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# Introduction: What is confabulation?

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## Introduction

What is confabulation? It may be preferable to start with an example since the natural starting point – a definition of the term ‘confabulation’ – is still a difficult and controversial topic. ‘I was at the office, doing the year-end inventory’, a former office worker might reply, when asked about what he did yesterday, even though he has been retired for 20 years. There are two types of memory patients: those who know they’ve lost memory capacities and those who don’t. Memory confabulators will not acknowledge that their memories are impaired and instead will produce confabulations when asked questions about their pasts. Confabulators seem to believe their claims, and the consensus among those who study them is that they are not deliberately lying, even though they have an obvious motive to do so in most occasions, to appear normal and healthy.

Confabulation in the clinic can be severely debilitating, and this provides another good motive to try to understand it. One’s credibility is a core feature of one’s identity. The brain damage that causes confabulation can turn rock-solid providers of information into people little more reliable than pathological liars. This is a large enough change to make people who knew the patient before come to see him or her as a different person. How can confabulators be of basically sound mind, yet not see their glaring errors? One approach to take in response is to argue that confabulation shows how modularized our cognition is: when we lose our somatosensory representations of the left arm – to use another type of confabulation as an example – we also lose any ability to make intelligent judgments about what the left arm is doing.

This collection is focused on delineating the basic parameters of confabulation. How exactly is the term to be defined? What are the clinical symptoms of each type of confabulation? Which brain functions are damaged in clinical confabulators? What are the neuropsychological characteristics of each type?

The phenomena of confabulation – the serene confidence, the isolated islands of deficit, and the creativity of the responses – lie at the confluence of streams of thought pursued by several different disciplines. Psychologists study confabulating patients in order to learn more about human memory. They also study the patients' willingness (or rather their stunning lack of willingness) to admit ignorance rather than to give a false answer. Both traditional neurologists and neuroscientists study the lesions of patients, using several different brain imaging techniques and sometimes by studying the brain of patients after their deaths. Cognitive neuropsychologists study how the specific lesions have specific effects on brain function and, ultimately, on outward behavior. Philosophers are interested in several questions that bear on confabulation. How is our knowledge system structured? Is it, for instance, a single homogeneous net or web of beliefs, or do we have different kinds of knowledge, perhaps represented in the brain in different ways? How do we understand the minds of others? What is the relation between knowledge and merely believing that one knows? What is the relation between knowing that  $p$  and feeling certain that  $p$ ?

We should pause to consider how lucky we are since it is not clear how often in the future all these disciplines, psychology, neuroscience, psychiatry, and philosophy will be able to interact in such a vital way. Only the most jaundiced old lab heeler would deny that the sciences of the mind and brain have entered a renaissance, thanks mainly to the rapid progress of neuroscience. Lines of inquiry can move easily across disciplines for those who are willing to follow them. One type of line of inquiry moves downward in the theoretical apparatus that we have set up to understand the world. In a sort of epistemic digestion, philosophers first size up the meal, and then scientists emulsify those products into simples consumable by any decent junior high-school student. A second line of inquiry moves in the opposite direction; the inquirer takes a finding in neuroscience and ponders what meaning it might have for our everyday mental lives, or even our fundamental nature. Confabulation is a rich phenomenon that supports both of these lines of inquiry and many others moving across the disciplines in all directions.

### **The problem of defining 'confabulation'**

Anyone broaching the topic of confabulation is faced immediately with a huge problem: there is no orthodox, problem-free definition of 'confabulation'. The one simple definition available seems to have major problems. The concept of confabulation was initially restricted to false claims presented as memories, and then grew to include other types of cases. '*Konfabulationen*' was first applied as a technical term by the German neurologists Bonhoeffer, Pick, and Wernicke in the early 1900s to false memory reports made by their patients,

who suffered from an amnesic syndrome that later came to be known as Korsakoff's amnesia. When asked about what they did yesterday, these patients do not remember, but will report events that either did not happen, or happened long ago. During the remainder of the 20th century, however, the use of 'confabulation' was gradually expanded to cover claims made by other types of patients, many of whom had no obvious memory disorder. This list grew to include patients who deny that they are injured, paralyzed, or blind; split-brain patients; patients with misidentification disorders (i.e. they make false claims about the identities of people they know); and patients with schizophrenia, as well as normal people and children reporting memories.

