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The hippocampus facilitates integration within a symbolic field

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This paper attempts to elaborate a fundamental brain mechanism involved in the creation and maintenance of symbolic fields of thought. It will integrate theories of psychic spaces as explored by Donald Winnicott and Wilfred Bion with the neuroscientific examinations of those with bilateral hippocampal injury to show how evidence from both disciplines sheds important light on this aspect of mind. Possibly originating as a way of maintaining an oriented, first person psychic map, this capacity allows individuals a dynamic narrative access to a realm of layered elements and their connections. If the proposed hypothesis is correct, the hippocampus facilitates the integration of this symbolic field of mind, where narrative forms of thinking, creativity, memory, and dreaming are intertwined. Without the hippocampus, there is an inability to engage many typical forms of thought itself. Also, noting the ways these individuals are not impaired supports theories about other faculties of mind, providing insight into their possible roles within human thought. The evidence of different systems working in conjunction with the symbolic field provides tantalizing clues about these fundamental mechanisms of brain and mind that are normally seamlessly integrated, and hints at future areas of clinical and laboratory research, both within neuroscience and psychoanalysis.

Keywords: psychoanalytic field, symbol, imagination, memory, alpha function, beta element, transitional object, dream, REM, NREM, intersubjective, bilateral hippocampal injury, Bion, Winnicott

Introduction

This paper selectively explores an integration of work by Donald Winnicott and Wilfred Bion with the neuroscientific evidence base regarding hippocampal function to speculate on something I am calling a symbolic field of thought. I will demonstrate how both theoreticians explored ideas that are foundational to the concept of psychic fields, and how specific integration of symbolic material is fundamental to this form of thought. I will then present neuroscientific evidence that integrates with these ideas and demonstrates how the hippocampus facilitates a first person, integrative symbolization of thought in a way that is linked, but fundamentally abstracted from, being in the external world. This evidence will support the proposal that in healthy form, hippocampal function inherently facilitates both the ongoing symbolization of neuronal stimuli and enables the ongoing reintegration of symbolic elements, forming a dynamic state of stable enough flux within the field itself.

The examination will propose that this process is very common, including its occurrence in such everyday events as a person describing a first person narrative, experiencing an integrated dream, imagining a route, or trying to solve a problem that draws on the use of symbolic information. It is a fundamental component of memory, creativity and thought itself.

However, just as critical as the symbolic field is the evidence of alternate systems of thought that become increasingly evident once the symbolic field is impaired. I will demonstrate how alternate methods of stimuli processing are also common and normal in everyday life, possibly even required for eventual symbolization to occur. This exploration lends itself to speculation of how the symbolic field appears to 'lay between' or 'on top of' multiple systems of thought, supporting, but also challenging, some of the theoretical musings of Winnicott, Bion and later theoreticians.

When running well enough, this dynamically integrative process provides the possibility for ongoing psychic adaption. It forms a flexible psychic map that helps individuals navigate their daily lives. The evidence provided is supportive of many psychoanalytic and neuroscientific theories, but expands and challenges others in productive ways. This examination also provides a fundamental framework where each discipline benefits the other in substantial and tangible ways.

The integration of neuroscience and psychoanalysis

There is a controversy regarding the integration of neuroscience and psychoanalysis. On one hand, some authors are exploring possible neurologic underpinnings around psychoanalytic concepts such as object relations (Kernberg, 2015) and dream material (Blechner, 2013). One group has even presented 'The Case for Neuropsychoanalysis' (Yovell *et al*., 2015) claiming its central relevance to psychoanalysis. However, this idea has been directly challenged by others who point out problems with several neuropsychoanalytic claims, even going so far as to state that several neuropsychoanalytic ideas, in their presented form, are frankly harmful to psychoanalysis as a whole (Blass and Carmeli, 2015). They point out that simply observing an overlap of described phenomenon is not, in itself, valid justification for the adoption of neuroscientific ideas by psychoanalysis, especially when the direct added value to psychoanalysis is unclear or even counter to contemporary psychoanalytic ideas and technique.

I agree with the critique of neuropsychoanalysis made by Blass and Carmeli in that any claim about the integration of neuroscience and psychoanalysis needs to prove and justify its relevance and value to each field with a full, fair and reasoned debate that pays fair heed to the reasoned methodologies of each field. I believe the phenomenon discussed below might meet such criteria.

Fields of interconnected symbols

A symbol is most simply defined as a thing that stands for something else. A field is a psychic space that is defined through forces that lend a particular dynamic nature to the surrounding space (Bohleber, 2013). Theories of

the mind's use of symbols and the concept of psychic fields are increasingly relevant to psychoanalysis and neuroscience. Within psychoanalysis, this began at its founding, with Freud referring to symbols in some of his first publications in 1893 (Freud, 1893) and in increasing detail when describing the shifting quality of symbols and their connections in dreams through the mechanisms of symbolization, displacement, projection, condensation, and rationalization that appear to underscore, shift, alter and distort mental material to become the manifest content of a dream (Freud, 1900).

The exploration has continued since that time. As of March 2015, 9604 articles referred to symbol use on PEP web. Fully every area within psychoanalysis addresses this topic. References to the hippocampus are somewhat more selective with only 483 articles listed.

In this paper I will focus on some of the fundamental ideas that formed my understanding of symbols and psychic fields, focusing on contributions by two influential authors, Donald Winnicott and Wilfred Bion. While I am aware the term 'psychic field' was not explicitly used by either Winnicott or Bion, they are often cited as fundamental in the concept's development (Bohleber, 2013) and I will demonstrate how I believe some of their ideas are adequately encompassed by this term.

Winnicott theorized about early symbol use from the perspective of a pediatrician engaged in observation of a mother and child and viewed psychic development as fundamentally requiring the playful creation and maintenance of transitional objects which inherently allowed space for experimentation with symbols and thought (Winnicott, 1953).

In his later career Winnicott became increasingly comfortable in underscoring this space's importance in daily life. In *Playing in Reality* he titles a chapter 'The Place Where We Live' (Winnicott, 1971, ch. 8). Here, rather than try to technically tell us what he means about 'where we live', he provides an experience of the place where his conception of the human mind resides:

> I may be *in* a muddle, and then I either crawl out of the muddle or else try to put things in order so that I may, at least for a time, know *where I am*. Or I may feel I am *at sea*, and I take bearings so that I may come to port (any port in a storm), and then when I am on dry land I look for a house built *on* rock rather than on sand; and *in* my own home, which (as I am English) is my castle, I am *in* a seventh heaven.
>
> (Winnicott, 1971, p. 104)

He then underscores that an important question about this expression is not only 'what is one doing?', but 'where is this?' He metaphorically recalls a string that both connects and separates objects, a fundamental and necessary component of everyday thought that exists in a potential space between not only objects, but between internal and external reality. This intermediate space exists in an individual listening to a symphony, an infant under the aegis of a mother, a group of teenagers participating in a pop session, and, I will add, between a good enough analyst and analysand. The space is filled not by the external world, nor by hardwired instinct or even inner

reality, but by the living integration of these elements within minds in that given moment. Somehow, in this space a capacity is born for an 'I' to be, to go, and to do in a fertile integrative playground of imaginative possibility. It is in this 'place' where people manage to psychically experience not only imagination, but also a space to authentically be alive within their minds (Winnicott, 1971, ch. 8).

