Where the Sun never Shines

Emerging Paradigms of Post-enlightened Cognition

Johannes Bruder

Abstract

In this paper, I elaborate on deliberations of "post-enlightened cognition" between cognitive neuroscience, psychology and artificial intelligence research. I show how the design of machine learning algorithms is entangled with research on creativity and pathology in cognitive neuroscience and psychology through an interest in "episodic memory" and various forms of "spontaneous thought". The most prominent forms of spontaneous thought – mind wandering and day dreaming – appear when the demands of the environment abate and have for a long time been stigmatized as signs of distraction or regarded as potentially pathological. Recent research in cognitive neuroscience, however, conceptualizes spontaneous thought as serving the purpose of, e.g., creative problem solving and hence invokes older discussions around the links between creativity and pathology. I discuss how attendant attempts at differentiating creative cognition from its pathological forms in contemporary psychology, cognitive neuroscience, and AI puts traditional understandings of rationality into question.

"New technologies foster efficiency and madness in the same flow."

(Guattari 2013: 27)

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Fig. 1: Picture by Robert Lindsell, taken at the Agincourt Reef, Great Barrier Reef, Queensland, Australia (licensed under Creative Commons 2.0)

Thinking of the underwater world just off Australia's West Coast, we imagine an abundance of colours, a submarine Garden of Eden, inhabited by a huge variety of fish and coral. But the Great Barrier Reef has already lost much of its magic. All I can see now are – brownish, greenish, greyish – coral in faded colours and one single tiny, yellow fish. As I advance into greater depth, however, the first creatures appear, colours intensify and the once lacklustre scene turns increasingly otherworldly. During the descent, a voice in my head repeats the words of an infamous deep sea explorer. "I have been diving now for twenty years. Yet, when I am alone in the sea at night, I am still afraid. It is in the night that you meet the strangest creatures. Their shapes, their colours, their movements are stolen from nightmares." (Cousteau 1964)

With Albert Falco's thoughts reverberating in my head, what I see before my eyes mingles with vivid memories of Jacques Cousteau's filmic documents of underwater expeditions, a sort of primeval scene of deep-sea exploration.[1] *A World without sun*, for instance, documents how a group of oceanauts around Cousteau explores the conditions of living and working in a submarine base 33 feet below the surface, just off the coast of Sudan. The divers made regular expeditions during the night, when some fish go to sleep between the rocks and those that steer clear of the day come out of their hideouts. In the recesses of the ocean at night, darkness provides a comforting intimacy that lures all kinds of strange creatures into the vicinity of the (human) observer. Cousteau's oceanauts had the opportu-

1 The following thoughts about Cousteau's "dark empiricism" were influenced by collaborative work with my colleague Jamie Allen that led up to a presentation at the Annual Meeting of the Gesellschaft für Medienwissenschaften in Berlin (June 2016).

nity to interact with and study living beings they could otherwise barely see from afar. Fear quickly turned into fascination with the unknown and an interest in the behaviour of that which cannot be seen from the surface. In the movie, the narrator calmly voices the thoughts of the insomniac crewmember Falco: "every time I come across a fish new to me, I am scared at first. Then, I absorb his reflexes and little by little gain his confidence."

Fig. 2: Agincourt Reef, Deep Dream version, Level 2 (made by the author)

Fig. 3: Agincourt Reef, Deep Dream version, Level 10 (made by the author)

As I write these lines, I am, of course, not descending into the (nocturnal) ocean. Staring into the flat depths of my laptop screen, I repeatedly hit the *Go Deeper!*

button within Google's Deep Dream Generator[2] and marvel at the creatures that emerge out of the blue after a couple of seconds. Trained – just like Cousteau's divers – to find everything that hides between the pixels, the algorithm gradually turns a photograph of the seemingly lifeless Great Barrier Reef into a colourful and psychedelic submarine world. The deeper I go the more creatures creep out of a picture. It appears as if they become more and more confident as the algorithm begins to "absorb their reflexes." In fact, however, it merely hallucinates what it has been trained to identify.

As many critics have remarked, DeepMind algorithms tend to suffer from pathological obsession with minuscule detail, also known as apophenia,[3] but their mothers and fathers regard this tendency as a defining characteristic rather than an problem. Wendy Chun has therefore called big data "the bastard child of psychoanalysis"[4] – a set of techniques or technologies developed for the study of the unconscious that, as Lennard Davis argues in his book *Obsession* (2008), is often implicated in the phenomena it explores. To analyse obsession, he suggests, one needs to be obsessed with obsession; being analytical then involves being able to prevent obsession form becoming pathological – as, for instance, in obsessive-compulsive disorder. In this paper, I intend to show that it would seem fair to assume that contemporary machine learning algorithms represent experimental technologies to re-establish the distinction between creativity and pathology through a novel "cerebral alley"[5] that involves cognitive science, psychology and artificial intelligence research.