This traditional definition of 'confabulation' contains three criteria: confabulations are (1) false (2) reports (3) about memories. There are significant problems with each of the three, however. First, relying on falsity alone to characterize the problem with the patient's claim can produce arbitrary results. If a Korsakoff's patient is asked what day of the week it is and happens to state correctly that it is Tuesday, we may still want to consider this a confabulation since he has, e.g. been wrong the previous four times he answered this question, and we have good reason to believe he is confabulatory in general. Second, the idea that confabulations are reports, or stories, implies that confabulations must be in a linguistic form, yet several researchers have categorized non-linguistic responses as confabulations. One group had patients (undergoing Wada testing in which one hemisphere is temporarily disabled) pointing to fabric samples with one hand to indicate which texture of fabric they had been stimulated with on the other hand. Another research group had patients reproduce from memory certain drawings that they had seen, and referred to cases in which the patients added extra features to the drawings which were not actually present as confabulations. Other researchers applied the term 'confabulation' to the behavior of patients who produced meaningless drawings as if they were correctly reproducing designs seen earlier. Finally, the problem with calling confabulations *memory* reports at all is that even in Korsakoff's syndrome, many confabulations are simply made up on the spot and not traceable to any actual memories. Making confabulation by definition only a disorder of memory also rules out by fiat the other putative cases of confabulation by, e.g. split-brain patients, misidentification patients, and patients who deny illness. One could take Moscovitch's pithy description of confabulation as 'honest lying' as a starting point for a broader definition. To confabulate is to make a false claim without an intent to deceive. But one then feels obliged to begin listing the exceptions, joking, kidding, being ironic or sarcastic, or even telling a story, none of which count as confabulating. This definition would also include all cases in which people mistakenly say false things as

confabulations, and it has the same problem noted above of categorizing as non-confabulations those cases in which an obviously confabulatory person happens to answer a question correctly.

Those using 'confabulation' in the broader sense are choosing to ignore any memory criterion, and hence must be assuming something else to be the core feature of confabulation. Neurologist Norman Geschwind's classic pair of articles entitled, 'Disconnexion syndromes in animals and man', published in the journal *Brain* in 1965, must have played a role in popularizing the broader sense of 'confabulation'. Geschwind used the word in a natural-sounding way that had nothing to do with memory, speaking for instance of a patient who 'gave confabulatory responses to visual field testing when there was no stimulus in the field....' (Geschwind, 1965, p. 597). 'I have seen a confused patient', he said, 'who gave confabulatory responses when asked to name objects held in his hand' (p. 597). Similarly, patients who deny that they are paralyzed have been claimed to confabulate when they provide reasons for why they cannot move ('My arthritis is bothering me', 'I'm tired of following your commands'). Another type of patient will deny blindness and attempt to answer questions about what he sees, producing what have been called confabulations. Misidentification patients have been said to confabulate when asked what the motives of the 'impostor' are, or why someone would go through the trouble to impersonate someone else ('Perhaps my father paid him to take care of me'). Similarly, when the left hemispheres of split-brain patients attempt unsuccessfully to answer questions without the necessary information (which is contained in their right hemispheres), this has also been called a confabulation.

There may be something broader than memory that encompasses all of these syndromes. Memory is a part of what constitutes our knowledge. Another part of our knowledge is contained in our current perceptions, of what we are seeing, of our own bodies, and of the people and things around us. The following broader definition is based on the idea that confabulation syndromes involve malfunctions in different knowledge domains, coupled with executive system damage (Hirstein, 2005). According to this two-phase approach, confabulation is caused by damage to two different brain systems. First, a perceptual or mnemonic system is damaged, the patient goes blind, loses his memory, or loses his ability to represent his body. But then a second line of defense has to fail since damage of only the first sort would produce someone who admitted the problem and sought help. If such a person did make up a memory, or a perception, as we all are prone to do, he would eventually realize that he was doing this. The brain's system of executive processes, tasked with checking, testing, and improving both mnemonic and perceptual states (Miller and Cohen, 2001; Fuster, 2002), must also fail before a person becomes confabulatory.

