Cognitive Neuroscience Glossary

This glossary was compiled by students of various university courses held by Fabio Richlan between 2011 and 2015.

Fabio Richlan, Ph.D.
Centre for Cognitive Neuroscience
University of Salzburg
Hellbrunnerstrasse 34, 5020 Salzburg, Austria
Tel: +43 (0) 662 / 8044 – 5170
Fax: +43 (0) 662 / 8044 – 5126
E-mail: fabio.richlan@sbg.ac.at
Web: www.uni-salzburg.at/ccns/people/richlan

10-20 system: An internationally recognized system to determine the location of EEG electrodes on the scalp. Morphologically exactly defined marks are used and electrodes are placed in reference to them in 10 and 20% steps, respectively (Jasper, 1958).

Action potential: The active or regenerative electrical signal that is required for synaptic communication. Action potentials are propagated along the axon and result in some distinct biological action (e.g. the release of neurotransmitter) (Palmer & Stuart, 2009).

Action value: The value or expected return of executing a given action (usually, in a given state or context). In the reinforcement learning literature, action value is usually expressed as a Q-value that depends on both state and action: Q (state, action). Action value can also be expressed as the probability of achieving reward R by executing a given action A in a given state S: P(R|A,S). (Pezzulo, van der Meer, Lansink, & Pennartz, 2014)

Adult neurogenesis: A specific case of cell-based brain plasticity where new neurons (and not only neurites and synapses) are added to the brain network in an activity-dependent way. In humans, new neurons are generated throughout life in the hippocampal region, which is thought to provide the functional backbone for learning and memory (May, 2011).

AHP: Averaged high posterior reconstruction for each BOLD signal (Nishimoto et al., 2011).

Akinetopsia: motion blindness, inability to perceive movements due to V5 cortex impairments. The patients normally see static objects (colors and shapes), but instead of perceiving fluent movements, they see everything 'frame by frame' (Kalat, 2008).

Angiogenesis: The physiological process of growing new blood vessels (May, 2011).

Anterior cingulate cortex (ACC): The anterior cingulate cortex (ACC) is the frontal part of the cingulate cortex. It has been implicated in a wide variety of autonomic functions, such as the regulation of blood pressure and heart rate. It may also play a role in many cognitive processes, such as reward anticipation, decision-making, empathy, impulse control, and emotion regulation (Harris et al., 2009).

Anterior to posterior commissure (AC-PC): The anterior commissure (AC) and posterior commissure (PC) are two structures in the brain that are used to define the Talairach coordinate system of the human brain. The anterior commissure is defined as the origin with coordinates (0, 0, 0).

Aphasia: is an impairment, due to acquired and recent damage of the central nervous system, of the ability to comprehend and formulate language. It is a multimodality disorder represented by a variety of impairments in auditory comprehension, reading, oral-expressive language, and writing. The disrupted language may be influenced by physiological inefficiency or impaired cognition, but it cannot be explained by dementia, sensory loss or motor dysfunction. Rosenbek, LaPointe, & Wertz (1989).

Apraxia: A neurological syndrome characterized by loss of skilled or purposeful movement that cannot be attributed to weakness or an inability to innervate the muscles. Apraxia results from lesions of the cerebral cortex, usually in the left hemisphere (Keretz, 1982).

Bandwith (BW): Bandwith is an all-inclusive term referring to the preselected band or range of frequencies which can govern both slice select and signal sampling (van Valkenburg, 1974).

Baseline: Serves as a value to compare the values of the ongoing processes during an explicit task with. Problem: comparison of studies with different baselines; which task should be used as the baseline (Binder, 2012)?

Bigram: Bigrams are ordered pairs of letters (Dehaene & Cohen, 2011).

Binocular rivalry: Binocular rivalry is the term of a phenomenon which occurs when dissimilar monocular stimuli are presented to corresponding retinal regions of both eyes, then one experiences a fluctuation in perception characterized by alternating periods of perceptual dominance of one of the two stimuli (Blake, 2001).

Blindsight: cortical blindness. Describes the ability of a person who is partially blind, to see and accurately reach for an object, which is located in the blind field. The person is not able to consciously perceive the object and therefore, is unaware of its existence. Blindsight is caused by damage to the "mammalian" visual system. (Carlson, 2010). Blindsight patients are able to carry out complex visual information processing completely unconsciously. The patients can guess (with accuracy much higher than random) about something they cannot consciously see or even avoid obstacles without any conscious experience of 'avoiding' (Kurzban, 2011). It is

usually caused by lesions in primary visual cortex (V1), but also by damaged optic tract. Other optic connections remain preserved (especially those to the superior colliculus).

Blood oxygen level dependent signal (BOLD): The signal is used by fMRI as a non-invasive but indirect measure of changes in neuronal activity. It arises from the magnetic properties of hemoglobin and the manner in which brain metabolism and blood flow are related to changes in neuronal activity (Fox & Raichle, 2007).

Bottom-up sensory information: External information taken up by the senses and projected to primary sensory cortices, which in turn drives secondary, tertiary and higher order association cortices via forward connections arising primarily from superficial pyramidal neurons (Price & Devlin, 2011).

Brain change analysis (atrophy): Brain atrophy (atrophy of any tissue means a decrement in the size of the cell, which can be due to progressive loss of cytoplasmic proteins. In brain tissue, atrophy describes a loss of neurons and the connections between them) measured by MRI is a potentially useful tool for monitoring disease progression in, for example, multiple sclerosis (Chard et al., 2002).

Brain-computer-interface (BCI): Humans can be trained to use their brain activity to control artificial devices. Individuals are extensively trained to intentionally control certain aspects of recorded brain activity. For example, participants learn by trial and error to voluntarily control scalp-recorded electroencephalograms (EEGs), such as specific EEG frequency bands or slow wave deflections of the cortical potential. Such voluntarily controlled brain signals can subsequently be used to control artificial devices to allow subjects to spell words or move cursors on computer displays in two dimensions. Interestingly, subjects can even learn to regulate signals recorded using functional MRI in real-time (Haynes & Rees, 2006).

