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Dreaming as a story-telling instinct

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Dreams create new stories out of nothing. Although dreams contain themes, concerns, dream figures, objects, etc. that correspond closely to waking life, these are only story elements. The story itself weaves these mnemonic items together in a manner far more novel than a simple assemblage or collage, producing an experience having a life-like timeframe and life-like (if often bizarre and impossible) causality (Pace-Schott, 2007; Hobson, 2009). It is as if one is immersed in another “reality” entirely of one’s own non-volitional, making (see Rechtschaffen, 1978). Given this phenomenology, it’s not difficult to see why some indigenous animist societies believe dreams represent a separate world parallel with waking life (Nielsen, 1991). But neuroscience offers some other explanations.

Recent speculations have focused on the brain’s “default network” as a possible neural substrate of dreaming (Pace-Schott, 2007, 2011a,b; Nir and Tononi, 2010; Wamsley and Stickgold, 2010; Domhoff, 2011). The default network consists of regions that, in the absence of exteroreceptive attention or narrowly focused mental effort, support self-directed concerns, immersion in one’s inner life (e.g., daydreaming) or imagining the inner life of others (Theory of Mind) (Buckner et al., 2008; Andrews-Hanna, 2012; Buckner, 2012). Most importantly for the current topic, the default network also simulates future scenarios and re-creates past ones drawing upon material in episodic, autobiographical, and semantic memory (Schacter et al., 2007; Schacter, 2012). Here I will suggest that such constructive activities of the brain represent a “hard-wired” tendency to represent reality in the form of narrative—a “story-telling” instinct or module.

The default network was originally identified using positron emission tomography (PET) as those regions showing task-induced deactivation (Gusnard et al., 2001; Raichle et al., 2001). Subsequently, it was discovered that temporal synchrony of low frequency (0.01–0.1 Hz) spontaneous fluctuations of the blood-oxygen dependent (BOLD) signal of fMRI identifies both anatomical and functional connectivity among regions of the default network (Fox and Raichle, 2007; Greicius et al., 2008). This network consists of (1) medial parietal areas: posterior cingulate (pCC) and retrosplenial (Rsp) cortices; (2) posterior-lateral areas: inferior parietal lobule (IPL), temporoparietal junction (TPJ), lateral temporal cortex (LTC), temporal poles (TP); (3) medial temporal regions: hippocampal formation (HF), parahippocampal cortex (PHC); and (4) medial prefrontal areas: ventromedial (vmPFC) and dorsomedial (dmPFC) prefrontal cortices (Buckner et al., 2008; Spreng et al., 2009; Andrews-Hanna, 2012).

Resting state functional connectivity analyses of BOLD oscillations in waking have identified two default-network subsystems each of which fluctuates synchronously with central nodes in the pCC and anterior medial PFC (amPFC) but not with each other (Buckner et al., 2008; Andrews-Hanna et al., 2010; Andrews-Hanna, 2012). The dorsomedial prefrontal subsystem includes the dmPFC, LTC, TPJ, and TP whereas the medial temporal lobe subsystem includes the HF, PHC, Rsp, IPL, and vmPFC. The dorsomedial prefrontal subsystem selectively activates during experimental tasks involving reflection on one’s own mental state and that of others as well as other forms of social cognition (Andrews-Hanna et al., 2010; Mar, 2011; Andrews-Hanna, 2012). In contrast, the medial temporal lobe subsystem is selectively activated by retrieval of episodic and autobiographical memories as well as by imagination of future scenarios and concerns (Schacter et al., 2007; Andrews-Hanna et al., 2010; Andrews-Hanna, 2012; Schacter, 2012). The central nodes activate along with most tasks that recruit one or the other subsystem (Andrews-Hanna, 2012).

