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Confabulation: Developing the 'emotion dysregulation' hypothesis

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Abstract

Confabulations offer unique opportunities for establishing the neurobiological basis of delusional thinking. As regards causal factors, a review of the confabulation literature suggests that neither amnesia nor executive impairment can be the sole (or perhaps even the primary) cause of all delusional beliefs – though they may act in concert with other factors. A key perspective in the modern literature is that many delusions have an emotionally positive or 'wishful' element, that may serve to modulate or manage emotional experience. Some authors have referred to this perspective as the 'emotion dysregulation' hypothesis. In this article we review the theoretical underpinnings of this approach, and develop the idea by suggesting that the positive aspects of confabulatory states may have a role in *perpetuating* the imbalance between cognitive control and emotion. We draw on existing evidence from fields outside neuropsychology, to argue for three main causal factors: that positive emotions are related to more global or schematic forms of cognitive processing; that positive emotions influence the accuracy of memory recollection; and that positive emotions make people more susceptible to false memories. These findings suggest that the emotions that we *want* to feel (or do not want to feel) can influence the way we reconstruct past experiences and generate a sense of self – a proposition that bears on a unified theory of delusional belief states.

Keywords: memory; motivation; emotion; emotion regulation; executive function

> 'The patient suffers from defect of memory, and is incapable of sustained intellectual exertion. He is 'more emotional' (really there is here a loss or defect of the highest ["finest"] with increased manifestation of the lower ["coarser"] emotions)'
>
> H. Jackson, 1888, *Remarks on the diagnosis and treatment of diseases of the brain*

1. Confabulation: a unique opportunity?

Confabulation offers some unique opportunities for establishing the neurobiological basis of false or irrational beliefs. Unlike other classes of delusional belief, confabulations present a huge advantage in identifying a focal lesion site, in a patient who was pre-morbidly normal – an advantage not available to those studying false beliefs in either the neurologically normal, or the psychiatric population.

A key element in some confabulations of neurological patients has been their relatively stable yet extreme nature. The patients hold opinions about the world that are manifestly incorrect, and yet are held by the patient to be true in spite of clearly presented evidence to the contrary, and have long been recognised as being scientifically important. The phenomenon was comprehensively described for the first time by Korsakoff (1889/1996), in the context of a dense amnesic syndrome (though they need not be related, as discussed below). The disorder is also seen in a variety of other pathologies, such as cerebrovascular accidents (most prominently those involving the anterior cerebral artery), traumatic brain injury, and dementia (Dalla Barba, 1993; DeLuca, 2000a; DeLuca & Diamond, 1995; Downes & Mayes, 1995; Kaplan-Solms & Solms, 2000; Luria, 1976; Moscovitch & Melo, 1997; Nahum et al, 2012; Schnider et al, 1996); Solms, 1998; Talland, 1961). This review will focus on confabulation following focal brain lesion, where it appears to be more frequently observed, and is more severe, particularly after lesions that involve the medial and ventral surfaces of the frontal lobe.

2. Confabulation as secondary to amnesia

Confabulation has been defined in various ways over the years. The classic explanation of the disorder, following ideas from Bonhoffer (1901), suggests that

confabulation is secondary to amnesia, and it somehow represents 'gap-filling' motivated by embarrassment. De Luca (2000, pp.125-126) for example, claims that *all* cases of confabulation after ventromesial frontal lesions appear to show a degree of recent memory impairment. Related to this is the claim by Schnider and colleagues (Schnider, 2003; Schnider & Ptak, 1999; Schnider et al, 2002) that "the stories [of confabulating patients] can virtually always be traced back to elements of real events", so that the disorder perhaps relates to some sort of suppression mechanism, whose failure is associated with confabulation, where the patient may be unable to tag the difference between a memory of a true event and the memory of a thought or imagined experience (Schnider et al, 2002, p. 59). This gap-filling argument may well apply to some classes of confabulation (especially of the 'momentary confabulation' type, see Nahum et al, 2012).

However, there have been problems with the 'amnesia' account (see Fotopoulou, Solms & Turnbull, 2004 for review), and the gap-filling model remains problematic in several ways. Dalla Barba (2002), for example, has noted that amnesic patients that confabulate often present a preserved capacity to move forward and backward in time, and that confabulation can be better conceptualized as a positive symptom, where temporal consciousness interacts with inappropriate information. Another argument against the amnesic account is that there are many patients with amnesia (even after ventromesial frontal lesion) who are not confabulatory. For example, it has long been noted that, while confabulation is common in the acute stages of a Korsakoff psychosis, it recovers in the chronic period, leaving a *non*-confabulatory amnesia (see DeLuca, 2000 for review). The opposite dissociation is also true: there are reports of confabulation without serious memory impairment. The Burgess & McNeil (1999) patient [BE], for example, had relatively minor memory impairment. BE's anterograde memory test performance was at the lower end of the *normal* range, and he was described as "not clinically amnesic" (Burgess & McNeil, 1999, p.173).

One might be best conclude that memory impairment is a common presenting feature of many or most patients with confabulation, and that amnesia often plays a central role. However, the instances of double dissociation between confabulation and amnesia suggest that it cannot always be the sole (or at times even the primary) cause

of the delusional belief. Indeed, memory impairment will be the first of several psychological processes in this review which we suggest represents a multi-factorial pattern of causes.

3. Confabulation as secondary to executive impairment

A second class of explanatory account for confabulation relates to one or other aspect of impairment in executive ability (Baddeley & Wilson, 1986; Benson, Djenderedjian, Miller, Pachana, Chang, Itti, & Mena, 1996; Kapur & Couchlan, 1980; Papagno & Baddeley, 1997; Stuss, Alexander, Lieberman, & Levine, 1978). This includes abilities such as source monitoring (Johnson, 1991; Johnson, 1997) or the control of memory systems (Burgess & Shallice, 1996; Moscovitch, 1989; Schacter, Norman & Koutstaal, 1998).

The dysexecutive class of argument again appears plausible, especially because a frontal lesion site is common in confabulation. In addition, a few investigations have revealed that the severity of confabulation appears to improve as measures of executive function recover, even though the severity of amnesia remains constant (Cunningham et al, 1997; Kapur & Coughlan, 1980; Papagno & Baddeley, 1997). For these reasons, the literature has long regarded impairments of executive function as being at the core of confabulations (Baddeley & Wilson, 1986; Benson, Djenderedjian, Miller, et al., 1996; Kapur & Couchlan, 1980; Papagno & Baddeley, 1997; Stuss, Alexander, Lieberman, & Levine, 1978).

