
Confabulations (II): Explicative Models

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Introduction. Confabulations, or the production of false memories without deliberate intent to lie, is an intriguing phenomenon for which an attempt has been made to explain it since they were first described. Confabulations are a good example for illustrating the reconstructive character of memory. Nevertheless, their exact nature and the way in which they are produced are still controversial.

Objective. To review the different models proposed to explain the appearance of confabulations.

Development. Neuropsychological models that currently have some theoretical development and empirical evidence are reviewed. In addition, a brief reference to motivational models, that have recently begun to recover popularity, are presented. We conclude by presenting the last version of the strategic retrieval model that makes it possible to integrate the relevant elements from the others.

Conclusions. Early models of confabulations, which considered them a result of the need to fill memory gaps, are outdated nowadays. Nevertheless, emotional processes are taken into account to explain their content. From neuropsychological approaches, it is possible to distinguish models that consider confabulation as a result of a temporal or contextual problem, and those which consider that the main problem is on the memory retrieval process. More specifically, the strategic retrieval hypothesis states that confabulations are the result of a dysfunction in a complex system of monitoring the recovered information. This model would make it possible to integrate explanations and evidences coming from the other proposals.

Key words:

Affective neuropsychology, Confabulations, False memories, Neuropsychological models, Strategic retrieval, Working-with-memory

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Confabulaciones (II): Modelos explicativos

Introducción. Las confabulaciones o la producción de falsos recuerdos, sin la intención de mentir de forma deliberada, resultan un fenómeno intrigante que se ha intentado explicar desde que fueran descritas por primera vez. El fenómeno de las confabulaciones es un buen ejemplo del carácter reconstructivo de la memoria, sin embargo, aún es controvertida su naturaleza exacta y la forma en que se producen.

Objetivo. Revisar los diferentes modelos propuestos para explicar la aparición de confabulaciones.

Desarrollo. Se revisan los modelos neuropsicológicos que en la actualidad cuentan con cierto desarrollo teórico y evidencia empírica. También se hace referencia a modelos motivacionales, que han empezado a recuperar su popularidad recientemente, para terminar desarrollando la última versión del modelo de recuperación estratégica, que permite integrar los elementos relevantes de los otros.

Conclusiones. Los primeros modelos sobre confabulaciones, que las consideraban resultado de la necesidad de rellenar lagunas de memoria, están hoy día superados, aunque los elementos emocionales se están teniendo en cuenta para explicar su contenido. Dentro de la neuropsicología, podríamos distinguir aquellos modelos que consideran la confabulación como resultado de un problema temporal o contextual, y aquellos que ponen el problema en los procesos de recuperación de la memoria. En concreto la hipótesis de recuperación estratégica plantea que las confabulaciones son el resultado de una disfunción de complejos sistemas de monitorización de la información recuperada. Este modelo permitiría integrar explicaciones y evidencias procedentes de otras propuestas.

Palabras Clave:

Confabulaciones, Falsos recuerdos, Modelos neuropsicológicos, Neuropsicología afectiva, Recuperación estratégica, Trabajo-con-la-memoria

INTRODUCTION

We saw the difficulty to define confabulations in a previous work.¹ An operational definition of them would describe them as false memories, of which the patient is not aware and which the patient believes are genuine.² In that article, we reviewed the different classifications on the phenomenon and the brain regions involved in its appearance and the neuropsychological correlates associated to them. This work aims to review the different mechanisms proposed to explain confabulations. In the first place, the neuropsychological models that have demonstrated the greatest empirical evidence will be presented. In the second section, reference will be made, although briefly, to motivational models that have begun to recover popularity in recent years. Finally, the integrating model proposed by the Moscovitch group,^{3,4} that develop their proposal on the strategic retrieval, incorporating elements from other authors, will be presented

NEUROPSYCHOLOGICAL MODELS

The explicative models on confabulations proposed from neuropsychology could include two large groups: those of temporality, that emphasize failure to remember the temporal context of the information recalled, and that of retrieval, that locates the problem in this process, stressing the reconstructive character of memory. In the following, we will see the different proposals of several authors within both groups of theories.

