Emotional biases in confabulation: The role of the frontal lobes

by

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Declaration:

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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ABSTRACT

The neuropsychological understanding of confabulation has recently been enriched by the finding that confabulating patients present positive emotional biases in their false recollections. The exact mechanisms of this motivational phenomenon have been heuristically linked to the frontal lobe impairment accompanying confabulation. The present study aims at providing direct support for this claim. A patient with damage to the prefrontal cortex is examined and his performance is contrasted with two confabulating patients, a patient with non-frontal neurological damage and twenty matched controls on a number of tests of emotional processing. The tests were designed to assess judgment of emotional valence in verbal material and the effects of emotional valence and self-focus on explicit and implicit memory. Findings reveal that no positive affective biases could be elicited in frontal patient JZ in any of the three experimental conditions. The findings also reveal the presence of positive biases in the confabulating patients in three areas: in the form of difficulty with the processing of the negative word pairs; the valence judgement of affective material; and the implicit learning of words through self-focus manipulation. It is concluded that although much exploratory work is still required regarding the frontal lobes' involvement in confabulation, the initial findings do not support the theory that the frontal lobes are the origin of the positive affective biases widely seen in confabulation.

Key words: affect, implicit, explicit, valence, self-focus manipulation

INTRODUCTION

This research initiative has as its central aim the goal of establishing functional causality with regard to the neurological architecture underlying the positive affective biases demonstrated by many confabulating patients.

Various cognitive and neurobehavioural theories have dominated the neuropsychological literature regarding confabulation, i.e. the production of false narratives about the world or the self (Berrios, 2000). Many definitions of confabulation have been provided. Common to all is the notion that "patients sometimes make statements that are false or engage in behaviours that reflect false memories or beliefs, and they do this with no deliberate intention to deceive" (Johnson, Hayes, D'Esposito & Raye, 2000, p.383). The content of patients' confabulations is generally recognised as ranging from the relatively mundane right through to the fantastic and bizarre (Moscovitch & Melo, 1997). Despite the many controversies in defining and explaining confabulation, most recent models have by and large implicated damage to the frontal regions of the brain, in conjunction with diencephalic amnesias, as key components (DeLuca, 2000; Johnson et al, 2000).

Consequently, this research project has undertaken to specifically investigate the involvement of the frontal lobes in confabulation. In order to ascertain which regions (frontal lobes or diencephalon) are responsible for the positive affective biases seen in confabulation, such regions need to be examined differentially. Various tests have been devised to investigate potential affect biases in the frontal patient. These tests, which comprise both individual words and sentences of varying valence, have been constructed as a way of assessing both implicit and explicit memory for emotional content. The tests also assess valence judgement. All of these aspects of cognition are believed to fall under the functional realm of the 'executive functions' of the frontal lobes. Put differently, this research seeks to examine, by focusing on emotional implicit and explicit memory, exactly what aspect, if any, of the frontal lobes' executive system is making the positive 'wishfulness' displayed by many confabulating patients.

Frontal Lobes and Confabulation: Many researchers have demonstrated the involvement of frontal damage in confabulation. Conway and Tacchi (1996, p.325), for example, comment how patient OP displayed confabulations after "a closed head injury that caused bilateral damage to the temporal and frontal lobes". Moscovitch and Melo (1997) have implicated the ventromedial frontal cortex as key to confabulation, as a consequence of this region's role in the strategic retrieval processes of memory. Burgess and Shallice (1996), and Johnson, O'Connor and Cantor (1997) also comment on how confabulation is often seen with damage to the frontal brain regions. Turnbull, Berry and Evans (in press) add credence to case of frontal involvement when they comment how confabulations are often observed in conjunction with medial frontal lobe damage. Finally, in a study examining the neuropsychological and neuroanatomical correlates of confabulation, Fischer, Alexander, D'Esposito and Otto (1995) found when examining patients with anterior communicating artery aneurysms that confabulation in general seemed to involve the simultaneous disruption of medial basal forebrain and the frontal cognitive systems (executive and memory deficits) as well as the orbital frontal cortex. Consequently, it is now widely held that confabulation is at least partly caused by frontal lobe damage: "The notion that the frontal lobes are necessary for confabulation is now well established" (DeLuca, 2000, p. 125).

Frontal Lobes and Autobiographical Memory in Confabulation: Several researchers have stressed the importance of memory impairment in the production of confabulation (Baddeley & Wilson, 1986; Deluca, 2000). More specifically, autobiographical memory and its component processes have been at the centre of the debate. Broadly speaking, autobiographical memory is conceived as concerning the specific memories of events from an individual's own life. It may be seen as serving an indispensable role for the individual and his/her emotions, as a way of defining the self, and reminding one of the enduring nature of his/her existence over time (Conway & Pleydell-Pearce, 2000).

Conway and Tacchi (1996) suggest that the highly specific nature of some confabulations may arise from combinations of damaged and preserved memory processes in autobiographical memory 'construction'. In the light of this, a more complex definition of autobiographical memory emerges, one that defines autobiographical memories as "transitory dynamic mental constructions generated from an underlying knowledge base" (Conway & Pleydell-Pearce, 2000). Autobiographical knowledge has been seen as being pooled/stemming from three key areas, these being event-specific knowledge (ESK), general events, and lifetime periods (Conway & Pleydell-Pearce, 2000). This view comprises part of the theorisation that autobiographical memory is a superordinate system which takes memories from other 'lower' memory systems and integrates them into complex autobiographical representations (Conway & Fthenaki, 2000). "According to this view autobiographical knowledge is encoded through the goal structure of the working self, which also takes a major role in the construction of specific memories during remembering" (Conway & Pleydell-Pearce, 2000, p.266). The literature warns, however, that even in healthy individuals, autobiographical memories can be far from accurate, containing extraneous information, and may even be completely false, as a consequence of the complexity of being produced from a variety of multilayered knowledge structures (Conway & Tacchi, 1996). It is also important to note that because this autobiographical system receives information from a variety of subordinate sources, an array of lesions may affect autobiographical remembering.

At the level of the frontal lobes, dysfunctional executive control processes (frontal areas) may be viewed as compromising both the *search* of autobiographical memory, as well as the evaluation of long-term memory output (Moscovitch and Melo, 1997). This leads to patients struggling to distinguish between memories which they have from their current 'working' self (i.e. goals and intentions), and those which are part of their autobiographical knowledge, albeit less accessible. The reciprocal relationship between the 'working-self' and the autobiographical knowledge structures is termed the 'self-memory system'. The 'working self' is a vital concept here, and may be viewed as comprising the core part of the working memory, involved with certain control processes (goal hierarchies) which govern cognition and behaviour in ways most appropriate for the current context of the individual – "[it is] through this goal-based working-self system that memories are originally encoded and later constructed and reacted to during remembering" (Conway & Pleydell-Pearce, 2000, p.266). A study by Singer and Salovey (1993, as cited in Conway & Pleydell-Pearce, 2000, p.268) highlights this pivotal link between goals and memories through the finding that "memories associated with feelings of happiness and pride were strongly linked with goal attainment and the smooth running of personal plans [whereas] memories associated with feelings of sadness and anger were linked to the progressive failure to achieve goals".

Working memory refers to the "capacity to maintain information over short delays while that information is being transformed or co-ordinated with other ongoing mental operations", and may be seen to be mediated by the central executive functions (Goldberg & Gold, 1995, p.152). In other words, working memory function and the central executive functions go hand in hand, and problems with their interaction manifest in an inability to allocate attentional resources in a meaningful way when performing various tasks (Goldberg & Gold, 1995).

The above discussion regarding autobiographical memory processes and the 'working self' highlights the requisite involvement of both memory processes and the executive functions of the frontal lobes – known as the combined deficit model of confabulation.

Various authors have supported this model, which postulates that a combination of memory impairment and executive dysfunction is required for confabulation, thereby distinguishing between two component processes (Cunningham, Pliskin, Cassisi, Tsang & Rao, 1997). Indeed, research by Cunningham et al (1997, p.867) supports this model in demonstrating that when low-confabulating participants along with non-confabulators were compared to high-confabulating participants, the high-confabulators "performed significantly worse…on measures of memory and measures of executive function that assess sustained attention, mental tracking, and set-shifting ability. However, there were no differences between groups on measures of problem-solving, concept formation, and verbal fluency, suggesting a dissociation in executive functions that contribute to confabulation." Continuing with executive involvement, Moscovitch and Melo (1997, p.1017) found, when examining eight confabulating patients, "that confabulation is associated with impaired strategic retrieval processes resulting to damage in the region of the ventromedial cortex. These strategic retrieval processes help initiate and guide search in episodic and semantic memory and they help organize the output from those systems".

Moscovitch (1995) highlights strategic retrieval as a key component in confabulation due to the requirement of intelligent, self-initiated, and goal-directed processes – hence these may be seen as problem-solving tasks associated with memory. Broadly speaking, these 'problem solving' capabilities fall under the realm of the frontal lobes' executive functions. Further evidence is found in a number of studies (eg. Kopelman, 1987; Baddeley & Wilson, 1986; Stuss & Benson, 1986), which have shown "that confabulation is not correlated with severity of memory loss but rather with performance on cognitive tests sensitive to frontal lobe damage" (Moscovitch, 1995).

Frontal Lobes and Biases in Emotional Processing: Crucially, Conway and Tacchi (1996) further suggest that frontal executive dysfunction in the retrieval and evaluation of memories, which co-occurs with learnt knowledge about emotional consequences of thoughts, personal wishes and memories, could result in the affective biases seen in confabulations. They observed with patient OP that her confabulations served the purpose of rewriting her personal history in a way that made it more 'bearable'. This seemed to occur though OP's drawing on her recent and remote past as a way of making her current situation (an obviously difficult time) seem more positive. This process of OP's manifested, for example, in her referring to her 'wonderful friends' from her past as a way of compensating for her own family's indifferent attitude towards her current situation (Conway & Tacchi, 1996).

In parallel, recent research by Turnbull et al (in press) has revealed convincing evidence in support of Solms' (2000) initial hypothesis and clinical data regarding confabulating patients distorting reality in a tendentious direction. This research sought to examine whether or not confabulations are 'emotionally neutral' or biased in an 'affectively positive' way (Turnbull et al, in press). The findings, based on 16 patients' confabulations about locations, indicate that a 'wish-fulfillment' bias indeed exists. The patients' confabulations were indeed more positive than reality suggested. Such findings are supported by a case study by Fotopoulou, Solms & Turnbull, which also highlighted how the confabulatory statements of a patient ES contained far more pleasant content than the actual reality they were compared to (Fotopoulou et al, in press). In summary, these findings suggest that confabulations include motivated (or 'wishful') content. It therefore seems likely that some biases in emotional processing exist in the above-mentioned patients.

Many theories have placed such problems under the heading of a faulty executive system (executive dysfunction) (Burgess & Shallice, 1996; Conway & Pleydell-Pearce, 2000). Turnbull et al (in press), as previously mentioned, also highlight how frontal involvement is common in confabulating patients. In terms of the frontal lobes, many researchers have concluded that damage in the frontal regions leads to executive control problems. The executive system, which is involved in modulating memory retrieval processes, becomes impaired (Conway & Tacchi, 1996). It is also held that the "frontal brain regions are critical for retrieval, temporal discrimination, and self-monitoring" (Johnson, O'Connor & Cantor, 1997, p.191). However, these authors suggest that an additional factor might be needed to further specify the nature of confabulation, and they point to motivational or emotional factors (Turnbull et al, in press).