I explore this re-alignment of computing and the psy-sciences through cognitive neuroscience research on the "dark matter of cognition". Controlled to exhibit their creative potential, cognitive states such as mind wandering and day dreaming promise to promote incubation in humans and machines and augment neuro-psychology as well as data-driven science to "manage and utilize the unknown" (Halpern 2014, 17). They might, however, turn pathological if uncontrolled and play their part in disorders like attention deficit hyperactivity disorder (ADHD) and schizophrenia. Both modes of spontaneous thought are linked to "inceptionism", which will be briefly introduced in Section 1, followed by an exploration of the metaphors that helped ground DeepDream in neuroscience research. To show how the differentiation between creativity and pathology emerged in cognitive neurosci-

2 The principles of visualising neural networks with DeepDream are explained in two papers by Alexander Mordvintsev, Christopher Olah and Mike Tyka. (2015, 2015a)

3 See, e. g., Hito Steyerl's (2016) article on apophenia in machine learning for a detailed explanation of the phenomenon.

4 I am quoting here from a talk that Wendy Chun gave on the occasion of the symposium *Poetry of the Real* at the Academy of Art and Design FHNW in Basel, 15–17 June 2017.

5 Rodney Brooks, professor emeritus of robotics (Massachusetts Institute of Technology) in fact speaks of a "cerebral blind alley" that would hinder progress in the realm of AI. See Brooks et al. (2012) for further details.

ence, I will further describe how rest has been reconceptualised as a highly significant cognitive state within the neurosciences (Section 2) and provide some insights into how idleness has been recast as a source of creativity in between neuroscience and artificial intelligence (Section 3). In section 4, I will return to the depths of the ocean to show how darkness might turn a cognitive technique in pursuit of human creativity as well as algorithmic pattern recognition within a sea of data: a train of thought that will continue throughout the closing section's speculation about future forms of cognitive labour.

Where darkness (still) reigns

DeepDream, a convolutional deep neural network algorithm, caused quite a stir after it was let loose in 2015. It's online interface, the Deep Dream Generator, invites users to turn their run-of-the-mill photographs into beautiful, dream-like hallucinations and in turn provides Google with an abundance of free, unlabelled training data. Instead of analysing images for defining features that help identify particular animals, however, Deep Dream performs the obverse: it takes minuscule details as evidence for the presence of creatures it has been trained to recognize. Effectively, the algorithm projects its cognitive bias onto pictures – a technique that Google, by reference to Christopher Nolan's (2010) dream-heavy science fiction movie, calls "inceptionism." In the movie, Dominick Cobb and his team of dream stealers go on a mission to plant a specific thought in the Energy tycoon Robert Fisher's subconscious. While their usual business – stealing information by infiltrating the subconscious – affords no more than a shared dream, Cobb's team needs to design a dream within a dream in order to create a persistent idea. Only a vivid memory of Fisher's father telling him to take life into his own hands can convince the reluctant entrepreneur of breaking up his conglomerate. Crucially, the victim is afterwards not able to discern the implanted idea from his very own: it turns personal reality.

Although inceptionism is not much more than Google's attempt at effectively marketing the capacities of contemporary artificial intelligence solutions, it does exhibit epistemological guidelines of current machine learning technologies. DeepDream has been constructed to show how deep neural networks work or, to put it differently: how they may advance our understanding of various phenomena by mechanisms that apparently subtend how we (day)dream. Google's researchers are primarily exploiting insights generated by their CEO Demis Hassabis, who was one of the first to study the links between episodic memory and imagination as a PhD candidate at University College London (Hassabis et al. 2007) and designates episodic memory "the final piece of the jigsaw puzzle" (Burton-Hill 2016) of general-purpose artificial intelligence. The mechanisms that link episodic memory and imagination are characteristic of creative thought as well as of (day) dreaming and mind wandering, which seem to occupy the same spectrum

of undirected thought processes. Crucially, these modes of thought are characteristically non-conscious: new solutions and ideas that result from episodes of daydreaming and mind wandering appear to emerge from the blue.