Temporality theories

The hypothesis of confabulation as a temporal disorder establishes that patients who confabulate have a distorted sense of chronology, so that they may remember the contents of the events but not the order in which they occur.² This theory has been developed based on the observation that many confabulations may be tracked to a true original memory that is poorly situated in time or context.⁵ Although this explanation was already proposed by Korsakoff,⁶ currently we can find two slightly different versions within this perspective, one being that of the Dalla Barba group and the other of the Schnider group.

Dalla Barba et al.⁷⁻⁹ defend that confabulations reflect a pathological awareness of personal temporality. They hypothesize two models of awareness, *knowing consciousness* and temporal consciousness. They differentiate three dimensions of temporality -past, present and future - that could be related with three types of confabulations associated to past episodic memories, temporal-spatial disorientation and future plans, respectively. The

confabulations would affect these three dimensions and consequently would be considered as the result of a deficit in the temporal consciousness, which is responsible for the capacity to assign the representations of the memory to specific moments in time. As a result, habits and semantic knowledge are incorporated as personal events.

On their part, for Schnider and team,¹⁰⁻¹⁴ confabulations (spontaneous ones with behavior repercussion) are the result of a confusion of the current reality with past events. They designed a recognition task that is made up of two trials. In the first, the subject is shown a long series of pictures and is asked to indicate those that reappear during the course of the trial. One hour later, the second trial is administered on this task in which the same pictures are presented, but in different order. They are asked to forget what they have seen before, this task consisting in indicating which drawings are repeated within it. The first trial measures the capacity to learn and recognize new information. The second trial measures the capacity to detect if memory evoked by the representation of an item refers to that which is occurring at present or that which occurred in the previous trial. Schnider et al.¹⁰ found that while all the amnesic patients performed poorly on the first trial, only the amnesics who were also confabulators, also performed poorly on the second, committing errors called "temporal content confusion" (TCC). TCC is a tendency to use information that may have been relevant in a previous context and to insert it into a current context, when it is no longer relevant or appropriate. They hypothesize that an increase of the TCC and, therefore, of the confabulations, come from an incapacity to suppress previously activated memory traces, although currently irrelevant, this suggesting that suppression is the primary mechanism. This would be a very early processing process in which the relationship of a memory with reality would be verified, even before the context could be recognized, thus explaining the strong conviction with which the truthfulness of the memories is maintained. They propose that for spontaneous confabulations to occur, the crucial brain area is the anterior limbic structures, and more specifically, the orbitofrontal prefrontal cortex. They propose confabulations as a model to study how the brain adapts thought and behavior to the current reality. The confabulating acts based on inadequate memories in the present moment, based on expectations that cannot be satisfied in the present, which is based on some memories to which they are giving preeminence. In this way, they link the brain reward system with the confabulations and the capacity to monitor the current reality in relationship to thinking and behavior.

As Metcalf et al.¹⁵ point out, the principal limitation to the temporality hypothesis, both regarding the interpretation of Schnider and that of Dalla Barba, is that temporal context confusions have been observed both in confabulators and in non-confabulator amnesic patients. Furthermore, although

other authors find evidence of temporal confusion in confabulator patients,¹⁵ this was not more than one of a series of factors contributing to confabulation. Other important factors were: a) executive dysfunction, b) cues from the immediate setting, that either cause confabulation or influence their content and c) perseverations, especially in the semantic domain.