However, the dysexecutive account is open to the same classes of criticism that might be applied to amnesia. At least a single dissociation between confabulation and executive impairment has been reported, noting that patients can have substantial impairments of executive function *without* becoming confabulatory (see Solms & Turnbull, 2007, p1085 for review). Indeed, neurological and neurosurgical wards contain thousands of patients with substantial impairments of executive functions, of various types, but almost none of them are confabulatory – indeed, while disorganised thinking is common in dysexecutive patients, confabulation is actually rather rare.

A related criticism of the dysexecutive account is that the narrowness of content of confabulation, which is often rather selective in its nature (see below). Thus, when one speaks to a patient who confabulates, they are typically sensible on most topics, but have small corners of their mental life, often associated with family or work issues, in which they suddenly become rather delusional, (notable examples are Burgess & McNeil, 1999; Conway & Tacchi, 1996; Villiers, Zent, Eastman, & Swingler, 1996). One interesting case is Burgess and McNeil's (1999) report of a patient who confabulated in a single domain. His sole confabulation was that he would dress in formal clothes, several times a day, in the face of his wife's protests (though he never actually left the house because he was inevitably faced with knowing where he was to go, which in his amnesia he could never recall, p.166). In contrast to this highly specific false belief, he remained lucid and sensible on a wide range of other topics, and showed no other instances of false belief. According to a dysexecutive account, such a patient might well produce false beliefs across *all* (or at least a very wide range) of domains. For these reasons the dysexecutive account has been argued to represent "too *much* of an explanation for the syndrome" (Kinsbourne, 2000, p.158, emphasis added), in that it predicts a more diverse set of deficits than the patients actually produce.

In response to these difficulties, some authors have suggested that *both* an amnesic and a dysexecutive disorder are necessary to invoke a confabulatory state (De Luca, 2000) – a plausible argument, but one that opens the door for other explanatory variables beyond the realm of cognitive impairment.

4. From motivational influences to the emotion dysregulation hypothesis

One challenge facing both accounts of confabulation reviewed above is the *content* of confabulations. One way of addressing this is to ask *why* these patients confabulate on the specific occasions that they do - i.e. the issue of the specificity, or the *selectivity*, of confabulations. For many years, this important question was not a substantive issue in the literature. Remarkably, less than 20 years ago, Burgess and Mc Neil (1999) knew of "no formal empirical investigation of this dimension" (p.164), though their

clinical experience, and their knowledge of the literature, suggested that the content often reflected "the personal concerns, experiences and predilections" of the patient (p.164), a theme which we will explore in more detail below. This is now a much more closely investigated topic.

What then of the "personal concerns, experiences and predilections" of the Burgess and Mc Neil (1999) patient described above? His pre-morbid occupation was as a shopkeeper, punctuated by occasional activities in a more formal role as an Inspector, where he had a supervisory role (and hierarchically dominant) position judging the performance of other shopkeepers – a position he enjoyed. Thus, his confabulation of dressing in formal clothes is represents a potential return to a position of some influence and authority, which he had now lost as a result of his brain injury. In other, less emotionally important, domains of his life, he showed no features of delusional belief. Thus, his confabulation appears to represents an attempt to sustain an emotionally important aspect of his self-identity.

Thus, the delusional beliefs of the case placed the patient in a more positive life-setting than his circumstances would otherwise have located him. This motivational aspect of confabulation has long been reported at an anecdotal level. That is, confabulations might involve 'some kernels of truth of genuine experience' (Talland, 1961) re-cast to place the patient in a more positive light (Mercer, Wapner, Gardner & Benson, 1977). This includes the suggestion that there is a fantasy, or a 'wish-fulfilment' element to the delusional belief (Betlheim & Hartmann, 1951; Kaplan-Solms & Solms, 2000; Turnbull, Berry, & Evans, 2003; Villiers, Zent, Eastman, Swingler, 1996). In many cases, this modification allows the patient to avoid negative emotions, such as anxiety or a sense of loss (Conway & Tacchi, 1996; Lidz, 1942; Weinstein, Kahn & Malitz, 1956). At other times, the delusions are frankly grandiose (Berlyne, 1972; Moscovitch, 1989; Sabhesan & Natarajan, 1988; Weistein & Kahn, 1955). This earlier literature also suggested that the content might be influenced by pre-morbid personality traits (Gainotti, 1981; Moll, 1915; Moscovitch, 1989; Talland, 1961, Weinstein, 1996; Whitlock, 1981; Williams & Rupp, 1938).

One perspective on these 'wishful' delusions is that they serve to modulate emotional experience, or perhaps to shape the emotional consequences of ideas. In an extension of the argument suggested by Burgess and McNeil (1999, p.164), Kinsbourne (2000) pointed out that a clear contributory factor to confabulation is "the affective significance of the topic about which the patient confabulates. Patients mostly confabulate about personal matters that are emotionally significant to them, such as the integrity of their body... their prospects of recovering, and for reassuming their prior lifestyle and employment" (Kinsbourne, 2000, p.158). Similarly, Paterson & [1]Zangwill (1944) had described patients who held false beliefs about place as showing that "a strong desire was *actively inhibiting* the cognitive mechanisms which normally subserve orientation" (p.67, emphasis added) – suggesting the very interesting idea that emotion or motivational factors might distort the execution of otherwise normal cognitive operations. However, while these ideas had often been raised, the issue was not systematically investigated until the last decade.

In a series of papers, several researchers have attempted to investigate this issue empirically, demonstrating a number of key findings. Firstly, the false belief scenarios of confabulatory patients have a clear *positive* emotional bias, tending to be more pleasant than their actual circumstances [2]. The initial investigations addressed an unselected sample of confabulations, and found positive transformations in roughly 80% of instances (Fotopoulou et al, 2004), and far greater than the rate of (pseudo-confabulation) control conditions (c.f. Bajo, Fleminger & Kopelman, 2010). Notably, when the variance was narrowed to consider confabulations about *place*, rather than person, this positive bias was again replicated (Turnbull, Berry & Evans, 2004). One substantial fraction of this group go to very 'exotic' locations, such as a bistro in the South of France, or a ferry in the Caribbean. The other class of confabulators go to

[2] In making this claim of positive bias, we are aware that not all confabulations are positive (e.g. Nahum et al., 2010, 2012; Schnider et al, 1996). We have wondered about why our studies did not always conform with other reports on the question of emotional valence. One factor may be that many of the cases of negative confabulations appear to come from patients with temporal lobe lesions (including amygdala involvement), whereas our patients have tended to have medial frontal lesion sites.