Indeed, emotional processing has also been linked to frontal (executive) functions. For example, "ventral frontal-lobe damage can show impairments in a number of tasks in which an alteration of behavioral strategy is required in response to a change in environmental reinforcement contingencies (Damasio, 1994, as cited in Rolls, 2000). Emotions perform an integral part in such processes relating to the alteration of behaviours. Furthermore, research by Buchanan, Lutz, Mirzazade, Specht, Shah, Zilles and Jäncke (2000, p.227), investigating the recognition of the emotional prosody of words, implicates the frontal lobes by commenting on the finding of "bilateral involvement in the detection of emotion in language". Finally, research by Keightley, Winocur, Graham, Mayberg, Hevenor and Grady (2003, p.593), who investigated the emotional processing of visual stimuli, highlights how "the amygdala and related regions (thalamus, insula, rostral anterior cingulated, ventral and inferior prefrontal cortex) have been suggested to form a "primitive" neural system for processing emotional stimuli". Such findings clearly demonstrate the frontal lobe involvement in emotional processing. However, two crucial points must be noted. Firstly, emotional dysfunctions and motivational issues in relation to confabulation have yet to be systematically investigated or conceptualised as purely cognitive, whereas views on frontal lobe/executive dysfunction are now fairly widely accepted, documented and conceptualised as purely cognitive. Secondly, "evaluating the 'pleasantness' of false beliefs can often be hindered by the investigator's inability to estimate how pleasant the patient's *actual* circumstances might be" (Turnbull et al, in press). These facts show that this exploratory research initiative, investigating possible emotional and motivational biases in a frontal patient, is much needed.

Research hypothesis: Given the aforementioned information regarding both the frontal involvement in confabulations, and in emotional processing, the hypothesis of the present study is that the observed emotional biases in confabulation (i.e. motivational aspects) could be attributed to frontal damage. If this statement is true, then it will be expected that frontal patients exhibit some degree of positive affective bias in terms of their judgement of the valence of words and sentences, as well as their ability to remember, both implicitly and explicitly, words of positive valence. Hence, the aim of this study is to take steps towards determining the specific functions of the neural architecture involved in the pathology of confabulations. This goal is achieved through examining the frontal lobes' functioning by directly comparing a frontal patient with confabulating patients on the same tests.

MATERIALS AND METHODS

Case Histories

Frontal patient JZ

Background: Patient JZ is a 24-year-old, right-handed, English-speaking man from the Cape Town area. After leaving school, JZ's keen interest in computers led him to complete a three-year degree in Information Technology (IT) at the local Technikon. After working for a family friend for a short period, JZ began working with computers (IT) for a large local retail firm. He has a close relationship with his parents, his brother, and a recently adopted sister. JZ moved out of the family home into his own flat in 2001. He reported that he very much enjoyed the independence associated with living by himself. He especially enjoyed entertaining friends at his flat, as this demonstrated his independence. He was proud of the fact that he cooked and shopped for himself and saw these activities as important validations of his independence. JZ's mother reports that following his motor vehicle accident (MVA), the family has been brought even closer together, particularly JZ and his father. On the whole, JZ's family's genuine concern and keen interest in his situation have helped to facilitate his recovery greatly. JZ's own concerns following the MVA revolved around driving, returning to work and moving back into his flat again. He very much wished to be independent again. He also desired to return to work. However, JZ was not allowed to drive or work until a follow-up assessment scheduled for six months after his MVA.

Case Summary: JZ was involved in an MVA late one night in July 2003, in which one of the other two occupants of the car, a close friend of JZ, died following a coma. The accident was the result of a high-speed collision with another vehicle. Following the MVA, JZ was admitted to UCT Private Academic Hospital, remaining in a coma for four days. Initial pre-operative CT head scans are shown in Fig. 1 (the scan report was unavailable). In the two weeks following his MVA, JZ required two operations. A CT head scan without contrast (see Fig. 2), taken on the 04/08/2003 postoperatively , showed a comminuted depressed skull fracture of the left frontal bone with contusion of the underlying left frontal lobe. This was associated with mass effect and midline shift to the right. Mild dilatation of the temporal horn of the right lateral ventrical was also reported. No extra-axial hemorrhage was identified.

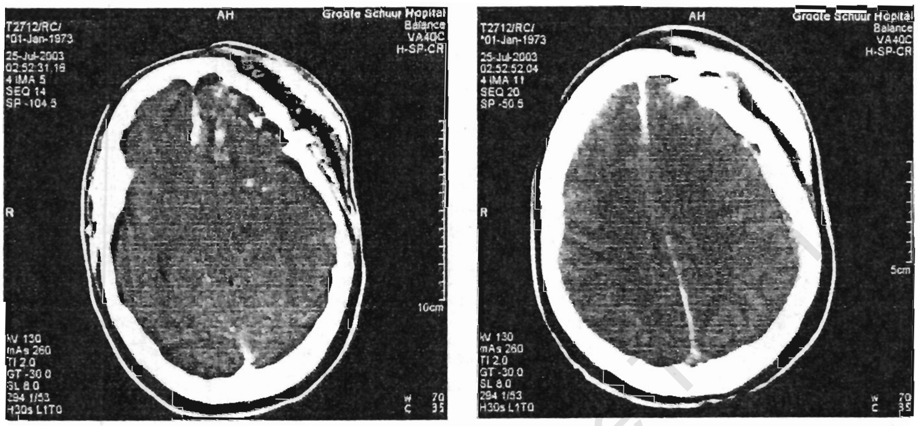

Figure 1: Pre-operative CT head scans of patient JZ

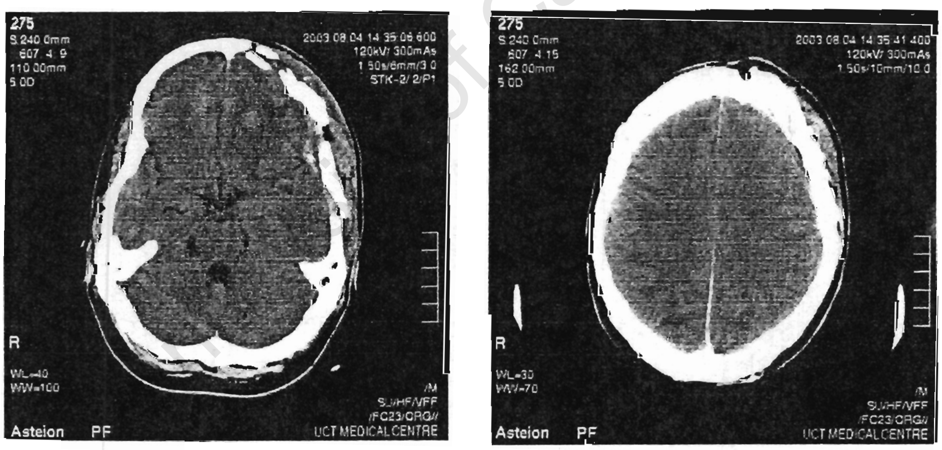

Figure 2: Post-operative CT head scans of patient JZ

Six weeks after the accident, at the time of the initial neuropsychological assessment, JZ reported post-traumatic amnesia for the five hours prior to the MVA, and for the two weeks following the MVA. Additionally, at the time of his neuropsychological assessment, he presented with naming difficulties, inappropriateness, disinhibition, anomia, consistent with his orbital/basal lesions, and deafness in his right ear, accompanied by problems with his balance when walking. Of these deficits, JZ only reported being aware of his right ear deafness and not remembering the events of the five hours prior to the MVA and the two weeks following the MVA. He did not volunteer having any difficulty with word finding, although on the day of his initial assessment he was overheard asking his mother for a 'hot drink' (for which he could not think of the name) when he actually meant to ask her to buy a coldrink. At JZ's initial neuropsychological assessment, it was noted that he had a curiously vague and detached way of describing that his good friend had died in the car crash — clearly demonstrating a slightly inappropriate affect.

After his initial assessment, JZ agreed that he did in fact have difficulty with the finding of words and with the naming of objects. JZ returned to his parent's home seven weeks after his MVA. According to his relatives, JZ had problems carrying out activities of daily living, as he found it difficult to concentrate on a given task and was easily distracted. Additionally, while a passenger in his parents' car, he often showed signs of frustration, frequently persuading them to swerve in between lanes and at times urging them to disregard the speed limit. Apart from these observations, JZ was reported to be sleeping well and spending most of his time at his computer, although the frustration of being stuck at home was an ongoing concern of his.

Confabulating patient RM

Background: Patient RM is a left-handed, English-speaking, 19-year-old male who was born in Newcastle, in the north of England. RM initially got along well with his father but their relationship has deteriorated over the last few years, particularly since his parents divorced in October 2002. RM had a normal upbringing during which he enjoyed school sports and going out with his friends. RM also had a girlfriend, but despite his false claims, this was not the case at the time of his injury. After leaving school RM got a job working as a window fitter on a temporary contract but was unemployed at the time of the accident.

Additionally, RM enjoyed smoking, and in the past consumed alcohol in 'normal' quantities and frequency. RM does not have a driving licence (although he has had driving practice). He has several friends and a cousin with whom he is very close.

Case Summary: RM was admitted to the hospital in mid-October 2002 following a severe motor vehicle accident (MVA) in which he was a rear-seat passenger. His Glasgow coma scale (GCS) on arrival at the hospital was 4/12. RM was found to have a traumatic subarachnoid haemorrhage, left frontal and bilateral temporal contusions. He required a bifrontal decompressure craniotomy and insertion of EVD following increased intracranial pressure five days after being admitted. Subsequent CT scans revealed bilateral-frontal damage with small contusions in the left frontal lobe and a larger single contusion in the right lobe. The bilateral riding bone flaps were noted. His CT scan on 13/10/02 showed a right frontal pressure bolt in situ. The left frontal contusion was more extensive and haemorrhagic, and the cisterns around the brainstem less compressed. No other change from the previous scan was seen. The CT head scan report from the 17/10/02 (see Fig. 3) commented that there was evidence of frontal and temporal contusions on the left side. In addition there was evidence of severe brain swelling with absence of sulci within the cerebral hemisphere.

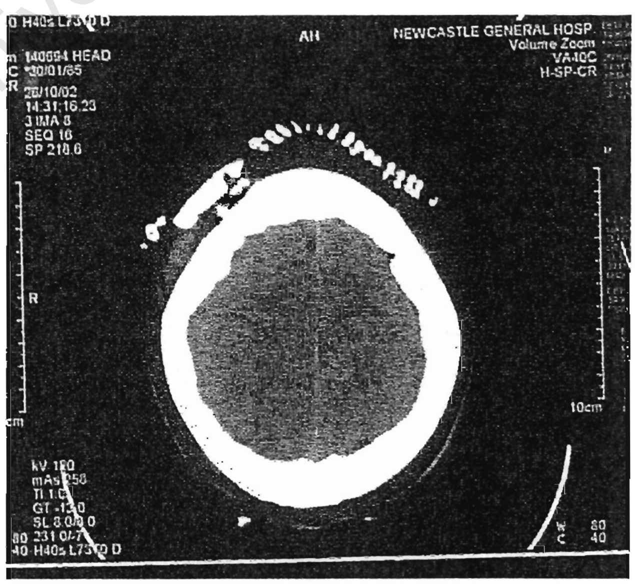

Figure 3: CT Head scan of patient RM

There was also effacement of the third ventricle and basal cisterns, suggesting severe raised intracranial pressure. Another CT scan taken two weeks later showed evidence of the bi-frontal craniotomy. Prominent bi-frontal contusion was still seen, and the ventricles were larger than before, presumably because there was less generalised swelling. No other change from the previous scan was seen.

RM initially presented with residual right-sided weakness and variable confusional state. He made slow but steady progress in respect to his physical state but his confusion and disorientation persisted. He was transferred to a rehabilitation unit at the end of March 2003, where formal neuropsychological assessment took place in the period June to August 2003. RM was found to be physically fully recovered and his confusion had cleared. He was orientated in time, place and person. His speech, comprehension, writing and reading were normal. However, his profound amnesia (retrograde and anterograde) and spontaneous confabulation were immediately observable. He also showed clear indication of frontal lobe pathology – he had problems in initiating behaviour, planning ahead and monitoring himself.

