

Evidence of a Cognitive Function within Dreams

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July 2010

Introduction

REM or “rapid eye movement” sleep (where most of our vivid dreams take place) has been linked to various mental and physiological functions including learning and memory consolidation (Moffit, 1993; Stickgold, 2005). Determining the specific function of the dream itself, however, has been somewhat difficult because of trying to establish rational linkages with something that appears to us as a non-rational experience. The bizarre nature of dreams, however, has been recently attributed to the unique combination of centers which are active and inactive during dreams, or as Braun puts it a “state of generalized brain activity with the specific exclusion of executive systems...” (Hobson, 2003). In simple terms, our rational mind remains asleep, while those centers which normally process internal information unconsciously (in both sleep and waking) become active. What we see as the dream is internal processing and communications taking place in language of hyper-connected association that is native to those normally unconscious brain centers. The implication is that the dream is not meaningless, but our observing the normal processing activity of internal information, in the absence of processing external sensory information and rational thought.

The Function of Dreaming

That we are observing the active ‘unconscious’ brain in dreams was theorized by Carl Jung, one of the founders of analytical psychology, who claimed that “dreams are the most readily accessible expression of the unconscious” (Jung, 1971: p283). Jung observed the language of the unconscious to be that of “symbols” or an “emotionally charged pictorial language” where a concept can express its unconscious meaning (Jung, 1973; p30). Many agree. Dream images appear to be picture-metaphors, or pictures of the way our minds make connections, a language that directly associates and connects seemingly unrelated information, or describes a first entity as resembling a second entity in some way, a way of noting and picturing similarity. Ernest Hartmann states that dream images also picture our emotions and contain the “feeling-state” of the dreamer (Hartmann, 2011). Fritz Perls, co-founder of Gestalt Therapy, understood this decades ago as he asked clients to ‘become’ and experience the images in their dreams, and express the emotions they contained.

Beyond a better understanding of dream imagery, there is a growing wealth of psychological theory and observation supportive of a meaningful function to the entire dream process, which might be described as three-fold: self-maintenance; creative problem resolution; and psychological growth. Dream examples supportive of these functions of dreaming can be found in Hoss (2005, 2010).

Jung (1973; p12, 273) stated that the general function of dreaming was to restore out psychological balance. He indicated the dreams achieve this through recognizing misconceptions of the ego, and ‘compensate’ for these deficiencies in our personality in order to bring our awareness back to reality, and warn of the dangers of our present course (Jung 1973 p 34, 127). Fiss (1987) agreed that dreams maintain the self and Jouvett (1998) indicated that they do this by reprogramming cortical networks to maintain psychological individuality despite adverse waking experiences. More recently, Stewart & Koulack (1993) indicated that dreams adapt to emotional stress, and Revonsuo (2000) took this further theorizing that they do this through a process of threat rehearsal.

Jung further recognized that the unconscious expression through dreams contains an inner knowledge and creative aspect calling it an “independent productive activity, constantly supplying us with content which if consciously recognized would extend the range of consciousness - it is a field of experience of unlimited extent” (Jung, 1971, 238). He indicated that dreams solve problems related to important unfinished business of the day. This function of solving emotionally important problems was also recognized by Monte Ullman (1959) and Greenberg and Pearlman (1975). Foulkes (1982) also supports dreaming as “active imagining” which creatively recombines memories and knowledge. Hatmann (2011) states that the “broad, loose connections of dreaming can provide a different perspective and can help us make important decisions and discoveries”. The creative problem solving history of dreams is well documented by Barrett (2001a).

Aside from self-maintenance and problem solving, dreams also may help bring about our psychological growth and maturation. Jung claimed that dreams contain a ‘transcendent’ function, which brings about the emergence of a new awareness and a more integrated personality (a process he called “individuation”). He observed a regulating or directing tendency at work creating a process of psychic growth whereby gradually a wider and more mature personality emerges (Jung 1973; p161). Jung wrote that the dream achieve this through: recognizing the motives of the ego and ‘compensating’ for these deficiencies by creatively integrating unconscious and conscious material (revealing new connections and viewpoints) in order to arrive at a new attitude whereby the unconscious and the conscious self are more integrally connected and move together. Others agree that dreams help develop the ego (Jones, 1962) and integrate our fragmented personality (Perls, 1974). David Feinstein (1990) observed how dreams mediate conscious and unconscious perceptions in order to achieve the self-maintenance and transcendent functions that Jung describes. He indicated that dreams either: find a way to accommodate the material within our internal model (the ‘old myth’); strengthen an unconscious ‘counter myth’ or creatively develop a ‘new myth’ (a new inner model) that better accommodates internal and external reality. Ernest Hartmann (2011) also characterizing dreams as a learning process; an adaptive, emotion guided, hyper-connective mental function, which is in part how the brain learns by creating new connections and weaving new material into established memory to arrive at new insights that might give us a broader view or perhaps make a change in our lives.