Hassabis himself reportedly cherishes the moments when the demands of the outside world abate and unfamiliar thoughts start to occupy his restless mind. In an article for the *guardian*, Clemency Burton-Hill (2016) portrays Hassabis as workaholic of a special kind, who, just like his restless algorithms, can never entirely "switch off." "I never had that work versus life thing; it's all part of the same canvas," Hassabis explains. "I do love reading books, watching films, listening to music, but it tends to all come back to what I do." Nevertheless, everything has its time: when everyone else is asleep, Hassabis's second day begins. "Until three or four in the morning, that's when I do my thinking: on research, on our next challenge, or I'll write up an algorithmic design document." The dark hours of the early morning provide an ulterior intimacy, free of external constraints, where the impressions of the "first day" mingle into a liberated, but goal-directed stream of consciousness. Darkness, as it were, turns into an effective technology of the self, a creativity technique, in that it promotes cognitive drift and the emergence of self-generated or "spontaneous" thought which potentially result in ground-breaking ideas.[6]

Neuroscientists Smallwood and Schooler (2015) define self-generated thought as the ability to mentally decouple from what happens in one's immediate surroundings. This category of cognitive states has until the late 1990s been known as the dark matter of cognition and more recently received increased attention in the context of neuroscientific explanations of creativity (see e. g., Beaty et al. 2014, Fox et al. 2015). More specifically, the kind of thinking without fixed course or certain aim characteristic of self-generated or spontaneous thought apparently defines a spectrum that includes creativity, mind wandering, stream of consciousness, and (day) dreaming (Christoff et al. 2016; see also Domhoff, Fox 2015). These cognitive states have been surrounded by epistemic "darkness" thanks to a long-standing neuroscientific fixation on cognitive experiments with entirely conscious and focused volunteers. Only when cognitive neuroscientists changed their experimental strategy and started scanning "resting brains" in the 1990s, the spontaneous thought family made its appearance in theatre of the brain sciences.

The title of one of the most influential papers on resting state research – *The brain's dark energy* (Raichle 2006) – conveys a feeling of how cognitive phenomena that had fallen below the threshold of brain imaging eventually came to bear in cognitive neuroscience. Within the classic cognitive neuroscience paradigm, volunteers in the MRI scanner are presented with mental tasks or stimuli such as images, e. g., of angry faces and spiders to provoke a brain response that is

6 Based on Nikolas Rose's account of governmentality in *Inventing Our Selves* (Rose 1998), Claudia Mareis (2016) interprets creativity techniques as technologies of the self. In post-war notions of creativity as democratic skill, creativity techniques are supposed to enable the individual to open her mind.

understood to represent fear and anxiety (see e. g., Holzschneider & Mulert 2011). By means of an array of statistical procedures the signal is subsequently "cleaned" to discard activations that are not related to the experimental task and to turn the cleansed data into brain images where the colouring of clearly delineated areas, regions or networks of firing neurons references the design of heat maps in other scientific fields such as climate research.

Although brain activations observed in classic brain imaging experiments accounted for but a fraction of the brain's energy consumption, brain activity purportedly not related to the experimental stimuli or tasks had till the mid-1990s been entirely ignored and vanished in the dark grey x-ray like scans of the brain's anatomy. Through a methodological twist[7] (Shulman et al. 1997), however, researchers found that brain activity in some regions will indeed decrease during task conditions and that other regions – particularly those involved in memory (Andreasen 1995) and complex reasoning (Christoff & Gabrieli 2000) – will increase their activity whenever the volunteers rest in between two tasks. The increase was subsequently referred to as, e. g., the brain's 'dark energy' and helped to account for the gap between energy consumption and cognitively significant activations. Moreover, it enabled researchers to shine a light on more mysterious cognitive phenomena, which had before been regarded as too psychological – or too dark – for cognitive neuroscience.

The explosion of "resting state imaging" resulted in a heightened interest in cognitive states that are task-unrelated, occur spontaneously and unintentionally and appear to be representative of what cognitive scientists call "internal processing" (Callard et al. 2013).[8] An initial emphasis on the brains at rest gradually gave way to research on the "default mode of the brain", which has been described as representing the state a brain returns to when the cognitive demands of the environment abate. Experimenters started targeting non-conscious forms of cognition through the design of their experiments and found the aptly called default network (DN) to be involved in many things self-referential and future-oriented, which range from distracting (mind wandering; Christoff et al. 2016) to goal-directed (autobiographical planning; Baird et al. 2011, Smallwood/O'Connor 2011).[9] Resting brains accordingly turned into relentlessly and restlessly active

7 See Callard & Margulies (2014) for a comprehensive account of the birth of resting state research.

8 The transition of cognitive neuroscience research – from task-based imaging to investigations of the brain's default activity – is in fact much more complicated and still ongoing. In the interest of brevity, I am describing the reorientations within neuroscience research only from the perspective of contemporary research on spontaneous thought.