According to his relatives, RM's personality was also affected in that he was irritable, aggressive and argumentative. He presented with exaggerated mood swings and would often cry without apparent reason. The patient also appeared anosognosic about his condition, in that he believed and supported that he had recovered fully from his accident and that he was "back to my own-self". He claimed that he could work, drive and live independently without any help or care. He insisted that his memory was good and kept repeating personal semantic information (correctly) to "prove his point". RM's grandfather passed away two years ago and RM was upset at the time but did not want to attend the funeral and he appeared to recover from the event normally. However, the theme of his grandfather's death often occurs (distorted) in RM's confabulations.

Confabulating patient TN

Background: Patient TN is a 55-year-old, English-speaking man who lives in Cape Town, although he was born in the Eastern Cape of South Africa. He is also fluent in Xhosa (his other home language) and Afrikaans. A highly successful lawyer by trade, TN holds a LLB degree, and started work as a state prosecutor. At the time of his motor vehicle accident, he was a prominent and highly respected member of the legal profession. TN is married with four children and many grandchildren, whom he loves to spend time with whenever he gets the opportunity to holiday. TN also enjoys drinking, and has a history of heavy alcohol consumption, which includes reportedly drinking around twelve beers a day on weekends, as well as enjoying drinking spirits.

Case Summary: TN was admitted to UCT Private Academic Hospital following a motor vehicle accident (MVA) in late July 2003. This accident took place while TN was driving to meet up with his wife at a meeting point along the national road. Following admission to the hospital, TN displayed spontaneous confabulation, accompanied with anterograde memory impairment. On examination, a CT head scan of TN revealed a diffuse picture comprising widespread generalised atrophy, with right temporal lobe contusion. The reported diffuse lesions were consistent with the neuronal shearing associated with high-velocity MVA's. TN was also left with back problems and a broken leg as a result of the MVA.

Non-frontal, neurological patient JH

Background: Patient JH is a 42-year-old, English-speaking man from Cape Town. JH was previously fit and well, working as a ballet dancer and more recently as a restaurant manager in Cape Town.

Case Summary: JH was admitted to Groote Schuur Hospital in mid-September 2003. One evening while watching television, JH's friends noticed that he suddenly was unable to speak and presented with severe right-sided weakness. On examination at the hospital, it was discovered that JH had a dense hemiplegia, more prominent in the upper than lower limbs. He also had facial weakness. It was determined that he could comprehend speech, even though he was unable to speak. A middle cerebral artery (MCA) cerebrovascular accident (CVA) was diagnosed. A CT scan taken on the 18/9/2003 revealed no abnormality, but an MRI scan taken on the 19/9/2003 (see Fig. 4) reported acute infarction of the left lentiform nucleus and head of the left caudate nucleus.

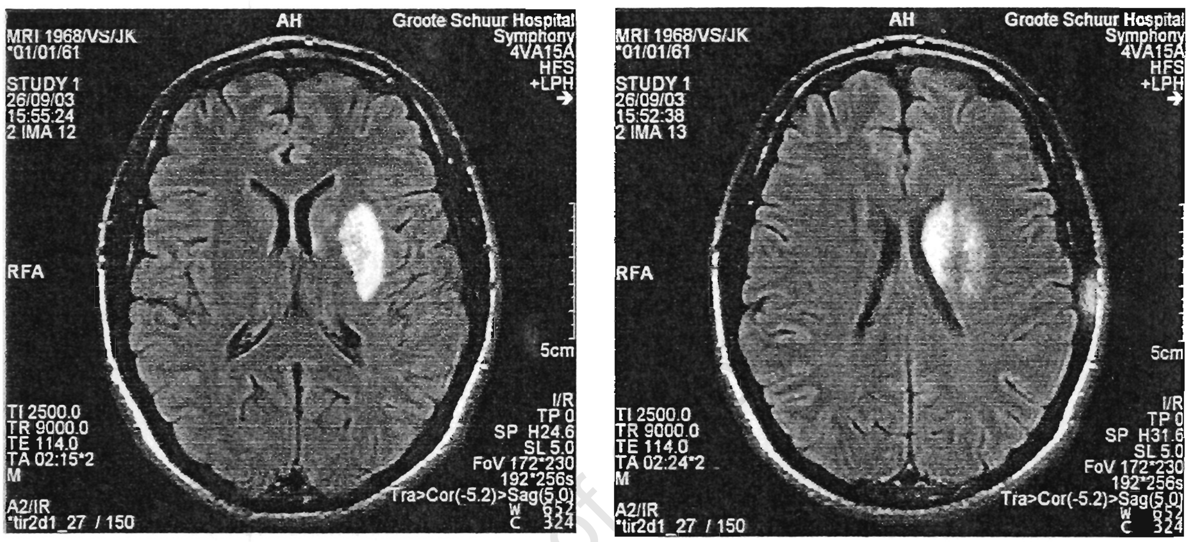

Figure 4: MRI scans of patient JH

Minimal haemorrhagic transformation was also noted, with no underlying carotid dissection or other vascular abnormality demonstrated. Within a week of his admission to hospital, JH was reported to have adequate oral strength and range, with his speech slowly improving. The experimental testing of JH took place at the beginning of the second week of his stay at Groote Schuur Hospital.

Normal controls

Twenty non-neuropsychologically impaired, English-speaking male controls were asked to participate in the study. These participants ranged in age, level of education and cultural background, in order to cover for the range differences displayed in the neuropsychological cases. A matched sampling approach was adopted to ensure an appropriate range of participants. The ages of these controls ranged from 19 years to 65 years, with a mean age of 38 years.

Neuropsychological evaluation

This research adopts three sets of standardised tests, administered to the frontal patient, as well as the confabulating patients, as a way of qualifying and confirming the quality of their respective disorders. The first test battery used was the WAIS III (Wechsler Adult Intelligence Scale), administered to assess the three patients' post-morbid intelligence. Secondly, the WMS III (Wechsler Memory Scale), a post-morbid battery of visual and verbal memory tests, was used. The final standardised test administered was the Delis-Kaplan Executive Function System (DK EFS) assessment, used as a way of comprehensively assessing the patients' executive (frontal) functioning.

A summary of the standardised test scores of patients TN, RM and JZ is represented in Table 1. In the WAIS III, JZ scored significantly higher than RM on all aspects except that of Working Memory, where his range of performance was low average, and that of RM's was average. TN's performance on the WAIS III was lower than JZ's on all the sub-tests except Verbal Comprehension, where they both scored equally. TN scored higher than RM on the Verbal IQ, the Performance IQ and the Verbal Comprehension measures, but performed lower than RM on the Perceptual Organisation and the Working Memory measures. RM's full scale IQ was borderline, two standard deviations below the mean, JZ's was average, while TN's IQ was classified as low average, one standard deviation below the mean. RM's intellectual abilities have been somewhat compromised in comparison with his premorbid intellectual functioning as estimated by his Wechsler Adult Reading Test (WART) score and his educational level. His poor performance on the WART may be attributed to his dysexecutive syndrome, including aspects such as poor attention, concentration and self-monitoring. JZ's intellectual abilities have been only mildly compromised in comparison with his level of premorbid intellectual functioning as estimated by his educational level. TN, on the other hand, performed very poorly when one considers how highly qualified a man he is – a clear indication of the severity of his brain injuries and the degree to which his mental faculties have been compromised as a result of the MVA.

Table 1

Neuropsychological Test Results for Patients TN, RM and JZ

Test	Normal Score	TN	RM	JZ
WAIS III				
Verbal IQ	100	91	89	96
Performance IQ	100	75	65	106
Verbal Comprehension	100	98	70	98
Perceptual Organization	100	62	64	118
Working Memory	100	63	99	82
Processing Speed	100	63	66	-
Full Scale IQ	**100**	**83**	**76**	**100**
WMS III				
Auditory Immediate Memory	100	65	53	94
Visual Immediate Memory	100	109	81	81
Immediate Memory	100	84	59	86
Auditory Delayed	100	71	55	55
Visual Delayed	100	106	68	62
Auditory Recognition Delayed	100	70	55	80
General Memory	100	81	52	57
Working Memory	100	99	96	85
DK EFS (average of score of primary measures reported)				
Trail Making	10	2	5	12
Verbal Fluency	10	4	5	3

Design Fluency	10	3	6	11
Colour-word	10	3	7	-
Sorting Test	10	7	6	15
Twenty Questions	10	2	5	12
Word Context	10	1	6	12
Tower Test	10	7	6	9
Proverbs	10	12	4	6

The WMS III scores indicate that, on the whole, JZ scored somewhat higher than RM, while TN performed the best of the three patients. However, none of the three patients performed better than the average range for any of the subtests concerned and were generally classified in the range between low average through to extremely low. These results are to be expected, given the patients' various pathologies and deficits. RM's memory scores on the WMS III are consistent with the clinically reported significant memory loss (his profound retreogarde and anterograde amnesia) and his frontal pathology, while JZ's WMS III scores show 'frontal' difficulties (e.g. critically monitoring the adequacy of his performances) in retrieving information from memory. Thus, while his recall abilities have been affected, his encoding and storage abilities, demonstrated by his good performance on recognition tasks, remain relatively intact. TN's performance on the WSM III clearly shows an anterograde memory impairment. He also displays a dysexecutive frontal picture and even confabulated during memory testing.

The DK EFS scores indicate that all patients had a degree of 'frontal' impairment. JZ performed higher than RM, scoring in the average range on five of his eight subtests, while RM performed below average on seven of his nine subtests, scoring average on the remaining two. TN performed lower than average on six of the nine subtests, scoring average on the remaining three. Although he performed better than RM and TN, JZ was still sufficiently impaired to be considered 'frontal', and his scores are consistent with the extensive contusion of his left frontal lobe (an orbital/basal picture) and slight midline shift to the right. RM's poor scores can be attributed to his bi-frontal damage, with small contusions in the left frontal lobe and a larger, single contusion in the right lobe. TN's poor performance can be attributed to the neuronal sheering and contusion which took place during his MVA, and the generalised atrophy possibly associated with his alcohol consumption. The only test where all three patients, JZ, RM and TN, performed equally poorly was the Verbal Fluency test, which measures the patients' ability to obey rules and initiate, their speed of processing, vocal knowledge, spelling, and their attention. Additionally, the Design Fluency, Twenty Questions, and Word Context tests were three tests where the confabulating patients could not adequately perform whereas the frontal patient could. The Design Fluency test measures the patient's motor speed, visual-perceptual skills, problem solving, creativity, simultaneous processing and inhibition. The Twenty Questions test, along with the Word Context test, primarily measures the patient's abstracting reasoning and logic.

Experimental materials and procedures

The second, and indeed focal part of this research's testing, concerns the use of three exploratory experiments, which were administered to all 24 participants. These experiments comprised six tests used to assess emotional influences on both explicit and implicit memory. They also served the purpose of trying to distinguish between encoding and retrieval difficulties, as well as evaluating the role of self-focusing in memory performance and confabulation. Such a comprehensive and detailed approach was required to address the complexity of emotional memory functioning. These tests were administered in English, as all participants were fluent in English.

The Affective Word Tests (AWT1 and AWT2) described below, have used the *Affective Norms for English Words (ANEW)* list, which currently involves more than 1000 positive/neutral/negative words, normed by using the Self Assessment Manikin to acquire ratings of pleasantness and other emotional dimensions. This ANEW list, as constructed by Bradley and Lang (1999, p.1), provides "a set of normative emotional ratings for a large number of words in the English language". These authors drew on dimensional views of emotion (positive/negative) in their compilation of the word lists (Bradley & Lang, 1999). Lists of words were administered to participants, who rated them according to valence and frequency dimensions. For this study, words from the standardised ANEW pool with a valence mean of greater than 7 were considered positive, a valence mean between 3 and 7 was considered neutral, while a valence mean below 3 was considered negative. Words were also included in this study on the basis of frequency (occurrence in spoken language) and, in the light of this, only words with a frequency of greater than 30 and less than 300 were included. Additionally, each word on the ANEW list has an arousal mean, which indicates the extent to which each word elicits feelings of 'calm' on the one extreme, to 'excited' on the other (Bradley & Lang, 1999). In this study, a word is considered an arousal word if it has an arousal mean of 5.5 or greater. Finally, no words considered to be 'Americanised' words were included in the study to avoid possible cultural biases. These ANEW lists are being utilised in this study, as they serve to increase the validity and reliability of the exploratory tests that follow.