The Neurology of Dreaming

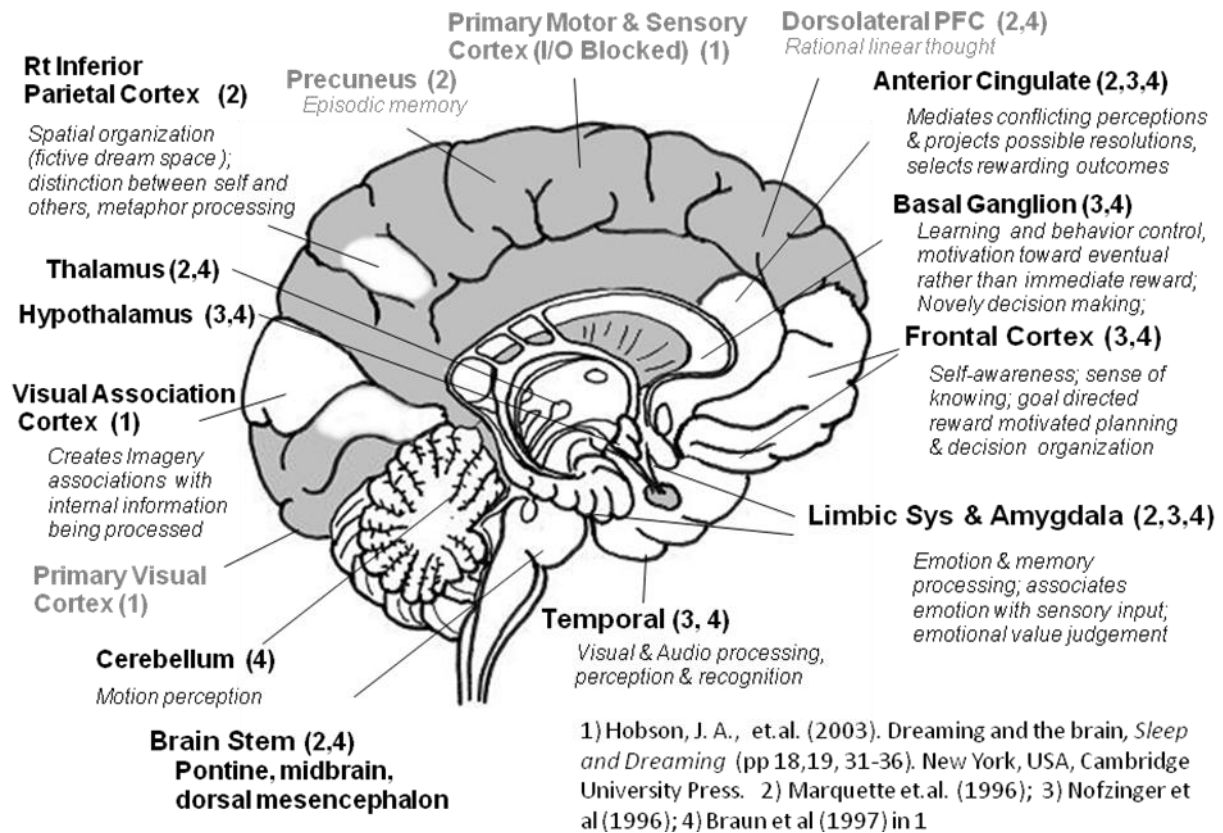
Some recent neurological findings account for the bizarre manner in which dreams appear to the waking mind, and appear supportive of an emotionally guided, self-restoration, creative problem solving and behavioral learning function. A diagram of the areas of the brain found active and inactive in REM sleep along with (*in italics*) a brief summary of the known functioning of each, is shown in figure 1, based on brain scans (Hobson et. al., 2003 & 2007; Dang-Vu et.al., 2007).

