilst some of the purported emotional biases in experimental decision making tasks might in fact be learned explicitly using DLPFC (Maia and McClelland 2004.; Dunn et al., 2006) people with VMPFC damage nevertheless fail to use the knowledge to guide their behaviour (Maia and McClelland 2004). Leaving aside for now the question of whether emotional factors are conscious or non-conscious, or if DLPFC also makes a contribution, what we do know is that people with VMPFC damage may be more impulsive in their decisions (Newcombe et al., 2011), less likely to consider future consequences (Bechara et al., 1994), insensitive to the likelihood of unfavourable outcomes (Clark et al., 2008), react differently to perceived unfairness (Koenigs and Tranel, 2007) and less likely to take into account the morality of their actions to achieve an outcome (Young and Koenigs 2007). VMPFC is involved in dealing with ambiguity, making decisions under uncertainty and where multiple attributes need to be compared (Fellows 2006), scenarios very familiar to practitioners assessing mental capacity.

**Implications for evaluating mental capacity**

This has implications for all concerned with mental capacity and clinical neuropsychologists especially who may be tasked with bringing objective psychometric evidence to bear on the issue. The test of mental capacity is always a functional test not a diagnostic exercise but neuropsychologists ought to be doing better. Burgess et al. (2006) note Penfield’s detailed description from the 1930s of catastrophic impairment in daily living skills, including cooking a meal, following frontal lobe injury. The authors comment, *“given this observation, one might imagine that by now we would know quite a lot about the processes involved in cooking a meal … But this is not the case at all … Instead EF [executive function] research has spent several decades investigating the dynamics of (by comparison) esoteric activities such as performing the Wisconsin Card Sorting Test”* (p.197).

What is required is an understanding of why current measures of executive function are so often not fit for purpose and an enthusiasm for a new clinical research agenda. To date much of the neuroeconomic research has focussed on tit-for-tat or trade-off type interactions under the rubric of game theory (giving rise to exercises such as the Prisoner’s Dilemma, Ultimatum Game, Dictator Game and Trust Game). Other tasks have been developed to explore risk tolerance such as the Balloon Analogue Risk task, a computerised task in which the objective is to inflate balloons as much as possible before they pop, larger balloons securing larger monetary gains, whilst balloons pop at different sizes. Another paradigm uses a willingness to pay approach. Several are based on a gambling theme such as the Columbia Card Task and Cambridge Gambling Task, but probably the most researched task is the Iowa Gambling Task (IGT), which is also available commercially. At present however these tasks remain subject to considerable debate as to what kind of executive processes they recruit (cognitive, emotional, conative). Dunn et al (2006) for example have argued that the Iowa Gambling Task is not wholly or even primarily driven by emotional influences.

These tasks are not without their limitations. Much of the research on which they are based concerns how people might select the best possible outcome knowing that other people (usually designated an ‘opponent’) are also seeking an optimal outcome for themselves. This is helpful in understanding how people might behave in a range of situations involving some form of negotiation such as a buying a car, signing a contract or a starting a relationship. However, often a person is not directly competing with another, probabilities are not pre-determined and outcomes are unknown. Monetising rewards in a digitised form may not be appropriate for all forms of decision making. Looking to the future more research into the links between social cognition, emotional processing and decision making may prove fruitful, along the lines of some of the subtests of the CANTAB battery although this is designed for research use rather than clinical practice.

At present we do not have the tools to investigate these different facets of decision making reliably. Not enough is known about the normal range of decision making and how one should deal with variability in order to better identify neurological impairments of decision making. In a mental capacity examination clinicians will always need to consider carefully premorbid propensities and exercise judgment as to whether decisions reflect merely unwise choices and behaviours rather than evidence of lack of capacity. Neuropsychological tests by themselves are not the final word on mental capacity but their contribution to the issues could be improved. It should be remembered that the field of neuroeconomics is in its infancy and significant progress has been made to date. There is a need to explore the generalisability of current tasks and consider a wider range of decision and choice paradigms with innovative approaches.

Neuropsychologists cannot fully replicate the real-life scenarios in which these complex decision making operations play out but with more sensitive and valid measures they can get closer to distilling the essence of decision making impairments. The question is whether neuropsychology as a profession is content to remain where the light shines on us brightest or ventures to search elsewhere in efforts to unlock the frontal paradox.

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