(One-stage theories have been proposed for specific confabulation syndromes, but I am not aware of any that has been proposed to cover the entire set.) According to this epistemic definition of 'confabulation':

Jan confabulates that  $p$  if and only if:

- (1) Jan claims that  $p$ .
- (2) Jan believes that  $p$ .
- (3) Jan's thought that  $p$  is ill-grounded.
- (4) Jan does not know that her thought is ill-grounded.
- (5) Jan should know that her thought is ill-grounded.
- (6) Jan is confident that  $p$ .

'Claiming' is broad enough to cover a wide variety of responses by subjects, including drawing, and pointing, as well as reports of all types. The second criterion captures the sincerity of confabulators. The third criterion refers to the problem that caused the flawed response to be generated, the first-phase problem. The fourth criterion refers to the failure of the second phase, the failure to reject the flawed response. The fifth criterion captures the normative element of our concept of confabulation: If the confabulator's brain (or specifically, her executive processes) were functioning properly, she would not make that claim. The last criterion refers to another important aspect of confabulators, the serene and complete certainty they have in their communications.

People will normally acknowledge their deficits. In order for confabulation to occur, there must be additional damage, one step up in the cognitive hierarchy, to processes that monitor the memory or perceptual representations, according to a two-phase approach. And here is where the modularization is surprising since it happens at the cognitive level, which is supposed to be much less modular or encapsulated than the lower perceptual levels. Confabulation may indicate that to a large degree, we have no global ability to monitor representations of all sorts, but rather we possess a set of monitoring abilities or executive processes, each of which is able to monitor a subset of our representations. An alternative scheme to this is that the executive processes at least attempt to do their work on every representation in consciousness, but that they are only successful on a subset of those.

Thus, there are currently two schools of thought on the proper scope of the concept of confabulation: those who remain true to the original sense and so believe that the term should only be applied to false memory reports and a growing number of those who believe that the term can be usefully applied to a broader range of disorders. An examination of the etymology of the term 'confabulation' itself turns out not to be terribly helpful. The Latin root '*con*'

means with, while *'fabulari'* means to talk or converse, so that its original meaning was simply to talk with. When the German neurologists at the turn of the 20th century began using *'konfabulation'*, they probably meant that their memory patients were creating fables when asked about their pasts. The patients were fabulists – fable tellers.

## Types of confabulations

If the confabulation syndromes do form a natural family, this should start to become apparent if we lay out the data in a perspicuous manner. Researchers have recorded confabulation in the following cases:

### Memory confabulations

Confabulations about memories are a defining characteristic of Korsakoff's syndrome and a similar syndrome caused by aneurysm of the anterior communicating artery. Alzheimer's patients will often produce memory confabulations, and children up to a certain age are also prone to reporting false memories, apparently because their brain's prefrontal areas have not yet fully developed, while the Alzheimer's patients' prefrontal lobes have been compromised by amyloid plaque lesions. All of these confabulators have an initial memory retrieval problem, coupled with a failure to monitor and correct their false 'memories'. In contrast, there exist many memory patients with damage only to more posterior parts of the memory system (e.g. to the hippocampus or other parts of the temporal lobes) who freely admit that they cannot remember and are not at all prone to producing confabulations. They have the first type of damage required to produce confabulation, but not the second since their frontal lobes are intact.

The patients with aneurysms of the anterior communicating artery – a tiny artery near the anterior commissure that completes the anterior portion of the Circle of Willis – provide our best clue about the locus of the frontal problems in memory confabulation. The location of the anterior communicating artery (ACoA) makes the posterior orbitomedial cortex an area of suspicion in confabulation. **John DeLuca** has written extensively on both the clinical and theoretical aspects of the confabulations produced by patients with damage to the ACoA. Here, he provides for us a concise overview of ACoA syndrome, especially with regard to confabulation, including several examples of actual confabulations from patient interviews.

But of course we are all capable of producing false memory reports on occasion. Researchers have lately developed several ways to provoke false memory reports in normal people, something that allows us to further probe the memory system itself, and its vulnerabilities, especially as it might pertain to witness testimony. **Lauren French, Marryanne Garry, and Elizabeth Loftus** are part

of a flourishing research paradigm in psychology that is beginning to delineate the important variables that affect whether or not one is able to produce false memories in normal people. They argue that false memories in normal people are often produced by the very processes that normally function to help us reconstruct memories as we recall them. An important larger point this makes is that normal people do confabulate, and this should militate against restricting the use of the term 'confabulation' to clinical patients. One powerful technique for doing this is simply to prod the person into saying something after she has admitted not having a memory. **Quin Chrobak** and **Maria Zaragoza** review the specific variables at work behind this phenomenon and present some interesting new findings of their own.