This study was approved by the Ethics Committee of the University of Cape Town Psychology Department. Additionally, approval for testing patients was granted by the Neurology Department of Groote Schuur Hospital, as well as by the hospital's Ethics Committee. The participants in this study — the four patients and twenty controls — all consented to participate in the study, and signed consent forms. These consent forms were accompanied by a participant information form which stipulated the aims/purpose of the study, the entirely voluntary nature of participation in the study, as well as the confidentiality and anonymity of all information gathered in the research testing.

The frontal patient JZ and confabulating patient TN were assessed individually. Confabulating patient RM was assessed by colleagues overseas in Newcastle, England. The non-frontal, neurological patient was assessed in the Neurology Ward of Groote Schuur Hospital in Cape Town. The twenty controls were also assessed individually, in two sessions on separate days. It is of importance to note that the two sessions required for the exploratory tests for all the participants were administered on separate days to avoid order affects.

Statistical Analyses

The structure of the statistical investigation in this study involved comparing each of the four patients' scores individually with the normal control group. In addition to these differences between groups comparisons, it was also required that test differences between groups comparisons be made between scores on each of the pairs of tests found in the three experiments. With these aims in mind, modified independent sample t-tests (Crawford & Howell, 1998), modified related (paired) samples t-tests (Crawford, Howell & Garthwaite, 1998), and related-samples t-tests, were adopted for the data analyses in this study. Confidence limits derived from these modified t-tests are also provided (Crawford & Garthwaite, 2002) to demonstrate the acceptable range of accuracy of each point estimate. One-tailed probability values are provided given the premise on which this research's experiment hypothesis is based: that patients will perform worse than controls on the range of experimental tests.

EMOTIONAL PROCESSESING IN IMPLICIT & EXPLICIT MEMORY

The first experiment in this study uses a pair of tests named the Affective Word Tests (AWT1 and AWT2), which focus on implicit and explicit memory respectively. Both these AWTs are comprised of a 15-word target list, made up of 5 positive, 5 negative and 5 neutral words — each AWT having its own unique list. The first of these tests (see Appendix A) involves the implicit learning of words from a list through the judgement of the valence of the words. Here, the participant is asked to judge whether they think each word is positive, negative or neutral. This aspect of the test is followed by a recall task where the participant is asked to remember as many of the words as possible, and then by a word recognition task, where a list of 30 randomly ordered words (15 words from the initial list) is read out and the participant is required to say whether each word was on the initial target list or not.

The second AWT (see Appendix B) involves the explicit learning of a new 15-word list, where the list of words is simply read to the participant who is asked to remember as many of the words as possible. This time they are instructed that they will be asked to recall the words (i.e. explicit learning). This initial task, which is the only aspect in which these first two AWTs differ, is then followed by the recall task and the word recognition task, both of which follow the same procedure as in the first AWT. In both these tests, the learning of the words is on a verbal basis, as the words are read out to the participant. The retrieval process in both of these two tests is considered 'explicit', as the participant is verbally instructed to remember what he can, and the two tests are paired together for comparison.

The aim of this first experiment is to investigate whether there are differences in the retrieval of *affective words* when implicit leaning is compared with explicit learning. This first experiment, therefore, is exploring the possible influence of emotional processing on verbal memory. In this light, the particular data gathered from this experiment includes, for the AWT1: the number of correct positive, negative and neutral valence judgements made, the reaction times taken for each judgement, and the number and type of deviations made (e.g. neutral to negative, positive to neutral); the number of positive, negative and neutral words correctly recalled; the number of positive, negative and neutral words correctly recognised (and how many of these were arousal words); and finally, the number of false positives identified (and how many of these were arousal words). Here, false positives are any words that the participant erroneously claims were on the initial AWT list.

For the AWT2, the data gathered includes: the number of positive, negative and neutral words correctly recalled; the number of positive, negative and neutral words correctly recognised (and how many of these were arousal words); and finally, the number of false positives identified (and how many of these were arousal words). With this aforementioned data, comparisons can be made with each participant's own data on the two AWT tests, as well as with each of the other participant's scores on the two tests (i.e. differences between groups and test differences between groups comparisons can be made).

These first two AWTs were tested over separate sessions. Additionally, to control for memory impairment, a delay of ten minutes was given between the encoding of the word list and the recall in the case of the normal controls, while immediate recall (no time delay) was used for patients.

<u>Results</u>

Table 2

AWT 1 and AWT2 summarised descriptive data for all participants

Test	JZ	RM	TN	JH	Normals
AWT1					
N°. correct - valence judgement					
Positive:	5	5	4	3	4 (0.94)
Negative:	5	5	3	5	5 (0.91)

Neutral:	5	2	2	3	2 (1.49)
Average reaction time (in seconds)					
Positive:	3,74	2,63	13,57	2,70	2,69 (1.76)
Negative:	4,25	1,40	10,56	2,38	2,98 (2.53)
Neutral:	4,43	4,00	11,67	1,87	2.05 (1.33)
N°. of deviations					
Positive → Negative	0	0	1	1	0.35 (0.58)
Positive → Neutral	0	0	0	1	0.7 (0.80)
Neutral → Positive	0	3	2	1	2.15 (1.49)
Neutral → Negative	0	0	1	1	1.00 (0.72)
Negative → Positive	0	0	2	[illegible]	0.10 (0.31)
Negative → Neutral	0	0	0	0	0.15 (0.67)
N°. correct recall					
Positive:	0	0	1	2	1 (1.04)
Negative:	1	0	0	0	1 (0.85)
Neutral:	2	1	0	4	2 (1.35)
N°. correct recognition					
Positive:	5	5	5	4	5 (0.41)
Negative:	3	5	4	3	4 (1.04)
Neutral:	5	5	5	5	5 (0.22)
AWT2					
N°. correct recall					
Positive:	1	1	0	1	2 (1.27)
Negative:	1	2	2	2	1 (1.28)
Neutral:	1	0	0	1	2 (1.28)
N°. correct recognition					
Positive:	4	5	5	3	4 (0.85)
Negative:	3	3	5	4	4 (0.92)

Neutral:	2	3	5	5	4 (0.82)

Note: The standard deviations of the normal controls are reported in brackets in Table 2.

Differences Between Groups

The results for the number of correct valence judgements (see Table 2) made by the four patients in the AWT1 test when compared to those made by the normal controls, reveal that patients JZ and TN produced significant differences from the control group. JZ scored 5 neutral words correct, $t = 1.965$, $p < 0.03$, compared to the controls' average of 2, and TN scored 3 negative words correct compared to the controls' average of 5, $t = -2.145$, $p < 0.02$. For JZ, the point estimate estimating the number of controls falling below his score was 96.79%, with confidence limits of 89.12% and 99.73%. For TN, the point estimate was 2.26%, with confidence limits of 0.13% and 8.55%.

The results of comparing average reaction times of patients with those of controls in the AWT1 valence judgement task (see Table Two), revealed that patients JZ and TN showed significant differences from controls. Both showed slower reaction times to those of the controls — JZ with the neutral word reaction times $t = 1.746$, $p < 0.04$, and TN with the positive $t = 6.033$, $p < 0.01$, negative, $t = 2.924$, $p < 0.01$, and neutral, $t = 7.059$, $p < 0.01$, reaction times. For JZ scores, the point estimate was 95.16%, with confidence limits of 85.67% and 99.37%. For patient TN, the point estimate was 100%, with a confidence limit of 100% for the positive reaction times. For TN's negative reaction times, the point estimate was 99.56%, with confidence limits of 97.42% and 100%, and for his neutral reaction times, the point estimate was again 100%, with a confidence limit of 100%.

The results for the total number of deviations in the AWT1 test reveal that only patient TN displayed a significant difference from the controls, $t = 5.981$, $p < 0.01$, for the negative to positive deviation, where he scored 2 deviations compared to the controls' average of 0.1. The point estimate for TN's score was 100%, with a confidence limit of 100%.

The results also indicate that none of the four patients displayed significant differences when compared to the normal controls on the word recall task of the AWT1. The total number of correct positive, negative and neutral recognitions in the AWT1 (see Table Two), show that patient JH displayed a significant difference, $t = -2.380$, $p < 0.014$, from the normal controls in the recognition of positive words, $t = -2.380$, $p < 0.014$, i.e. he correctly recognised significantly fewer positive words than the controls. The point estimate for JH's score was 1.40%, with confidence limits of 0.05% and 6.11%. Additionally the results do show that frontal patient JZ did show a positive bias, with fewer negative words in the recognition task, but this was not found to be significant. In terms of the number of the 15 target words that were arousal words in the AWT1 recognition task, only patient JH displayed a significant difference, $t = -1.859$, $p < 0.03$, to the controls, having 5 arousal words compared to the controls' average of 7. The point estimate obtained was 3.93%, with confidence limits of 0.41% and 12.47%.

The results also indicate significant differences between patients RM, $t = 3.637$, $p < 0.01$, TN, $t = 4.243$, $p < 0.01$, and JH, $t = 2.425$, $p < 0.01$, and controls regarding the total number of false positives identified in the AWT1 recognition task in relation to the controls. RM scored 8 false positives, while TN scored 9 and JH 6 — all three patients showing more false positives than the controls' average of 2. For RM, a point estimate of 99.91% was found for the number of controls falling below his score, with confidence limits at the 0.05 significant level of 99.32% and 100%. For TN, the point estimate was 99.98%, with confidence limits of 99.82% and 100%. For patient JH, the point estimate was found to be 98.73%, with confidence limits of 94.28% and 99.96%.

Only patient JH produced significant differences from the controls with regard to the number of false positives that were arousal quality words in the AWT1 recognition task, $t = 2.749$, $p < 0.01$. He scored 3 arousal words compared to the controls' average of 1. For his score, a point estimate of 99.36% was calculated, with confidence limits of 96.55% and 99.99%.

None of the patients displayed any significant difference from the controls in terms of the number of the arousal words recognised in the AWT2. The results, however, did indicate significant differences between patients RM, $t = 2.305$, $p < 0.01$, and TN, $t = 5.268$, $p < 0.01$, in the total number of false positives in comparison to those controls in the AWT2 recognition task. For RM, a point estimate of 98.37% was obtained, with confidence limits of 93.18% and 99.94%. For TN, the point estimate was 100%, with confidence limits of 99.99% and 100%.

Finally, in the same recognition condition, there was a significantly higher amount of words with arousal quality in the false positives of patient TN than in those of controls, $t = 2.440$, $p < 0.01$. Here, TN had a total of 3 arousal words compared to the controls' average of 1. A point estimate of 98.77% for the number of controls falling below TN's score was calculated here, with confidence limits at the 0.05 level of significance of 94.41% and 99.97%.

In summary, the critical finding is the lack of a positive bias in patient JZ in judging, recalling, recognising, and falsely recognizing words in comparison to controls, which is central in investigating the study's hypothesis. Patient JZ did show slower reaction times than the controls, but this was only for neutral words. Confabulating patient TN showed a positive bias when it came to the valence judgement of the affective words learnt through both explicit and implicit learning. TN got fewer negative words than positive words correct, revealing a slight positive bias. Another clear indication of a positive bias in TN was that he displayed a significant difference from the controls for the negative to positive deviations — judging significantly more negative words as being positive. All in all, the controls did show a very slight positive trend in most of the above-mentioned tests. No positive biases where recorded for any of the patients in the recall or recognition tasks of the tests.