In the third place, the theory of monitoring reality and source deals with a more general case of the temporality theory, and will be commented on in this section. It understands confabulations as the result of an incapacity to determine the source of the memories.² Monitoring reality refers to the process of distinguishing a perception of the past of an act of imagination of the past.¹⁶ Monitoring the source also contemplates the capacity to distinguish different sources of information and to specify the conditions under which a memory was acquired (e.g., the spatial, temporal and social context of an event; the setting and modalities through which they were perceived).^{17, 18}

According to Johnson et al., memories generated internally differ from those generated externally by having fewer spatial and temporal contextual attributes and fewer semantic details. On the contrary, they have more operational attributes associated with them and coded in memory traces. They propose that the brain distinguishes between memories regarding real events and those regarding imaginations based on the quality of the memories, it being possible to give rise to confusions of time and context (source monitoring) or of events experiences or imagined (reality monitoring). These authors establish that a failure in the different mechanisms could underlie the production of confabulations, including a failure in the coding, retrieval, motivation and evaluation processes. Deficits in judgment or motivation could give rise to using lax decision criteria to evaluate the reality of an event. Poor functioning of the retrieval processes could give rise to failed access to stored information that could be useful when identifying the source of a specific event. And the failed acquisition could produce memories that would lack the type of cues that would help to determine the source in a normal process.¹⁹

From the investigations performed aimed at testing this hypothesis, it can be concluded that although failure in source monitoring is a characteristic of the confabulations, it is not the cause.¹⁴ This is, the incapacity to indicate the time in which something occurred in the past and to indicate the source of this information is present in the confabulating patients, but is not specific to them (the monitoring deficit of source can occur in patients with very little, or no, confabulations (nor does it predict the confabulations. Furthermore, there is some discrepancy about the brain regions involved in source monitoring (dorsolateral prefrontal regions) and those identified as crucial for the confabulations (orbitomedial and ventromedial regions).^{2, 14}

The empirical evidence supporting the temporality theory fundamentally comes from studies on confabulations in the episodic domain. However, these theories cannot explain spontaneous or fantastic confabulations, and the confabulations cannot affect the semantic memory.²

Retrieval theories

Confabulations are an excellent example that memory is a reconstructive process²⁰ and in virtue of this, they could be the result of deficit in the retrieval processes of the information from the memory more than deficits in decoding, consolidation or storage processes. The most solid evidence in favor of the retrieval hypothesis is that it affects both remote memories and those acquired after the establishment of the deficit. However, retrieval is not a unique process and an attempt is made to determine what aspect of the retrieval is deteriorated in patients who confabulate.²¹

There are two theories developed in different contexts (Moscovitch et al. based on patients; Burgess and Shallice²² based on healthy controls), that explain the dysfunctional retrieval processes that could give rise to the confabulations.

Gilboa and Moscovitch² developed a global neuropsychological model of the memory that could explain the phenomenon of the confabulations. The coding and storage processes of any event experienced consciously are dependent on the hippocampus and related limbic structures. The hippocampal complex helps to form a memory trace that consists in the joint activation of a group of neocortical neurons. These memory traces are distributed at random, that is, they are not organized by subjects or temporal order. These authors^{2, 23-25} distinguish two types of retrieval processes: *associative /dependent on cues and strategic*. The first is a relatively automatic process in which a specific proximal cue automatically interacts with the information storied in the memory to retrieve the memory sought and other memories that serve as material for more searches. They call these ecphory cue storage interactions and agree that they are mediated by medial temporal lobe and posterior neocortex structures (the cue directly activates the hippocampal-neocortical neuronal group). The strategic retrieval processes, on the other hand, are routines that are applied to the memory when the proximal cues are ineffective. On the *input* level, the strategic processes contribute to:

1. framing the memory problem (establish a retrieval mode);
2. using general and personal knowledge to constrain memory until the routines dependent on associative cues can generate a possible solution.

On the *output* level, post-ecphoric strategic processes include:

3. monitoring, which implies evaluating and verifying the accuracy of the retrieved memory, and
4. locating the retrieved memory within the appropriate space-temporal context in relationship to other events.

It is supposed that the strategic retrieval processes are mediated by the prefrontal cortex that acts as a structure that works-with-the-memory, which initiates and organizes retrieval, and after the information has been retrieved, participates in the monitoring, evaluation and verification of these retrieved memory traces.