Brodmann area (BA): Brodman divided the cortex into areas which differ from one another in the cell types and microscopic organization. This differentiation has been used as a basis for characterizing and labelling different cortical regions. Areas are numbered from 1 to 52 (Brodmann, 1909).

Cached value: A scalar value that captures how much reward or punishment may be expected in the future, based on the history of returns obtained in the past. A cached value does not specify the nature or features of the outcome. (Pezzulo et al., 2014)

Callosal agenesis: A rare birth defect in which the corpus callosum fails to develop (Fox & Raichle, 2007).

Capgras delusion: a belief that a well-known person (a friend or member of family) was replaced by someone else that looks exactly the same. The phenomenon can be explained as an inconsistency between affective and declarative cognition. While declarative memory remains intact, impairments in emotional recognition produce the feeling of replacement. It can be

selective or linked with a whole group of people. Capgras delusion usually goes with different mental disorders (Ramachandran, 1996).

Cell proliferation: Growth, spreading, and sustainment of cells (May, 2011).

Cerebellum: The cerebellum is a region of the brain that has been ascribed an important role in motor control. It has also been implicated in certain cognitive functions such as attention and language, and in regulation of fear and pleasure (Harris et al., 2009).

Chills: An objective measure of peak emotional arousal; people brought in music that gives them "chills," which are believed to be physical manifestations of peak emotional responses, and related to increased sympathetic nervous system arousal. Chills correlate with activity in brain structures that respond to other pleasant stimuli and reward such as the ventral striatum, insula, and orbitofrontal cortex. Conversely, chills correlate negatively with activity in ventromedial prefrontal cortex (VMPFC), amygdala, and anterior hippocampus (Zatorre & Valimpoor, 2013).

Cognitive bias: The term describes general patterns of irrational perception of the reality, which influence on people's attitudes, emotions, reasoning and actions. According to Haselton et al., (2014) cognitive bias describe cases in which human cognition reliably produces representations that are disfigured compared to some aspect of objective reality.

Cognitive dissonance: Is a psychological state in which person's cognitions, like beliefs, attitudes, as well as, behaviors—are at odds (Festinger, 1957). Cognitive dissonance is considered as an aversive state (Elliot & Devine, 1994). Individual, who experiences the cognitive dissonance, is motivated to solve the occurred inconsistency to reduction a discomfort or mental stress caused by it. According to Festinger's (1957) people have an inner drive to keep all attitudes and beliefs in harmony and avoid disharmony -> dissonance.

Cognitive ontology: Cognitive ontology is the systematization (formal description of terms and their relationships) of features of human cognition. With respect to cognitive neuroscience, the goal is to know which cognitive functions are associated with specific task manipulations and to map these functions onto specific brain regions (Poldrack, 2011).

Computational neuroscience: Computational neuroscience aims at understanding the computational phenotype of observed brain activation using mechanistic (= how could a process take place) or process (= how could a process be implemented) models. Specific aims are modelling mechanisms of information processing or inferring physiological processes from measured brain activity (see DCM). A subclass of computational neuroscience is computational psychiatry, which tries to identify characteristics in the generative model (see generative model) of a particular patient-group and thus improve diagnosis and the assessment of at-risk individuals or therapeutic success in clinical work (Stephan & Mathys, 2014).

Cross-frequency coupling: Oscillations that characteristically modulate in one frequency range, that vary as a function of another frequency. For example spectral power in the gamma range is often seen to correlate with the phase of slow oscillations (Ketz et al., 2015).

DARTEL: Diffeomorphic Anatomical Registration using Exponentiated Lie algebra (DARTEL) offers an alternative to classical image normalisation and smoothing routines as implemented in SPM. DARTEL iteratively aligns grey and white matter images with their common respective averages, becoming increasingly precise as registration proceeds. Thus, DARTEL provides a much more sophisticated and detailed image registration method compared to standard preprocessing methods (Ashburner, 2007).

Declarative memory: According to Diekelmann and Born (2010), declarative memory can be described as "memories that are accessible to conscious recollection including memories for facts and episodes, for example, learning vocabulary or remembering events. Declarative memories rely on the hippocampus and associated medial temporal lobe structures, together with neocortical regions for long-term storage" (p.114). Declarative memory is often tested by word learning tasks (e.g. Plihal & Born, 1997).

Default mode: The brain remains active in an organized fashion during the resting state; this is called the default mode of brain function (Fox & Raichle, 2007).

Default mode network: involving those regions which seem to return to an active state spontaneously whenever attention is not directed to an extrinsic input (Binder, 2012).

Dentritic processing: income synaptic information is transformed into specific patterns of action potential output (Grienberger et al., 2015).

Developmental dyslexia: Developmental dyslexia is defined as a specific disorder of reading development. It is characterized by an unexpected impairment in the acquisition of reading skills despite normal intelligence, motivation, and adequate schooling (Ferrer et al., 2010). According to the diagnostic criteria of DSM-IV and ICD-10, performance in reading accuracy and/or fluency, reading comprehension, and/or spelling is substantially below the performance expected from the person's chronological age, intelligence, education, and sensory acuity. In addition, the difficulties significantly interfere with academic achievement or activities in everyday life that require reading skills (Richlan 2012; Richlan et al., 2009, 2010, 2011; Wimmer et al., 2010).

Diffusion tensor imaging (DTI): An MRI imaging technique that takes advantage of the restricted diffusion of water through myelinated nerve fibers in the brain to map the anatomical connectivity between brain areas (Fox & Raichle, 2007).

Diffusion weighted imaging (DWI): Theoretically aims to detect motion over very small distances, such as Brownian motion. (Note: motion of water molecules that diffuse along the white matter tract following the 'pathway of least resistance') (Takahara et al., 2004).

Double-dipping: instantiation of the non-independence error by using the same dataset for selection and selective analysis (Poldrack, 2011).