### **Confabulations about intentions and actions**

Patients who have undergone a split-brain operation will tend to confabulate about actions performed by the right hemisphere. In a typical experiment, commands are sent to the right hemisphere only (by presenting them briefly in the left visual field), but the left hemisphere, unaware of this, confabulates a reason for why the left hand obeyed the command. There are many cases of confabulations about actions and intentions that do not involve the right hemisphere or any obvious lateral element, however. Similar sorts of confabulations can be elicited by brain stimulation. For example, the patient's cortex is stimulated, causing her arm to move. When asked why the arm moved, the patient claims that she felt like stretching her arm. Hypnotized people may also confabulate, e.g. the subject is given a hypnotic suggestion to perform a certain action, but then confabulates a different reason for it when asked.

Patients with hemiplegia of the left arm may also claim that they moved when asked to by their attending physicians. Or, they may produce a confabulation about why they did not move when asked. **Kenneth Heilman** has been systematically testing several different hypotheses about why a certain group of patients with brain damage which causes paralysis or great weakness of their left arms are unaware, or deny, that there is anything wrong with them. His contribution here chronicles the steady progression of testing and refinement of his hypothesis, according to which denial of disability is due to malfunction in a complex, multiply parallel system for representing our bodies. Just as in the case of memory, where paradigms have been developed to elicit confabulations from normal people, in the study of action and intention, experimental paradigms have recently been developed to produce confabulations about actions from normal people. In her contribution, **Thalia Wheatley** summarizes these findings and offers a novel solution to the question of what differentiates normal mistakes from pathological confabulation.

## Perceptual confabulations

Patients with Anton's syndrome are at least partially blind; but they insist that they can see. Their posterior damage typically involves bilateral lesions to the occipital cortex, causing the blindness, coupled with prefrontal damage, causing the inability to become aware of the blindness (according to a two-phase approach). Split-brain patients will also confabulate when asked about what they perceived, given certain situations. The easiest way to demonstrate this is to have the patient close his eyes while you place an ordinary object such as a key in his left hand. Then, ask him to identify the object in his hand. The right hemisphere 'knows' that it is a key, but it cannot produce speech. But the patient, or at least his left hemisphere, won't admit ignorance, and instead will confidently produce plausible but false answers: a pen, a lighter.

The patients who deny paralysis have a condition referred to as *anosognosia*, meaning unawareness of illness. They typically have a loss of one or more somatosensory systems for representing features of the affected limb. Apparently, certain types of damage (e.g. to the right inferior parietal lobe) can cause both the somatosensory problem, and at least temporarily affect prefrontal functioning enough to cause the confabulated denials of illness (Berti et al., 2005). Some patients will deny that the affected limb is even their own. In his extensive clinical experience with different types of confabulating patients, **Todd Feinberg** has become increasingly suspicious that certain patterns in their confabulations might indicate some sort of unified and psychologically interesting process at work behind them.

Perceptual confabulations are also issued by patients suffering from the misidentification syndromes (especially Capgras' syndrome). A popular approach here is to argue that these patients have a malfunction at the perceptual level to a process that produces a feeling of familiarity and/or emotional warmth at the sight of a loved one. This produces a sense of foreignness when the patient looks at his e.g. father that he explains by producing a confabulation about an impostor. The patient is unable to realize the implausibility of his claim due to additional frontal damage, adherents to this approach typically claim. There is an intriguing similarity between asomatognosia and Capgras' syndrome. The asomatognosic claims that this is not his arm, the Capgras' patient claims that this is not his father. In both cases, the very familiar is claimed to be not associated with the self. **V. S. Ramachandran** and I propose a theory designed to allow us to begin to systematize our thinking about these syndromes.