Synchrony of BOLD fluctuations among components of the default network persists into light (Drummond et al., 2005; Horovitz et al., 2008; Larson-Prior et al., 2009) and Stage 2 (Laufs et al., 2007) NREM sleep. However, in slow-wave sleep (SWS), frontal regions may uncouple from the rest of the default network (Horovitz et al., 2009; Samann et al., 2011, but see Koike et al., 2011). In the one study examining REM, unlike both waking and NREM, there appeared a lack of connectivity between the dorsomedial prefrontal subsystem and the posterior central node of the default network in the pCC (Koike et al., 2011). Koike et al. speculate that this disconnection contributes to the illogic and bizarre nature of dream cognition, as has also been suggested for loss of antero-posterior EEG synchrony in the fast, gamma (>30 Hz) frequencies during REM (Corsi-Cabrera et al., 2003, 2008).

Earlier PET and fMRI *activation* studies of sleep also showed distinctly different activity in medial limbic versus lateral association cortex during REM sleep. After sleep onset during NREM, widespread cortical and subcortical areas become less active (Braun et al., 1997; Maquet et al., 1997; Nozinger et al., 2002; Kaufmann et al., 2006). However, with the onset of REM sleep, midline limbic regions of the frontal cortex and subcortex reactivate to levels equaling and sometimes exceeding those of waking, whereas lateral and posterior-medial cortical areas remain in a NREM-like deactivated state (Maquet et al., 1996, 2005; Braun et al., 1997,
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temporal subsystem). Similarly, in comparison

memory (both functions of the mediotem-

tem( e.g.,v mPFC,H F ,P HC )o ft h ed e f a u l t

ies, the anterior central node (amPFC)

But do dreams actually tell stories?
Cipolli and Poli (1992) applied a formal,
story grammar developed to describe nar-
rative texts (Mandler and Johnson, 1977)
to REM-dream reports collected by instru-
mental laboratory awakenings. Formal

elements of dream narratives resembled
typical stories, for example, by inclusion of
characters, settings and a hierarchical
event structure (Cipolli and Poli, 1992).
Moreover, these elements remained sta-
ble between the nocturnal report and its
retrospective morning report suggest-
ing that story-like structure was a fea-
ture of the dream experience itself rather
than being imposed upon its recall dur-

ing waking. Cippolli and Poli suggest that
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However, story structure may also be
the basic manner in which brain orga-
nizes experience. Although obscured by

temporal progression of events and of
cause and effect in waking, this ten-
dency may become more apparent dur-
ing the non-volitional process of dreaming
and pathological states such as delirium
or confabulation (Solms, 1997; Hobson,
1999; Schnider, 2003, 2008; Hirstein,
2005).

Like dreaming, spontaneous behavioral
confabulation involves a fictive narrative
produced effortlessly, without insight as to
its veracity, that is often acted upon by the
patient (Schnider, 2003, 2008; Hirstein,
2005; Gilboa et al., 2006; Nahum et al.,
2012). Spontaneous confabulation results
from lesions of the anterior limbic system
including posterior medial orbitofrontal
cortex (pmOPFC, part of vmPFC) and its
subcortical connections (Schnider, 2003,
2008; Hirstein, 2005; Gilboa et al., 2006).
Confabulated memories usually contain
real autobiographical events including
those from the remote past (Schnider,
2003, 2008; Hirstein, 2005). Such loss
of insight has been attributed to disrup-
tion of a reality filtering function local-
ized to the vmPFC/pmOPFC (Schnider,
2003, 2008) or to a more general deficit
in strategic retrieval and verification of
memories (Gilboa et al., 2006). In either
case, however, phenomenological similari-
ties exist with dreaming. For example,
confabulators create plausible but false
explanations for inconsistencies in their
stories (Hirstein, 2005), closely resem-
bling “ad-hoc explanations” for improb-
able dream occurrences (Williams et al.,
recognition” (Hirstein, 2005) in confab-
ulation parallels dreamers’ assigning an
identity to dream characters perceptu-
ally dissimilar to their waking counterpart
(Kahn et al., 2000).