Down state: A period of inhibition during slow-wave sleep. The neurons located in the neocortex are resting. (Carlson, 2010)

Dynamic bayesian network: A class of computational models performing statistical inferences over variables that unfold in time (e.g., what is the probability of reaching a state S while knowing the starting state and the executed action) following Bayes' rule. (Pezzulo et al., 2014)

Dynamic causal modelling (DCM): DCM investigates the effective connectivity underlying brain activation, i.e. synaptic coupling in neuronal populations that are likely causes of observed BOLD signals or electrophysiological responses. This mapping rests on a forward model, which models how neuronal responses induce changes in neuronal measures. In general, DCM is a Bayesian system identification framework that models neuronal population dynamics. The aim is to investigate subject- or group-specific parameters based on fMRI or EEG data (a process called model inversion) to infer the underlying connectivity and possible hierarchies in brain processing (Stephan & Mathys, 2014).

Early right anterior negativity (ERAN): The ERAN is assumed to reflect early and fairly automatic processes of syntactic structure building. It is typically followed by an N5 (a negativity maximal around 500 ms). Both event-related brain potentials (ERPs) can be elicited in 5-year-old children, and recent data indicate that they can even be observed even in 2.5-year-olds (Jentschke et al., 2008).

Effective connectivity: Effective connectivity deals with directed interactions between brain regions. It affords mechanistic explanations of how activity in one brain area is driven (i.e., caused) by influences from other areas. An example of effective connectivity is dynamic causal modeling (DCM) (Schurz et al., 2014a).

Electroencephalography (EEG): A technique used to measure neural activity by monitoring electrical signals from the brain that reach the scalp (Fox & Raichle, 2007)

Enriched environment: Based on the assumption that brains in different surroundings are affected differently, enriched environment studies compare the structural and functional properties of individuals' brains from plain environments to brains that were embedded in a controlled sensory (visually, auditory, gustatory, olfactory, somatosensory), socially (e.g., more individuals), or motor-sensory (more possibilities to engage motor-activity; e.g., toys) stimulating setting (May, 2011).

Ethical considerations: Structural and functional neural correlates have been identified that could potentially be used to reveal sensitive personal information without a person's knowledge, or even against their will. Such an ability to reveal covert mental states and traits (e.g., emotional states, drug abuse, product preferences) using neuroimaging techniques could potentially lead to serious violations of "mental privacy". Further development of this area highlights even

further the importance of ethical guidelines regarding the acquisition and storage of brain scanning results outside medical and scientific settings. Benefits include the large number of important potential clinical applications (e.g., for paralyzed "locked-in" patients) (Haynes & Rees, 2006).

Event-related Desynchronization (ERD): An ERD reflects a change in the ongoing EEG/MEG, is not phase-locked (contrary to an ERP), and results in a desynchronization of oscillations post-stimulus which goes along with an absolute voltage decrease (Pfurtscheller & Lopes da Silva, 1999).

Event-related functional magnetic resonance imaging (efMRI): Event-related functional magnetic resonance imaging is a technique in magnetic resonance imaging that can be used to detect changes in the BOLD (Blood Oxygen Level Dependent) hemodynamic response to neural activity in response to certain events (Friston, et al., 1998).

Event-related Potential (ERP): A change in electrical activity that is time-locked to specific events such as the presentation of a stimulus or the onset of a response. When the events are repeated many times, averaging the EEG signals reveals the relatively small changes in neural activity triggered by these events. In this manner, the back event-related signal with great temporal resolution (Hagoort et al., 1996). An ERP reflects an internally or externally paced event and is phase-locked. In neuroscience most popular are electro-cortical ERPs derived from the scalp with an EEG (Pfurtscheller & Lopes da Silva, 1999).

Event-related Synchronization (ERS): An ERS reflects a change in the ongoing EEG/MEG, is not phase-locked (contrary to an ERP), and results in a synchronization of oscillations post-stimulus which goes along with an absolute voltage increase (Pfurtscheller & Lopes da Silva, 1999).

Ex-illiterates: Ex-illiterates are people who learned to read during adulthood (Dehaene & Cohen, 2011).

Extrastriate body area (EBA): Lies on the lateral surface of the brain adjacent to MT (visual motion area) and primarily responds to images of bodies and body parts. Thereby, it is more engaged in the perception of the form/identity of bodies than in their actions. Furthermore, it is more involved in perceiving other people's bodies than one's own (Kanwisher, 2010).

Family Wise Error (FWE) vs. False Discovery Rate (FDR): FWE correction controls for the probability of making at least one false positive error, an assumption which is known to be conservative. A different approach is to control for the proportion of all the false positive errors among all the discoveries – False Discovery Rate (FDR) (Smith, 2009).

Fixation-related fMRI: A combination of eye tracking and fMRI. Specifically, self-paced eye movements are used as markers for calculating hemodynamic brain responses. The crucial analysis step is realized during the subject-specific first level model specification. In contrast to traditional event-related analysis, where the onsets of stimuli are modeled, in the fixation-

related analysis each first fixation on an item is modeled by a hemodynamic response function (Richlan et al., 2014b).

Fluid attenuated inversion recovery (FLAIR): A pulse sequence used in MRI and can be used in 3D and 2D imaging. This pulse sequence is an inversion recovery technique that nulls fluids. Thus, one can suppress CSF effects on images in order to discover periventricular lesions (like MS) (Hajnal et al., 1992).

Forward inference: Inferring the presence of activation in a voxel given the presence of a particular cognitive process (Poldrack, 2011).

Free energy: Free energy represents an upper bound on surprise, i.e. the mismatch between a model of the world (see generative model) and observations. This measure can be used for formal model comparisons – or be applied to brain activation and behavior as discussed in the 'free energy principle' (Friston, Kilner, & Harrison, 2006), stating that biological systems have to build a model of their environment and by minimizing free energy they can optimize this model. In the context of neuroscience, this was formalized as predictive coding (see predictive coding), interpreting brain activation in terms of bottom-up and top-down signaling (Stephan & Mathys, 2014).