What about the delusions of those with schizophrenia? In their contribution, **Peter McKenna**, **Elvira Lorente-Rivera**, and **German Berrios** examine



first the early history of confabulation as a symptom among a certain subtype of schizophrenics, and then describe the dynamics of this type of confabulation. **Max Coltheart** and **Martha Turner** use information about confabulations from delusional patients in order to explore a broader sense of ‘confabulation’, intended to apply to both memory patients and delusional confabulators. In this broader sense, confabulation is ‘providing an answer to an unanswerable question’. Confabulators, whether they are also deluded or not, seem to have false beliefs. They certainly make false claims, while giving no appearance of lying or conscious deception. Are the deluded patients self-deceived in claiming that their arms are fine? Using his theory of self-deception – those curious occasions when we believe something even though we possess good evidence that it is false – **Alfred Mele** examines this question. One prototypical example of this is the doctor who believes that he is fine, even though he is aware that he has several symptoms that he would diagnose as indicating a serious cancer if he saw those symptoms in someone else. What about the patient who denies that his arm is paralyzed and says he’s merely tired? Is this perhaps a case in which the patient is both self-deceived and confabulating?

There is an important commonality among several of the perceptual confabulation syndromes: they involve either right hemisphere damage or disconnection. When the right hemisphere is the primary source for a type of knowledge, for instance knowledge of the body, knowledge of the actions of the left hand, knowledge of the contents of the left visual field, and in many people, knowledge of how to recognize other people, damage or disconnection seems to set the stage for confabulation. A second type of damage is required if the two-phase theory is correct. There may be cases here in which the same event that damaged or disconnected a right hemisphere knowledge source also damaged or disconnected an executive process tasked with monitoring knowledge from that source. This would be more likely to happen if the executive processes tasked with monitoring representations produced by the right hemisphere tended themselves to be located primarily in the right hemisphere.

### **Confabulations about emotions**

False attributions of emotions can count as confabulations. For example, in one experiment, people were given an injection of adrenaline without their knowledge, but attributed their inability to sleep to, e.g. nervousness about what they had to do the next day. We may all be guilty of confabulating about our emotions on occasion, perhaps due to the combination of our feeling responsible for giving coherent accounts of our emotions and the opacity of our emotions to cognition. The emotion itself is ill-grounded because it was produced in a non-normal way – the shot of adrenaline. Perhaps the people

who confabulated were people who have trouble describing their emotions (i.e. they were alexithymic), or perhaps the example does show that we are not good at monitoring our emotions. We cannot apply the sorts of cognitive manipulations here that we can when we, e.g., check for contradictions. Given the right hemisphere's greater role in producing and perceiving emotions, there may also be a lateral element to the neural locus of confabulations about emotions.

## Confabulation in general

It appears that there are confabulations about every type of intentional state, that is, every type of mental state with representational content. Even the emotions that we confabulate about at least present themselves as having a specific representational content, e.g. I am anxious *about my upcoming exam*. In theory, given the brain's large number of knowledge sources, there are many more confabulation syndromes than those listed here, but they should all follow the same pattern, damage to a posterior knowledge system (either perceptual or mnemonic), coupled with damage to prefrontal executive processes responsible for monitoring and correcting the representations delivered by that epistemic system. There are important functional links between the posterior orbitomedial cortex and the corpus callosum. Given the existence of dense interconnections between the left and right orbitomedial cortices, cutting their commissures may have the same effect of lesioning them directly.

One feature that may link all or most of the confabulation syndromes is reduced autonomic activity. There is a common finding in confabulators of a hypo-responsive, or unresponsive autonomic system. Korsakoff's patients show damage to noradrenergic structures. People with orbitofrontal damage and sociopaths (who may be confabulatory) show reduced autonomic activity to certain types of stimuli. Capgras, patients show reduced responses to the sight of familiar people. Patients with neglect and flattened affect show either no, or greatly reduced, skin conductance activity (Heilman et al., 1978). This may explain the tendency of confabulators to be unconcerned about their problems when confronted with them. It may indicate that our doubts need to be bolstered by autonomically generated feelings of uncertainty before we actually attend to them and begin to revise our beliefs. There may be several different prefrontal areas, each tasked with checking a certain type of representation, but all of these areas might stop actions based on ill-grounded representations by initiating inhibitory autonomic activity.