'safe' locations, such as their home, their parent's home, or their old university[3]. The sorts of predisposition that might predict this choice is incompletely understood (for a review see Fotopolou, 2009) but is clearly an interesting issue for future research. A further key finding was that the confabulating patients tend to show a clear selective bias in the specific circumstances of their delusional misrememberings (Fotopoulou et al, 2008, Turnbull, Berry & Evans, 2004) – in that they are directed towards self (rather than towards others), and occur when only for negative (rather than positive) false beliefs. In other words, they show a self-protective (or defensive) function.

There is a newer experimental literature that has challenged the positive bias hypothesis. Using EEG, Liverani and colleagues (2016) explored the effects of emotional manipulation (positive versus neutral IAPS images) on a task designed to investigate "reality filtering" as a putative mechanism of confabulation, on a group of neurologically normal individuals. Their main finding was that "orbitofrontal reality filtering" (the ability to place oneself correctly in time and space) is not influenced by the emotional valence of the processed material, thus contesting the positive bias hypothesis. Clearly, these emerging results contribute to the ongoing debate of the role that emotion may have on the generation of confabulation. They need to be considered, however, with caution since the performance of normotypical individuals cannot be directly extrapolated to brain injured populations. Some form of replication and extension seems appropriate, using confabulating patients (of the sort that our paper reviews) as experimental subjects. In addition, the material used to elicit emotional states in this study were IAPS pictures, a type of emotional stimulus which has been contested in terms of ecological validity compared to other methods (film clips, autobiographical recall etc, Coan & Allen, 2007). This may be an important issue, particularly when considering that several authors have stressed the fact that confabulations are strongly linked to *personally* relevant emotional events (see Salas et al 2011, 2015).

[3] Using the taxonomy proposed by Nahum et al., (2012) these types of confabulation are perhaps best categorized as 'fantastic', since they refer to implausible experiences that are incompatible with common notions of reality. The 'fantastic' nature of these confabulations, or their incompatibility with reality, has been described by Solms (2000) as characterized by features such as exemption from mutual contradiction and the replacement of external reality by psychical reality.

In sum, recent theoretical accounts, which emphasize the relevance of motivational influences in confabulation, have stressed the need to generate 'combined' models where multiple contributing factors (cognitive impairment, emotion, premorbid personality, etc.) are considered (for a review see Fotopolou, 2009). These accounts are interesting, since they explain confabulation as the product of a *dysregulation* between top-down cognitive control processes (memory retrieval, inhibition) and bottom up emotive influences (Conway, 2005, Fotopolou 2009, 2010; Turnbull, Evans & Owen, 2005). Betlheim and Hartman (1924), for example, while describing Korsakoff patients, speak of a lack of *cognitive restraint*, which allows the normally implicit effect of primitive, emotion-based forms of cognition to become more explicit and colour recollection. More recently, Solms (2000) proposed that confabulations result from the combined effect of executive impairment, altered memory recollection and the *release* of deeper, and normally inhibited, cognitive modes. On a similar theme, Fotopolou and colleagues (2008) have viewed confabulation as a deficit in the *control* and *regulation* of memory retrieval, which allows motivational factors to acquire a greater role than usual in determining which memories are selected for retrieval and accepted as true (p. 1438). The key point here, for authors adhering to the emotion dysregulation hypothesis, is that the lack of cognitive regulation allows a disproportionately positive image of the self (rather than the 'actual' self) influences the memory reconstruction process more heavily (Conway and Pleydell-Pearce, 2000; Fotopolou, 2009, 2010)

5. Exploring the cognitive control-emotion interaction

Compared to the 'cognitive' and 'motivational' accounts, an emotion regulation model is perhaps better suited to explain the complex interplay between negative (cognitive impairment) and positive (emotion enhancement) symptoms, as well as secondary reactions to the illness, such as denial and compensatory efforts to sustain a positive image of the self. Nevertheless, beyond the point of *suggesting* an emotion regulation hypothesis, there has been little elaboration from authors regarding the nature of this process. This is surprising, considering that emotion dysregulation has been historically described as a core feature of brain injury (Ben-Yishai & Diller, 2011; Goldstein, 1965 [1995]; Klonoff, Lage & Chiapello, 1993; Salas, 2012) and that

outside the field of neuropsychology there is a vast experimental literature looking at the neural basis and neuropsychological correlates of emotion regulation (for reviews see Gross, 2014, 2015). As a consequence, it seems timely to bring together these separate fields, to theoretically justify this hypothesis and begin to delineate potential ways in which it can be experimentally tested.

What, then, is the place of emotion regulation in neuropsychology? While it has not always been labelled in this way, there are many historic descriptions of emotion dysregulation after brain damage, all of them emphasizing a (hierarchical) disruption in the balance between cognitive control and emotion. Amongst the more commonly cited is the 1868 observation by Harlow of Phineas Gage: 'that the *equilibrium* or *balance* (so to speak) between his intellectual abilities and his animal propensities, seems to have been destroyed (p. 277). A few decades later, Hughlings Jackson (quoted at the start of the paper) referred to the same phenomenon, and similar arguments were presented by Kurt Goldstein in his famous case, Lanutti (Hanfmann, Rickers-Ovsiankina & Goldstein, 1944). We do not suggest, of course, that these failures of emotion regulation *lead* to confabulation. Phineas Gage was not (to the best of our knowledge) confabulatory. However, this literature does remind us that emotion has long been understood, at least anecdotally at first, as playing an important role in several aspects of mental life, including in several previously regarded as strictly cognitive.

Evidence from contemporary neuropsychology has supported these early descriptions, suggesting that damage to the frontal lobes, and its cognitive control functions, can alter the ability to shape the influence that emotion has on behaviour and cognition. Most of the existing studies on this topic have explored how damage to ventromedial areas of the PFC can trigger an 'imbalanced activity within the impulsive and reflective neural systems' (Bechara, 2004, p. 176), where emotional decision making (Bechara, Tranel & Damasio, 2000; Damasio, 1994) and emotional and social behaviour become markedly compromised (Beer et al., 2003, 2006). More recently, a handful of articles have explored how damage to more *lateral* areas of the PFC can also modify the balance between cognition and emotion (Salas et al., 2013, 2014), consistent with group studies reporting 'exaggerated' emotional reactivity to negative (sad) stimuli after damage to the left PFC (Gillihan et al., 2010). Damage to the right

PFC also appears to compromise the regulation of emotions. Salas et al (2016) demonstrate this in individuals with unilateral focal lesions to the right PFC, confirmed by functional imaging work (Falquez et al, 2014).