Frequency bands: Formations of neural oscillations that can be found in EEG, MEG, or local field potentials. These bands both clinically and functionally defined show correlations between behavior and changes in oscillatory power within a given frequency band. A common definition of these bands are: delta – 1-4 Hz, theta – 4-8 Hz, alpha – 8-12 Hz, beta – 12-30 Hz, and gamma – 30-100 Hz (Ketz el al., 2015; Nyhus & Curran, 2010).

Function-location meta-analysis: Collective analysis of functional neuroimaging data combined from multiple studies. The variable of interest is the location rather than the magnitude of the effect (Fox et al., 1998).

Functional acquisition cycle: A sequence in which images of the brain are captured. Functional refers to a scanning protocol that favours the measurement of moment-to-moment changes in brain activation, rather than anatomical details.

Functional brain connectivity: Functional brain connectivity provides insights about the integration of neurocognitive processes during task or during the resting state. It typically involves analysis of temporal correlations between blood oxygenation level–dependent (BOLD) signal time series across brain regions (Schurz et al., in press).

Functional specificity: The approach of functional specificity searches for regions, which are more engaged for a specific function compared to another function (Kanwisher, 2010).

Fusiform face area (FFA): lies in the midfusiform gyrus on the bottom surface of the cerebral cortex, above the cerebellum and is highly selective for the processing of faces, including familiar/unfamiliar faces, schematic faces, cartoon faces and animal faces. Furthermore, responses are independent from size, location or viewpoint of the presented face. The FFA is

sensitive to multiple aspects of face stimuli including face parts, the T-shaped configuration of face parts or external features like hair (Kanwisher, 2010).

FWHM: Full width at half maximum (FWHM) refers to the most commonly applied smoothing function of imaging data using Gaussian kernels. FWHM simply refers to the size of the Gaussian kernel that is used for smoothing: imagining a Gaussian distribution, one simply determines the boundaries of the half-maximum of the distribution (e.g. if the maximum of the distribution is y=1, one determines the x1 and x2 where y=0.5). The boundaries then determine the width of the smoothing kernel. Therefore, smoothing with FWHM replaces each value in an image with a weighted average of itself and its neighbours. In practice, FWHM has to be substantially greater than the voxel size (at least double the size of the voxel) (Worsley & Friston, 2007).

Gaussian smoothing kernel: Gaussian smoothing kernels are applied to fMRI data to remove signal fluctuations that deviate from normal distribution. By applying Gaussian smoothing kernels, researchers ensure that the data they are modelling follow a normal distribution and can thus be subjected to parametric statistics.

Gaze-continguent display change paradigms: Gaze-continguent paradigms rely on fast and exactly timed display changes in response to a participant's eye movement behavior. Crucially, the display changes have to occur during a saccade, when visual processing is suppressed and the participant is unaware of the change. Examples of gaze-continguent paradigms are moving window, moving mask, and invisible boundary (Richlan et al., 2013a).

Generative models: Probabilistic models of how (sensory) data are caused including both bottom-up (recognizing) and top-down (predicting) connections. Models learn multilayer representations by adjusting the top-down connection weights to better predict sensory input. Import characteristics of generative models are the concept of interactivity and the calculation of prediction errors to adjust existing weights (e.g., by back-propagation of errors) (Price & Devlin, 2011).

Generative model of plan values: An internal model that encodes the probabilistic relations between states, actions, and rewards. Such a model permits to generate observable data (in this case, expected reward observations) given some other hidden (non-directly observable) parameters, and ultimately permits to estimate the value of a plan. (Pezzulo et al., 2014)

Glucocorticoids (e.g. cortisol): Hormones secreted from the adrenal glands as end products of the Hypothalamic-pituitary-adrenal axis (HPA). Their function is to control energy metabolism (e.g. appetite) and the response to stressors from perception of the stressor to physiological and behavioral adaptation. They cover a wide spectrum of actions involving inflammatory, immune, metabolic, cardiovascular, bone, visceral and brain responses to changes from internal or external sources (Joels et al., 2007).

Gradient echo planar imaging sequence (EPI): A data acquisition procedure that is sensitive to the BOLD contrast and that permits very rapid acquisition of fMRI with multiple images collected at the same time (Stark, 1999).

Hemodynamic response: The dynamic changes of blood flow and the ratio of oxygenated and deoxygenated blood (see BOLD).

Hidden markov models: A computational model that casts a decision process as an inference process on discrete hidden states of the environment and that has the Markov property is called Hidden Markov Model. (Vilares & Kording, 2011)

Higher-order consciousness (HoC): a frame of reference seemingly encompassing past, present and future. Above all, it consists of ability to experience a sense of self and explicit construction of past and future scenes (Edelman D., Baars B. J., 2005). We are still not sure about its presence in any nonhuman species.

Hippocampus: The hippocampus is an important part of the vertebrate brain. It is part of the limbic system and is thought to play an important role in the consolidation of information from short-term memory to long-term memory and spatial navigation (Harris et al., 2009).

Hypnogram: is a form of polysomnography that in a graphic form represents organization of sleep during the night. Hypnogram presents the recordings of the brain waves activity from an electroencephalogram (EEG) during sleep. The various stages of sleep are represented on the vertical axis and time is shown on the horizontal axis. The REM stage is often emphasized by a dark line (Geyer et al., 2009).

IKEA effect: This cognitive bias shows that work put to creation 'self-made' product leads to increased valuation of it. Interestingly, the bias occurs only when work results in successful completion, hence when individual built and then destroyed the product, or failed to complete it, the IKEA effect disappear (Norton et al., 2011). The bias can be observed in case of partially 'self - made' IKEA furniture, which required single-handed assemble.

Independent Component Analysis (ICA): The Independent Component Analysis (ICA) of a random vector consists of searching for the linear transformation that minimizes the statistical dependence between its components. In order to design a practical optimization criterion, the expression of mutual information is being resorted to, as a function of cumulants. The concept of ICA may be seen as an extension of Principal Component Analysis, which only imposes independence up to second order and consequently defines directions that are orthogonal. Applications of ICA include data compression, detection and localization of sources, or blind identification and deconvolution (Lacoume, 1992).