Similarly, Wilfred Bion developed a concept of mind as being made up, in part, of a dynamically interwoven lattice of elements and links (Bion, 1959). In this model, various parts of the nervous system transmit neuronal stimuli to the brain which transforms this stimulus into basic thought elements. The unabstracted agglomeration of psychical and physical neuronal stimuli around an experience are referred to as beta elements (Bion, 1962, p. 58). Beta elements have various descriptors like 'static elements', 'things in themselves' and 'undigested facts' (Bion, 1962, p. 7). While beta elements can be abstracted into symbolized elements of thought, as beta elements they are unmetabolized by normal thought processing and are 'unthinkable'. They exist *outside* conscious thought, memories or dreams. However, beta elements can be elaborated through projection and action and be 'acted out' by the individual, but in ways that are largely outside consciousness.

Through a process of alpha function, Bion proposes beta elements can be abstracted into alpha elements. Alpha elements can be linked together in sensical and dynamic ways that are fundamental to thought, memories and dreams (Bion, 1962, ch. 20). Bion is quite explicit in his statements that those who cannot engage in alpha function cannot engage in functional dreaming (Bion, 1962, p. 15).

Bion, like Winnicott, refers to the in-between or interpreter aspect of symbolic thought as fundamental to a functioning form of creative and dynamic thinking. In *Learning from Experience*, Bion describes alpha function and dreaming as forming a 'barrier' between, but also interconnecting, conscious and unconscious thought, thus protecting the mind from a near psychotic state (Bion, 1962, p. 16).

Both Winnicott's transitional spaces and Bion's alpha function have been fertile ground in psychoanalysis. Winnicott's later work is increasingly centred on facilitating a space where a patient can have the capacity to think in unrestrained and authentic ways. Bion's alpha function in turn is linked to a concept of reverie, a state attained either alone or with others where elements of thought can be metabolized, either by abstracting beta elements into alpha elements, or by working with alpha elements to further metabolize experience in meaningful ways. Of note, Bion, like Winnicott, does not limit this psychic function to occurring between certain combinations of people and instead describes an apparatus of mind that may engage when certain psychic conditions are met and are possible in individuals *and* groups. In *Learning from Experience* he theorizes about a container and contained which might initially begin for an infant through a relationship with its mother, but which may be internalized in the infant and thus result in a process that exists completely within an infant's mind, (Bion, 1962, p. 91). He then variously describes this function as occurring in dyads (Bion, 1967, p. 116), possible in individual minds (Bion, 1992, p. 53) or groups (Bion, 1962, p. 99). To me, it

seems that for both Bion and Winnicott, details about the number of specific minds involved in the process are less important than having the necessary capacity for this psychic apparatus to function.

Bion does make clear that there are methods and conditions that may enhance or incapacitate this process. In his Los Angeles Seminars, Bion makes explicit and practical recommendations that analysts should abandon memory and desire, implying that active, conscious, pre-session influence of memory and desire impairs the analyst's ability to engage in reverie with patients during the session (Aguayo, 2014).

The use of reverie to facilitate exploration of psychic space has been expanded by other authors since that time. Thomas Ogden wrote about reverie and the third (Ogden, 1994). The Barrangers developed psychoanalytic field theory which has continued to be developed by Antonio Ferro, Giuseppe Civitarese, and others (Civitarese and Ferro, 2015, ch. 1). And while many theoreticians focus on the intersubjective nature of certain psychic fields (in no small part due to its direct clinical relevance to psychoanalysis), there has been ongoing recognition of how psychic fields also occur within individuals[1] (Bohleber, 2013).

Less well known to the psychoanalytic community is that similar ideas exist within the field of neuroscience. While the language is different, there are theories that propose the mind integrates fragile new memory traces into shifting networks of remote and semantic memory (Nadel *et al*., 2012). There is emerging research regarding a state of ongoing dismemberment and consolidation of complex interrelated memories of all types that selectively strengthen and recombine elements of these traces and effect the network as a whole (Wamsley and Stickgold, 2011). It is recognized that much of this integration occurs in various forms of thinking, taking advantage of mental systems that are particularly active in various stages of sleep (Wamsley *et al*., 2010a, 2010b), but also can be taken advantage of while awake (Llewellyn, 2013).

I wish to underscore how all these perspectives zero in on one aspect of the mind *as an informational matrix, lattice, space or field, frequently taking the experiential form of a first person narrative, where the primary aspect of the field is its dynamically interconnected symbolic nature*. I will refer to this as the symbolic field. The symbolic field is a psychic space where *everything in the field has nuanced meaning primarily through dynamic symbolic relationships within the field itself*. While this field is facilitated by hippocampal function, and stored organically in a distributed fashion throughout one or more brains, the symbolic field itself is not made up of organic material, but is usefully conceived of as being composed of the dynamic informational lattice alone. This symbolic field is often experienced as central to the self, with nuances of dynamic flux that are fundamental to a sense of identity, imagination, thought and dream. In keeping with the concept of fields, I am theorizing that while symbolic fields can be unique to each individual, they can also be attuned with others, creating shared 'rhythms' or tight processing networks of thought. This concept is in keeping with the above ideas of Bion and Winnicott, but also the neuroscientific recognition that brains

[1]For example, Antonio Ferro calls individual psychic fields "subjective fields" (Bohleber, 2013).

already contain multiple and often near-duplicate processing centres of information that are in communication with each other in various ways. This, combined with our evolutionary history of functioning in groups, provides evidence that humans are in many ways fundamentally adapted to be distributed processors of psychic information, and this is true whether we recognize the multiple dendrites within one section of the brain as separate processors in communication, identify the hippocampi and amygdala within a single brain hemisphere as separate but in communication, consider two brain hemispheres communicating via the corpus collosum, or see two or more physically separated brains working in conjunction in processing certain psychic stimuli. Distributed processing adds redundancy, stability, nuance and power[2] to any computational system, but makes the exact determination of 'what is happening where' increasingly difficult.

However, even with distributed processing, there is still one situation that can starkly reveal the role of specific brain structures in the processing of information, the situation of zero. So while I believe symbolic fields are a 'scalable' phenomenon that are fundamental to many forms of psychic fields, including intersubjective fields, I also believe the investigation embodied in this paper is most simply begun through the examination of individuals whose hippocampi are bilaterally non-functional. This leaves the presentation of direct evidence of the scalability of this symbolic process outside the scope of this paper, but I hope most readers will begin to recognize the applicability of this concept to larger groups once the initial evidence is presented.

While the concept of a symbolic field overlaps the psychic spaces proposed by Bion, Winnicott, and other authors, the integration of neuroscientific evidence with psychoanalytic ideas will hopefully add valuable perspective to this concept of mind. While there are difficulties in interpreting the different cultures, I believe the integration tangibly underscores the presence and function of symbolic fields, but also reveals how this symbolization is simply a part of a larger dynamic structure of mind. For example, this exploration will illustrate distinct and measurable boundaries related to symbolic fields. Similarly, it is quite clear that those who cannot maintain this kind of symbolic function *are* still able to learn from certain kinds of experience, psychic and otherwise, challenging some previously held psychoanalytic conceptions. However, especially important to psychoanalysis, there is evidence that there are specific conditions where the symbolic field can be made to flourish, languish, grow or collapse. This, combined with evidence that symbolic activity could be a measurable phenomenon within the brain, provides potential pathways for psychoanalysts to generate further techniques to help our analysands, and ourselves, develop this important aspect of mind.