Taken together, the emergent neuroanatomical evidence from studies with brain injured patients offers promising support for the emotion dysregulation hypothesis: when ventral or lateral portions of the frontal lobes are damaged, impairment in the cognitive control of emotion is observed, as well as an increase in emotional reactivity - two sides of the same coin. A question that is pertinent here is: which are the *specific* cognitive control processes that, when impaired, compromise emotion regulation? In this regard, evidence from lesion studies suggests that deficits in *inhibition* are the most common neuropsychological impairment associated to the disruption of emotion regulation. Falquez and colleagues (2015), for example, reported that deficits in go/no-go tasks are associated to a higher frequency of use of maladaptative emotion regulation strategies (e.g. rumination, catastrophizing). Furthermore, inhibition impairments have also been related to difficulties in implementing two specific types of emotion regulation strategy: suppression (the voluntary inhibition of prepotent emotional reactions, Salas et al., 2016) and reappraisal (the positive re-interpretation of negative events, Salas, Gross & Turnbull, 2014; Falquez et al., 2014). Another neuropsychological process that has been proposed as having a role in the regulation of emotional responses is verbal fluency. In-depth case studies, and lesion studies, have reported that verbal fluency impairment, often observed after left PFC damage, is associated to an increased difficulty in generating positive re-interpretations of negative events (Salas, Gross & Turnbull, 2014; Salas et al., 2013, 2014). Overall, it appears that there is some evidence to support inhibition and verbal fluency as key neuropsychological processes in the voluntary regulation of emotion. Such findings are consistent with behavioural and neuroimaging studies exploring the relationship between executive function and emotion regulation in normotypical individuals (for reviews see Schmeichel & Tang, 2015; Gross, 20014).

6. Confabulation, positive emotions and emotion dysregulation.

So far, evidence from studies of brain-injured individuals appears to support the idea that, when cognitive control (inhibition or verbal fluency) is compromised after

prefrontal damage, the influence of emotions on cognition and behaviour is enhanced. In this section we will address another aspect of this problem, which is the potential role that confabulations' positive emotional state may have in *perpetuating* the imbalance between cognitive control and emotion.

For those supporting the emotion dysregulation hypothesis, the core deficit is a deterioration of executive processes, especially as regards emotionally charged memories. Without this regulatory control, a normally present self-serving positive bias is exaggerated during retrieval, thus generating a disproportionately positive image of the self and its surrounding context (Conway and Pleydell-Pearce, 2000; Fotopoulou, 2009, 2010; Fotopoulou, Conway, Solms et al., 2008, Turnbull et al, 2004). The impact of the emotional subjective experience generated by a confabulation (the 'disproportionately positive image') is here interesting to consider in the light of a vast literature that has explored how positive and negative emotions shape cognition in general, and memory in particular. In this section we briefly mention three key findings, which are relevant to understand how the positive emotional state triggered by confabulation can perpetuate a pathological memory reconstructive loop.

1. *Positive emotions are related to more global or schematic forms of cognitive processing*.

It has been widely reported that the subjective emotional state of an individual can alter the way in which he/she processes information about the world or him/herself (Gasper & Clore, 2002; Solms & Turnbull, 2002; Panksepp, 1998). Evidence suggests that when individuals are in positive moods, they tend to rely more on general knowledge (or schemas). In contrast, negative moods lead to a conservative judgement that adheres more closely to the details of the information that is presented (for reviews see Bless & Schwartz, 1999; Forgas, 2002). In other words, positive emotion promotes a form of interpretative relational processing, where individuals tend to notice the more global characteristics, or the gist of an event, rather than the details (Clore et al., 2001; Fiedler, 2001; Kensinger, 2009). In contrast, negative emotion produces narrowed attention, and information processing becomes more detailed and stimulus bound (Clore & Storbeck, 2006; Schwarz, 1990, 2011; 351; 425).

2. *Positive emotions influence accuracy of memory recollection.*

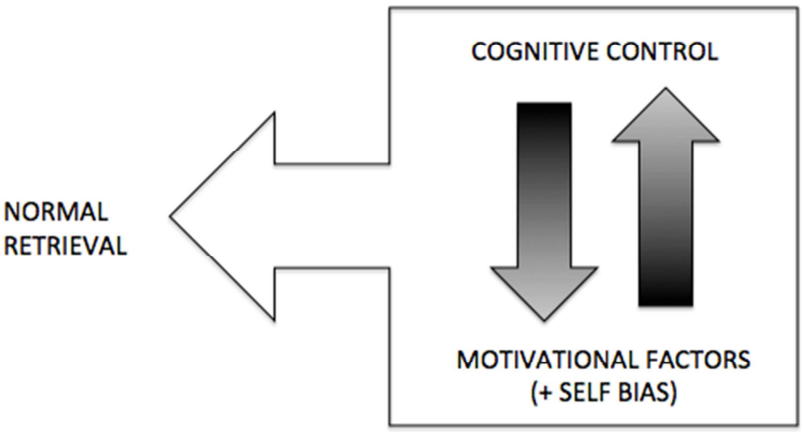
In a similar fashion, it has also been reported that emotional valence has a differential impact in autobiographical memory (for a review see Holland & Kensinger, 2010). For example, positive events seem to come to mind more easily than negative ones (Levine & Bluck, 2004) - and when positive emotion is induced, individuals exhibit more intrusion errors, becoming less accurate in the reconstruction of memories, (Bless et al., 1996; Levine & Bluck, 2004; Park & Banaji, 2002). It appears that, when remembering positive events, people tend to 'paint with broad strokes', probably because positive memories are consistent with their goals, and do not require a critical evaluation – as is the case with memories of negative events (Levine & Bluck, 2004). This idea is consistent with the mood congruency framework of memory, which suggests that information which is congruent with people's moods is more likely to be perceived, attended, stored, retrieved and considered when making judgements and decisions (for a review see Rusting, 1998; Bower & Cohen, 2014). Of particular interest for the problem of confabulation, some studies have reported that positive moods may lead to more reliable mood congruency memory than negative moods (Matt, Vasquez & Campbell, 1992; Rusting, 1998; Singer & Salovey, 1988).

3. *Positive emotions make people more susceptible to false memories.*

An important corollary of this valence effect to the problem of confabulation is that positive and negative emotions are differentially related to memory 'malleability', or the generation of false memories. Here, there is evidence suggesting that positive emotion is associated to a greater propensity for memory distortion than negative emotion (Baker-Ward, Eaton, Banks & 2005; Bohn & Berntsen, 2007; Levine & Bluck, 2004). People are more susceptible to false memories when in a pleasant state (Bless et al., 1996; Park & Banaji, 2000; Storbeck & Clore; 2005) while negative mood makes people more conservative in endorsing items that are related –but not identical- to studied items (Storbeck & Clore; 2005). Similarly, Kensinger and Schacter (2006) have noted that when an event is perceived as positive, there is a decrease in memory consistency and an increase in memory overconfidence.