Inhibition of return: Inhibition of return is an orientation mechanism that delays the detection of an object in a previously attended location (Klein, 2000).

Interactive account of vOT function: Model based on a generic framework for understanding brain function developed by Cathy Price and Joe Devlin with respect to visual word recognition in

ventral occipitotemporal cortex (vOT). It generally explains brain activation in terms of a synthesis of feed-forward connections (e.g., visual input), top-down predictions conveyed by backward connections, and the mismatch between these bottom-up and top-down inputs (prediction errors) (Price & Devlin, 2011).

Internally generated sequences (IGS): A sequence of multi-neuron firing activity that does not reflect an ongoing behavioral sequence (e.g., of actions, positions visited) but is instead generated on the basis of internal brain dynamics. IGSs may arise spontaneously or can be triggered by external cues. (Pezzulo et al., 2014)

Instrumental Controller: A behavioral controller (i.e., a device for action selection) that supports instrumental behavior (i.e., an action aimed at achieving a goal or obtaining a reward) and can learn arbitrary actions (e.g., press a lever) to this purpose. In the reinforcement learning literature, instrumental controllers are usually divided into model-based and model-free classes and contrasted with Pavlovian controllers, which are limited to an innate and reinforcer-specific repertoire of actions (e.g., approach, salivate). (Pezzulo et al., 2014)

Jet lag: According to ICD – 10, it is a subtype of circadian rhythm sleep disorder. Jet lag is characterized by the conflict between endogenous pattern of sleep and wakefulness and the pattern required by a new time zone.

Kalman filter: A decision-model based on inference on continuous hidden states in the environment (with a Gaussian probability distribution) is called Kalman model. When these models are used to make estimates about a given point in time, given only the past, they are called Kalman filter. If both the past and the future are taken into account, the models are called smoother (Vilares & Kording, 2011)

K-Complex: is a high-amplitude, biphasic wave of at least 0.5 second duration, which consists of a well delineated negative sharp wave, immediately followed by a positive component standing out from the background EEG. Usually maximal amplitude occurs over the frontal regions (Iber et al., 2007). K -Complex is one of prominent markers of N2 sleep stage (the second marker are sleep spindles). Spindles are frequently superimposed on K complexes, but they are narrower, not biphasic, and usually have lower amplitude (Geyer et al., 2009).

Kuramoto Model: The Kuramoto model of coupled phase oscillators is one of the most abstract and fundamental model used to investigate neural oscillations and synchronization (Kuramoto, 1984). It captures the activity of a local system (e.g., a single neuron or neural ensemble) by its circular phase alone and hence ignores the amplitude of oscillations (amplitude is constant). Interactions amongst these oscillators are introduced by a simple algebraic form (such as a sine function) and collectively generate a dynamical pattern at the global scale.

Lie detection: Several physiological indicators of emotional reactions have been used for lie detection (blood pressure, respiration) and these “polygraphic” tests (several physiological responses are simultaneously acquired), have been heavily debated. EEG and fMRI, with the aim of directly

measuring the neural mechanisms involved in deception, potentially allow the identification of intentional distortions of test results. Recent studies have investigated the feasibility of using fMRI responses to detect individual lies in individual subjects. Information in several individual brain areas (particularly the parietal and prefrontal cortex) can be used to detect deception, and this can be improved by combining information across different regions (Haynes & Rees, 2006).

Limbic system theory of emotion: A specialized group of neural structures working collectively to form a unitary emotion system (Mac, 1949; Maclean, 1952).

Linear regression: Computation of a scaling factor such that multiplication of a regressor time course by this scaling factor will remove the greatest amount of variance when subtracted from a signal of interest (Fox & Raichle, 2007).

Local combination detector model (LCD model): The local combination detector (LCD) model emphasizes the role of a fraction of occipitotemporal neurons which become attuned to fragments of writing. Thereby it postulates a process which proceeds in a highly parallel way. Written words are encoded by a hierarchy of neurons with increasingly larger receptive fields tuned with successive response to abstract letter identities, bigrams, morphemes and small words. After lesions of the left occipitotemporal cortex such efficient parallel processing of letter strings is no longer possible, thereby causing a specific reading impairment (pure alexia) (Dehaene & Cohen, 2011).

Locked-in syndrome (LiS, pseudocoma): Describes patients who are awake and conscious, but have no capabilities of producing speech, performing limb, or face movements (Laureys et al., 2005). The most common reason of LiS is ventral pontine lesions. According to Bauer et al. (1979) we can distinguish three forms of LiS: classical, incomplete and total locked-in syndrome. The classical LiS is describes by total immobility except for vertical eye movements or blinking; (b) incomplete LIS is characterized by remains of residual voluntary motion; and (c) total LIS consists of complete immobility including all eye movements consciousness is preserved. People in LiS remaining paralyzed and voiceless for their all life, there is no possibility to change this condition. Misdiagnoses are very common in case of the locked – in syndrome. It has been shown that more than half of the time members of family, not the physician, realize that the patient was aware (Laureys et al., 2005).

Long-term depression (LTD): A long-term decrease in the excitability of a neuron to a particular synaptic input caused by stimulation of the terminal button while the postsynaptic membrane is hyperpolarized or slightly depolarized. LTD as well as LTP play an important role in many forms of learning (Carlson, 1986, Diekelmann & Born, 2010).

Long-term potentiation (LTP): A long-term increase in the excitability of a neuron to a particular synaptic input caused by repeated high-frequency activity of that input. Long-term

potentiation is thought to be a crucial mechanism for learning and memory processes in the brain (Carlson, 2010; Rosanova & Ulrich, 2005; Diekelmann & Born, 2010)

Lucid dream: is a dream during which one is aware that is dreaming. Lucid dreams are considered to be mainly Rapid Eye Movement sleep (REM) phenomena. Sleepers experienced lucid dreams can consciously influence the dream content and because of that they are able to perform pre-arranged tasks while dreaming. To mark events or actions during a lucid dream, lucid dreamers can produce a specific eye movement pattern (e.g., left-right-left-right) that can be detected by EOG (Erlacher et al., 2014).