Most writers today agree that there is an intimate connection between intentional states and consciousness itself, although just what 'intimate' means is

still under dispute. One version, from Searle (1990), is that intentional states must be either actually or potentially conscious. Each type of confabulation involves a type of conscious state, a perceptual state, a memory, an intention, and so on. According to one way of understanding executive processes, each of them takes the current conscious state as its input and performs an operation on it. The primary goal, shared by all the executive processes, is to improve the effectiveness of that person's actions. Subsidiary to this, many of the executive processes of interest in confabulation have the goal of improving the quality of the representations (e.g. beliefs, perceptual representations) of that particular person's cognitive system. As the play of consciousness proceeds, each executive process attempts to perform its specific operation on the current thought. We use executive processes to check memories, but we also use them to check thoughts of all sorts against our memories. As each watcher of the play of consciousness falls asleep, the potential for a type of confabulation opens up. **Gianfranco Dalla Barba's** contribution to this volume also explores the relation between consciousness and memory confabulations. Beginning with several examples from the clinic, Dalla Barba moves to an analysis of the phenomenology of remembering, and then to more philosophical issues about our consciousness of time.

Several of the contributors touch on the question of motivational factors at work behind confabulations. **Aikaterini Fotopoulou** looked at memory confabulations and spontaneous confabulations and found a positive bias in both, beyond our normal human tendency to be positive. Feinberg argues that what he calls personal confabulation (in which the patients 'represent themselves, their personal experiences, and their problems and preoccupations in a story') to be motivated. Mele, on the other hand, argues that motivation is not playing a role in the confabulations of Capgras' syndrome patients or anosognosics.

## Conclusion

Making a sincere claim to someone, especially in response to a specific request, is similar in many ways to giving a present. We tell people things because we care about them. The present may be small or large. It may be expected or a complete surprise, and it may be of great value, or absolutely worthless. False or ill-grounded claims make bad presents; their normal value is nothing or worse than nothing since we may still waste time and energy because we believed the claim. Our minds track the value of these presents with great accuracy, especially when we are considering offering one. We do not give away valuable information to just anyone. We also do not give worthless things to people for no reason. We do not deliberately make false claims to our friends,

and lying to random strangers is fairly close to being pathological. To care about someone is care about what you say to him or her. Confabulators fail exactly here, they dispense worthless claims sincerely, while seeming not to care that they are disbelieved. Their claims seem valuable to them, but they are actually worthless because they were generated by malfunctioning brain processes.

Why don't they know that they don't know? Why doesn't the Anton's patient know that he doesn't know how many fingers the doctor is holding up? Why doesn't the anosognosic know that his arm is paralyzed? Why doesn't the split-brain patient know that he doesn't know what stimulus his right hemisphere was exposed to? Why doesn't the Korsakoff's patient know that he doesn't remember what he did yesterday? Why doesn't the Capgras' patient know that he is misperceiving his father? There are many deeper questions, about what confabulation means for our conception of our nature. How does confabulation relate to artistic creativity, for instance? The recent appearance of cases in which people who had no previous interest in art or music became obsessed with them after stroke or other brain damage raises the question as to whether this sudden creative outburst might be a release or disinhibition of something that was already there, perhaps in the same way that some types of confabulation seem to be due to disinhibition. Within the realm of social psychology, does confabulation belong to that set of phenomena in which we humans in general tend to rate our intelligence, our abilities, our confidence as higher than they really are, or should be? The hope is that this volume marks the beginning of an interdisciplinary research paradigm on confabulation. Perhaps it will show that confabulation is much more than just an odd foible we humans are prone to, but is instead deeply revealing of our mental lives and what lies behind them.

## References

- Berti, A., Bottini, G., Gandola, M., et al. (2005). Shared cortical anatomy for motor awareness and motor control. *Science*, **309** (5733), 488–491.
- Fuster J. (2002). Physiology of executive functions: The perception-action cycle. In *Principles of Frontal Lobe Function* (eds. D.T. Stuss and R.T. Knight). Oxford, Oxford University Press.
- Geschwind, N. (1965). Disconnexion syndromes in animals and man. *Brain*, **88**, 237–644.
- Heilman, K. M., Schwartz, H. D., Watson, R. (1978). Hypoarousal in patients with the neglect syndrome and emotional indifference. *Neurology*, **28**, 229–232.
- Hirstein, W. (2005). *Brain Fiction: Self-Deception and the Riddle of Confabulation*. Cambridge, MA, MIT Press.
- Miller E.K. and Cohen J.D. (2001). An integrative theory of prefrontal cortex function. *Annual Reviews of Neuroscience*, **24**, 167–202.
- Searle John, R. (1990). Consciousness, explanatory inversion and cognitive science. *Behavioral and Brain Sciences*, **13** (4), 585–595.