Test Differences Between Groups

When recording the results of the comparisons between the AWT1 and AWT2 tests, only patients JZ and JH displayed significant differences regarding the number of correctly recalled words from each test (see Table 2). For both patient JZ, $t = -2.339$, $p < 0.01$, and JH, $t = -1.894$, $p < 0.03$, the significant difference was found between the number of neutral words recalled. For JZ, confidence limits at the 0.05 significance level were 0.05% and 6.49%, with a point estimate for the percentage of the normal population to a have more extreme discrepancy between errors made on the two tests of 1.52%. For JH, the confidence limits were 0.36% and 11.92%, with a point estimate of 3.68%.

When comparing the number of correctly recognised positive, negative and neutral words in the AWT1 versus the AWT2 test, the test differences between groups results reveal that only patient JZ and the normal controls displayed significant difference between the two tests (see Table 2). In JZ's case, this difference, $t = -3.023$, $p < 0.01$, was between the number of neutral words of the two tests. The confidence limits obtained were 0.01% and 2.17%, with a point estimate of 0.35%. For the controls, significant differences were found for both positive, $t = 3.90$, $p < 0.01$, and neutral words, $t = 3.58$, $p < 0.01$.

Finally, the test differences between groups comparison indicates that only the normal control group showed a significant difference when comparing the total number of arousal words in the recognition task in the AWT1 versus the AWT2 test (see Table 2), $t = 7.254$, $p <$

0.01. No significant findings were demonstrated regarding the comparisons of the total number of false positives from each AWT test, and if any of these were arousal words.

In summary, the findings from the comparison between the AWT1 and the AWT2 reveal that no differences could be found between the number of positive or negative words recalled or recognised by either the patients or normal controls. The two non-confabulating patients both showed a significant difference regarding the recall of neutral words, where both scored significantly more correct neutral words in the AWT1 under the influence of implicit learning. The results also show how with the recognition task, both JZ and the normal controls scored significantly more neutral words correct in the AWT1, with its implicit learning. This finding was also shown in the positive words of the normal controls.

Discussion

The aim of this first experiment was to explore the possible influence of emotional processing on verbal memory, through ascertaining whether there are differences in retrieval of affective words (positive, negative and neutral) when implicit leaning is compared with explicit learning. Hence, the key hypotheses investigated were firstly, whether positive affective biases occur during valence judgement, recall, and recognition of words, in frontal non-confabulating and confabulating patients in comparison with normal controls, and secondly, whether there are differences in the retrieval (recall and recognition) of affective words when implicit learning is compared to explicit learning between these populations.

The results from the AWT1 valence judgment reveal that confabulating patient TN produced a significant difference from the control group: TN judged fewer negative words correctly compared to controls, suggestive of the problems confabulators face with judging negative material. TN also got fewer negative words than positive words correct, revealing a slight positive bias and supporting the belief that confabulating patients show this tendency.

Therefore, the fact that patient TN made significantly more errors with the negative words is consistent with the theories that confabulating patients struggle to process material of negative valence, and this accounts for his producing a positive bias in relation to his negative errors.

The results for the total number of deviations in the AWT1 test revealed that only patient TN displayed a significant difference from the controls, for the negative to positive deviation, where he scored more deviations compared to the controls. This is further evidence of a positive bias in the confabulating patient, and is an important finding as it supports the tendency seen in confabulators reported in previous research. Interestingly, confabulating patient RM also displayed this tendency when converting 3 neutral words to positives, although this finding was not significantly different from the controls.

The findings also show that none of the four patients displayed significant differences when compared to the normal controls on the word recall task of the AWT1. The results do show that frontal patient JZ displayed a significant difference for positive words on the recognition task, i.e. he correctly recognised significantly fewer positive words than the controls. Contrary to the hypothesis under investigation, this finding shows the opposite emotional bias in memory recognition.

The results also indicate how significant differences were found with patients RM, TN and JH regarding the total number of false positives they identified in the AWT1 recognition task in relation to the controls. The differences between groups findings of the AWT1 revealed no positive biases when it came to the recall and recognition of affective words learnt through both explicit and implicit learning. Here, the critical finding is the lack of a positive bias in patient JZ, as this is central in investigating the study's hypothesis. Additionally, it is worth reiterating the importance of the finding of the positive bias elicited in the confabulating patient, as this finding once again confirms the idea that confabulators do display positive biases in the judgement of affective material. Importantly, this finding in this study's newly investigated area of the valence judgement of affective words is able to extend the current knowledge on confabulators problems with emotional processing.

In terms of the differences between groups results from the AWT2, the findings reveal a similar trend to the AWT1 results. Results on the number of correctly recalled words in comparison to the controls in the AWT2 test reveal that none of the four participants showed any significant differences, and hence no positive affective bias was found. The finding that none of the patients displayed any significant difference to the controls in terms of the number of arousal words they recognised, again demonstrates how the presence of arousal quality words seems to have little bearing on the success of recognition, regardless of the underlying pathology. The finding that only patients RM and TN displayed a significant difference in the total number of false positives that they scored in comparison to the controls for the AWT2 recognition task, can be seen to be part of the frontal symptom of disinhibition.

These findings seem to suggest that emotional words are better remembered and less likely to be included in memory intrusions in the confabulating patient. All in all, the above-mentioned findings suggest that, with the clear exception of confabulating patient TN, who showed a positive bias in judging the emotional valence of words, no positive affective biases seemed to occur in the remaining participants in the valence judgement, recall, or recognition of words. These findings are nonetheless highly important as they not only further validate the theory that confabulating patients often exhibit positive affective bias, but they also shed significant light on the question of whether or not the frontal lobes have a role in such bias.

The test differences between groups findings in the AWT1 and AWT2 tests revealed that implicit learning facilitated the recall of words of neutral valence only, in a frontal patient and a non-frontal patient, but not in the two patients who confabulated, and not for words of positive or negative affect quality. The findings based on recognition, revealing that in the case of frontal patient JZ and the normal controls, significant differences between the number of neutral words (for JZ) and for positive and neutral words (for the controls), are indicative of the fact that implicit learning fails to facilitate the recognition of affective material more so than the adoption of explicit learning tactics is able to.

SELF-FOCUS MANIPULATION AT ENCODING VERSUS RETRIEVAL

The second experiment in this study also comprises a pair of AWTs — specifically named the ISE and ISR tests. These AWTs consist of two implicit learning tasks, both including self-focus manipulation, at the level of encoding in the first task and at the level of retrieval in the second. Both these tests are considered as implicit tests because there is no instruction given to the participants to memorise (learn) the target material. The third test, called 'Implicit Self-focus at Encoding' (ISE, see Appendix C), is a *conceptual encoding task*, and was administered by Watkins (2002) in his research investigating implicit memory biases as part of mood-congruent memory (MCM). This involves the participant being asked to think of a self-referent scene/memory for each word on a randomly-sorted 15-word list (self-focus at encoding), which comprises 5 positive, 5 negative and 5 neutral words. Once this is done, the participant is asked four questions: "whether the scene was an actual scene from their past or an imagined scene, (2) whether they were the principal character of the scene, (3) to rate the vividness of the scene, and (4) to rate the pleasantness-unpleasantness of the scene" (Watkins, 2002, pp.387-388). Such questions facilitate the implicit learning through making the participant engage further with the learnt material. Following this, a free association task with cue words relating to the original word list (studied) and another word list (unstudied) are used (Watkins, 2002). This free association involves the participant being asked to respond spontaneously (as quickly as possible) with the first three words that come to mind on hearing each cue word.

The final AWT, named 'Implicit Self-focus at Retrieval' (ISR, see Appendix D), is also a *conceptual encoding* task, but focuses this time on self-focus at retrieval. Once again a different 15-word list, randomly sorted between 5 positive, 5 negative and 5 neutral words, is used. The only aspect in which the ISR differs from the ISE, apart from adopting different word lists, is with the final task. Here, instead of simply being supplied with an individual cue word, the participant is read a sentence involving his own name (self-focus at retrieval), which he is required to complete by free association. As with the ISE, the participant is once again asked to respond spontaneously (as quickly as possible) with the first three words that come to mind on hearing each cue sentence. The aim of this experiment, therefore, is to investigate how self-referent scenes at encoding and at retrieval might influence implicit learning. Once again, as in the first experiment, the possible influences of emotional processing on memory are being investigated, but with the added variable of self-reference/focus.

For both the ISE and ISR, the data gathered includes the total number of primed words, and most importantly the specific valence of each of the primed words. Priming (implicit learning) will be revealed by subtracting the number of unstudied targets from the number of studied targets produced. Additionally, it is also recorded whether the self-referent scenes associated with the primed words were actual memories of the participants', or just imagined ones. The final data gathered from these tests is the total number of pleasant (positive), unpleasant (negative) and neutral, self-referent memories of each participant from the 15 cue words from each test.

With this data, comparisons can be made between each participant's own data on the ISE and ISR tests, as well as between each of the other participant's scores on the two tests (i.e. within and between group comparisons can be made). The ISE and the ISR were assessed in different sessions, to avoid 'contaminating' one test with the materials of the other.

Results

Table 3

ISE and ISR summarised descriptive data for all participants

Test	JZ	RM	TN	JH	Normals
ISE					
Total N°. of primed words	5	4	8	10	7.60 (2.60)
Positive:	3	4	3	4	3.20 (1.36)
Negative:	2	0	3	3	2.05 (1.19)
Neutral:	0	0	2	3	2.35 (1.59)
N°. of pleasant, unpleasant & neutral self-referent memories					
Pleasant:	8	11	7	7	7.20 (2.28)
Unpleasant:	7	2	4	6	4.85 (1.46)
Neutral:	0	2	4	2	2.95 (2.16)
ISR					
Total N°. of primed words	11	5	9	8	6.40 (3.03)
Positive:	4	4	3	3	2.25 (1.45)
Negative:	3	1	4	4	2.10 (1.02)
Neutral:	4	0	2	1	2.05 (1.32)
N°. of pleasant, unpleasant & neutral self-referent memories					
Pleasant:	8	12	8	7	7.35 (1.60)
Unpleasant:	7	3	5	5	5.70 (2.32)
Neutral:	0	0	2	3	1.95 (1.88)

Note: The standard deviations of the normal controls are reported in brackets in Table 3.

Differences Between Groups

The results of the total number of primed words recalled by the four patients in the ISE test demonstrate no significant difference to those of the controls (see Table 3). Frontal patient RM did, however, show an interesting tendency towards positive bias in that all of his primed words were positive (a large discrepancy between the total number of positive primed words, scoring 4, and negative primed words, scoring 0), the only patient to show this trend. There was no effect for the valence of the primed words in any of the patients when compared to the controls. There was also no difference in the valence of the self-referent memories produced by subjects in the ISE, apart from patient RM who displayed significant differences, $t = -1.905$, $p < 0.03$, from controls in the number of unpleasant memories reported, showing far fewer than the normal controls. A point estimate for the number of controls falling below his score was calculated at 3.60%, with confidence limits at the 0.05 significance level of 0.35% and 11.76%. It is interesting to note that everybody (including controls) showed some degree of positive bias, albeit small.

Regarding the ISR test, the results demonstrated no significant differences for any of the patients for the total number of primed words achieved when compared with the controls (see Table 3). For the valence of the primed words, patients TN, $t = 1.818$, $p < 0.04$, and JH, $t = 1.818$, $p < 0.04$, both exhibited identical significant differences to the controls for the number of negative primed words, with confidence limits at the 0.05 significance level of 86.88% and 99.52%, and a point estimate of 95.76%. TN and JH both scored 4 negative words, compared to the control groups' average of 2. Once again, RM was the only patient to have a large discrepancy between the number of negative and positive primed words, showing far more positive primed words than negative, which is again suggestive of a positive bias.

With the results for the total number of pleasant, unpleasant and neutral self-referent memories in the ISR test, only patient RM, $t = 2.836$, $p < 0.01$, demonstrated a significant difference from the control group's total, in the case of his pleasant memories, scoring 12 compared to the controls' average of 7. Here, confidence limits were 97.01% and 100%, with a point estimate of 99.47%. No significant differences were found between the patients and the controls regarding whether the self-referent scenes associated with the primed words were actual memories of the participants', or just imagined ones for the ISR test.