Magnetisation transfer (MT) parameter maps: MT imaging is a semi-quantitative structural imaging protocol as an alternative to standard T1-weighted structural images. MT-weighted images provide improved segmentation (white matter vs. grey matter) compared to T1-weighted images, particularly in subcortical regions (Helms et al., 2009).

Magnetoencephalography (MEG): A non-invasive technique that allows the detection of the changing magnetic fields that are associated with brain activity on a timescale of milliseconds (Fox & Raichle, 2007).

MAP: Maximum a posterior reconstruction for each BOLD signal (Nishimoto et al., 2011).

Markov property: Decision-Making can be cast as a problem of inference on hidden states of the world (e.g., the source of a sound or the correct path to take when walking through a city). In case such a problem can be conditioned entirely on the present state in the world (without taking the history of previous states into account) this decision-process has the Markov-property. In other words, the present state fully captures the information provided by all previous states, such that the decision can be exclusively based on the present state (e.g., a rat in a maze at a certain position searching for reward). (Vilares & Kording, 2011)

Maxwell's equations: are a set of partial differential equations that describe and predict the behavior of electromagnetic waves in free space, in dielectrics, and at conductor-dielectric boundaries. Magnetic waves, generated by neurons therefore can be sensed outside the brain and head. Unlike the electric potential field, which is a scalar quantity the magnetic field is a vector. Buzsaki (2006).

Mental imagery: The conscious recollection of an object or a scene in its absence (Fox & Raichle, 2007).

Mesolimbic reward system: In animals, the phylogenetically ancient mesolimbic reward system serves to reinforce biologically significant behaviors, such as eating, sex, or caring for offspring. In humans, dopamine release and hemodynamic activity in the mesolimbic areas has also been demonstrated to reinforce biologically adaptive behaviors, such as eating and behaviors related to love and sex (Zatorre & Valimpoor, 2013).

Mirror neuron: A mirror neuron is a visuomotor neuron in the brain of primates which shows the same activation pattern when perceiving an action and performing the same action (Rizzolatti & Craighero, 2004).

Mismatch negativity (MMN) or mismatch field (MMF): Is a component of event related potentials, which indicates a pre – attentive sensory memory processes (Pengamin et al., 2008). MMN appears in response to an odd stimulus in a sequence of series of standard stimuli. The MMN usually peaks at 150–250 ms from the change onset – occurrence of the deviant stimuli (Naatanen et al., 2007).

Mixed instrumental controller: A controller that combines (mixes) the functionalities of model-based and model-free ones rather than arbitrating between them. (Pezzulo et al., 2014)

MNI (the MNI-brain): The Montreal Neurological Institute defined a new standard brain by using a large series of MRI scans on normal controls (Brett et al., 2001).

Model-based and model-free systems: Model-based and model-free systems relate to the idea that there a several interacting systems in the brain relevant for goal-directed (model-based) and habitual (model-free) behaviour. Imaging studies have shown that model-free (reward) prediction errors are correlated with activity in the ventral striatum, whereas model-based (state) prediction errors are encoded in parietal and prefrontal areas. This view, however, has been challenged recently by studies showing that activity in the ventral striatum reflects a mixture of both prediction errors, challenging the notion of separate systems in the brain (Stephan & Mathys, 2014).

Model-based fMRI: Model-based fMRI simply refers to a functional imaging study using a model of how a process might take place in the brain (see computational neuroscience). Most prominent examples come from learning problems that include the calculation of prediction errors (see prediction error). Given such a model, subject-specific parameters can be estimated based on individual behaviour in a task (a process called model inversion), for example an individual learning rate. Based on these parameters it is then possible to produce individual trial-by-trial predictions from that model, e.g. individual prediction errors based on individual learning rates. These can then be used as regressors in a standard mass-univariate analysis of an event-related experimental design. One very influential example is the association of dopaminergic firing with the signalling of reward prediction errors (Schultz, Montague, & Dayan, 1997) (Stephan & Mathys, 2014).

Motion-energy encoding model: The model separately describes the neural mechanisms mediating visual motion information and their coupling to much slower hemodynamic mechanisms (Nishimoto et al., 2011).

Multi-Parameter Maps: Multi-Paramter Maps (MPMs) are a structural imaging protocol based on a 3D multi-echo fast low angle shot (FLASH) sequences, typically consisting of magnetisation transfer weighted (MTw) sequences, a proton density weighted (PDw) sequences and standard

T1-weighted (T1w) sequences. MPMs are important for improved segmentation of brain tissue and are of particular high relevance for identifying subcortical brain regions, for example regions of the human midbrain or basal ganglia (Helms, Draganski, Frackowiak, Ashburner, & Weiskopf, 2009).

Multivariate analysis: Considers multiple decision variables and takes into account patterns of information that might be present across multiple voxels. By accumulating weak information across many spatial locations, the sensitivity of human neuroimaging can be dramatically increased. Single brain regions (without individually carrying information) might carry information when they are jointly analyzed. Fine-grained spatial information can be revealed, which is discarded in conventional analyses (due to spatial smoothing). The increased sensitivity of decoding-based approaches potentially allows even quasi-online estimates of a person's perceptual or cognitive state (Haynes & Rees, 2006).

Myosin: is a contractile protein found in skeletal muscles. Human myosin is only twofold slower than the myosin of the 100-fold smaller rat (Szent – Györgyi, 1951). Buzsaki (2006).

N1 sleep stage: according to the rules of classification of sleep course in human - The AASM manual for the scoring of sleep and associated events, N1 occurs mostly in the beginning of sleep (Iber et al., 2007). N1 is characterized by: - EEG: Low-amplitude, mixed frequency - increasing slow waves in the range 4-7 Hz - delta / theta – activity, less than 50% alpha activity. Sharp waves occur near transition to N2 sleep stage. Some people do not exhibit prominent alpha activity, what makes the detection of sleep onset difficult. Vertex waves are common in this stage. - EOG: Slow-rolling eye movements (Geyer et al., 2009). - EMG: The chin EMG amplitude is variable, often lower than in stage W (wake) (Iber et al., 2007).