Jung stated that “the unconscious meaning of a conscious experience is revealed in dreams, where it appears not as rational thought but as a symbolic image...an emotionally charged picture language” (Jung, 1973, p5, 30). The unique combination of active and inactive centers may account for this. During REM, executive functions are inactive including: rational thought and linear logic, episodic memory and sensory and motor functions. However a unique combination of centers, involving the ‘emotional brain’ the visual ‘association’ cortex and much of the unconscious brain, become active which not only stimulates the dream and dream imagery, but suggests a high degree of unconscious internal processing and cognition.

Inactivity in the dorsolateral pre-frontal cortex permits the bizarre, non-linear dreaming to proceed without filtering or reflection on rational models, and the changes to the precuneus (Fosse, 2003) all but eliminate the waking life episode which might have triggered the dream. The emotional tension and

memories associated with the waking event, however, remain accessible and are processed by the highly active limbic system or ‘emotional brain’. The exception being Trauma related dreams which may repetitively replay the traumatic episode (Barrett, 2001b) until a degree of mastery is acquired.

Figure 1 – The Dreaming Brain



High activity in the amygdala and associated limbic system has lead many researchers to conclude that dreams “selectively process emotionally relevant memories” via and interplay between the cortex and the limbic system (Nofzinger, Braun, and Marquet in Hobson et. al., 2003) and that the amygdale actually “orchestrates” the dream activity (Dang-Vu et. al. 2007) integrating dream emotion with actions, and helping to form dream image-to-emotional memory associations. Hartmann (2011) contends that emotion not only guides the dream but also plays a greater role in the organization of memory according to what is most important to us.

Dream imagery arising in the form emotionally charged ‘picture-metaphor’ is in part due to the active visual association cortex, which forms picture associations with the information it receives. The interplay with the limbic system and the amygdale (which is known to associate emotion with imagery) as well as the active right inferior parietal cortex (involved in our perception of a visual space) plus the active right temporal lobe (figurative language and metaphor processing) supports the creation of these pictue-metaphors as representing meaningful emotionally driven internal connections (Hobson, 2003, p32; Jung-Beeman, 2005; Bottini et al., 1994). This is the “unconscious meaning” of the waking experience that Jung describes.

There are a number of centers that are active during REM which play an important, although unconscious, role in waking cognition, that might be responsible for the “transcendent” function that Jung discussed, the learning that Hartmann describes as well as the capability for creative problem solving observed by so many. The anterior cingulate may be involved in mediating much of this internal decision making and problem resolution. It is known to: monitor anomalies and initiate action to resolve inconsistencies between conflicting perceptions; mediate resolution by anticipating the consequences based on experience or imagined outcomes (dream scenarios?); select responses based on valuing the rewards; monitor the outcome; and adapt behavior based on that outcome (Carter 1998; Bush, 2002; Apps, 2009; Hayden, 2009; Botvinick, 1999; Luu, 2004; Allman, 2001; Posner, 1998). It does not do this alone but networks with other adjacent structures to perform this activity including: the basal ganglion (involved in motivation and reward learning and deciding which of several possible behaviors to execute); the hypothalamus (which organizes complex emotions and motivation); the orbitofrontal cortex (involved in regulating our planning behavior); the frontopolar cortex (which processes internally generated information for abstract and analogical reasoning, planning and problem solving); the medial prefrontal cortex (involved in goal-directed behavior, social and self-referential activities as well as self-monitoring of learning and our sense of knowing). (Kringelbach, 2004 & 2005; Bechara, et al 1994; Green, 2006; Christoff, 2000; Braver, 2002; Gusnard, 2001; Marley, 2009) The Hippocampal and Entorhinal structures which provide memory consolidation, optimization, encoding and retrieval functions, as well as extinction learning, are active and may become involved in learning and memory storage of the dream resolution.

In summary, the capability therefore exists for our dreaming mind to not only make new connections and reveal them in meaningful picture-metaphors, but find a resolution to the emotionally important issues that the dream is dealing with by: recognizing anomalies, conflicting perceptions and threats to our inner sense of self; mediating a resolution by creating imagined outcomes in the form of dream scenarios; monitoring the outcome; selecting a scenario based on achieving the anticipated rewards; and encoding that result in memory as something learned.