9 The default mode of the brain and the default network do not necessarily overlap. Cognitive processes that are counted as part of the default mode often engage more brain resources than the default network.

brains that appear to be particularly creative when allowed to take a break from cognitively overwhelming environments.

This is not to say that spontaneous thought suggests a brain out of control. In the event of mind wandering, for instance, the default network is considered to interact with the so-called executive network, which is specialized in control and planning and had for a long time been considered to have an antagonistic relation to the DN. The focus in cognitive neuroscience has hence shifted from an interest in the contents of spontaneous thought to the dynamics between brain networks that subtend the formerly dark matter of cognition. In a paper published on arXiv.org in April 2017 (Andrews-Hanna et al. 2017), a group of leading resting state researchers explains this transition to an interest in the dynamic couplings of distinct brain networks that undergirds the kind of spontaneous thought characteristic of mind-wandering by analogy to an old Sufi parable attributed to Mullah Nasrudin.

> A police officer approaches a drunk man who's searching for something beneath a lamppost, "What are you looking for?" "My keys, Sir," the drunk man replies. The police officer helps to look for a few minutes. Finding nothing, the officer asks, "Are you sure you lost them under the lamppost?" "No," says the drunk, "I lost them in the park." "Then why are you searching here?!?" "Because there's a light." Like the drunk man, the field of psychology may have neglected spontaneous thought for over a century because it is shrouded in darkness. From Behaviourism through the Cognitive Revolution, the field looked for psychological processes under the light of experimental tasks. Methodological innovations in neuroscience and psychology moved our gaze a little further, but still we look only at those forms of "mind-wandering" that can be illuminated by their contents. Now it's time to break out the flashlights, to step into the darkness wherein lies the dynamics of spontaneous thought. (Andrews-Hanna et al. 2017, 25)

With the shift towards investigations into the dynamics between brain networks that subtend different forms of unintended, introverted thought, the distinction between and the control of pathological and volitional mental states turned a significantly technical problem: the secret of incubation appears to revolve around entering the twilight zone of the wandering mind in an algorithmically controlled fashion.

Pathology and Technology

The dynamics of spontaneous thought have stepped into the limelight of neuroscience research primarily since they appear to govern whether introversion makes us creative or mad. Although mind wanderers and day dreamers seem to border the realm of unhappiness (Killingsworth & Gilbert 2010; Sood & Jones 2013) and excessive variability of thought represents a defining feature of ADHD

(Seli et al. 2015), mind wandering and day dreaming are in general considered beneficial if they fall into a twilight zone between dreaming and goal-directed thought. If liberated from environmental constraints, the brain transitions freely between different mental states and memories – a dynamic that is enhanced by undemanding tasks or a quiet environment. (Baird et al. 2012; Beaty et al. 2015) Whenever the stream of consciousness is automatically (rumination and obsessive thinking characteristic of e. g., attention-deficit hyperactivity disorder [ADHD] and depression) or deliberately (goal-directed thought and enforced attention) constrained, however, our ability to be creative appears to be significantly reduced. While suppressing the spontaneity of mental states is key in avoiding pathological forms of spontaneous thought, avoiding it entirely appears to make us unimaginative and close-minded. (Andrews-Hanna et al. 2017)

Incubation is, so to speak, jammed in between mental illness and misguided attempts at defining professional work ethics through attention and focus. Technically, it is apparently supported by rapid shifts between spontaneous and controlled processes, or generative and evaluative states (Ramey & Chrysikou 2014). The underlying, delicate balance is achieved through the interaction of hippocampus and pre-frontal cortex. The hippocampus is not necessary for spontaneous thought per se, yet crucial for processing the form and content of mind wandering. It is, so to speak, the working memory that provisionally stores vivid, episodic memories[10] and processes them for long-term storage as soon as a quiet environment supports it in going offline: when we sleep soundly, the hippocampus begins to recall and remix stored episodes in the process of memory consolidation (Moscovitch et al. 2016). The pre-frontal cortex controls that this process of memory consolidation does not get out of hand and defies reality. Memory consolidation is an entirely unconscious process but we are invited to witness how the pre-frontal cortex playfully puts the consolidated memory to the test in dreams, where cinematic vividness meets otherworldly narratives and incomprehensible turns. Mind wandering and day dreaming are much more controlled and yet devoid of meta-awareness: when our mind wanders, we can typically not recall how a particular thought came into being after it attracted our attention.