In summary, confabulating RM was the only patient to have a large discrepancy between the number of negative and positive primed words, scoring far more positive words on both the ISE and the ISR test, which is indicative of a positive bias. Also indicative of the positive bias in RM is the fact that he had significantly more pleasant memories than the controls on the ISR, and significantly fewer unpleasant memories than the controls in the ISE test. The control group displayed a slight positive bias on both tests concerning the number of pleasant self-referent memories. It is noteworthy that confabulating patient TN displayed a negative bias on the ISR. Once more, no positive biases could be demonstrated in frontal patient JZ. It is of some interest that confabulating patient TN displayed a negative bias on the ISR. These results from the ISE and ISR reveal that only patients TN and JH showed significant differences from the controls on the ISR, scoring more negative words.

Test Differences Between Groups

When recording the results of the test differences between groups comparisons on the total number of primed words for the ISE and ISR tests, the findings show that only patient JZ, $t = -1.968$, $p < 0.03$, demonstrated a significant difference between the two tests — scoring 5 primed words on the ISE compared to 11 on the ISR. The confidence limits obtained for JZ at the 0.05 level of significance were 0.27% and 10.84%, with the point estimate for the percentage of the normal population to a have more extreme discrepancy between errors made on the two tests at 3.20%. Of these primed words, 3 were positive in the ISE and 2 were negative, while in the ISE, 4 were positive, 3 negative and 4 neutral. Again this shows a consistent positive bias, even if not significantly different to controls.

The results of the comparison between the ISE and the ISR for the valence of the primed words revealed that only patient JZ and the normal controls displayed any significant differences (see Table 3). For patient JZ, this difference, $t = -2.199$, $p < 0.02$, lay in the number of neutral primed words between the two tests, having more in the ISR. The confidence limits obtained for JZ at the 0.05 level of significance were 0.10% and 7.93%, with the point estimate of 2.02%. For the controls, the significant difference, $t = 2.646$, $p < 0.01$, was found for the positive primed words, with more in the ISE. No significant differences were demonstrated between the ISE and ISR tests for the number of pleasant, unpleasant and neutral self-referent memories (see Table 3) for any of the participants (patients and normal controls), or for whether the memories linked to the self-referent scenes were actual or imagined.

Discussion

The aim of this second experiment was to investigate the potential influence of self-focus manipulation on implicit learning, as another way of investigating the influences of emotional processing on memory. To achieve this goal, implicit learning was manipulated, firstly by introducing a self-focus task at the encoding stage of the memory process (in the ISE test), and then secondly, through introducing a self-focus task at the retrieval stage of the memory process (in the ISR test). By examining the number of primed words from each test, along with the affective quality (positive, negative or neutral) of each of these primed words, a picture would emerge as to whether self-focus at either encoding and/or retrieval in any way influences implicit memory/learning.

In addition, this test examined potential positive affective biases in the valence of the scenes linked to the primed words. A final variable to be included into this analysis is the issue of whether or not the self-referent scenes associated with the primed words were actual or simply imagined memories of the participants', and whether this had any significant bearing on the quality of implicit learning. This experiment could thus reveal if there are any differences between the two types of implicit learning (self-focused or not), between controls, frontal patients and frontal confabulating patients.

The results for the ISE test revealed that none of the patients displayed a significant difference to the controls for either the total number of primed words, or the positive, negative or neutral valence of the primed words. This finding, coupled with the fact that only patient RM had a significant difference from the controls for the total number of pleasant, unpleasant and neutral self-referent memories reported, seems to suggest that the quality of implicit learning occurring during the self-focus at encoding task was unaffected by the nature of the patients' pathology. The control group did display a slight positive bias for the number of pleasant self-referent memories in the ISE, but this can be accounted for by the presence of a few outliers (extreme scores) in their overall data.

Yet more evidence of the positive emotional biases in confabulators is the fact that patient RM had significantly fewer unpleasant memories than the controls in the ISE test and significantly more pleasant memories than the controls on the ISR. Additionally, RM was also shown to have a large discrepancy between the number of negative and positive primed words, again indicative of a positive bias. Once again, the fact that such biases have been elicited in this new area of investigation and testing is a very important finding. It is also salient that confabulating patient TN displayed a negative bias on the ISR, as this finding seems to contradict the belief that confabulators experience difficulties with processing negative material. Here, however, TN did generally perform poorly on all the tests in relation to the other participants. It is likely that his poor performances can be attributed to the severity of the brain injuries he suffered in his MVA.

The initial findings of the ISE are replicated in the ISR test where once again no significant differences between the patients and the controls were found with respect to either the total number of primed words, or whether the self-referent scenes associated with the primed words were actual memories of the participants', or just imagined ones. An important aspect where the ISR between-group findings differed from the ISE, is with respect to the valence of the primed words, where significant differences where found for patients TN and JH for the number of negative primed words. Once again, no significant positive affective biases were revealed in comparison to the controls, although RM did display a clear positive bias (see below). The self-focus at retrieval seems not to produce any difference in the quality of priming.

A finding of some interest is the fact that a significant difference was found between confabulating patient RM and controls in the total number of pleasant, unpleasant and neutral self-referent memories in the ISR. RM's total of 12 pleasant self-referent memories does indicate a significant positive bias in relation to the controls' 7 self-referent memories on average. Coupled with this is the finding that RM was the only patient to have a large discrepancy between the number of negative and positive primed words, suggesting that he struggled to implicitly learn the negative primed words. This finding is indicative of a positive bias in the confabulating patient, which is again in line with the belief that confabulating patients struggle cognitively with material of negative valence. Frontal patient JZ exhibited no positive bias in either the ISE or the ISR tests. The control group did display a slight positive bias for the number of pleasant self-referent memories in the ISR, but once again this can be accounted for by the presence of a few outliers (extreme scores) in their overall data.

Of some interest are the test differences between groups results between the ISE and ISR, which revealed that frontal patient JZ was the only participant to demonstrate a significant difference between the two tests: for the total number of primed words, he scored 11 on the ISR compared to 5 on the ISE. This suggests that the self-focus at retrieval was of some benefit to the frontal patient. This might be due to the fact that the additional opportunity afforded through the self-focus at retrieval task to relate personally with the affective material (in the sense that JZ is picturing himself with the task) is facilitating the retrieval process — through the 'working self' relating the primed words to event-specific knowledge (ESK) from autobiographical memory.

Although the results revealed no significant differences between the two tests for confabulating patient RM, he did show positive emotional bias in both tests and, of the two types of self-focus manipulation in the tests, self-focus at retrieval had the greatest effect on him in terms of the degree of positive bias shown. Also, the test differences between groups results demonstrate how patient JZ and the normal controls displayed significant differences for the valence of the primed words. JZ learned more neutral words in the ISR compared to the ISE. However, this difference was not observed for positive words and thus such a bias was not revealed. The normal controls displayed a significant difference between the positive primed words, with more recorded in the ISE.

In general, these findings suggest that although both self-focus at retrieval and encoding might well influence implicit learning, neither appears to do so more than the other and neither appears to exert more influence on the learning of positive versus negative or neutral words. Generally, there was no significant difference in the number of positive primed words learnt between the two self-focus manipulations for any of the populations tested.

EMOTIONAL PROCESSING OF SENTENCES AND WORDS

The Affective Sentence Test (AST) and the Epairs test constitute the third experiment in this study. Both these tests focus on emotional processing itself, rather than the influence of emotional processing on memory as in the previous two experiments. In the case of the AST, 16 (randomly ordered) sentences depicting 8 pleasant and 8 unpleasant situations are given to the participant (see Appendix E). The participant is then asked to decide whether each situation is pleasant or unpleasant — being required to employ an explicit affective valence judgment for this prose material. The Epairs test (see Appendix F) consists of 30 word pairs presented in a random order, comprising 10 pairs of two positive words, 10 pairs of two negative words and 10 pairs with one positive word and one negative word (i.e. mixed). The participant is required to answer whether each of the 30 pairs of words is the "same" or "different" with respect to their un/pleasantness. The results of this AST can then be compared to the Epairs results as a way of comparing two types of emotional processing: affective judgement of individual words versus affective judgement of prose (sentences).

The Epairs tests uses implicit valence judgement as the participant is only asked to say whether each word-pair is the same, or different, not to report their valence. In the light of this, the data gathered from the AST is the total number of errors made regarding the positive versus negative valence judgements for the 16 sentences. For the Epairs test, the data gathered is the total number of errors in the three major groups/word parings of the test, i.e. the positive, negative and mixed word parings. Using this data, comparisons can then be made, not only between each participant's own data on the AST and Epairs tests, but also between each of the other participant's scores' on the two tests (i.e. within and between group comparisons can be made).

Results

Table 4

AST and Epairs summarised descriptive data for all participants

Test	JZ	RM	TN	JH	Normals
AST					
N°. of errors – sentence valence judgement					
Positive:	0	0	2	1	0.2 (0.41)
Negative:	0	0	1	1	0.1 (0.31)
EPAIRS					
N°. of errors – word-pairs valence judgement					
Positive:	0	1	7	3	1.40 (1.35)
Negative:	0	4	6	3	1.10 (1.21)
Mixed:	1	1	4	5	1.20 (1.28)

Note: The standard deviations of the normal controls are reported in brackets in Table 4.

Differences Between Groups

The results for the total number of errors made by each of the four patients in the AST sentence valance task when compared to the normal controls demonstrate that patient JZ showed no significant differences between his own scores and those of the controls. Patients TN and JH did show significant differences between the total number of errors they made in comparison to the controls (see Table 4). For TN both the number of errors made with the negative sentences, $t = 2.833$, $p < 0.00$, and the positive sentences, $t = 4.284$, $p < 0.00$, were significantly more than the controls. Confidence limits at the 0.05 significance level for TN's positive errors stood at 99.83% and 100%, with a point estimate of 99.98%. For his negative errors, these were 97% and 100%, with a point estimate of 99.47%. For JH, his positive errors, $t = 1.904$, $p < 0.03$, and negative errors, $t = 2.833$, $p < 0.01$, were also significantly more than the controls. Confidence limits at the 0.05 significance level for JH's data stood at

88.23% and 99.65% for the positive errors, with a point estimate of 96.39%. For his negative errors, these were 97% and 100%, with a point estimate of 99.47%.

The results of the number of errors made by the four patients in the Epairs test demonstrate how patients RM, TN and JH showed significant differences in comparison to controls (see Table 4). RM showed significantly more errors than the controls for negative word pairs, $t = 2.339$, $p < 0.01$. This result was accompanied by a point estimate for the number of controls falling below his score at 98.48%, and confidence limits at the 0.05 significance level of 93.51% and 99.94%. TN showed significant results for the positive, $t = 4.048$, $p < 0.01$, negative, $t = 3.952$, $p < 0.01$, and mixed word-pairs $t = 2.135$, $p < 0.02$, scoring more errors than the controls in all three categories. For TN's positive errors, confidence limits at the 0.05 significance level were at 99.71% and 100%, with a point estimate for the number of controls falling below his score of 99.97%. For his negative errors, these were 99.65% and 100%, with a point estimate of 99.96%. For TN's mixed errors, confidence limits were 91.33% and 99.86%, with a point estimate of 97.70%. JH showed significantly more errors than the controls for the mixed word-pairs, $t = 2.897$, $p < 0.01$, with confidence limits at the 0.05 significance level of 97.30% and 100%, and a point estimate of 99.54%.

In summary, the results show that no positive biases were elicited for any of the patients in the AST test, most notably for patient JZ. With the Epairs test, confabulating patient RM was the only patient to display a positive bias, showing a marked difficulty with the processing of the negative word pairs in comparison to both the control group's performance and his own performance on the positive pairs, where he made far fewer errors. Confabulating patient TN showed a marked difficulty in judging the emotionality of word-pairs, irrespective of emotional valence.