Some Evidence from Dream Observation

If dreams do have the capability as discussed above then we should be able to observe the process in the images and activities within the dream. The following observations suggest that dreams do reflect the creation of new connections as well as the conflict resolution and new learning that is hypothesized above. In fact dream observations show another factor to be evident in the learning, that dreams self-reward as a means of reinforcing a dream scenario which achieves the anticipated results.

This initial dream illustrates the nature of dream imagery and Hartmann’s contention that dreams create new connections expressed in picture-metaphor, relating one entity as resembling another in some way, and that “these connections can often produce something new or at least show us something new”. This was a dream of a woman who was having relationship problems with her husband that she didn’t fully understand. *“I have a recurrent dream of being terribly angry with my husband, who I am running away from. These dreams continued until one night I turned around and faced my husband and looked at his face – it was my father’s face.”* Here the dream made the connection (father to husband) in a picture-metaphor that combined the two visually, and that was obvious enough to produce a new awareness, an awareness that perhaps the problems with her husband were in part based on unresolved issues with her father.

Hartmann’s contention that dream images picture our emotions and place the “feeling-state or idea directly into an image” is illustrated in the following example. *“I dreamed I was alone on a beach and noticed a vase lying in the sand. I awoke feeling very sad.”* Working with a Gestalt role-play approach at the time, I asked the subject to “become” the vase and express herself. She did not say a word but began

crying heavily. As she reflected on the image of the vase she recognized it as the one her husband, who had just passed away, gave her on their wedding day. She had not fully grieved until that point and was brought to tears by the flood of emotions contained in the image of that lone vase on the beach, which was a picture combination of the memories of her tender relation with her husband combined with the image and feeling of now being alone and isolated.

Jung indicated that dreams function to restore our psychological balance by recognizing and then compensating for our ego misconceptions, in order to “bring the conscious mind back to reality and warn of the dangers of our present course.” This dream illustrates that concept by first illustrating the viewpoint of the ego in the extreme essence of what it had become, and then compensating by warning of the dangers of continuing in this manner. In life this dreamer was anxiously and frequently trying to suppress a side of herself she considered evil. *“I dreamed that this evil person had come alive again and feared that an evil “entity” was at work. I went through a ritual of exorcism to eliminate the entity, but the more I tried the darker the sky became. Suddenly a voice said, ‘stop - you are only making it worse.’”*

This next example illustrates the principle of ‘compensation’ and ‘transcendence’ in a dream which reveals the present view of the ego, then provides an alternative viewpoint, which is shown move the dreamer from their present state to a new one. This dream also illustrates the archetypal theme of ‘death’ of the old self and ‘rebirth’ of the new that he said often accompanies such change. This is a dream of a girl who for a second time had been fired from her job, this one being a job that was very important to her. She felt that she was at an end with nowhere to turn. *“I dreamed a building fell on me and I was crushed under the rubble. All went dark and I stopped breathing. I knew I was dead and it was all over, there was no future. Then I became another person in the dream who was strong and determined, and dug my body out of the rubble. Suddenly I came back to life and realized that I could go on.”* In addition to taking the dream ego through a transition from the old view to the new, the dream appears to self-reward that scenario by bringing the dreamer back to life. There may have been learning from this because the dreamer’s behavior following the dream, to ‘pick herself up’ and go, paralleled that of the dream.

In the neurological description above, the role of the anterior cingulate was to initiate action and ‘mediate’ a solution between conflicting perceptions. We can see that action taking place in the following dream. The dreamer in this case had been unexpectedly offered an exciting new professional opportunity, but it required them to make use of talents they had not tapped into for many years. This created an anxiety and the dreamer was on the verge of declining the opportunity out of a stated belief that “there is no way I can resurrect my old talents, they are gone forever”. This conflict seems to have stimulated the following dream: *“I was wandering through a desert and saw an old rusty car. I looked inside and found an old man who was not moving. I was going to give him up for dead, but my unknown companion urged me to wake the man. I argued that it was useless, but after much discussion reluctantly gave in and shook the man. When I did, both the man and the car came to life and the car began to transform into a newer car.”* Here the ego misconception “my old talents are gone forever” appears in the picture-metaphor of the seemingly dead old man in the rusty car. A mediating action then took place in the form of a negotiation between the ‘unknown’ companion (unconscious perception or inner ‘sense of knowing’?) and the ego perception. A behavior scenario was then projected in the form of the ego finally accepting the argument and waking the old man. The dream then proceeds to reward the anticipated outcome, with the old man and the car coming back to life. After the dream a change in attitude and behavior did take place as the dreamer did proceed with the new opportunity with great success.