There is still debate regarding the relationship between emotional valence and susceptibility to false memories, with some studies claiming a similar effect for

negative emotions (Brainerd et al., 2008; Porter, Spencer & Birt, 2003). However, the relevance of this data to multifactorial models of confabulation appears undeniable. If confabulations place individuals in positive emotional scenarios, it is possible that the resulting subjective emotional state triggered by confabulations enhances even further the exaggeration of a positive self-serving bias. In other words, the positive emotional quality of confabulations can lead individuals to pay less attention to information that is incongruent with the activated positive self-schemas, or to accept more promptly information that is erroneous, but is consistent with the activated positive self-schema. In sum, the impact of positive emotions on cognition can compromise even *further* the inhibition and monitoring of false memories during retrieval (see Fig 1).



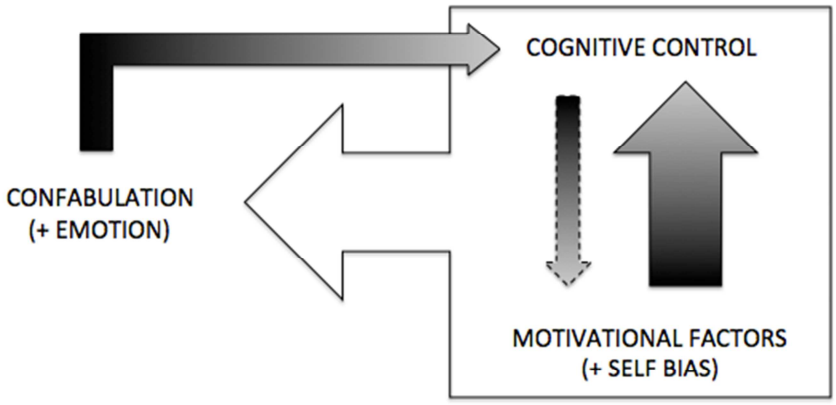


FIG 1. The Emotion Dysregulation Hypothesis and Confabulation. The figure 1a (top) describes the normal reconstructive process by which memories are retrieved. Here, there is balance between cognitive control and motivational influences in the reconstruction process, so the retrieved memories are influenced by normal positive self-bias and cognitive control mechanisms guarantee that there is correspondence with previous experience. Fig 1b (bottom) depicts a pathological retrieval where, due to impairment in cognitive control, a dysregulation of emotion influences in the reconstruction process takes place. As a consequence, memories that are coherent with a disproportionately positive image of the self, but do not correspond with previous experience, are retrieved and accepted as true [confabulation]. The positive subjective experience associated to confabulations influences information processing, and autobiographical memory retrieval, thus generating a pathological loop.

7. The self-regulatory nature of memory reconstruction

A core tenet of the emotion dysregulation hypothesis is that the process of autobiographical memory recollection has a *reconstructive* nature (Conway & Pleydell-Pearce, 2000; Fotopolou, 2009; 2010) and that the self is constantly re-created as a consequence of such process. As noted by McAdams (2001), individuals actively remember and imagine autobiographical information in order to bring coherence and continuity to their selves. This idea has led some authors to propose that memory cannot be considered merely as a cognitive process, but as one that is central in the constitution and maintenance of the self: a Self-Memory System (Conway & Pleydell-Pearce, 2000). From this point of view, the preservation of *coherence*, the agreement between a memory representation and the conceptual self (self-images, life story and beliefs), is a powerful influence in the memory reconstruction process (Conway & Loveday, 2015), one that is pathologically exacerbated in cases of confabulation.

Conway and colleagues' ideas appear consistent with a view of memory as a self-regulatory tool. In fact, the Self-Memory System does consider goals as influencing what memories are encoded or retrieved, but no direct reference is made to emotion regulation as a main goal. This contrasts, however, with evidence from studies exploring the influence that emotion has on memory processes. Here, it has been noted that memory reconstruction has a key role regulating emotions, since people can, more or less voluntarily, choose memories to modulate how they feel (Koole, 2009; Holland & Kensinger, 2010; Pasupathi, 2003). In other words, the emotions that we *want* to feel (or do not want to feel) can influence the way we reconstruct past experiences (Holland & Kensinger, 2010). For example, individuals can recall positive memories in order to maintain positive moods (e.g. Joorman et al., 2004), or recall positive emotions in order to repair negative emotional states (e.g. Josephson, Singer & Salovey, 1996).

8. Closing comments

In this article we have attempted to conceptually develop a model of confabulation based on the so-called emotion (or affect) dysregulation hypothesis (Turnbull et al, 2004; Fotopoulou, 2009; 2010). We have reviewed the traditional 'cognitive' and 'emotional' accounts of confabulation, suggesting that a better understanding of the processes underlying confabulation can be reached by considering the interaction between cognitive and emotional factors. In fact, the central tenant of the emotional dysregulation hypothesis is that damage to memory retrieval inhibitory mechanisms interacts with abnormally enhanced motivational factors, resulting in the abnormal influence of these elements in the memory reconstructive process. We have contributed to this hypothesis by including another potentially relevant aspect to this model: the role that the emotionally positive experience of the confabulation may have in perpetuating a pathological cognitive-emotional loop. Here, evidence from studies exploring the influence that positive emotion has in cognition in general, and memory in particular, enriches the model.

We have been able to sketch the issues that seem most central in understanding the potential emotion-related causes of confabulation. These are, firstly, that emotion

seems to play an important causative role in confabulation, though perhaps not an invariable one, as it may well act in concert with our factors, such as impaired executive function. Secondly, as regards mechanism, both the lesion site data, and the 'defensive' content of many confabulations, suggest that the impaired psychological process is not that of basic emotions, but of emotion *regulation*. Thirdly, we have the prospect of identifying more specific psychological skills that are core to this process, such as impaired inhibition. Finally, we can frame the positive emotional bias seen in confabulation in the context of a more general (but more modest) bias seen in the neurologically normal. This perspective allows us to better understand confabulation as an exaggerated instance of a class of biased belief which is widely present – thus locating confabulation in the greater family of false belief disorders. It seems clear to us that a unified theory of such belief states is a necessary and worthy aspiration for the field, and we look forward to the role which confabulation might play in better understanding this important psychological phenomenon.

8. References

Baddeley, A. D., & Wilson, B. (1986). Amnesia, autobiographical memory and confabulation. In D. C. Rubin (Ed.), *Autobiographical memory* (pp. 225–252). New York: Cambridge University Press.

Bajo, A., Fleminger, S., & Kopelman, M. (2010). Confabulations are emotionally charged, but not always for the best. *Journal of the International Neuropsychological Society*, *16*(06), 975-983.