Neither fully conscious and focused, nor absentminded, the "healthy, creative individual" has the capacity to dream lucidly without being asleep, to live through scenarios without getting lost in its thoughts. (Fox et al. 2013) While cognitive neuroscientists are busying themselves with the de-stigmatization of cognitive

10 In contrast to semantic memory (Gershman & Law 2017), episodic memory is highly visual and detail-rich; it involves information that is marginalized in the process of consolidation but might be recalled in the future and experienced as intuition or a feeling. People who suffer from hippocampal amnesia, for instance, experience mainly verbally mediated, semantic thoughts anchored in the present: they can describe a beach but fail when asked to imagine being at a beach (McCormick et al. 2017).

states such as mind wandering and the identification of neural switches that prevent spontaneous thought from turning into rumination, obsessive thought and a hazard for well-being, artificial intelligence researchers target to institutionalize the sort of hazy creativity that mind wandering supports in their algorithms. Since the creative potential of mind wandering is rooted in the capacity to link the future to subjective episodes in the past, a team of researchers at Google's DeepMind division, for instance, recently designed an algorithm that mimics the interaction between hippocampus and pre-frontal cortex (Pritzel et al. 2017).[11]

Contemporary artificial intelligence, in general, builds on the mechanisms that purportedly govern how human brains employ non-conscious memory replay to update their cognitive architecture. By focussing on the process that turns episodic memory into the raw material of imagination, Google DeepMind developers are accelerating the trend towards substituting expertise with an unconstrained and playful engagement with the world.[12] Google DeepMind CEO Demis Hassabis does not waste any opportunity to proclaim that the "research team behind AlphaGo will now throw their considerable energy into the next set of grand challenges, developing algorithms that could one day help scientists as they tackle some of our most complex problems, such as finding new cures for diseases, dramatically reducing energy consumption, or inventing revolutionary new materials" (Byford 2017). In conjunction with the neuroscientific models used in the design of DeepMind algorithms, the future test beds of Google's AI provide some clues as to how research will proceed. Playing legacy ATARI 2600 video games or Go in the present might indeed help speed up and improve medical diagnostics in the future (Mnih et al. 2015). The fact that DeepMind is now moving from board games to e-sports and *StarCraft II* is not only due to Hassabis' fondness of video games. After DeepMind algorithms have internalized the purportedly decisive mechanisms of undirected thought processes and before they can curtail the data deluge that currently encompasses many fields such as "climate, economics, disease" (Rowan 2015), they will continue and relentlessly optimize their cognitive architecture where the sun never shines: shielded from human intervention in what the former game designer calls cleaner and more constrained "microcosms of the real world" (The Economist 2016).

11 Pritzel and colleagues (2017) tested their approach in classic Atari video games such as Pac-Man and Pong, where it outperformed other deep-learning machines in early learning stages.

12 Media theorist Matteo Pasquinelli (2017) describes said trend as turning information into logic, for "a representation of the world becomes a new function in the same world."

Restlessness and Strength

While Google DeepMind has moved on to video games, the evolution of their infamous Go algorithm AlphaGo remains highly interesting as regards the epistemology of machine learning in the early twenty-first century. The first versions of AlphaGo learned to react on 30 million positions from games played by human experts and subsequently played itself before taking on other Go algorithms. To learn about the human element, AlphaGo faced a sparring partner, but Fan Hui, the European Go champion after all, was soon outplayed and the algorithm ready to take on new and bigger challenges. Its devastating victory in the DeepMind challenge against Lee Sedol, the currently second highest ranked Go player worldwide, was a demonstration of the algorithm's capabilities and garnered widespread attention, yet the DeepMind team did not rest before AlphaGo reached the top of the Go world. After secretly playing 51 professional opponents online, the algorithm eventually took on the World's best player, Ke Jie, during the *Future of Go* summit in May 2017 and succeeded. In an interview with China Global Television Network after the summit, Ke Jie admitted that the "gap between AlphaGo and I is so huge that I won't catch up with it all my life. AlphaGo can see the whole universe, while I can only see a small pond. So, let it explore the universe, and I will just fish in my own pond".[13] In October 2017, DeepMind researchers eventually published a paper that introduced AlphaGo *Zero* (Silver et al. 2017), the first version of AlphaGo that learned to play Go from scratch and without human input. Since the learning process appears to be much more effective when the algorithm's mind wanders where humans had never dared to go, the ponds of the world's best human players have gotten too small for Google's ambitions.