The hippocampus

The hippocampus is a deep in-folding of the surface of the brain that is sometimes referred to as the 'paleo cortex', due in part to its evolutionary

[2]Each combination of processing units can create unique and new phenomenon that is not simply additive in comparison to other systems.

positioning between the primitive 'reptilian brain' that controls fundamental body functions such as breathing and the more recently developed neocortex.

The hippocampus emits an oscillatory wave that is picked up on electroencephalography (EEG) with a frequency range of 3 to 10 Hz and is known as the 'hippocampal theta rhythm'. In rat models, the theta rhythm is most present during periods of exploratory activity (when a rat is exploring new surroundings or searching for something) and is regarded as being a neuro-physiologic component of REM sleep (Poe *et al.*, 2000) a period associated with strongly emotional and integrated night-time dreaming (Wamsley and Stickgold, 2011). It decreases when the rat is engaged in activities that are less exploratory, like eating or grooming (Hasselmo *et al.*, 2002). The hippocampal theta rhythm has been confirmed to occur in the human hippocampus as well (Ekstrom *et al.*, 2005).

While rare, there are a number of situations where the hippocampus becomes damaged bilaterally, knocking out this brain function and giving researchers the opportunity to note the impacts of the damage, but also hypothesize on the function of the hippocampus when intact.

Anterograde amnesia

One catastrophic impact on individuals with bilateral hippocampal damage is the profundity of their memory impairment. Classically, this takes the form of the individuals only being able to hold new pieces of information in mind while maintaining conscious, focused attention. If they become distracted for even a few moments, the information is permanently inaccessible in a way that makes it apparent that the information had not been fundamentally stored in some crucial way. Current organic models of this process hypothesize that hippocampal function somehow facilitates transition of memory from a form requiring immediate attention into extra-hippocampal forms that exist in a distributed way throughout the neocortex (Yamashita *et al.*, 2009; Winocur *et al.*, 2010; McClelland *et al.*, 1995).

An example of this tragedy is the unfortunate experience of Clive Wearing. A British conductor prior to a severe infection of viral encephalitis that destroyed much of his bilateral temporal lobes, Mr Wearing was tortured by his inability to store psychic events so they would mentally persist outside the present moment. A radio show interviewed Clive's wife who described journals filled with dated entries, with many entries claiming to be the first 'real' Clive and that all the previous entries were written by someone else, with those entries only to be crossed out later and replaced by the most current entry (Abumrad, 2007).

However, while anterograde amnesia exists in patients with hippocampal damage, more nuanced studies surrounding the role of the hippocampus in mental function have occurred in the last 10 years that have dramatically augmented the understanding of memory, imagination, thought and dream.

Boundary extension hints at symbol use

Boundary extension is an effect that is easily tested, but interestingly, is evidence of a mental 'error' that is present in people *without* brain injury. It is

demonstrated by showing someone with normal hippocampal function a picture of an object with a background (for example, a teddy bear in front of a stairway) and asked to remember the picture. The picture is then hidden from view and the individual is asked to draw the exact picture from memory. Through careful testing it has been validated that individuals *without* brain injury tend to unconsciously and automatically *distort* their drawings by 'extending' the boundary of the picture and drawing the figure smaller than originally presented (Mullally *et al*., 2012).

This error supplies support for a process of symbolization. In the normal re-creation of the picture, the error demonstrates that different things are being done to the two parts of the picture. Somehow, part of the colours and lines on the picture are designated as one 'thing' with certain characteristics ('teddy bear') while another set of colours and lines are designated as something else ('stairway'). When asked to reproduce the picture, the distortion hints that the mind is *not* simply 'remembering' the completely stored picture as a thing-in-itself. Instead, the mind appears to 'create' the picture again, by unconsciously putting the two symbols together. This view of memory storage as an ongoing unconscious process of consolidation, dismemberment, manipulation of component parts and then reconsolidation is challenging previous views of memory (Nadel *et al*., 2012).

Also of importance here is how those who have bilateral hippocampal damage respond to a similar task. If asked to draw the picture after it has been removed, but while maintaining attention, those with hippocampal injury tend *not* to engage in boundary extension! Instead, they tend to draw their pictures with the same proportion of object and environment as the original picture demonstrated (Mullally *et al*., 2012).

In this way, those with hippocampal injury are *technically* more accurate than the normal population in that they do not engage in this clear memory error. However, these results also hint at a loss of symbolic processing. Instead of facilitating the hippocampus and storing the picture as a symbolic stairway and a separate and discreet symbolic teddy bear, the hippocampal injury leaves the viewer trying to hold the picture in immediate memory as a single thing, 'a-teddy-bear-with-some-stairs-behind-it' which can only be informationally perceived and manipulated as a single thing-in-itself. This failure of abstraction might explain the lack of boundary extension, but also the inability to remember the single thing-in-itself outside of immediate memory.

Let me underscore here how this hypothesis is consistent with one aspect of Bion's description of beta elements in that there is no separation of stimuli into discernible elements, instead reflecting more agglomerated stimuli as it was initially received by the nervous system (Bion, 1962, p. 58).

Loss of the first person, experiential narrative

H.M. suffered from crippling seizures early in life and agreed to a bilateral medial temporal lobe resection (which contains the hippocampi) at age 27. In some ways the surgery was a success in that the frequency of his seizures did decrease after the procedure, his IQ remained at an admirable 112 and

his family reported he seemed to have the same basic personality as before (Corkin, 2013).

However, while H.M. did have crippling anterograde amnesia, it is useful to engage in a closer inspection of the totality of his disability. For while it is true that H.M. had problems remembering new experiences *after* his surgery, it also became increasingly clear (although generally less known) that H.M. struggled with other specific types of mental functioning.

For example, while H.M could recount the 'fact' of events prior to his surgery, he struggled to mentally re-live them. For example, if asked directly, he could accurately tell you, in an impersonal fashion, that there was a second world war, a stock market crash in 1929, or specific details of his youth, such as the fact that he took banjo lessons as a child. However, *H.M. had a vast deficit in his ability to describe events in a first person, experiential narrative*.

Here is an example of an investigator trying to get H.M. to recount a personal experience. It will be helpful to know that H.M. had two romantic relationships prior to his surgery.

> *E*: Did you once fall in love with somebody?
> *H.M.*: Yes.
> *E*: O.k. Tell me about it.
> *H.M.*: Well, just how you felt and everything and the way it could be. And they would fall for you. And you still didn't know.
> *E*: Can you tell me about when you first felt that you were falling in love with somebody? ... One specific event?
> *H.M.*: No.
> *E*: No, you can't think of that? ... Can you think of one specific event lasting for several hours from your early childhood? ... Can you come up with anything like that?
> *H.M.* No, I can't. (Steinvorth *et al.*, 2005)

A review of 147 cases of temporal lobe damage was completed in 2001. In it, they noted that all 147 patients demonstrated deficits in this ability, referred to by neuroscientists as deficits in 'episodic memory' or more specifically, autobiographical memory (Spiers *et al.*, 2001).

Both Winnicott and Bion make reference to the narrative structure of thought as being a central component to their descriptions of thinking. It is a fundamental component of Winnicott's example above and Bion also refers to the narrative structure of dream thoughts.

> The sleeping man has an emotional experience, converts it into alpha-elements and so becomes capable of dream thoughts. Thus he is free to become conscious (that is wake up) and describe the emotional experience by a narrative usually known as a dream.
>
> (Bion, 1962, p. 15)

So let me again make the developing case for symbolic processing, underscoring the immersive depth of one's own experience in personal, narrative and meaningful ways. For while H.M. appears to be able to maintain a

non-first person, impersonal level of information access, the immersive, first person, in-vivo narrative of his actual experience cannot be reported, or even apparently experienced within the mind.