N2 sleep stage: according to the rules of classification of sleep course in human - The AASM manual for the scoring of sleep and associated events, N2 is the second stage of non-rapid eye movement sleep (Iber et al., 2007). During N2 dreaming is very rare and waking up sleeper is quite easy. - EEG: Stage 2 sleep is characterized by the presence of one or more K complexes and sleep spindles. - EOG: no eye movement activity (Geyer et al., 2009). - EMG: usually no motion artifacts. The chin EMG is of variable amplitude, but usually lower than in stage W (wake), may be as low as in REM sleep (Iber et al., 2007).

N3 sleep stage (Slow Waves Sleep , SWS, deep sleep): according to the rules of classification of sleep course in human - The AASM manual for the scoring of sleep and associated event, the slow waves sleep is the third non-rapid eye movement sleep stage (Iber et al., 2007). The onset of SWS is tightly linked to the secretion of growth hormone with maximal release occurring within minutes of the onset of the change from stage N2 into stage N3 (Silber et al., 2007). During period of SWS cells are repaired, the defense system is stimulated. Deep sleep promotes also the brain plasticity. The SWS markedly decline across the lifespan (Cordi et al., 2014). In this stage occur several parasomnias (a category of disorders occurring during

sleep), like sleep walking and night terrors (Geyer, et al., 2009). N3 is characterized by: - EEG shows minimum 20% of delta waves of 0,5 – 2 Hz frequencies with peak-to peak amplitude of >75 µV in the frontal derivation of an 30 second epoch. Rarely sleep spindles may be seen also during N3. - EOG: No eye movement (Silber et al., 2007). - EMG: The chin EMG is of variable amplitude, often lower than in stage N2, sometimes may be as low as in REM sleep (Iber et al., 2007).

Narcolepsy: neurological disorder characterized by periods of sleep at inappropriate times (Nishino, 2007). Primary symptom is the sleep attack.

Narcoleptic sleep attack: overwhelming urge to sleep. Primary symptom of narcolepsy. It can appear at any time but usually during boring or monotonous conditions. (Carlson, 2010)

Near-infrared spectroscopy (NIRS): A brain imaging method that uses near-infrared light to measure the concentration changes of oxygenated and deoxygenated hemoglobin in the brain. The temporal resolution is comparable to fMRI but the spatial resolution is worse (Burns & Ciurczak,2007).

Neural Efficiency: The neural efficiency hypothesis describes the phenomenon that brighter individuals show lower brain activation than less bright individuals when working on the same cognitive tasks (Neubauer et al., 2004).

Neural Oscillations: A neural oscillation is rhythmic or repetitive neural activity in the central nervous system. Neural tissue can generate oscillatory activity driven by interactions between neurons (Schnitzler & Gross, 2005). At the level of neural ensembles, synchronized activity of large numbers of neurons can give rise to macroscopic oscillations, which can be observed in the electroencephalogram. Neural oscillations and synchronization have been linked to many cognitive functions such as information transfer, perception, motor control and memory.

Neuronal recycling hypothesis: The neuronal recycling hypothesis is a concept generated to explain the reading-specific processes of the visual word form area (VWFA). It postulates the capture of pre-existing cortical systems for reading/recognition of written words, but it does not assume any novel form of learning or plasticity. The idea behind this proposal is the fact that the time writing exists is too short to have influenced the human genome so that the brain cannot have evolved a dedicated mechanism for reading. Therefore reading must involve a "neuronal recycling" process to "recycle" in some extent a cortical territory evolved for object and face recognition. Further it hypothesizes bidirectional constraints between brain and culture (reading acquisition influences specific regions of the cortex and the writing systems must have developed appropriate to the brain's learnability constraints) (Dehaene & Cohen, 2011).

Noise: Modulation in a measured signal that is unrelated to the effect of interest. Noise is usually minimized through averaging, allowing the effect of interest to be emphasized (Fox & Raichle, 2007).

Non-independence error or selection bias: The violation of the independence assumption between sample selection and subsequent statistical measure. In fMRI analysis the non-independence error arises when a subset of voxels is selected for a subsequent analysis, but the null-hypothesis of the analysis is not independent of the selection criteria used to choose the voxels in the first place. Every conclusion from this analysis will be circular (since it is presumed by the selection criterion) as well as biased (especially when no correction for multiple comparisons is carried out in the primary analysis random noise will be overrepresented) (Poldrack, 2011).

Oneirology: the scientific study of dreaming.

Orthographic depth: Orthographic depth refers to the complexity, consistency, or transparency of grapheme-phoneme correspondences in written alphabetic language (Richlan, 2014).

Oscillatory transcranial direct current stimulation (otDCS): A non-invasive neuroscientific method. otDCS is the combination of tDCS and tACS. An alternating current is superimposed onto a direct current. (Herrmann et al., 2013, Groppa et al., 2010)

Othello syndrome: an erotomanic spectrum disorder that refers to delusional belief systems where the most prominent theme is infidelity of sexual partner. It occurs in the context of global psychiatric disorders, traumatic brain injuries and other neurological impairments (Butler, 2000). Othello syndrome is a form of secondary erotomania (DSM-IV Axis I: 297, 1. Delusional Disorder, Erotomanic Type).