Baker-Ward, L. E., Eaton, K. L., & Banks, J. B. (2005). Young soccer players' reports of a tournament win or loss: Different emotions, different narratives. *Journal of Cognition and Development*, *6*(4), 507-527.

Barba, G. D., Nedjam, Z., & Dubois, B. (1999). Confabulation, executive functions, and source memory in Alzheimer's disease. *Cognitive Neuropsychology*, *16*(3-5), 385-398.

Bechara, A. (2004). Disturbances of emotion regulation after focal brain lesions. International Review of Neurobiology, 62, pp. 159-193.

Bechara, a, Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain : A Journal of Neurology*, *123 (Pt 1*, 2189–202. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11050020

Beer, J. S., Heerey, E. a, Keltner, D., Scabini, D., & Knight, R. T. (2003). The regulatory function of self-conscious emotion: insights from patients with orbitofrontal damage. *Journal of Personality and Social Psychology*, *85*(4), 594–604. http://doi.org/10.1037/0022-3514.85.4.594

Beer, J. S., John, O. P., Scabini, D., & Knight, R. T. (2006). Orbitofrontal cortex and social behavior: integrating self-monitoring and emotion-cognition interactions. *Journal of Cognitive Neuroscience*, *18*(6), 871–9. http://doi.org/10.1162/jocn.2006.18.6.871

Benson, D. F., Djenderedjian, A., Miller, M. D., Pachana, N. A., Chang, M. D., Itti, L., & Mena, I. (1996). Neural basis of confabulation. *Neurology*, *46*, 1239–1243.

Ben-Yishay, Y., & Diller, L. (2011). *Handbook of Holistic Neuropsychological Rehabilitation. Outpatient Rehabilitation of Traumatic Brain Injury*. New York: Oxford University Press.

Betlheim, S., Hartmann, H. (1924/1951). On parapraxes in the Korsakow psychosis. In D. Rapaport (Ed.), *Organization and pathology of thought* (pp. 289–307). New York: Columbia University Press.

Bless, H., Clore, G. L., Schwarz, N., Golisano, V., Rabe, C., & Wölk, M. (1996). Mood and the use of scripts: Does a happy mood really lead to mindlessness? *Journal of personality and social psychology*, *71*(4), 665.

Bless, H., & Schwarz, N. (1999). Sufficient and necessary conditions in dual-process models. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (423-440). New York: Guilford Press.

Bohn, A., & Berntsen, D. (2007). Pleasantness bias in flashbulb memories: Positive and negative flashbulb memories of the fall of the Berlin Wall among East and West Germans. *Memory & Cognition*, *35*(3), 565-577.

Bonhoffer, K. (1901). Der Korsakowsche Symptomenkomplex in seinen Beziehungen zu den verschiedenen Krankheitsformen. *Algemeine Zeitschrift für Psychiatrie*, 61: 744–752.

Bower, G. H., & Cohen, P. R. (2014). Emotional influences in memory and thinking: Data and theory. *Affect and cognition*, 291-331.

Burgess, P. W., & McNeil, J. E. (1999). Content-specific confabulation. *Cortex*, *35*, 163–182.

Burgess, P. W., & Shallice, T. (1996). Confabulation and the control of recollection. *Memory*, *4*, 359–411.

Clore GL, Wyer RS, Dienes B, Gasper K, Gohm C, Isbell L. Affective feelings as feedback: Some cognitive consequences. In: Martin LL, Clore GL, editors. Theories of mood and cognition: A user's handbook. Mahwah, NJ: Erlbaum; 2001. p. 27–62.

Coan, J. A., & Allen, J. J. (2007). *Handbook of emotion elicitation and assessment*. Oxford University Press.

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, 53, 594-628.

Conway, M. A., & Loveday, C. (2015). Remembering, imagining, false memories & personal meanings. *Consciousness and cognition*, *33*, 574-581.

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self memory system. *Psychological Review*, 107, 261-288.

Conway, M. A., & Tacchi, P. C. (1996). Motivated confabulation. *Neurocase*, *2*, 325–338.

Cunningham, J. M., Pliskin, N. H., Cassissi, J. E., Tsang, B., & Rao, S. M. (1997). Relationship between confabulation and measures of memory and executive function. *Journal of Clinical and Experimental Neuropsychology*, *19*, 867–877.

Damasio, A. R. (1994). *Descartes' Error: emotion, reason and the human brain*. New York: Putnam's Sons.

Dalla Barba, G. (1993a). Different patterns of confabulation. *Cortex*, *29*, 567–581.

Dalla Barba, G. (2002). *Memory, consciousness and temporality*. Springer Science & Business Media.

De Luca, J. (2000). A cognitive perspective on confabulation. *Neuro-Psychoanalysis*, 2: 119–132.

DeLuca, J., & Diamond, B. J. (1995). Aneurysm of the anterior communicating artery: A review of neuroanatomical and neuro- psychological sequelae. *Journal of Clinical and Experimental Neuropsychology*, 17, 100–121.

Downes, J. J., & Mayes, A. R. (1995). How bad memories can sometimes lead to fantastic beliefs and strange visions. In R. Campbell & M. A. Conway (Eds.), *Broken memories: case studies in the neuropsychology of memory* (pp. 115–123). Oxford: Blackwell.

Falquez, R., Couto, B., Ibañez, A., Freitag, M., Berger, M., Arens, E., … Barnow, S. (2014). Detaching from the negative by reappraisal: the role of right superior frontal gyrus (BA9/32). *Frontiers in Behavioural Neuroscience*, *8*(165), 1–16.

Fiedler K. Affective states trigger processes of assimilation and accommodation. In: Martin LL, Clore GL, editors. Theories of mood and cognition: A user's guidebook. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers; 2001. p. 85–98.

Forgas, J. P. (2002). Feeling and doing: Affective influences on inter behavior. *Psychological inquiry*, *13*(1), 1-28.

Fotopoulou, A. (2008). False selves in neuropsychological rehabilitation: The challenge of confabulation. *Neuropsychological rehabilitation*, *18*(5-6), 541-565.

Fotopoulou, A. (2009). Disentangling the motivational theories of confabulation. In Hirstein (Ed.) *Confabulation: Views from neuroscience, psychiatry, psychology, and philosophy*, 263.

Fotopoulou, A. (2010). The affective neuropsychology of confabulation and delusion. *Cognitive Neuropsychiatry*, *15*(1-3), 38-63.

Fotopoulou, A., Solms, M., & Turnbull, O. (2004). Wishful reality distortions in confabulation: A case report. *Neuropsychologia*, *42*(6), 727-744.

Fotopoulou, A., Conway, M.A., and Solms, M. (2007). Confabulation: Motivated reality monitoring. Neuropsychologia, 45, 2180–2190.