What is often omitted from discourses about artificial intelligence is that its contemporary forms are not designed to reproduce human intelligence or creativity but to advance where humans typically hit the wall. The fact that these algorithms are more than ever inspired by the mechanisms that supposedly govern (spontaneous) human thought is only seemingly paradoxical. The cerebral alley that now enables us to rethink mind wandering and day dreaming as machinic epistemology was indeed never envisioned as a one-way street. To the extent that artificial intelligence researchers are dipping into higher cognitive functions and mental disorders to refine their algorithms, they expect neuroscience to profit from artificially intelligent prototypes, which Demis Hassabis deems plausible simulacra of biological brains. "Distilling intelligence into an algorithmic construct and comparing it to the human brain might yield insights into some of the deepest and the most enduring mysteries of the mind, such as the nature of creativity, dreams, and perhaps one day, even consciousness" (Hassabis et al. 2017). Indeed, neuroscientists have started to employ deep neural network algorithms as models of how the brain processes cognitive input (Kriegeskorte 2015).

13 Quoted in *The Alpha and Omega of Go* (Jiajui 2017).

Meanwhile, our understanding of undirected, spontaneous thought is becoming increasingly mechanistic. Concepts such as "dark control" (Dohmatob et al. 2017) begin to surface in between the disciplines of neuroscience and artificial intelligence. Recasting human thought in mathematical terms of control theory and reinforcement learning, the authors propose that "imperfect memory recall, random day-time mind-wandering, and seemingly arbitrary dreams during sleep may provide blocks of pseudo-experience to iteratively optimize the behaviour of the organism" (ibid, 2). These moments of disconnection, which are purportedly feared by most of us and have for a long time been discouraged as sinful idleness, are now in the process of being re-appropriated in the name of innovation.[14] At the heart of this endeavour is the technological colonization of "rest" or, put differently, the design of restlessly mind wandering algorithms that are indifferent to the concept of "knocking off". In response to an interviewer, who was interested in whether AlphaGo ever gets to rest, Demis Hassabis reportedly said that it "didn't even have Christmas off" (Burton-Hill 2016) and, with a twinkle in his eye, speculated that the algorithm might indeed enjoy this particular mode of restlessness. DeepMind algorithms are constantly at work, day and night, roaming an ocean of data to optimize their cognitive architecture for adventures in pattern recognition to come.

What Darkness Promotes

Information processing had a stake in oceanic metaphors for quite some time now. In 2008, *Wired* magazine's editor in chief Chris Anderson introduced the meanwhile all-to-familiar idea of the data deluge, which has purportedly brought about a move away from scientific method towards a worship of the law of big numbers. The link between catastrophic flooding and machine sensing is anything but accidental; ever since have the masses of water characteristic both of floods and oceans provided vivid images to what critics of statistical reasoning and big data currently fear: that we might drown in seas of data instead of advancing to an enlightened consciousness. Hito Steyerl (2016), for instance, quotes from a SIGINT column on the internal NSA website: "Developers, please help! We're drowning (not waving) in a sea of data – with data, data everywhere, but not a drop of information."

14 Wilson et al. (2014) report that their experimental subjects found spontaneous thought processes to be unpleasant and emotionally aversive. Their claims have, however, been contested by Fox et al. (2014), who claim that Wilson et al's data do not reflect their interpretations. One should not overlook the stakes that both groups have in their respective claims: Fox and colleagues belong to the most active groups in the de-stigmatization of spontaneous thought processes, whereas Wilson and colleagues administer the benefits of meditation and other techniques of mental training.

Masses of water and the ocean, in particular, have always occupied a specific place in our global Northern consciousness.[15] Hans Blumenberg writes that in "Christian iconography (...), the sea is the place where evil appears, sometimes with the Gnostic touch that it stands for all-devouring Matter that takes everything back into itself." (Blumenberg 1996: 8) The self-acclaimed techno-anthropologist Nick Seaver suggests that "the ocean appears to communicate big data's scale, formlessness, and resource-richness" (Seaver 2014) and historian Rebecca Lemov finds discourses around big data to frame it as an inhuman, raw force of nature that can neither be modified, nor regulated. (Lemov 2016) Those fears seem somewhat misplaced considering that centuries of seafaring and shipping have turned the oceans into a forgotten space that eludes our consciousness to a degree where we need TV cameras or anthropologist's GoPros on fish trawlers[16] to remind us of the dangers that the open sea holds in readiness. The deluge, however, invokes the fear not only of drowning in a sea of data, but more generally of the dark depths below the surface, which have never ceased to elude the grasp of enlightened rationality. In his ethnography of how marine microbiologists engage their subjects of study through field and laboratory techniques and technologies, anthropologist Stefan Helmreich paints a picture of the ocean as the host to hyperactive kinship, where ideas about relations are promiscuously reconfigured, day in, day out. (Helmreich 2009) This thought seems to be frightening to many; instead of a cosy habitat, we see an uncanny abyss.