Place cells and the cognitive map

The hippocampus has also been associated with a brain system that signals an individual's position. Dr John M. O'Keefe, Dr May-Britt Moser and Dr Edvard Moser pioneered this research, finding 'place cells' within the hippocampus (O'Keefe *et al.*, 1998). These cells, first confirmed in rats, fire whenever the individual is in a certain physical location. When the individual physically moves, different place cells fire. Interestingly, the place cells that are highly activated during the day, are reactivated that night during sleep, supporting evidence of an integrative mental function occurring during sleep (Pavlides and Winson, 1989). In 1993 O'Keefe demonstrated that there is an evidentiary link between place cell firing and hippocampal theta rhythms (O'Keefe and Reece, 1993).

If the concept of place cells is combined with the clinically validated assumption that the mind has the capacity to build and store psychic maps, the value of place cells grows exponentially. This process of shifting but reliably connected place cells has the effect of orienting the internal psychic map with the external physical world and allowing individuals to not only travel around the physical world in a more knowledgeable way, but also, through imagination, allow psychic travel within the psychic map, using their oriented position to make reasoned predictions about what 'lies ahead' both physically and temporally. And just as someone can 'see ahead' using a psychic map, it also allows the person to make increasingly educated guesses about what the future may hold, even if this is actually based on a map constructed largely of various integrations of past experience (Mullally and Maguire, 2013). The more accurate, predictive and dynamic a psychic map is, the better the individuals survive and can pass their genetic material to the next generation. If the map also incorporates feeling states like threat levels or accurate representations of the people they may encounter and how the interactions would proceed, the map becomes that much more powerful. If we allow for the ongoing development of this 'map' and place cells under evolutionary pressures, we can come to a reasonable explanation of one basic form of thought, the possible origin of symbolic fields and maybe a foundational aspect of the mind itself.

Integrative processing, cognitive maps, and thinking

Exploring the intertwining nature of cognitive maps, memory and different types of thinking, Dr Elanor Maguire and colleagues did an intriguing study of a male taxi cab driver, T.T., who unfortunately suffered severe bilateral hippocampal damage after a bout of encephalitis (Maguire *et al.*, 2006). After the infection, T.T. was found to have roughly the same I.Q. as before his injury and did well on executive, perceptual and language tests. However, he was profoundly amnestic to events before and after the injury. The man had been a taxi cab driver in London for 37 years at the time of

his injury, something that requires extreme proficiency at navigating and recognizing the confusing web of streets in the city. However, he was unable to manage driving his taxi after his injury.

The goal of the study was to elucidate information about T.T. compared to 10 people of roughly the same age, I.Q. and taxi cab driving experience as T.T. without hippocampal injury. In the first part of the study they compared recognition of landmarks and asked whether the landmarks were in London (answered, yes or no). After that, they then asked T.T. and the controls to compare the relative distance between the landmarks.

In both of these tasks, T.T. *scored similar to controls*. Consistent with H.M., it appears that significant 'factual' elements of T.T.'s knowledge of the city of London was preserved. These findings underscore that T.T. continued to have a certain kind of understanding of geography, relative locations and other critical pieces of information about the city of London.

In the next part of the study they used a computerized model of the city of London to test the driving skills of the individuals. They did this by replicating various taxi cab rides in a simulator, asking the participants to take a simulated rider from one part of the city to another.

T.T.'s capacity to drive routes was extremely interesting. *This is because on certain drives, T.T. was able to drive with the same accuracy as controls!* However, on other trips, he was completely incapable, becoming hopelessly lost.

Central to my thesis is the discovery that T.T. drove well on drives primarily made up of main 'artery' routes of the city of London, the routes driven most often by taxi cab drivers, while on the non-artery routes he would be unable to complete the drives. Even more interestingly, on follow-up, it was discovered that while T.T. could drive these main routes in the simulator, if he was asked to verbally walk through and *describe* the routes, as if he was driving them, he was unable to do so. There was a lot of speculation in this paper about what enabled T.T. to have such vastly different capabilities. Let me throw my hat into the ring, borrowing from some speculations made in the paper and relating to analytic theorizing around beta elements.

The routes that T.T. was able to drive were ones that we might typically say that taxi drivers could engage in 'on automatic pilot' or without 'having to think about it'. We all have this experience when driving on extremely familiar routes. On these routes we only rarely 'think' about the driving of the route, we are 'just doing it'. It is only when something new happens that we mentally shift into needing to 'think' about what we are doing. It was the routes that were not of this automatic, well-rehearsed quality, the kind that required thoughtful consideration where T.T. was disabled. Also, asking T.T. to describe the routes, despite his ability to mechanically drive them, required him to 'think' about these routes in a way that was not simply acting them out, so even though he could drive the routes, he could not verbally describe them.

I am underscoring that what T.T. seems to have lost is his ability to engage in a process that required active, immersive, immediate manipulation and integration of his psychic map, thus creating the more intimate system of knowledge of cities that taxi cab drivers are so well known for. He has lost his capacity to access this dynamic map of London within his mind so

he might get from psychic 'here' on the map to a different psychic 'there'. He could not engage the part of the mind that symbolically conceives, 'I am unfolding this experiential map of London in my mind, I will focus myself *here* on the map. I want to go *there*. I am now imagining travelling proposed routes in my mind, seeing and experiencing myself driving the route, adapting and accommodating to the map in various ways on different routes to see how they will work. Is it rush hour? Is it tourist season? Ah! There is the best route – this is how I get from *here* to *there*.' All the lively and dynamic ways T.T. might integrate the tens of thousands of interrelated symbolic elements of personal experience about driving in London (studying for the intensive taxi driving exam, 37 years of driving the streets, experiencing frustration in traffic and joy at avoiding it, etc.) to form this map had become *consciously and unconsciously* inaccessible. Instead he was left with only his automatic pilot, a rote script of behavioural patterns. When these patterns happened to work, everything was fine, but unfortunately, life throws too many changes at individuals for this process to work consistently.

This view proposes that this mental process, facilitated by the hippocampus, is actually used in many situations that we do not always recognize as being related to first person experience. Also, I might underscore that T.T. has lost the capacity to fundamentally *think* in many of the critical ways we might even give the term '*thinking*'. I am proposing he can re-engage and replay a previously well recorded message in his mind, but he cannot engage in an in-vivo, real time, reimagining of his thoughts to discover something new: an on-the-fly conceived-of route across the city of London. He cannot engage immersive hippocampal functions consciously or unconsciously. Saying it another way, while he can drive quite well in beta, 'acting out' in well-conditioned, automatic, but unconsidered ways, T.T.'s alpha function is crippled and he cannot engage in a waking dream of thought to get from here to there. When presented with familiar stimuli, say a picture of a landmark, he can relay rote information that was previously stored in relation to pictures (its rough location in the city) but only in ways that reflects the *conditioned*, pre-recorded relationship rather than an in-vivo, 'I am thinking this out right now', *symbolic* solution to his need. While he can act out the conditioned content of previously stored patterns, he cannot explore, generate and manipulate the inter-related elements that form a dynamic symbolic field. He cannot live symbolic experience in real-time, instead he is stuck replaying old memories within his mind.