Additionally, Moscovitch and Winocur²⁶ developed a model on the hypothetical roles of prefrontal cortex in the strategic recovery and its interactions with the hippocampal complex (Figure 1).

This model suggests that if the internal or external cues cannot generate a memory directly, the dorsolateral prefrontal cortex initiates the recovery, initiating a retrieval mode that establishes the objectives of the task. The ventrolateral prefrontal cortex plays a role in the specification and description of the necessary cues to access and interact with the hippocampal complex code, which generates the memory trace. This process is reiterative. Once the memory trace is activated, the information passes to the ventromedial prefrontal cortex, which determines its acceptances or rejection, based on an intuitive "sensation of correction." This region can play an inhibitory role (of rejection) in a dual process, in which the frontal pole plays the role of reciprocal confirmation. The dorsolateral prefrontal cortex intervenes in the additional processing and in the strategic deliberation, interacting with the posterior and ventrolateral neocortex to determine the compatibility of the retrieved memory with other knowledge and influences in the selection of the response.

This model could explain both the spontaneous and provoked confabulations. Although the errors in the retrieval process directed by cues can give rise to confabulations, they are not a necessary condition to confabulate, but then the strategic recovery process must be initiated. In the confabulations, the initiation process of the search often fails, giving rise to a high rate of omissions, which could be a result of a dorsolateral prefrontal cortex dysfunction. Poor specification of cues by the ventromedial prefrontal region could give rise to the activation of memories that are inconsistent with the memory task in the existence of lesions in this area give rise to indiscriminate acceptance of the memories activated and thus, in the case of erroneous traces, to confabulations.

As indicated by Metcalfe et al.,¹⁵ in the Moscovitch group model, the final process of locating the memory within the

appropriate space-temporal context is not well explained. The proposal of Burgess and Shallice,²² based on the analysis of the analysis of the autobiographical protocols of healthy volunteers, elaborates this question better, proposing that the dysfunction of the temporal context is part of the monitoring and evaluation process. These authors identify three components of the strategic retrieval model:

- a) *description processes*, that specifies the type of trace that satisfies the demands of the retrieval task;
- b) *memory editing processes*, that are continually involved in verifying that the different outputs of the memory search adapts between each other and to the requirements of the task, and
- c) *mediator processes*, that are general strategic procedures and those of problem-solving used to monitor adaptation and plausibility of the retrieved memories, but they are not specific processes of memory.

For these authors, the confabulations are the result of deficits in the description, edition and mediator processes. The involvement of the different components will give rise to different types of confabulation.