Test Differences Between Groups

When comparing the test differences between groups performances in terms of positive and negative errors made in the AST and Epairs tests, patients RM with negative errors, $t = -2.167$, $p < 0.02$, TN with negative errors, $t = -2.910$, $p < 0.01$, and the normal controls, with both positive, $t = -3.479$, $p < 0.002$, and negative errors, $t = -3.823$, $p < 0.001$, all exhibited significant differences between the number of errors they made on the two tests. RM scored no negative errors on the AST and 4 negative errors for the Epairs (i.e. negative word-pairs). The confidence limits obtained for RM at the 0.05 level of significance were 0.12% and 8.29%, with the point estimate for the percentage of the normal population to have a more extreme discrepancy between errors made on the two tests being 2.16%. TN scored 1 negative error on the AST and 6 negative errors for the Epairs. Here, confidence limits were 0.01% and 2.64%, with a point estimate of 0.45%. The controls averaged 0.2 positive errors on the AST and 1.4 positive errors in the Epairs. For the negative errors, the controls averaged 0.1 for the AST and 1.1 for the Epairs. None of the other participants showed a significant difference between the number of positive or negative errors they made between the AST and Epairs tests.

Discussion

The aim of this third experiment was to investigate emotional processing in two forms, namely sentences and words, and to see where any positive affective biases could be demonstrated. From this investigation, two key findings could emerge. The first would be whether or not differences (in terms of difficulty/mistakes made) in emotional judgement exist between words and sentences. The second major finding to emerge revolves around whether patients of varying pathologies display any difference in the quality of their emotional processing (i.e. affective bias), for sentence valence judgement in the first instance, and for the word valence judgement in the second instance, where implicit valence judgement is required.

The results from the test differences between groups show that both confabulating patients and the normal controls displayed significant differences between the number of errors made in the two tests. RM and TN both scored more negative errors on the Epairs than they did on the AST. All in all, the processing of the affective sentences in the AST proved by far the easier task than the processing of the word-pairs in the Epairs. TN's performance on the whole of the Epairs test can be considered impaired when compared to the other participants, as he scored far more errors.

The differences between groups findings for the AST reveal interestingly that frontal patient JZ scored no positive or negative errors and showed no significant differences between his own scores and those of the controls. Hence, no affect bias, positive, negative or neutral, was demonstrated. RM displayed no positive bias, which is surprising given that he did so in other tests in this study. The results also show that the patients TN did display a small affective bias: TN scored more positive than negative errors and hence displayed a slight negative bias, which is somewhat surprising given that confabulators often struggle with negative material. JH recorded one positive and one negative error and so displayed no bias either way, although he did make significantly more errors than the normal controls.

The differences between groups results for the Epairs test reveal, again interestingly, that once more patient TN revealed significant differences between his valence judgements for word-pairs in comparison to the controls for the positive, negative and mixed pairs. This finding seems in keeping with the majority of TN's performances. TN's dysexecutive problems seem to hamper his performances on all the cognitive tasks assigned to him. Most notably, frontal patient JZ displayed no positive affective bias in the Epairs. Confabulating patient RM, however, demonstrated a clear positive bias in that he struggled with the negative word-pairs and performed well with the positive ones. Again, this finding is highly salient given theories on the difficulties such patients are believed to experience with the processing of negative material. Patient JH also displayed affective bias, but for the mixed pairs. This poor performance is slightly surprising but may be attributed to the fact that JH may have misunderstood the instructions to the test as he appeared to be performing at chance for this specific task. These findings reveal that the frontal patient displayed no tendency towards positive affective bias on either sentence or word-pair valence judgement tasks, which questions the hypothesised frontal lobe involvement in positive affective bias seen in many confabulating patients.

GENERAL DISCUSSION

The central focus of this study was to investigate the role of frontal lobe deficits in the positive affective biases observed in many confabulating patients. To achieve this goal, a frontal patient was tested over three experimental test conditions: involving implicit and explicit memory, self-focus manipulation at encoding and retrieval, and sentence and word-pair valence judgement tasks. Each test was designed to investigate a different aspect of emotional processing. The frontal patient's results on the experimental tests were contrasted with the results of a non-frontal (MCA) stroke patient, two confabulating patients, and twenty normal controls. The findings reveal that no positive affective biases could be elicited in frontal patient JZ in any of the three experimental conditions. This finding challenges the hypothesis that the frontal lobes play a role in the positive affective biases seen in many confabulating patients.

Other important findings include the presence of positive bias in both the confabulating patients: in the case of RM, this was demonstrated in a marked difficulty with the processing of the negative word pairs in the Epairs test. RM demonstrated a clear positive bias in that he struggled with the negative word-pairs and performed well with the positive ones. Specifically, RM showed a marked difficulty with the processing of the negative word pairs in comparison to both the control group's performance and his own performance on the positive pairs, where he made far fewer errors. Again, this finding is highly salient given theories on the difficulties such patients are believed to experience with the processing of negative material. RM also showed a clear positive bias in the ISE and ISR tests, where he had showed significantly fewer unpleasant self-referent memories than the normal controls in the ISE, and significantly more pleasant self-referent memories in the ISR. In both these tests, RM also showed the tendency for positive bias in scoring a large discrepancy between the number of negative and positive primed words. For patient TN, the positive bias emerged with the valence judgement of the affective material in the AWT1 test. TN not only scored more negative than positive errors, he also scored significantly more negative errors than the controls. Additionally, TN also scored significantly more negative to positive deviations than the controls, showing that he judged negative words to be positive.

Concerning the experimental test conditions themselves, the findings reveal that in the AWT1 and AWT2 tests implicit learning facilitated the recall of words of neutral valence only, in a frontal patient and a non-frontal patient, but not in the two patients who confabulated, and not for words of positive or negative affect quality. Based on the findings of the recognition task, significant differences between the number of neutral words (for JZ) and for positive and neutral words (for the controls), were indicative of the fact that implicit learning fails to facilitate the recognition of affective material more so than the adoption of explicit learning tactics is able to. For the ISE and ISR, the findings suggested that although both self-focus at retrieval and encoding might well influence implicit learning, neither appears to do so more than the other, and neither appears to influence more the learning of positive versus negative or neutral words. Finally, the comparison between the AST and Epairs tests revealed how the processing of the affective sentences in the AST proved by far the easier task than the processing of the word-pairs in the Epairs.

Previous research into positive affective biases in confabulating patients has focused on the emotional processing and the positive affective bias of confabulating patients, in their everyday thoughts and conversations (e.g. Conway & Tacchi, 1996; Turnbull et al, in press), and has had somewhat limited scope concerning the investigation of affective biases within other cognitive domains. The role of autobiographical memory specifically has been at the heart of such research initiatives. Here, the research has been conceptualised around the theories of the reciprocal relationship between the 'working-self' and the autobiographical knowledge structures. This reciprocal relationship, termed the 'self-memory system', is involved with certain control processes (goal hierarchies) which govern cognition and behaviour in ways most appropriate for the current context of the individual (Conway & Pleydell-Pearce, 2000). Conway and Tacchi (1996) have suggested that frontal executive dysfunction in the retrieval and evaluation processing of memories, which co-occurs with learnt knowledge about emotional consequences of thoughts, personal wishes and memories, could result in the affective biases seen in confabulations. In this respect, little is known about how such biases may manifest in the memory processes surrounding the emotional processing of words and sentences.

This new dimension to the investigation was the heuristic departure point for this study. The present thesis has extended the investigation into memory functioning, going beyond autobiographical memory processes, the 'working self' and the involvement of the executive functions of the frontal lobes in the strategic retrieval of memory (Moscovitch & Melo, 1997), to include the influences of implicit and explicit memory processes on both the learning and judging of affective material. Research in these specific areas significantly complements the existing literature (e.g. Fotopoulou, Solms & Turnbull, in press; Turnbull et al, in press).

The aforementioned central finding in this study, i.e. that the frontal patient displayed no positive biases in any of the experimental conditions, might be accounted for by various factors. Firstly, a frontal lobe lesion other than the orbital/basal lesion shown in JZ might produce a different picture regarding emotional processing. Another possible reason for this finding is the pathology involved in JZ's case. Motor vehicle accidents, unlike other brain pathologies, e.g. stroke, result in relatively diffuse brain lesions. In the light of this, more frontal patients will need to be investigated before any final conclusions can be drawn. Finally, it is possible that the positive biases observed in previous research in confabulating patients may not be linked exclusively to frontal damage. Maybe the latter needs to be superimposed on severe memory problems for the behavioural effect to become obvious, as in the case of confabulating patients. Whatever the case, this finding goes some way in addressing the research question as to whether the frontal lobes play a role in the biases seen in the emotional processing of many confabulating patients.

The finding of the presence of positive bias in the confabulating patients, for implicit and explicit emotional judgement, but not in episodic memory, is especially noteworthy given that previous research (Conway and Tacchi, 1996; Fotopoulou, Solms & Turnbull, in press; Turnbull et al, in press) has clearly demonstrated such bias in autobiographical memory. A possible interpretation of this study's findings might be that confabulating patients face problems in processing negative emotions when faced with such a task, but these problems do not affect the consolidation of information, and thus do not lead to long-term memory emotional bias. It may be the case that confabulating patients show emotional biases in processing ongoing unpleasant reality and they distort their memories on the basis of this. In other words, although normal individuals, through the ventromedial prefrontal cortex, are able to keep relevant information in mind selectively, confabulating patients, with damage to the ventromedial cortex are unable to suppress information that is not relevant to the here-and-now and thus they randomly bring to consciousness information from the past (Schnider, Valenza, Morand & Michel, 2002).

What this study has found is that confabulating patients face difficulties (namely errors and slower response times) in actually processing unpleasant information in consciousness. Thus, patients can no longer selectively inhibit non-relevant information according to reality but instead they process information according to emotional criteria. Therefore, although the memory of confabulating patients is not contaminated by emotional biases in itself (which this study has found), when confabulators try to retrieve autobiographical information, their retrieval mechanisms might select and assemble as candidates for recollection the pieces of their past that have a positive emotional significance.

In terms of the limitations of this study, the fact that the experimental tests adopted have not been extensively used in prior research, and are in their developmental stages, may be construed as placing limitations on the validity of the findings. However, the ISE and ISR were derived from tests investigating implicit memory bias in depressed individual (Watkins, 2002), while all the tests were minimally tested in their pilot stages of this study on a range of patients. Additionally, these observations must be seen in light of the fact that the study is exploratory in nature, and hence is at the forefront of a new avenue of enquiry into the complex topic of confabulation.

Another practical issue, concerning the generalisabilty of the results, is the nature of frontal patient JZ's frontal pathology — an orbital/basal frontal picture. As documented by Johnson et al (1997, p.203), "[c]onfabulation occurs in conjunction with damage in the left, right, and bilateral frontal brain regions. The exact relationship between location and extent of frontal lesions and confabulation remains to be specified." In the light of this, it would be somewhat premature to draw final conclusions based on the evidence of this study, before investigations (using the same experimental conditions) have been carried out involving frontal patients with mesial and dorsolateral lesions or even a combination of such lesions. Suffice to say that before these other lesion sites have been investigated in this regard, no final conclusions should be drawn.

A final observation on the perceived limitations of this study involves the use of one-tailed probability tests, which were adopted because it was hypothesised that the four neurologically damaged patients would perform worse than the healthy controls on the range of experimental tests. Given this justifiable decision to use one-tailed tests, it must be acknowledged that the chances of making a Type I error (i.e. erroneously saying that a significant difference exists, when in fact it does not) are increased — a risk that was considered acceptable given the exploratory nature of the study.

Given the above, significantly more research in the area of assessing implicit and explicit learning of emotional content, and the valence judgement of affective material, needs to be done before any final conclusions can be drawn. Where this thesis has been able to contribute significantly is in providing new evidence that the emotional biases seen in confabulating patients in the realm of autobiographical memory are now extended to a new area of cognitive function, to include the implicit and explicit emotional judgement of affective material. Additionally, this thesis has begun to shed light on the complex functions of the frontal architecture and the role of this in the phenomenon of confabulation.