Much of our fear with regard to the deep ocean appears to be triggered by its persistent intangibility, or its resistance to human cognitive capabilities and we have used science and technology to shed more (en)light(enment) on that which has been hiding in the dark depths shadows. On their website[17], Princeton University Press announces Robert D. Ballard and Will Hively's book *The Eternal Darkness: A Personal History of Deep Sea Exploration* (2017), which prominently features Jack Cousteau's expeditions into a *World without Sun*, with the following words:

15 Anthropologist Karin Amimoto Ingersoll shows in regard to (native Hawaiian) Kanaka epistemology that the land-centric viewpoints of enlightened Global Northerners are anything but universal. (Ingersoll 2016) From a different angle and by elaborating on the meaning of jungle in the monsoon belt, architect Dilip da Cunha states that the act of separating land and water "is a land-centric idea conceived to contain and control wetness." (Da Cunha 2018) In both cases, the differentiation between land and water appears to be connected to making water bodies serve land: "draining it, irrigating it, providing it with a waterfront for real estate, even making it with depositions of silt, but primarily keeping it dry for settlement." (ibid)

16 I am alluding to documentary TV series such as Discovery Channel's *Deadliest Catch* (2005-), shot in the Bering Sea, and the documentary film *Leviathan* (2012), directed by Véréna Paravel and Lucien Castaing-Taylor of the Sensory Ethnography Lab at Harvard University.

17 Please see http://press.princeton.edu/titles/11000.html for further information.

> Until a few decades ago, the ocean depths were almost as mysterious and inaccessible as outer space. Oceans cover two-thirds of the earth's surface with an average depth of more than two miles – yet humans had never ventured more than a few hundred feet below the waves. One of the great scientific and archaeological feats of our time has been finally to cast light on the "eternal darkness" of the deep sea.

In the book itself the reader finds Ballard, himself a seasoned explorer of the oceans' shallower depths and credited with the discovery of the wreck of the Titanic, take account of "how twentieth-century explorers have pushed back the frontiers of technology to take us into the midst of a world we could once only guess at." (ibid) While deep sea explorers have done their part in making the ocean appear less frightening (for themselves), it remains the most alien place on earth – an atopia, dark and forbidding, a non-place, validated as a genuine threat to experience and something entirely unreasonable. Cousteau's documentaries have indeed pioneered the illumination of a world without sun; yet, they do no more than besiege the eternal darkness of the deep sea. The footage offers glimpses into a world where, as the narrator explains at the very beginning of the documentary, the sun never shines but darkness flees the light of the cameras only to return a moment later. Invincible and omnipresent, by day and by night, it engulfs the oceanauts and their bright, camera-mounted lamps.

While *A World without Sun* seemingly sheds light on the deep sea on our screens, what it illuminates in the first place is the seemingly invincible darkness itself. It did catch on to the crew of Conshelf II, however not as a mere impediment of the visual sense, but as a more comprehensive cognitive displacement. In *World without Sun*, the narrator repeatedly explains how the sense of time became hazy for the crew, how they began to neglect the clock and the calendar, how they were about to lose touch with the world above. At around 25 minutes into the documentary, the narrator explains that sun and shadow have lost their meaning in the surroundings of the Conshelf's deep cabin and yet the oceanauts struggled to fall asleep for it were the quiet moments when anxieties about containment and isolation crept up.

This special cognitive and psychological constellation underwater is a defining topic of *A World without Sun*. After all, the purpose of the month-long experiment was to test the physiological and psychological effects of living and working in isolation from that which happens on the surface. (Clark 2014) Whereas divers would typically return to the well-lit surface after their expeditions into submarine life, the crew of the Conshelf II became part of an eco-system where the sun never shines. In this dimmed environment, their minds had ample time to wander and process the cognitive input of the "day." Falco's thoughts about the nightmarish character of submarine life, for instance, arise, as the narrator emphasizes, when everyone else is in bed and Falco is 'left to his thoughts.' It was reportedly Jacques Cousteau's decision that visitors from above were not allowed on the Conshelf II to prevent their special rhythm of life to be distracted: isolation was a feature of the

mission, not an impediment, and it served the purpose to prevent the divers from disconnecting from the untamed nature of the deep.