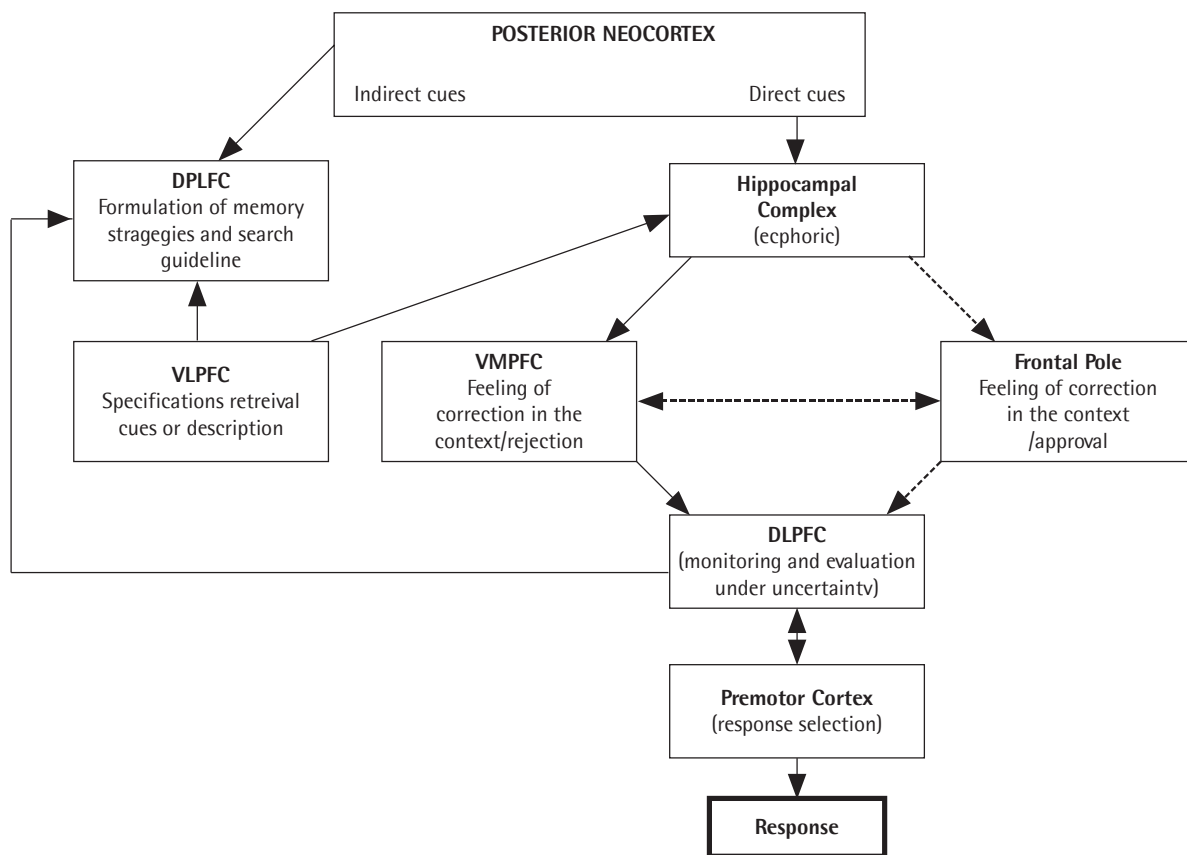
In summary, according to the theories of the retrieval deficits, it is considered that confabulations are the result of: a) a system of defective memory that creates failed cue-memory associations; b) failed search strategies that cause omission errors and commission errors on accessing erroneous proximal cues; c) both of the above are necessary conditions but not sufficient for confabulations to occur. The third component that gives rise to confabulations would be defective monitoring and error on suppressing failed memories.²

From the point of view of more specific neuropsychological deficits, worse performance in recall memory than recognition as well as specific executive deficits, such as problems to initiate response (of search) and problems to monitor and suppress inappropriate responses would be expected in accordance with these models. However, as has been reviewed in a previous work,¹ the neuropsychological correlates of the confabulations found have not been consistent in the different works. However, it seems that both a memory and executive dysfunction are necessary elements, their characteristics are not sufficiently specified.

MOTIVATIONAL MODELS

Compensation

The first investigations on the subject considered confabulations as a reflection of the psychological defense mechanisms activated in response to the "predicament" or to



DLPFC = Dorsolateral Prefrontal Cortex; VLPFC = Ventrolateral Prefrontal Cortex; VMPFC = Ventromedial Prefrontal Cortex; DLPFC = Dorsolateral Prefrontal Cortex.
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Figure 1 | Proposal of neuropsychological model of strategic retrieval to explain the confabulation's (taken from Moscovitch and Winocur, 2002)

the need to cover memory lapsus or fill knowledge gaps.²⁷ They also resorted to the high suggestibility of the patients who confabulate. However, implicit in the definition of confabulation is the fact that the patient is not aware of the memory deficit or at least not capable of appreciating its severity and implications. Thus, it is difficult for the embarrassing situation of not remembering information to motivate the filling of the "vacuum" with a confabulation. There is also evidence that patients who confabulate are not more prone to suggestion than those who do not confabulate.²⁸ For these reasons, this hypothesis has progressively been losing acceptance. In addition, in any event, the compensation theory could explain the secondary confabulations developed to reconcile the beliefs but not the primary confabulations.