Therefore, in both confabulation and
dreaming, altered functioning of the pre-
frontal cortex may release from reality-
filtering or executive constraint an innate
human tendency to create stories that
organize past, present, and future reality.
Dreaming may represent a potent, nat-
urally occurring form of confabulation
in which imaginary events are not only
created and believed but are vividly expe-
rienced as organized, multimodal halluci-
nations (Hobson, 1999; Pace-Schott, 2007,
2011a). Of course, hallucinosis differenti-
ates dreaming and confabulation as does

the fact that vmPFC/pmOPFC damage
leads to confabulation whereas its activa-
tion accompanies dreaming. Nonetheless,
in both phenomena, involuntary gener-
ation of an organized, fictive narrative
entirely lacking insight suggests that they
may share neural mechanisms. Possibly,
the loss of pre-frontally mediated real-
ity monitoring, due either to pmOPFC
damage in confabulation or lateral frontal
inactivity during dreaming, may release
narrative-production mechanisms from
inhibitory restraint.

But what about normal narrative
production? Braun et al. (2001) per-
formed PET conjunction analysis to
identify modality-independent regions
activated by storytelling in both English
and American Sign Language. Although
activity was shared in widespread medial
and lateral cortical areas, medial prefrontal
activation could be most directly related
to the generic production of narrative dis-
course apart from the imagery, lexical,
and memory processes shared by the two
modes of storytelling (Braun et al., 2001).
Therefore, portions of this same network
may be engaged in volitional storytelling
(see Mar, 2004 for review).

However, this putative storytelling
module expressed as dreaming or confab-
ulation rarely yields levels of organization
equal to volitional narrative. For example,
discontinuities in dream plots are suffi-
ciently common that judges are unable
to distinguish artificial reports created
by splicing together text from different
dreamers’ reports from intact dreams
(Stickgold et al., 1994). Nonetheless, the
brain may attempt to impose wake-like
temporal causality on any experience, real,
or imagined. Dream hallucinosis itself may
generate low-level narrative coherence
by associative processes in which images
evoke related images (see Rittenhouse
et al., 1994) that are successively woven
together by this putative tendency to orga-

ize experience as a story (Pace-Schott,
2005). In dreaming, diminished capac-
ity for working memory, due to lateral
prefrontal inactivity, may prevent reflec-
tion upon immediately past events leading
to an unquestioned, forward progression
of the plot as well as frequent narrative
divergence. Interestingly, recent studies of
lucid dreaming have shown both return
of wake-like, gamma-frequency activity in
the lateral PFC (Voss et al., 2009) and reactivation of portions of posterior default network along with lateral parietal, prefrontal, and occipito-temporal regions (Dresler et al., 2012).

So what might this storytelling module operating during dreams suggest to individuals wholly unfamiliar with neuroscience and scientific psychology? A keen interest in dreams among some hunter-gatherer societies is exemplified by the practice of dream sharing (Wax, 2004). Dreams are sometimes recounted as experiences from another, parallel existence. For example, The Amazonian Ese Eja believe that, during dreaming, their spirit inhabits a parallel world populated by other spirits, including those of animals (Peluso, 2004). Similarly, the Amazonian Mehinkaku believe each individual contains several types of souls distinct from their waking selves, one of which, the “eye soul,” is active during the night experiencing dreams but sleeps during the day (Gregor, 1981). Similarly, among the Andamanese Onggei society, discussion of sensory details from multiple individuals’ dreams is used to build consensus as to the probable locations of seasonal food sources (Pandya, 2004). Therefore, recalled dreams provide a ready source of story-like narrative that can acquire cultural significance equal to or exceeding the retelling of waking events.

Basic human storytelling tendencies are widely postulated (e.g., Schechtman, 1996; Nigam, 2012; Stafford, 2012). By providing a template into which any experience, real or imaginary, can be inserted, story-telling may be one way the brain has evolved to efficiently represent and record waking experience. Evolution may have subsequently exploited this capacity for multifold purposes including future simulation. Hobson’s (2009) protoconsciousness theory, describes how dreams adaptively support waking consciousness. Similarly, evolution may have exploited dreamed scenarios to rehearse survival strategies (Revonsuo, 2000). In indigenous societies, story-like structure may have facilitated integration of dream phenomena such as parasomnias (e.g., sleep paralysis, see Cheyne, 2003), lucidity, partial awakenings and dream bizarreness into existing belief systems, or even to create new beliefs and legends (see Nielsen, 1991).

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