So let me propose a parallel here between H.M. and T.T. regarding T.T.'s psychic map of London, and H.M's memory of personal romantic experience. The hypothesis is that psychically manipulating a first person map of London has many parallels to immersing one's self in their first person psychic 'map' of romantic life and pursuits. They both explore an integrated compilation of historical experience, emotions, knowledge, and ideas, in complicated and creative ways. Both are explored within the human mind in what might be loosely described as a first person narrative. Possibly stored similarly, possibly explored similarly, possibly sharing similar deficits when bilateral hippocampal injury organically impairs the process of live

integration itself. The hippocampal injury restricts the individual to acting out the already rehearsed components of thought.

The integrative capacity is an imaginative capacity

There have been even more focused studies exploring the role of the hippocampus directly in creativity in contrast to what many typically refer to as simply 'memory'. The studies give further evidence for recognition that mechanisms that produce and process memories are also fundamental to creative thought processes. This challenges the conventional conception of memories as somehow being static and immutable recordings of past and externally validated historical events, implying a more dynamic function of memory playing an active role in creative thought and the act of thinking itself.

Demis Hassabis and company explore this in a paper entitled (appropriately enough) 'Patients with Hippocampal Injury Cannot Imagine New Experiences' (Hassabis *et al.*, 2007). In the study, they have individuals with bilateral hippocampal injury and controls describe imaginative events that have nothing to do with specific memories or past experiences. He is simply telling the individuals to make something up based on a generic cue.

> Cue: Imagine you are lying on a white sandy beach in a beautiful tropical bay
> Uninjured Control: It's very hot and the sun is beating down on me. The sand underneath me is almost unbearably hot. I can hear the sounds of small wavelets lapping on the beach. The sea is a gorgeous aquamarine color. Behind me is a row of palm trees and I can hear rustling every so often in the slight breeze. To my left the beach curves round and becomes a point. And on the point there are a couple of buildings, wooden buildings, maybe someone's hut or a bar of some sort. The other end of the beach, looking the other way, ends in big brown rocks. There's no one else around. Out to sea is a fishing boat. It's quite an old creaking looking boat, chugging past on its small engine. It has a cabin in the middle and pile of nets in the back of the boat. There's a guy in the front and I wave to him and he waves back. . . . [continues] . . .
> Injured Subject: As for seeing I can't really, apart from just sky. I can hear the sound of seagulls and of the sea . . . um . . . I can feel the grains of sand between my fingers . . . um . . . I can hear one of those ship's hooters [Laughter] . . . um . . . that's about it. (interviewer: *Are you're actually seeing this in your mind's eye?)* No, the only thing I can see is blue. (interviewer: *So if you look around what can you see?)* Really all I can see is the colour of the blue sky and the white sand, the rest of it, the sound of things, obviously I'm just hearing. (interviewer: *Can you see anything else?)* No, its like I'm just floating. (Italics and clarification made to distinguish who is speaking in the example above)
>
> (Hassabis et al., 2007)

The inability of the subject stands in stark contrast to these patient's continued ability to construct narratives that avoid a need to engage in what I am describing as symbolic field processing. This was supported in a study by Elizabeth Race, who had patients with hippocampal injury attempt to engage in narrative descriptions in three scenarios, one about an imagined future scenario, another about a past personal experience, and a narrative

description of a scene while a picture was present during their entire descriptive process. The patients were quite impaired in their ability to narratively describe possible future and past situations, but were relatively unimpaired when compared to controls in their ability to describe narrative events when the picture was present before them during the entire process (Race *et al.*, 2011).

There is also evidence that this impairment in imaginative capacity is not simply limited to visual scenes. This was explored when Mellissa Duff and colleagues found significant deficits in individuals with hippocampal injury compared to controls when they studied their capacity for verbal play with an unimpaired individual (Duff *et al.*, 2009) and on the Torrence Test of Creative Thinking (Duff *et al.*, 2013) which measures creativity in a number of different realms.

So there is growing evidence that hippocampal function is linked not just to memory but facilitates the creative process. However, in elucidating the link between creativity and memory, Nadel and colleagues (2012) present evidence supporting how psychic exploration of symbolic memory is similar to spontaneous acts of creativity within the mind. Creativity requires access to a symbolic network which itself requires access to the integrative capacity facilitated by the hippocampus. Called the transformational hypothesis of memory, they explore how hippocampal memory and extra hippocampal memory are in a regular state of flux between forms and degrees of consolidation and reconsolidation, incorporating new information and understanding in ongoing ways (Winocur *et al.*, 2010; Nadel *et al.*, 2012). This implies, and Nadel clearly states, that merely having a reminder of a memory seems to have the potential to shift primary memory location and consolidation state, allowing a creative process to reintegrate memories even as we are remembering them. This supports the idea that simply recalling a memory has the capacity to shift elements of thought from a consolidated, non-hippocampal form into a hippocampal and unconsolidated state where rearrangement and reconsolidation of the elements are a fundamental part of the thinking and remembering itself. *This implies that each time we 'remember' something symbolically we are fundamentally dismantling and reconstructing it, reimagining it in different subtle and not so subtle ways*. This theory is much more compatible with the concept of a symbolic field as an informational lattice of symbols that are in various levels of dynamic flux than previous models of static memory where a 'long term memory' was somehow organically 'intended' to be an immutable, high fidelity recording of a past event. This updated model underscores the symbolic field's primary function as a map to help us navigate the present moment, both by helping us know where we are (both physically and psychically), but also by helping generate a useful, rapidly updated and integrated map that predicts what the future may hold depending on how we might respond. This shift in priority underscores the way that 'memory' of the type within the symbolic field is fundamentally dynamic rather than static in nature.

The impact on dreaming

The role of the hippocampus in sleep and dreaming is an area of active research and debate.[3] However, it has become increasingly accepted that the ongoing memory reconsolidation process cited above is present and active during sleep, engaging in a process that results in the noted improvements in capacity occurring between falling asleep and waking (Stickgold and Walker, 2007; Diekelmann and Born, 2010). Studies have demonstrated improved abilities after sleep in such areas as direct physical dexterity in finger tapping exercises (Walker *et al*., 2002; Korman *et al*., 2007), visual discrimination (Stickgold *et al*., 2000), and word use (Dumay and Gaskel, 2005). In regards to narrative scenes specifically, it has been demonstrated that after attempting a maze, those subjects who took a nap and dreamt about mazes showed up to a *ten-fold improvement* in the maze after waking compared to those that either did not take a nap, or those that did sleep but did not have a dream containing mazes (Wamsley *et al*., 2010b).[4]

Complicating matters is that REM sleep and hippocampal activity are not completely linked and each can occur independent of the other (Moroni *et al*., 2007; Diekelmann and Born, 2010; Torda, 1969). Additionally, as evidenced below, sleep images are not solely the purview of REM sleep or hippocampal function, but occur in various stages of sleep and can be independent of hippocampal function (Stickgold, 2000) – so simply having an image in mind during sleep is not evidence of hippocampal function or that the integrative function of the type I am discussing has or has not occurred.[5]

However, supporting the role of the hippocampus in sleep, is that in addition to the theta rhythm occurring during REM sleep (Ekstrom *et al*., 2005), functional MRI (fMRI) of the brain before and after sleep has shown that hippocampal activation has occurred (Stickgold and Walker, 2007). Similarly, in a study of verbal learning and sleep deprivation, it was noted how in the normal, non-sleep deprived state there is activation of the medial temporal lobes (which contains the hippocampus) that corresponds to normal learning, but in the sleep deprived state there is a decrease in verbal ability and learning that corresponded to a decrease in activation of medial temporal lobes, and an interesting increase in parietal lobe activity[6] (Drummond *et al*., 2000).