The affective neuropsychology of the confabulations

More recently, however, interest has been recovered in the emotional aspects and content of the confabulations.

Fotopoulou et al.,²⁹⁻³⁴ motivated by the clinical descriptions of Conway and Tacchi³⁵ of a female confabulating patient who had constructed the events of her past much more favorably than they really were, began to take interest experimentally regarding the role of emotions in the confabulations.

The authors were able to demonstrate their principal hypothesis, that the false memories of the confabulating patients have a self-serving bias that is superior to that usually found in the memory distortions of the healthy volunteers.^{29, 32} As commented by Fotopoulou,³⁴ the exaggeration of these memory biases is not seen as a motivational exaggeration per se (psychogenic explanation) but rather is conceptualized as the direct result of reduced executive control on memory, thus allowing integration of this model with other more established positions. They propose, therefore, a compromise between the influence of the cognitive control and motivational influences in memory. More specifically, they propose that when the irrelevant

representations are not inhibited in the memory and the memories are not appropriately retrieved, the motivational factors can acquire a more important role when determining which memories are selected for retrieval and accepted as true.

OVERALL PROPOSAL OF THE MOSCOVITCH GROUP

Gilboa et al.³ performed a series of experiments aimed at studying if the temporality hypothesis could be adapted within the strategic retrieval hypothesis. They finish by concluding that, in fact, the evidence supports the strategic retrieval models on the explanations based on temporality, considering the following results: 1) The content confusion errors are as frequent in the confabulations as the context confusion errors; 2) there are also confabulations in semantic memory retrieval (where the temporal context is not irrelevant); and 3) confabulations appear even when the components of initiation and search for the retrieval process are minimized, suggesting that the defective monitoring in retrieval is a crucial element for confabulation. These questions allow the authors to reformulate the previously presented strategic retrieval model, fundamentally 1) extending the specifications and importance of these monitoring processes in the production of the confabulations and 2) integrating elements from other models, which would determine the content of the confabulations and exacerbate their production. In a later article, Gilboa⁴ improves the proposal even more, specifically distinguishing between core, constitutional deficits and characteristics associated to the confabulations. The model is shown in the following (Fig. 2).

Among the core deficits, that is, those necessary for the confabulations to occur, he distinguishes, on the one hand, a monitoring deficit, which would refer to two subprocesses (monitoring of the "feeling of rightness" and of "editor"), and on another, a deficit in the control processes. The constitutional deficits would be those that occur in all or almost all the confabulators, their convergence together with the core deficits being necessary for the confabulation to occur. However, they are not specific to the confabulators. Memory dysfunction, search strategy (initiation of search and cue specification) and temporal context confusion (TCC) errors would be constitutional processes. Finally, there would be characteristics associated to the confabulations, such as desires, source monitoring deficits, schemas, environmental cues, the perseverations and familiarity, that determine the frequency of the confabulations and their content. Some of them are normal characteristics of the reconstruction of the memory more than "deficits" (e.g., biases in retrieval of more positive content; priority of the well-established representations).

Thus, this working-with-memory model makes it possible to explain the confabulations and their different

manifestations. Briefly, we see the functioning of each one of the most important components, following Gilboa et al.³

Formulation of a retrieval strategy

The authors consider that the formulation of retrieval strategies, defective search strategies, can, on the one hand, give rise to absence of response. However, on the other hand, the content of the confabulation could also be affected, thus generating an associative retrieval, as occurs when perseverative responses appear in memory tasks. Furthermore, the cues from the immediate environment would serve as responses when an internal search strategy is not applied.