Aside from self-rewarding an anticipated result, often dreams are observed to ‘illuminate’ an accepted conclusion with various forms of light and sometimes color (Hoss, 2005; Hamilton, 2005). In waking life this dreamer was dealing with an internal conflict involving male aggressiveness and how to act in a social environment in a way that would not always result in getting hurt and rejected. He had the

following dream: *“Two unknown men were trying to convince us to let them kill a dog they considered aggressive and threatening. The dog suddenly decided to roll over and play dead in order to spare its life. At that point the dog turned into a cute puppy, and the men stopped, convinced that the dog was no longer a threat. The dog was suddenly illuminated by a street lamp overhead.”* Here again the dream represented the manner the ego had developed in dealing with threatening social situation as the aggressive dog. Again a ‘mediation’ took place between the dream ego and other unknown parties, imagining and discussing various scenarios, including the option of “killing the dog” (suppression). At one point a new behavioral scenario was tested, that of “playing dead.” This was observed to have a rewarding outcome. The dream then reinforced this outcome with rewarding action as well as illumination at the point of acceptance.

Finally the following is an example a series of dream sequences during a single night which is suggestive of dreaming brain mediating a resolution by testing and monitoring the outcome of various imagined scenario’s. In life this dreamer had gone through multiple traumas related to expressing her “masculine” side. In life when she would assert herself either in a creative or defensive way, her efforts would be rebutted, early in life by her mother (whose reaction was that she was acting in a “sinister” manner) or her ex husband who was alcoholic and would not only “squash” her attempts but represented a poor masculine role model. The dream contained the following three sequences in this order: *“1) Two sinister looking men pulled another man out of a car that had been blocking traffic, after some discussion they suddenly killed him and slammed the door; 2) I am in a hotel room bed. I rolled over and a man was in my bed. I am upset that the hotel had booked the man in same room with me. 3) I went to the office to change rooms, but had to crawl through a dark hole in the building. Suddenly a man and a woman pulled me ‘up from the darkness’ into a lighted room.”* Here we see three scenarios being tested, three attempts at integrating the masculine and feminine (if we take a Jungian perspective on the dream). The first scenario illustrates a mediation of sorts taking place with an unsuccessful ending of killing or suppressing the masculine (metaphorically the element that was blocking her progress). Reference to the males being “sinister” may be the recalled influence of her mother, being strong enough to defeated that scenario. In the next scenario there is an attempt at integration with the masculine by placing the masculine and feminine (ego identity) together on a motel room bed. This was rejected outright by the ego. In the third scenario the dreamer is searching for someone in authority to resolve the situation but finds themselves going within into darkness. Here the dream appears to reward appropriate action by showing a union of masculine and feminine pulling the dreamer out of the hole and into the light.

Conclusions

Many early as well as more contemporary theories and observations on the functions of dreams, picture dreaming as being involved in: a) psychological self-maintenance or restoration; b) creative problem solving; and c) new learning leading the potential of transcending ones present state or views. The combination of active cognitive, emotional and memory processing centers in the brain during REM suggest that the capability is there to support these functions. In particular the centers active during REM have a known capability in the waking state to: a) recognize and respond to emotionally important anomalies, threats, and/or conflicting perceptions; b) tap into memory and structure creative associations, connections and analogies with the conflicting information; c) reveal or ‘picture’ the ego perception and alternative perceptions in a compensatory fashion typically through picture-metaphor; d) mediate a resolution by projecting, testing and monitoring the outcome of various imagined behavioral scenario’s (dream sequences); and e) select by rewarding scenario that has the anticipated consequences, often reinforcing it with illumination and/or a pleasing ending; f) encoding this learning into memory. This sequence of events can be observed in the imagery and storyline of a sampling of dreams, suggesting that the dreaming brain does employ the cognitive abilities of its active centers to process information during dreams.

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