[3]See the discussion between Sue Llewellyn (Llewellyn, 2013) and Mark Solms (Solms, 2013), but be sure to review Dr Llewellyn's responses to Dr Solms claims in the response section of that volume (Bloom, 2013, pp. 644 and 645).

[4]Interestingly, it was those who had significant difficulty with the maze initially who seemed to dream about it. This supports the idea that one function of emotions may be to tag activities during the day for further mental processing during the night in dreams.

[5]This fact complicates a claim that H.M. dreamt 'normally' (Solms, 2013). While H.M. may have reported anecdotal mental images while asleep, without further clarification and testing, this does not prove or disprove the role of the hippocampus in symbolic processing. It is actually evidenced below that those with hippocampal dysfunction continue to have sleep images, it is the *symbolic integration of these images that is impaired*.

[6]Which provides tantalizing hints that when symbolic processing is impaired, somatic systems may try to compensate in the processing of stimuli, possibly explaining some of the somatic expression of psychic distress we are so familiar with.

However, in my thesis I am exploring the *functional impact* of the hippocampus in the integration of symbolic thought into a symbolic field. In that vein, let me select three studies that gather sleep reports from individuals both with and without hippocampal injuries that I believe add to the understanding of both symbolic and extra symbolic thought.

The first study examines sleep images occurring outside REM that occurred after a period of extensive Tetris playing in five individuals with medial temporal lobe damage and multiple controls (Stickgold, 2000). The individuals and controls were reawakened in the first hour of sleep and directed to report their mental sleep experiences. Three of the five brain injured individuals reported experiences related to Tetris over the course of the study. Some reported simply thinking about organizing objects falling from above, while others reported visual images of shapes falling before their eyes. The reports were given even as the injured individuals could not recall playing Tetris. However, these sleep reports *were quite similar to the control group's reports*. The researches go on to talk about these stereotyped images across all groups saying "Unlike the images of REM sleep dreams, these images were relatively accurate representations of the actual visual imagery perceived during play of the game, albeit abstracted, with removal of nonessential game elements. This highly consistent imagery across participants and groups suggests that image construction in all groups extracted and abstracted the most salient aspects of the experience by a similar process" (Stickgold, 2000). To me, this suggests that this kind of non-REM dreaming is *independent* of hippocampal function.

In the second study, normal controls played an intensive, full body video game and dream material was recorded at various points during the night with attention given to whether the material contained direct memories of the video game or indirectly blended game memories with other experiences. It was discovered that early after falling asleep the sleep images were quite literal and associated with direct reports of playing the game (similar to the Tetris study). Later in the night there were increasingly indirect references to the game with the fluid incorporation of other mental material (Wamsley and Stickgold, 2011). Their conclusion was that there appears to be a gradual, functional abstraction and integration of intensive daytime events with an existing mental structure over the course of a night's sleep.

The third study examines REM sleep reports of those with bilateral hippocampal injury compared to controls (Torda, 1969). The reports were collected after the individuals were awakened 10 minutes after initiating REM sleep and repeating a verbal cue designed to help those with hippocampal injury stay on task. REM sleep reports in uninjured control subjects typically include highly symbolic and integrated material. The reports were then compared by several independent evaluators. This is part of what was said:

> The dreams of F1, F2 and M1 (the individuals with bilateral hippocampal injury) were short and simple. The reports contained one scene with recurrent repetition of one or more parts of the scene. The dreams lacked imaginative, unusual or mysterious details and intensive emotions. The content was stereotyped, repetitious and lacked daily residue. During awakening each subject mentioned having a pressing

> physiologic need (e.g. pain, hunger, thirst, sexual craving, etc.) *The dreams lacked recent symbolic elaboration and problem solving quality. They were reality-bound and consisted of visual representation of an old event that once offered a solution for a similar physiological need* [emphasis added]. During the interview sessions, following the termination of the dream experiments, each subject was repeatedly confronted with the details of each dream, and was asked to associate to the details. The associations revealed that the events reported in the dream occurred before the onset of the encephalitis.
>
> (Torda, 1969)

These results build on the studies above, *but also clearly demonstrate dysfunction around integration of dream material*. In the study, a man who had gone on a hike the day before experienced a static psychic replaying of a pre-injury event when he had ridden a horse and his legs hurt. A sexually deprived woman had a similar experience replaying a past sexual encounter. Unfortunately, the evidence here indicates that while the injured individuals provided evidence of *attempts* at integration, these attempts appear to have failed. I have a hypothesis that earlier in the night the individuals had sleep experiences similar to the Tetris study about their day's activities, incorporating them on some level of beta elements. However, without hippocampal function, there was an impairment that prevented the abstraction of these beta elements into symbolized and interconnected alpha elements and similarly impaired the integration of past and present psychic elements into what we as analysts would call a dream. In each, we the reader can make the connection between the events (due to our own alpha function) but it is doubtful if this is actually happening in the minds of the subjects with hippocampal injury.

This phenomenon is then *functionally* similar to H.M.'s preserved ability to discuss concrete and rote facts of his romantic life or T.T.'s capacity to know information about monuments in the city of London. There is evidence of access to a certain, prerecorded report of events, but we cannot get an integrated narrative map of thought, dynamically modified and integrated in real-time.

It is also interesting to note that from another perspective, these studies may helpfully underscore what 'underlies' dream function and the symbolic field itself. Consistent with Winnicott's string or Bion's view of the dream as a psychic barrier, this view conceives of the dynamic relational lattice as an information structure that *overlies* otherwise isolated beta elements, or connects less integrated pools of alpha elements, in ways that are frankly mysterious and not fully understood at the present time. This perspective sees the experiential elements revealed in the Torda and Tetris studies as more primordial elements that are bare of some of the dense layers of symbolic connections that make up a typical symbolic field of thought. If we take the step to recognize how symbolic connections can just as easily obfuscate elemental experience as clarify them, we can recognize a certain level of 'truth' available in these primordial elements – in ways, they may be the basic 'facts' of the mind.

Other causes of hippocampal dysfunction

Of significant clinical importance, there is evidence that a wide array of phenomenon may affect the functionality of the hippocampus both transiently and chronically. For example, Sinead Mullally of Trinity College in London studied the possibility of *virtual* hippocampal injury (Mullally and O'Mara, 2013). Employing college students from Trinity College, she was able to induce a selective, virtual hippocampal injury while non-hippocampal function remained intact. This impairment was accomplished by having some students engage in the 2-Back mental working task,[7] which has been shown to reduce activity in the medial temporal lobe.

Students were divided into two groups, one to engage in the 2-Back task and the other the 0-Back task (a task which has not been shown to impair medial temporal lobe activity). The two groups were then put through a series of memory tests. After the tests, the results were broken down into hippocampal dependent and hippocampal independent aspects of memory. While both groups scored similarly on the hippocampal-independent results, the hippocampal-dependent results were different, with the 2-Back group showing impairment.

The data from this study is quite in keeping with the previous sleep deprivation study which led to a decrease in activation of the medial temporal lobes, and a corresponding decrease in the mind's capacity for free recall related to verbal learning (Drummond *et al*., 2000), except here it is noted that the effect is happening while the individuals are awake during the entire study.

These studies indicate that just as hippocampal function can be 'turned down' (through engaging in the 2-Back mental task or sleep deprivation), there exists ways in which integrative thinking might also be 'turned up' (through stopping the task or getting a good night's sleep).