Specification of the retrieval cues

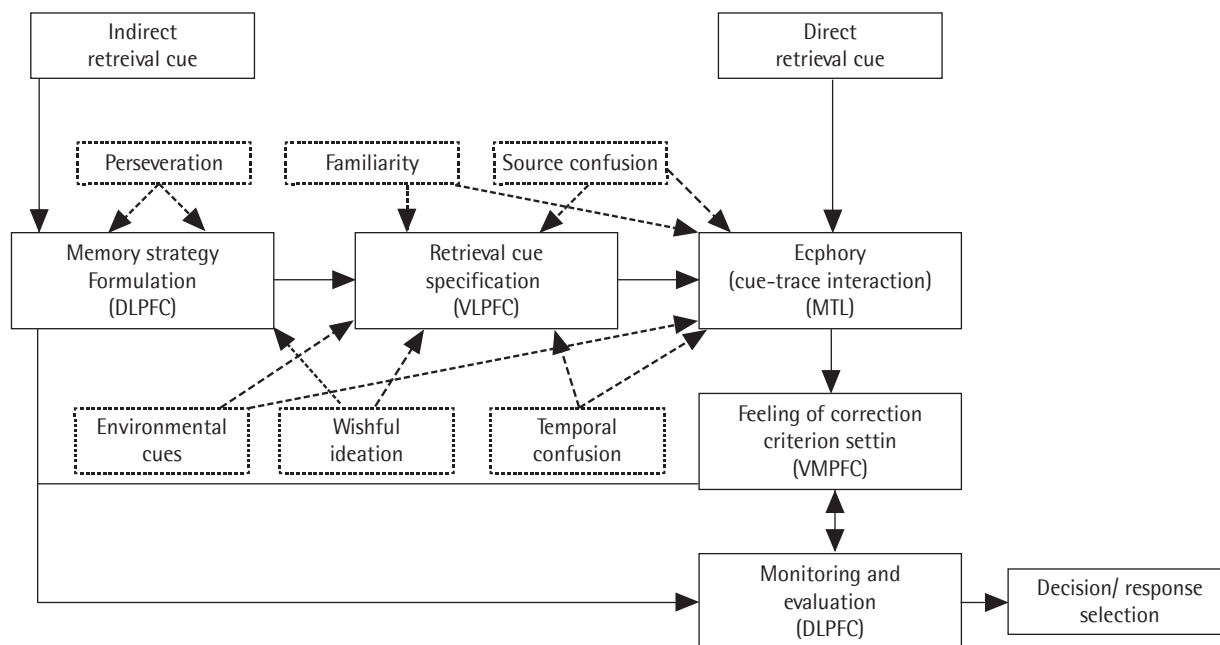
The following process considered by the authors as necessary when a search strategy is formulated and initiated is the generation of a series of retrieval cues to reach the long-term memory storage. Defective formation of cues would give rise to erroneous or irrelevant interactions between them and the representations of the memory (ecphoric). The authors mean that this thus explains the content and context confusions. In addition, they consider that wishful ideation would also give rise to positive biases in the confabulation content as it would also act as a generator mechanism of irrelevant retrieval cues.

Monitoring

The authors propose that amnesia, poor search strategies and deficient specification of cues may give rise to the activation of inappropriate memories in all the amnesic patients studied (patients with ruptured anterior communicating artery aneurysm) but that, in addition, confabulators produce a greater number of unusual errors (idiosyncratic intrusions, acceptance of unbelievable information), attributing these errors to monitoring mechanism failures.

Pre-conscious "Feeling of rightness or correction"

The authors propose the existence of a pre-conscious mechanism, consisting in a feeling of correction, that guides the decision making of the memory. A failure in the adjustment of the "feeling of rightness or correction" would give rise to one of the clearest clinical characteristics of confabulations, the subject's absolute belief about the truth of the erroneous memories. In the way that the authors propose, there would be three assumptions on which this



When a memory cue does not directly activate a memory representation, reiterative WWM processes need to be invoked in order to generate appropriate memory cues. WWM processes comprise of three basic processes: (i) formulation of a search strategy mediated by the dorsolateral PFC (DLPFC); (ii) specification of retrieval cues mediated by the ventrolateral prefrontal cortex (VLPFC); (iii) feeling of rightness and monitoring and evaluation (DLPFC). Cue-dependent retrieval rarely results in confabulation, and when errors occur they are usually considered intrusions or false recognitions and are independent of confabulation. Confabulation occurs when feelings of rightness and monitoring components fail to filter out erroneous memories. The content of confabulation is influenced by processes such as the ones denoted by dashed boxes and arrows that affect working-with-memory processes.