Fotopoulou, A., Conway, M. A., Solms, M., Tyrer, S., & Kopelman, M. (2008). Self-serving confabulation in prose recall. *Neuropsychologia*, *46*(5), 1429–1441.

Fotopoulou, A., Conway, M.A., Tyrer, S., Birchall, D., Griffiths, P. & Solms, M. (2008). Is the content of confabulation positive? An experimental study. *Cortex, 44* (7): 764–772

Gainotti, G. (1981). Confabulation of denial in senile dementia: An experimental study. *Psychiatrica Clinica*, *8*, 99–108.

Gasper, K. (2003). When necessity is the mother of invention : Mood and problem solving. *Journal of Experimental Social Psychology*, *39*, 248–262.

Gasper, K. (2004). Do you see what I see? Affect and visual information processing. *Cognition and Emotion*, 18, 405-421.

Gasper, K., & Clore, G. L. (2002). Attending to the big picture: Mood and global vs. local processing of visual information. *Psychological Science*, 13, 34-40.

Goldstein, K. (1965[1995]). *The Organism. A Holistic Approach to Biology Derived from Pathological Data in Man. Notes*. New York: Zone Books.

Gross, J. (2014). *Handbook of Emotion Regulation*. New York: The Guilford Press.

Gross, J. J. (2015). Emotion Regulation: Current Status and Future Prospects. *Psychological Inquiry*, *26*(1), 1–26.

Hanfmann, E., Rickers-Ovsiankina, M., & Goldstein, K. (1944). Case Lanuti: Extreme concretization of behavior due to damage of the brain cortex. *Psychological Monographs*, *57*(4), 1–72.

Harlow, J. M. (1868). Recovery from the passage of an iron bar through the head. *Publications of the Massachusetts Medical Society*, *2*(3), 274-281.

Jackson, H. (1888). Remarks on the diagnosis and treatment of diseases of the brain. The British Medical Journal, pp. 111-117.

Johnson, M. L. (1991). Reality monitoring: Evidence from confabulation in organic brain disease patients. In G. P. Prigatano, & D. L. Schacter (Eds.), *Awareness of deficit after brain damage* (pp. 176–197). Oxford: Oxford University Press.

Johnson, M. L. (1997). Source monitoring and memory distortion. *Philosophical Transactions: Biological Sciences*, *352*(1362), 1733– 1745.

Joorman J, & Siemer M. (2004). Memory accessibility, mood regulation, and dysphoria: Difficulties in repairing sad mood with happy memories? *Journal of Abnormal Psychology*, 113:179–88.

Josephson, B., Singer, J., & Salovey, P. (1996). Mood regulation and memory: Repairing sad moods with happy memories. *Cognition & Emotion*, *10*(4), 437-444.

Kaplan-Solms, K., & Solms, M. (2000). *Clinical studies in neuro- psychoanalysis: Introduction to a depth neuropsychology*. New York: Karnac Books.

Kapur, N., & Couchlan, A. K. (1980). Confabulation after frontal lobe dysfunction. *Journal of Neurology, Neurosurgery and Psychiatry*, *43*, 461–463.

Kensinger, E. a. (2009). Remembering the Details: Effects of Emotion. *Emotion Review*, *1*(2), 99–113. http://doi.org/10.1177/1754073908100432

Kensinger, E. A., & Schacter, D. L. (2006). When the Red Sox shocked the Yankees: Comparing negative and positive memories. *Psychonomic Bulletin & Review*, *13*(5), 757-763.

Nahum, L., Bouzerda-Wahlen, A., Guggisberg, A., Ptak, R., & Schnider, A. (2012). Forms of confabulation: dissociations and associations. *Neuropsychologia*, *50*(10), 2524-2534.

Nahum, L., Ptak, R., Leemann, B., Lalive, P., & Schnider, A. (2010). Behaviorally spontaneous confabulation in limbic encephalitis: the roles of reality filtering and strategic monitoring. *Journal of the International Neuropsychological Society*, *16*(06), 995-1005.

Salas, C. E., Gross, J. J., Rafal, R. D., Viñas-Guasch, N., & Turnbull, O. H. (2013). Concrete behaviour and reappraisal deficits after a left frontal stroke: A case study. *Neuropsychological Rehabilitation*, (April), 37–41. http://doi.org/10.1080/09602011.2013.784709

Schnider, A., C. von Däniken, and K. Gutbrod, The mechanisms of spontaneous and provoked confabulations. Brain, 1996. 119: p. 1365-1375.

Solms, M. (2000). A psychoanalytic perspective on confabulation. *Neuropsychoanalysis*, *2*(2), 133-138.

Kinsbourne, M. (2000). The mechanism of confabulation. *Neuropsychoanalysis*, 2, 158–162.

Klonoff, P. S., Lage, G., & Chiapello, D. (1993). Varieties of the catastrophic reaction to brain injury. A self psychology perspective. *Bulletin of the Menninger Clinic*, *57*(2), 227–241.

Koole, S. L. (2009). The psychology of emotion regulation: An integrative review. *Cognition and Emotion*, *23*(1), 4-41.

Korsakoff, S. S. (1989/1996). Medico-psychological study of a memory disorder. *Consciousness and Cognition*, 5: 2– 21.

Lidz, T. (1942). The amnestic syndrome. Archives of Neurology and Psychiatry, 47, 588–605.

Liverani, M.C., Manuel, A.L., Guggisberg, A.G., Nahum, L. & Schnider, A. (2016). No influence of positive emotion on orbitofrontal reality filtering: relevance for confabulation. Frontiers of Behavioural Neuroscience 31 May: 1-18.

Luria, A. R. (1976). *The neuropsychology of memory*. Washington DC: V.H. Winston.

Matt, G. E., Vázquez, C., & Campbell, W. K. (1992). Mood-congruent recall of affectively toned stimuli: A meta-analytic review. *Clinical Psychology Review*, *12*(2), 227-255.

McAdams, D.P. (2001). The psychology of life stories. *Review of General Psychology*, **5**(2), 100–122.

Mercer, B., Wapner, W., Gardner, H., & Benson, F. (1977). A study of confabulation. *Archives of Neurology*, *34*, 429–433.

Moll, J. M. (1915). The “amnestic” or “Korsakoff” syndrome, with alcoholic aetiology: An analysis of thirty cases. *Journal of Mental Sciences*, *61*, 424–443.

Moscovitch, M. (1989). Confabulation and the frontal system: Strategic versus associative retrieval in neuropsychological theories of memory. In H. L. Roediger, & F. I. Craik (Eds.), *Varieties of memory and consciousness: Essays in the honour of Endel Tulving* (pp. 133–160). Hillsdale: Lawrence Erlbaum Associates.