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Appendix A

(AWT 1)

Affective Words Test (AWT)

Learning trial: Implicit

Affective Judgement

Word	Positive	Neutral	Negative
Hairdryer			
Scared			
Sunrise			
Pencil			
Jealousy			
Fame			
Lion			
Toy			
Icebox			
Secure			
Terrified			
Traitor			
Hide			
Hostag			
Admired			

Total Sum: Σ Σ Σ

Total Correct: Σ____________ Σ____________ Σ____________

Total Deviation:		
positive→negative:	neutral→positive:	Negative→positive:
positive→neutral:	neutral→negative:	Negative→neutral:

Affective Words Test (AWT)

Free Recall

Word	Correct
Scared	
Sunrise	
Pencil	
Jealousy	
Fame	
Lion	
Hide	
Traitor	
Secure	
Terrified	
Icebox	
Toy	
Admired	
Hostage	
Hairdryer	

Affective Word Test (AWT)

Recognition

Word	**Right**	**False positive**
Blister		
Fame		
Shamed		
Admired		
Concentrate		
Sunlight		
Hostage		
Tease		
Whistle		
Secure		
Millionaire		
Icebox		
Lonely		
Lamp		
Lion		
Hairdryer		
Reward		
Hide		
Sad		
Traitor		
Jealousy		
Adorable		
Pencil		
Scared		
Cast		
Sunrise		
Angry		
Terrified		
Cabinet		
Toy		
Σ		

Appendix B

(AWT 2)

AWT – Explicit Learning

Name: Date:

Recording sheet

List A: Explicit Learning

Word	V	1	Int	Re	
Hostile -a	☹				
Beast Na	😐				
Deformed -	☹				
Profit +a	☺				
Torture –a	☹				
Trumpet Na	😐				
Excuse Na	😐				
Delight +	☺				
Aroused -a	☺				
Kindness +	☺				
Poverty -	☹				
Warmth +	☺				
Habit N	😐				
Curtains N	😐				
Fearful –a	☹				

Total Sum
Total Correct

AWT Explicit Learning– Delayed Recall

List A: Delayed Recall

Hostile -a	☹
Beast Na	😐
Deformed -	☹
Profit +a	☺
Torture –a	☹
Trumpet Na	😐
Excuse Na	😐
Delight +	☺
Aroused +a	☺
Kindness +	☺
Poverty -	☹
Warmth +	☺
Habit N	😐
Curtains N	😐
Fearful –a	☹

Positive ☺ ______

Negative ☹ ______

Neutral 😐 ______

AWT Source-Recognition

Recognition

Word	**V**	**right**	**false**
Rescue +a	☺		
Trumpet Na	😐		
Aroused +a	☺		
Bless +	☺		
Excuse Na	😐		
Hostile –a	☹		
Burial -	☹		
Torture-a	☹		
Luxury +	☺		
Kindness +	☺		
Poverty -	☹		
Unhappy -	☹		
Warmth+	☺		
Habit N	😐		
Glory +a	☺		
Disaster –a	☹		
Curtains N	😐		
Stagnant	😐		
Fearful –a	☹		
Ankle N	😐		
Profit +a	☺		
Deformed -	☹		
Paradise +	☺		
Infection -	☹		
Errand N	😐		
Hawk Na	😐		
Beast Na	😐		
Headache -	☹		
Tool Na	😐		
Delight +	☺		

Positive ☺ ______

Negative ☹ ______

Neutral 😐 ______

Appendix C

(ISE Test)

ISE

Instructions:
I am going to read some words out to you.
For each word you have to think of a scene in which you are involved.
You do not have to tell me this scene but I am going to ask you some questions about it. Ready?

Questions:
1. Is it an actual scene from the past or an imagined scene?
2. Where you the main character in the scene?
3. How vivid was the scene? 1 Not vivid at all 2 3 4 5 Extremely vivid
4. How pleasant or unpleasant was the scene? 1 Very unpleasant 234567 Very Pleasant

List A: Target words **(Read out only the first word in pair)**

Gun (shooting)
Baby (nappy)
Bus (driver)
Bench (park)
Holidays (summer)
Song (music)
Hell (devil)
Happy (glad)
Foot (toe)
Guilty (crime)
Alone (lonely)
Angry (shouting)
Pretty (girl)
News (broadcast)
Garden (flower)

List B: Un-studied

Afraid (scared)
Glass (water)
Metal (Copper)
Trouble (problem)
Bed (sleep)
Honest (truth)

Doctor (prescription)
Depression (suicide)
Stress (tests)
Birthday (gift)
Friend (trust)
Plane (fly)
Funeral (death)
Freedom (escape)
Arm (sleeve)

Now we are going to do something else.
I am going to read out some words to you. I just want you to give me the first 3 words that come to mind for each word that I say. Try to be spontaneous and answer as fast as possible. Do not take too much time thinking of each word. Simply say the first thing that comes to mind.

Retrieval cue list: **(Read out only the word in brackets)**

1. Garden (flower), __________, ______________, _____________
2. Plane (fly), ______________, _______________, _____________
3. Guilty (crime), ___________, ______________, ____________
4. Alone (lonely), _____________, _____________, ______________
5. Angry (shouting), ____________, _____________, _____________
6. Pretty (girl), _____________, _______________, ______________
7. Funeral (death), _____________, ______________, ______________
8. Bed (Sleep), _____________, _______________, _______________
9. Stress (tests), _____________, _______________, _______________
10. Holidays (summer), _____________, _____________, ___________
11. Bus (driver), _______________, _______________, ______________
12. Metal (copper), _____________, _______________, _____________
13. Hell (devil), ______________, ________________, ______________
14. Happy (glad), ______________, _______________, _____________

15. Foot (toe), ________________, ________________, ______________

16. Gun (shooting), ______________, ______________, ______________

17. Glass (water), ______________, ________________, _____________

18. Bench (park), ______________, ________________, _____________

19. Trouble (problem), _____________, _____________, ____________

20. Afraid (scared), ______________, ______________, _____________

21. Honest (truth), ______________, ______________, ______________

22. Arm (sleeve), _______________, ______________, _____________

23. Baby (nappy), ______________, ________________, _____________

24. Friend (trust), ______________, ________________, _____________

25. Doctor (prescription), ___________, _____________, ____________

26. Depression (suicide), ____________, ____________, ____________

27. Song (music), ______________, ________________, _____________

28. Birthday (gift), _____________, ________________, _____________

29. News (broadcast), __________, ________________, _____________

30. Freedom (escape), __________, ________________, _____________

Appendix D

(ISR Test)

Implicit Self-Retrieval Test (ISR)

For each question ask the subject for an example, remembered or imagined. Ask whether it is vivid and whether it is pleasant or unpleasant?

List A: (Target words) **(Read out only the first word in pair)**

1. Broken (leg)
2. Food (eat)
3. Fire (flames)
4. Health (exercise)
5. Dog (pet)
6. Fight (bloody)
7. Lawn (garden)
8. Knife (cut)
9. Chair (sit)
10. Pain (suffer)
11. Circle (drawing)
12. Stomach (digestion)
13. Journal [newspaper] (article)
14. Art (painting)
15. Game (play)

List B: (Unstudied words)

1. Afraid (scared)
2. Glass (water)
3. Metal (Copper)
4. Trouble (problem)
5. Bed (sleep)
6. Honest (truth)
7. Doctor (prescription)
8. Depression (suicide)
9. Stress (tests)
10. Birthday (gift)
11. Friend (trust)
12. News (broadcast)
13. Funeral (death)
14. Freedom (escape)
15. Arm (sleeve)

Retrieval cue list:

1. Name's leg is (A),__________, ___________, ____________
2. Name is in the garden(A),_________, ___________, __________
3. Name is playing (A), __________, ____________, ___________
4. Name is thinking about a death(A),_______,________,________
5. Name is eating (A), _________, ___________, ___________
6. Name is sitting (A), _________, ___________, ___________
7. Name is reading an article (A), ________, _________, ________
8. Name is sleeping (A), ________, ___________, __________
9. Name is taking tests(A), _________, __________, __________
10. Name sees the flames (A), _________, __________, ________
11. Name has a pet (A), _________, __________, __________
12. Name believes it's copper (A), _________, _________, ________
13. Name is exercising (A), _________, _________, _________
14. Name is suffering (A), __________, __________, _________
15. Name is working on his painting (A), _____, ________, ______
16. Name is digesting (A), _________, _________, __________
17. Name drinks water (A), _________, __________, _________
18. Name has cut himself (A), _________, __________, ________
19. Name has problems (A), _________, ___________, _______
20. Name is scared(A), ___________, ___________, __________
21. Name tells the truth(A), __________, __________, ________
22. Name is looking at his sleeves(A), ________, _________, ______
23. Name saw the bloody (A), _________, __________, ________

24. Name likes trust(A), ___________, ___________, ___________

25. Name has a prescription(A), _________, __________, _________

26. Name thinks about suicide(A), _________, __________, _______

27. Name is drawing a (A), _________, __________, ___________

28. Name got a gift (A), ___________, ___________, ___________

29. Name is listening to a broadcast(A), _______. ________, _______

30. Name has escaped (A), __________, ___________, ___________

Appendix E

(AST)

Affective Sentences Test

Instructions:

Try to imagine that the following things are happening to you. Is the situation pleasant or unpleasant?

Examples:

Your child is ill and you feel…
They gave you a gift and you feel…
You have a new girlfriend…

Tests items:

1. You lost your money and you feel…

2. You broke a promise and you feel…

3. You did the job and you feel…

4. You crashed the car and you feel…

5. You bought a house and you feel…

6. You helped your son and you feel…

7. You failed the test and you feel…

8. You lost your keys and you feel…

9. You won the game and you feel…

10. You arrived late and you feel…

11. You ate well and you feel…

12. You took ill and you feel…

13. You won the prize and you feel…

14. You were promoted and you feel…

15. You lied to your friend and you feel…

16. You had a holiday and you feel…

Scoring Sheet (AST):

1. ◙
2. ◙
3. ☺
4. ◙
5. ☺
6. ☺
7. ◙
8. ◙
9. ☺
10. ◙
11. ☺
12. ◙
13. ☺
14. ☺
15. ◙
16. ☺

Appendix F

(Epairs Test)

Implicit Emotional Pairs
(E-pairs)
Scoring Sheet

Instructions: For every pair of words please tell me whether the two words are same, or different, with respect to their pleasantness or unpleasantness.

Examples: *The Same or Different?*

Happy	**Beautiful**
Smile	**Cry**
Murder	**Hell**

Test items:

	1	
Afraid		**Brother**
	2	
Lost		**Bomb**
	3	
Learn		**Guilty**
	4	
Pride		**Alone**
	5	
Happy		**Truth**

	6	
Victory		**Snow**
	7	
Destroy		**Respect**
	8	
Sin		**Dollar**
	9	
Justice		**Heaven**
	10	
Opinion		**Evil**
	11	
Loved		**Honest**
	12	
Fear		**Alive**
	13	
Tragedy		**Angry**
	14	
Prison		**Lie**
	15	
Money		**Spring**

Dirt	16	**Hell**
Waste	17	**Sick**
Friend	18	**Pain**
Wish	19	**Capable**
Failure	20	**Trouble**
Pretty	21	**Mistake**
Blind	22	**Stress**
Idea	23	**Fun**
Joy	24	**Freedom**
Health	25	**Bright**

	26	
Slave		**Danger**
	27	
Dead		**Kind**
	28	
Garden		**Win**
	29	
Dirty		**Hate**
	30	
Crime		**Damage**

Scoring Sheet (Epairs):

1. Different
2. Same
3. Different
4. Different
5. Same
6. Same
7. Different
8. Different
9. Same
10. Different
11. Same
12. Different
13. Same
14. Same
15. Same
16. Same
17. Same
18. Different
19. Same
20. Same
21. Different
22. Same
23. Same
24. Same
25. Same
26. Same
27. Different
28. Same
29. Same
30. Same

Neuropsychologia

print page | close wind

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