Figure 2 Working-with-memory and confabulations (taken from Gilboa, 2010)

process would function: i) the feeling of correction is the result of an early categorical selection (true/false) of memory cues based on its compatibility with the general cognitive schemas that guide or serve as support for the reconstruction of the memories. ii) There would be two factors that affect the intensity of the correction feeling: the strength of the schema and grade of compatibility or deviation of the memory from it. iii) The most relevant, rich and robust cognitive schema is that of the self. Autobiographic memories, therefore, would evoke an extraordinary sense of confidence in their truthfulness.

The suggest that when there is a failure in the preconscious processes of feeling of correction, the result is the appearance of acceptance of false memories with high confidence, and considering that the autobiographical memories play an important role in the guidance of behavior, confabulations with the behavior repercussion would appear.

Gilboa et al.³ point out some data that indicate the ventromedial and orbitofrontal prefrontal cortex as a possible neuroanatomic base of this process, since, specifically the ventromedial prefrontal cortex has been proposed as an integrator element of the cognitive processes with somatic signs that is capable of biasing decision-making on a preconscious level.^{36, 37}

Monitoring and evaluation

The final fundamental process proposed by the authors would be the constant evaluation of the retrieved memories, in order to verify their truthfulness. Thus, these memories are compared with other retrieved contents, with the available information and with the memory task using similar processes to problem-solving procedures. These largely depend on the working memory and also on the detection and conflict resolving processes. The authors

suggests that the poor functioning of these processes would give rise to confabulations that not only are inexact in regards to retrieval content but also that they would lack internal consistency.

The authors contemplate the possibility of interaction between the monitoring systems. Thus, early, rapid decisions based on emotional processing could be followed by a careful cognitive evaluation on their plausibility. It is also possible that when the contradictions are confronted, healthy subjects may admit the failure of their memories, even if the "feeling of correction" persists. Therefore, if a system assumes the functions of another one, the confabulations may be resolved.

Relationship with temporal confusion

Finally, the authors complete the explanation of their model searching for parallelisms with the systems proposed by other models. They propose that the two monitoring systems proposed would correspond with two forms of representation of temporal information. On the one hand, the "feeling of correction" would correspond to the concept of the "Temporal Context Confusion" of Schnider in the sense of adaption or suppression of thoughts to the current reality. Both are conceptualized as rapid, automatic and relatively impenetrable to reasoning. Both are represented directly and have a strong affinity with the motion or the brain reward system whose epicenter is in the ventromedial/orbitofrontal cortex. In the second place, the monitoring and evaluation system are related with the constructive nature of the autobiographical memory and probably with the dorsolateral prefrontal cortex.

CONCLUSIONS

Confabulations are a good example to illustrate memory as a reconstructive process. The first models on confabulation, that consider them a result of the need to fill memory gaps, are currently outdated, although the emotional elements are being considered to explain their content. From neuropsychology, many authors have made proposals to explain the phenomenon. Fundamentally, these could be grouped into those that define them as a result of a temporality problem and those that have been emphasizing dysfunction in retrieval processes. Within the latter, this theory that has been most developed and that accumulates more evidence is that of the Moscovitch group.²³⁻²⁶ They formulate confabulations as the result of a dysfunctional strategic retrieval process, in which, more than search processes, the most important for their appearance would be the efficacy of the monitoring processes. In their most recent version,^{3, 4} they give even more importance to the

relevance of the defective monitoring process, distinguishing several subprocesses within these, that would act both on a preconscious level, automatically conferring a feeling of adaptation to the retrieved material, as well as subsequently evaluating the adaptation of this material more consciously. Finally, they establish parallelism between the processes described by them and those developed by other relevant models, including the series of temporality to those of strategic retrieval.

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