Moscovitch, M., & Melo, B. (1997). Strategic retrieval and the frontal lobes: Evidence from confabulation and amnesia. *Neuropsychologia*, 35, 1017–1021.

Panksepp, J. (1998). *Affective Neuroscience: the foundations of human and animal emotions*. New York: Oxford University Press.

Papagno, C., & Baddeley, A. D. (1997). Confabulation and dysexecutive patient: Implications for models of retrieval. *Cortex*, *33*, 743–752.

Park, J., & Banaji, M. R. (2000). Mood and heuristics: the influence of happy and sad states on sensitivity and bias in stereotyping. *Journal of personality and social psychology*, *78*(6), 1005.

Paterson, A., & Zangwill, O. L. (1944). Recovery of spatial orientation in the post-traumatic confusional state. *Brain*, *67*(1), 54-68.

Pasupathi, M. (2003). Emotion regulation during social remembering: Differences between emotions elicited during an event and emotions elicited when talking about it. *Memory*, *11*(2), 151-163.

Rusting, C.L. (1998). Personality, mood, and cognitive processing of emotional information: Three conceptual frameworks. *Psychological Bulletin*, (124):165–96.

Salas, C. E., Radovic, D., & Turnbull, O. H. (2011). Inside-out: Comparing internally generated and externally generated basic emotions. Emotion, 9: 1-11.

Salas, C. E. (2012). Surviving Catastrophic Reaction after Brain Injury: The Use of Self- Regulation and Self – Other Regulation. *Neuropsychoanalysis*, *14*(1), 77–92.

Salas, C. E., Gross, J. J., Rafal, R. D., Viñas-Guasch, N., & Turnbull, O. H. (2013). Concrete behaviour and reappraisal deficits after a left frontal stroke: A case study. *Neuropsychological Rehabilitation*, (April), 37–41.

Salas, C. E., Gross, J. J., & Turnbull, O. H. (2014). Reappraisal generation after acquired brain damage: The role of laterality and cognitive control. *Frontiers in Psychology*, *5*(242).

Salas, C. E., Radovic, D., Yuen, K. S. L., Yeates, G. N., Castro, O., & Turnbull, O. H. (2014). "Opening an emotional dimension in me": Changes in emotional reactivity and emotion regulation in a case of executive impairment after left fronto-parietal damage. *Bulletin of the Menninger Clinic*, *78*(4), 301–334.

Salas, C.E.; Radovic, D.; Castro, O. & Turnbull, O.H. (2015). Internally and externally generated emotions in people with acquired brain injury: A brief report on right hemisphere damage. Frontiers in Psychology, 6: 1-9.

Salas, C.E., Castro, O., Yuen, KS., Radovic, D., D'Avossa, G., & Turnbull, O.H. (2016). Just can't hide it: a behavioral study of emotional response modulation after right prefrontal damage. Manuscript in preparation

Schacter, D. L., Norman, K. A., & Koutstaal, W. (1998). The cognitive neuroscience of memory. *Annual Review of Psychology*, *49*, 289–318.

Schnider, A. (2003). Spontaneous confabulation and the adaptation of thought to ongoing reality. *Nature Reviews Neuroscience*, *4*, 662–671.

Schnider, A., & Ptak, R. (1999). Spontaneous confabulators fail to suppress currently irrelevant memory traces. *Nature Neuroscience*, *2*(7), 677– 681.

Schnider, A., Valenza, N., Morand, S., & Michel, C. M. (2002). Early cortical distinction between memories that pertain to ongoing reality and memories that don't. *Cerebral Cortex*, *12*, 54–61.

Schwarz N. Feelings as information: Informational and motivational functions of affective states. In: Higgins ET, Sorrentino RM, editors. *Handbook of motivation and cognition: Foundations of social behavior*, vol. 2. New York, NY: Guilford Press; 1990. p. 527–61.

Schwarz, N. (2011). Feelings-as-information theory. P. Van Lange, A. Kruglanski, & E. T. Higgins (eds.), *Handbook of theories of social psychology*, *1*, 289-308.

Singer, J. A., & Salovey, P. (1988). Mood and memory: Evaluating the network theory of affect. *Clinical Psychology Review*, *8*(2), 211-251.

Solms, M. (1998). Psychoanalytic observations on four cases on ventromesial frontal lobe damage. *Psyche-Zeitschrift Fur Psychoanalyse Und Ihre Anwendungen*, 52, 919–962.

Solms, M. (2000). A psychoanalytic perspective on confabulation. *Neuro-psychoanalysis*, 2, 133-143.

Solms, M., & Turnbull, O. (2002). *The brain and the inner world: An introduction to the neuroscience of subjective experience*. Karnac Books.

Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory mood and the false memory effect. *Psychological Science*, *16*(10), 785-791.

Stuss, D. T., Alexander, M. P., Lieberman, A., & Levine, H. (1978). An extraordinary form of confabulation. *Neurology*, *28*, 1166–1172.

Talland, G. A. (1961). Confabulation in the Wernicke–Korsakoff syndrome. *Journal of Nervous and Mental Disease*, 132: 361–381.

Turnbull, O. H., Berry, H., & Evans, C. E. (2004). A positive emotional bias in confabulatory false beliefs about place. *Brain and cognition*, *55*(3), 490-494.

Turnbull, O.H., Jenkins, S. & Rowley, M.L. (2004). The pleasantness of false beliefs: An emotion-based account of confabulation. *Neuropsychoanalysis*, 6: 5-16.

Turnbull, O. H., & Solms, M. (2007). Awareness, desire, and false beliefs: Freud in the light of modern neuropsychology. *Cortex*, *43*(8), 1083-1090.

Turnbull, O. H., Evans, C. E., & Owen, V. (2005). Negative emotions and anosognosia. *Cortex*, *41*(1), 67-75.

Villiers, C. D., Zent, R., Eastman, R. W., & Swingler, D. (1996). A flight of fantasy: False memories in frontal lobe disease. *Journal of Neurology, Neurosurgery and Psychiatry*, *61*, 652–653.

Weinstein, E. A. (1996). Symbolic aspects of confabulation following brain damage: Influence of premorbid personality. *Bulletin of the Menninger Clinic*, *60*, 331–350.

Weinstein, E. A., Kahn, R. L., & Malitz, S. (1956). Confabulation as a social process. *Psychiatry*, *19*, 383–396.

Whitlock, F. A. (1981). Some observations on the meaning of confabulation. *British Journal of Medical Psychology*, *54*, 213–218.

Williams, H. W., & Rupp, C. (1938). Observations on confabulation. *American Journal of Psychiatry*, *95*, 395–405.