Whereas other metaphors of information processing – such as surfing the web or the much more significant metaphor of "data mining" – imply that we already have the necessary tools and technologies at hand, the data deluge presents a scenario that communicates a demand for a novel cognitive paradigm between psychology and artificial intelligence where the ocean as space of hyperactive kinship turns into the medium of *katabasis*, or a gradual descent in search of understanding, renewal and rebirth. The night sea journey is, according to Psychoanalyst Carl Gustav Jung "a kind of *descensus ad inferos* – a descent into Hades and a journey to the land of ghosts somewhere beyond this world, beyond consciousness, hence an immersion into the unconscious" (Jung 1969, par. 455) – a technology of the self, as it were, that allows us to perceive where darkness prevails.[18]

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In an article on the then-emerging field of resting state research, Felicity Callard and Daniel Margulies (2010) locate the neuroscientific transformation of "rest" within the context of post-Fordist production and claim that it projects an industrious subject that can never entirely switch off. Over the course of this article I have tried to show how research in cognitive (neuro) science might indeed procure new forms of restless cognitive labour, which mobilize a vast terrain characterized by complexes of human psycho-socio-cognitive capabilities that were hitherto regarded insignificant or even counterproductive. Investigations of the beneficial forms of mind wandering and daydreaming have over the last years been entangled with attempts at modelling non-conscious creativity in silico. A side effect of the new intimacy between algorithms and brains is the revaluation of rest as another form of (cognitive) labour that must be carefully managed – both in human minds and in information processing algorithms – in order to be sustainable. While psychologists try and establish cognitive techniques that prevent mind wandering from turning into depressive rumination, Google DeepMind researchers program their algorithms to continue exploration of seemingly absurd strategies after they completed a steep learning curve. Cognitive darkness turns technique of the self

18 An interesting attempt at "homing in on" the ocean, mentally and imaginatively, is Steve Mentz's concept of "Blue Humanities." See, e. g., Mentz (2009) and Gillis (2013). Recognizing, in the words of science writer Arthur C. Clarke and numerous marine biologists, that "the name of this planet should be Ocean, not Earth," blue humanities scholarship uses the alienating pressure of the deep ocean to estrange familiar stories and rewrite familiar narratives. Against discourses that situate human cultures in pastoral fields, enclosed gardens or teeming cities the blue humanities pose the sailor and the swimmer as representative figures, each differently threatened by and attuned to an inhospitable fluid environment. (Mentz 2018, pp. 69–70)

that helps elicit the creative leaps that contemporary creatives and data scientists appear to favour in equal fashion.

Why, then, should we look towards the oceans instead of the mine? After all, darkness is a feature that the deep ocean and subterranean worlds share. Shannon Mattern (2018) elaborates on the intimate link between big data and older forms of extraction, exemplified in the metaphor-turned-technique of data mining. Mines as well as the deep ocean abolish the difference between night and day, and break the rhythm of nature to "extend the lives of man-made artefacts that, above ground, in a more volatile climate, would disintegrate and decompose in a fraction of time." (ibid: 60) Whereas data mining belongs to the realm of extractive imperialism (Petras & Veltmeyer 2014) and communicates our global Northern desire to conquer ground and bring to light, mind wandering algorithms are designed to perform best from within a dimly lit ocean of data. The algorithmic modelling of beneficial forms of spontaneous thought is as much an attempt at designing creative technologies as it is a gesture towards techniques for survival in the event of deluge and cognitive overload.

The emergence of controlled mind wandering as a creativity technique in both humans and machines marks the emergence of a novel paradigm of post-anthropocentric and thus also post-enlightened cognition geared towards being in the thick of data – of which the Cloud, not the airy, celestial Gestalt, but the misty surround is but another instance. (Bruder, forthcoming 2019) Whereas data mining is for enlightened science and represents the dissecting view from above, mind wandering and dreaming appeal to a condition where data are no longer grounded through the coordinates of their production. The devices that are currently being designed by MIT's Dream Lab – e.g. the micro dream recorder NightOrb[19] – provide glimpses into the future of work in between two formerly clearly delineated states of consciousness and make us guess at whether we are witnessing the emergence of more inclusive epistemologies and ontologies through self-augmenting devices and machine learning algorithms, or another imperialism that, once again, involves appropriating enlightened rationality's former "Other" in the fashion of Dominic Cobb's dream stealers.

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19 See https://engineeringdreams.net. I would like to thank Maya Indira Ganesh for bringing this project to my attention.

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