This evidence is in keeping with the complicated way hippocampal function is affected by psychological states and conditions. For example, those diagnosed with post-traumatic stress disorder have been found to have impairments in various cognitive and memory functions that pairs with abnormal findings in their hippocampal activity and volume (Shin *et al*., 2004; Levy-Gigi *et al*., 2015). Alterations in hippocampal function and volume have also been found in those with even a single episode of major depression (Frodl *et al*., 2002). On a transient level, differences in hippocampal blood oxygenation were noted in individuals just listening to sad compared to happy music (Mitterschiffthaler *et al*., 2007).

To make the clinical impact on psychoanalysis of this phenomenon clear, what if certain activities in the clinical hour affected the imaginative and integrative capacity of those we treat on the level of hippocampal activity? What if analysands *and* analysts shift, in response to stimuli and psychic engagement in the hour, from being more like T.T. or H.M. or Clive

[7]Interestingly, the 2-Back mental working task requires individuals to maintain intense attention and concentration on continually updating their working memory from a somewhat remote list of numbers or letters, a mental state that is in stark contrast to being without memory or desire.

Wearing, to more like those with more functional, imaginative, creative and integrative capacities?

This realization paves the way for many intriguing questions regarding this phenomenon that have yet to be answered. For example, it makes sense that Bion's recommendation to approach each session without memory or desire might implicitly be related to augmenting hippocampal function, both within the analyst and the analysand, and raises questions of whether there might be other techniques that similarly affect this capacity. Since hippocampal activity can be measured on various scans of the brain, is there a way of measuring different techniques to see which might affect this capacity to integrate thoughts? What if there are other techniques, as yet unconceived, that might cause the hippocampus to become active in ways that positively affect the mind's capacity to integrate information? While I certainly hope this information would not be used to generate restrictive rules, it might be clinically useful for analysts to know how certain types of interpretations or holding activity might affect hippocampal function for certain patients in certain situations. If such information could be used in an educated and thoughtful way, within our existing understanding and methodologies, it has the potential to improve the capacity to dream our thoughts and aid the living, dreaming capacity of those we treat.

Preserved systems

In addition to the papers presented above, there is other support for the existence of ongoing mental processing that runs independently of hippocampal function. This section is not meant to be exhaustive, but simply demonstrative of the implications of other systems of thought.

Specific exploration of this learning was explored with H.M. In one clever study, H.M. was exposed to drawing a figure while only being able to look at his drawing in a mirror – a skill he did not possess before the injury. H.M. became better and better at this skill over time, even as his capacity to remember and report the actual training continued to be severely impaired. H.M. retained almost complete mastery of the skill one year later (Gabrieli *et al*., 1993).

In 1966 H.M. was able to accurately draw a diagram of a new home he had moved to from memory, even though the move occurred after his injury (Corkin, 2002). The thinking is that H.M.'s physical, active, bodily engagement with living in a house day in and day out activated the alternate system of 'memory' that H.M. could rely on to generate the map.

These accomplishments seem compatible with the Tetris sleep image study quoted above (Stickgold, 2000) which demonstrated ongoing sleep integration of physical experience despite hippocampal injury.

Similarly, Larry Squire notes a consistency in which rat, monkey and human studies have all independently converged on evidence supporting the ongoing extra-hippocampal capacities to learn physical skills, retain conditioned information and a mental phenomenon called priming (Squire, 1992). This was also confirmed in the review article of 147 patients with hippocampal damage that noted that while *all* 147 subjects had anterograde

amnesia, they also confirmed that *none* of the patients had evidence of impairments in short-term memory, learning skills, priming, classical conditioning or category learning (Spiers *et al*., 2001).

The exploration of these differences in capacities is the edge of current neuroscience. Various authors make reference to hippocampal vs extra-hippocampal memory, contextual vs schematic memory, or semantic vs episodic memory, stretching to characterize the differences between these forms of thought (Winocur *et al*., 2010). While the details and intricacies of the relationships are not fully understood, there is a growing appreciation for these fundamentally different systems of information.

Discussion

So let me return again to Winnicott's statement about where a person lives and appoint the binocular perspective of this emerging research:

> I may be *in* a muddle, and then I either crawl out of the muddle or else try to put things in order so that I may, at least for a time, know *where I am*. Or I may feel I am *at sea*, and I take bearings so that I may come to port (any port in a storm), and then when I am on dry land I look for a house built *on* rock rather than on sand; and *in* my own home, which (as I am English) is my castle, I am *in* a seventh heaven.
>
> (Winnicott, 1971, p. 104).

Notice the way Winnicott has his own place in his thoughts (the 'I' of a storyteller) and he leads us on a first person, intimate journey with him. This journey, however brief, has multiple levels of dynamic integration. It is a statement of thought, playful symbolism, recollection and belief infused with deep connection and the mysterious nature of a dream. It is a journey that is on one level about discrete information ('I am English'), but filled with subtle, and not-so-subtle connections between ideas – some factual, others whimsical, some personal, cultural, religious, or emotional. On this journey we are immersed in a dancing first person narrative of connection, image, fact and emotion. This is where Winnicott proposes being alive happens.

This paper demonstrates how the hippocampus might play a central role in the process Winnicott so poetically presented above. From this view, Winnicott is demonstrating his unique integration of life experience, brain function, understanding and environment which combine to form a snapshot of his map of thought. This network is not made up of hardware, instinct nor objects, but the integrated web of psychic connections that relate these elements together at one unique moment in time.

Through the integration of studies regarding hippocampal damage with certain ideas of Winnicott, Bion, and psychoanalytic field theory, we can see how the hippocampus facilitates the capacity to immerse the mind into this level of integrated experience, metaphor, imagination and dream. The capacity 'sinks us down' into this informational map, expanding its psychic 'all-aroundedness' into an experience that is designed, not to necessarily have high fidelity to individual historic events, but to provide us access to a dynamic guide as we travel the journey of our lives in the present moment,

informing us of what just happened, what is happening and what may be just around the corner.

The shocking degree of impairment in those with hippocampal dysfunction reveals how healthy hippocampal processing within a symbolic field is a fundamental part of thought itself. While the neuroscientific study of impairment of hippocampal function is in its infancy, when integrated with the study of psychoanalytic fields, they together provide us with a greater perspective and understanding of the mind, confirming and challenging many beliefs and theories central to psychoanalysis and neuroscience.

It is also clear to me that Bionian models of thought predicted much of this research on hippocampal function. Theories of alpha function and the evidence of hippocampal processing have marked similarities. Reverie can be seen as hippocampal processing of particularly salient elements within a particular moment. It could also be seen how excessive engagement of certain mental tasks and stressors, such as Dr Mullally's 2-Back mental work task impairs hippocampal processing of stimuli, something Bion possibly intuited in his recommendation that analysts abandon memory and desire with their patients before and during session. The functional impairment of hippocampal processing also paves the way to an increased understanding of multiple forms of psychic injury including impairments in symbolic thinking and memory related to attention disorders, depression, anxiety, and trauma.

In addition, alongside the symbolic field, this paper reports evidence of other mechanisms of mind that run independent of symbolism's immersive and integrative patterns. With some similarities to beta elements, there is evidence of how they are expressed through action, but that they also respond to the environment through unconscious enhancement and are active during the night in their own forms of 'dreams', although in a form we rarely conceive of.

The fact that hippocampal function can be accentuated or impaired through certain mental experiences should make clear the need to further study this process. Since I believe there could be general agreement that an improved capacity to integrate symbolic thought is fundamentally desired by both the psychoanalytic and neuroscientific theorists and clinicians, this concept might also overcome the reasonable challenges presented by Rachel Blass and Zvi Carmeli on the value of integrating important concepts between psychoanalysis and neuroscience. For while the hippocampus was initially explored through the relatively concrete example of boundary extension, the sheer breadth and complexity of symbol use in human thought demonstrates how this process is active in a vast multitude of arenas, stretching to conceive, symbolize and bridge ideas encompassing countless aspects of conception within the human mind itself.

Translations of summary

L'hippocampe facilite l'intégration d'un champ symbolique. L'auteur de cet article tente d'étudier un mécanisme cérébral fondamental impliqué dans la création et la conservation des champs symboliques de la pensée. Associant les théories des espaces psychiques de Donald Winnicott et Wilfred Bion

aux examens neuroscientifiques de patients souffrant de lésions bilatérales de l'hippocampe, il montre comment les éléments de preuve de ces deux disciplines apportent un éclairage important à cet aspect du psychisme. Étant vraisemblablement à l'origine un moyen de conserver un schéma psychique orienté, à la première personne, cette capacité donne aux individus l'accès, sous la forme d' un récit dynamique, à un domaine d'éléments superposés et connectés. Si cette hypothèse s'avère correcte, l'hippocampe facilite l'intégration de ce champ symbolique du psychisme, où les formes narratives de la pensée, de la créativité, de la mémoire et de l'activité onirique sont entrecroisées. En l'absence d'hippocampe, on observe chez les individus une incapacité à enclencher de nombreux mécanismes de pensée parmi les plus typiques. De plus, l'observation chez ces mêmes individus de capacités inaltérées étaye les théories sur certaines autres facultés du psychisme, théories qui éclairent le rôle éventuel joué par ces dernières dans les processus de pensée. Les preuves quant aux différents systèmes qui fonctionnent conjointement avec le champ symbolique fournissent des indices attrayants sur ces mécanismes fondamentaux du cerveau et du psychisme qui sont normalement intégrés sans heurt, et ouvrent de nouveaux domaines de recherche clinique et en laboratoire dans le champ des neurosciences comme dans celui de la psychanalyse.

Der Hippocampus unterstützt die Integration innerhalb eines symbolischen Feldes. Dieser Beitrag ist ein Versuch, einen grundlegenden, an der Erzeugung und Aufrechterhaltung symbolischer Denkfelder beteiligten Hirnmechanismus zu erörtern. Der Autor verbindet Theorien psychischer Räume, wie sie von Donald Winnicott und Wilfred Bion erforscht wurden, mit den neurowissenschaftlichen Untersuchungen an Menschen mit beidseitigen hippocampalen Läsionen, um zu zeigen, dass Funde aus beiden Disziplinen Licht auf diesen Aspekt der Psyche werfen. Diese Fähigkeit, die sich vermutlich als eine Möglichkeit entwickelt hat, die psychische Orientierung in der Ersten Person aufrechtzuerhalten, gewährt Individuen einen dynamischen narrativen Zugang zu einem aus geschichteten, untereinander verbundenen Elementen bestehenden Bereich. Wenn die hier formulierte Hypothese zutrifft, unterstützt der Hippocampus die Integration dieses symbolischen mentalen Feldes, in dem sich narrative Formen des Denkens, Kreativität, Gedächtnis und Träumen miteinander verflechten. Ohne den Hippocampus stehen dem Menschen zahlreine typische Formen des Denkens nicht zur Verfügung. Die Art der Nicht-Beeinträchtigung der Probanden bestätigt darüber hinaus Theorien über andere geistige Fähigkeiten und gewährt Einblick in die Funktionen, die sie möglicherweise im menschlichen Denken erfüllen. Die Daten, die eine Kooperation zwischen unterschiedlichen Systemen und dem symbolischen Feld belegen, liefern auch faszinierende Hinweise auf diese grundlegenden Mechanismen des Gehirns und der Psyche, die normalerweise nahtlos ineinander übergehen. Sie lenken die Aufmerksamkeit auf Bereiche der klinischen Forschung und der Laborforschung sowohl in den Neurowissenschaften als auch in der Psychoanalyse.

L'ippocampo facilita l'integrazione all'interno di un campo simbolico. Scopo del paper è di articolare un discorso attorno a un meccanismo cerebrale fondamentale coinvolto nella creazione e nel mantenimento di campi simbolici di pensiero. Teorie psicoanalitiche sullo spazio psichico come quelle esplorate da Donald Winnicott e Wilfred Bion saranno qui integrate con i risultati di studi neuroscientifici su soggetti che hanno riportato danni bilaterali all'ippocampo, allo scopo di mostrare come le prove raccolte da entrambe le discipline possano gettare luce su importanti aspetti di questa funzione mentale. Sviluppata forse come modo per mantenere una mappa psichica orientata e in prima persona, la capacità psichica in esame fornisce agli individui un accesso di natura dinamica e narrativa a una realtà fatta di elementi stratificati e delle connessioni esistenti tra essi. Se l'ipotesi proposta è corretta, allora si potrà sostenere che l'ippocampo facilita l'integrazione di questo campo simbolico della mente, all'interno del quale le forme narrative del pensiero, della creatività, della memoria e del sogno sono tutte interconnesse. Senza l'ippocampo non si è in grado di accedere a molte forme tipiche del pensare; d'altra parte, soffermarsi a osservare anche gli aspetti del pensiero rispetto a cui gli individui privi di un ippocampo funzionale non hanno subito limitazioni corrobora le teorie relative ad altre facoltà della mente, offrendo peraltro spunti rispetto ai ruoli di queste ultime nell'ambito del pensiero umano. Le prove relative alla sinergia di diversi sistemi con il campo simbolico forniscono indizi straordinariamente interessanti su questi fondamentali meccanismi di mente e cervello (meccanismi che in casi normali sono perfettamente integrati), e indicano oltre a ciò future aree di ricerca sia clinica che sperimentale, e in ambito tanto neuroscientifico quanto psicoanalitico.

El hipocampo facilita la integración dentro de un campo simbólico. El presente artículo intenta explicar un mecanismo cerebral fundamental que participa en la creación y el mantenimiento de campos simbólicos de pensamiento. Se integran teorías sobre espacios psíquicos como los explorados por Donald Winnicott y Wilfred Bion con exámenes neurocientíficos en personas con lesiones bilaterales en el hipocampo a fin de demostrar cómo las evidencias de ambas disciplinas arrojan gran luz a este aspecto de la mente. Esta capacidad, probablemente originada como una manera de mantener un mapa psíquico orientado en primera persona, permite un acceso narrativo dinámico a un campo de elementos estratificados y sus conexiones. Si la hipótesis propuesta es correcta, el hipocampo facilita la integración de este

campo simbólico de la mente, donde las formas narrativas de pensamiento, la creatividad, la memoria y el sueño están entretejidas. Sin hipocampo hay una incapacidad de emprender muchas formas típicas del pensamiento mismo. Asimismo, la observación de las maneras en que estas personas no están discapacitadas va en apoyo a las teorías acerca de otras facultades de la mente, lo cual aporta un mayor conocimiento sobre sus posibles roles dentro del pensamiento humano. La evidencia de que hay diferentes sistemas que trabajan en conjunción con el campo simbólico provee claves fascinantes acerca de estos mecanismos fundamentales del cerebro y de la mente que normalmente se integran a la perfección, y apuntan hacia futuras áreas de investigación clínica y de laboratorio, tanto en neurociencias como en psicoanálisis.

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