P300 (P3 or LPC – Late Positive Component): Is an evoked potential which occurs as a response to stimuli which are unexpected, infrequent, or motivationally relevant (Knyazev, 2006). The P300 peaks occur near 350ms and have a maximal parietal topography (Laureys, 2007). In the typical P300 paradigm studies, a participant is asked to respond to a relatively seldom appearing target stimulus and to ignore more common non - target stimulus (Knyazev, 2006). The P300 evokes even in response to non – target stimuli, but is smaller than in case of the target stimuli (Van de Kruijs, 2010). Moreover the amplitude of the P3 increases when the task has got motivational relevance or the relevance of the target stimulus (Knyazev, 2006). There is also Brain Computer Interfaces (BCI), which is based on P300 components. An advantage of this P300 – based BCI is relatively short time of user training, because P300 is "automatically" brain's response to the salient stimuli (Laureys, 2007). We can distinguish P3a and P3b components. The P3a amplitude is more prominent in involuntary attention processes, whereas P3b is elicited when voluntary attentional mechanisms are required. P3a occurs for example during perception of deviant stimuli, while P3b evokes in response to the task relevant stimuli – when the target occurrence require perform certain action, for example calculating or pushing the button.

P3b: Is a task-relevant potential elicited during target stimulus processing (Polich, 2007). P3b is stronger when subject have to respond to a task relevant stimuli (Van de Kruijs, 2010). This

response is followed voluntary and consciously. P3b amplitude is influenced by the amount of attentional resources distributed to the task (Kok, 1997). P3b latency is like an index of classification speed, which is proportional to the required time to detect and classify a target stimulus (Polich, 2007).

Parafoveal preprocessing: During natural reading one not only processes the currently fixated word but also preprocesses the upcoming, parafoveal word. Parafoveal preprocessing is most often studied by means of the invisible boundary paradigm. This technique allows one to (partially or totally) prevent parafoveal preprocessing. The unequivocal finding with this technique is that valid previews result in shorter processing times of the target words compared to situations in which parafoveal preview is prevented (e.g., approximately 20% shorter gaze durations (Gagl et al., 2014; Hutzler et al., 2013).

Parahippocampal place area (PPA): Lies adjacent to the collateral sulcus in parahippocampal cortex and responds to images of scenes, including indoor and outdoor scenes, familiar and unfamiliar scenes. The PPA is primarily responsive to the spatial layout of scenes (Kanwisher, 2010).

Parkinson's disease: A degenerative disorder of the basal ganglia in which the pathology results from the loss of dopaminergic cells in the substantia nigra. Primary symptoms include difficulty in initiating movement, slowness of movement, poorly articulated speech, and, in some cases, resting tremor (Hamani et al., 2006).

Partially observable markov decision process (POMDP): A POMDP models decision processes of an agent whose state transitions possess the Markov property (i.e., the probability that the process moves to a new state St+1 is only influenced by the current state St and selected action A) but for which the agent cannot directly observe the underlying (hidden) state and thus has to infer it from observations. (Pezzulo et al., 2014)

Pattern recognition: Functional MRI measures brain activity repeatedly every few seconds in a large number of small volumes (voxels). The joint activity in a subset constitutes a spatial pattern. Different pattern vectors reflect different mental states; for example, those associated with different images viewed by the subject. Each vector can be interpreted as a point in an N-dimensional space. Each measurement of brain activity corresponds to a single point. A successful classifier will learn to distinguish between pattern vectors measured under different mental states (Haynes & Rees, 2006).

Pattern vector: A vector is a set of one or more numerical elements. A pattern vector is the set of values that together represent the value of each individual voxel in a particular spatial pattern (Haynes & Rees, 2006).

Pavlovian value: The value of a given state, for example, a place at which an agent is located. In the reinforcement literature this is usually expressed as a state-dependent value V(S) and contrasted with the aforementioned Q value that also depends on action. In probabilistic terms

Pavlovian value can be expressed as the probability that a given state provides reward: P(R|S). (Pezzulo et al., 2014)

Phase Locking Index (PLI): The PLI is an analysis method of EEG signals which emerged from theoretical studies of oscillating (chaotic) systems with couplings. It is used to quantify in a statistical sense the phase synchronization of such systems from experimental data and, thereby, to characterize their coupling (Rosenblum et al., 1996).

Place cells: Are pyramidal neurons, most often studied in rats, that are located within the CA3 and CA1 hippocampal subfields. Firing patterns are determined by environmental sensory inputs - they become active when the animal enters a particular area in the environment (Bush et al., 2014).

Plan value: The cumulative value of executing an action plan (e.g., a spatial or behavioral trajectory). Here, this value is calculated using IGSs: by stochastically retrieving successor states from hippocampal memory, considering their values (coded in VS), and integrating these states and values. The integration can follow a diffusion-to-bound rule or a Bayesian scheme that uses cached Q values as priors. (Pezzulo et al., 2014)

Polysomnography (PSG): is a test used in the study of sleep and as a medical tool used to diagnose sleep disorders. Polysomnography records the brain waves, the oxygen level in blood, heart rate and breathing, movement of chest during breathing, muscle tone, body position as well as eye and leg movements during the study. The result of PSG is called a polysomnogram.

Positron emission tomography (PET): Positron emission tomography is a nuclear medicine, functional imaging technique that produces a three-dimensional image of functional processes in the body (Bailey et al., 2005). The system detects pairs of gamma rays emitted indirectly by a positron-emitting radionuclide (tracer), which is introduced into the body on a biologically active molecule. Three-dimensional images of tracer concentration within the body are then constructed by computer analysis. PET was the most frequently used brain mapping technique before the development of fMRI.

Poststimulus undershoot: Refers to the transient signal drop below baseline after stimulus cessation (Frahm et al., 1992; Kwong et al., 1992).

Power spectral density: The distribution of power at each frequency in a time-varying signal, generally displayed with power on the y-axis and frequency along the x-axis (Fox & Raichle, 2007).

Precuneus: The precuneus belongs to the superior parietal lobule forward of the occipital lobe (cuneus). It has been implicated in processes related to episodic memory, visuospatial processing, self-referential processing, and certain aspects of consciousness (Harris et al., 2009).

Prediction accuracy: The correlation between predicted and observed BOLD signals (Price & Devlin, 2011).

Prediction error: The difference between bottom-up (sensory) input and top-down predictions. Any irresolvable match (e.g., in vOT: processing of pseudowords) elicits prediction error, which in turn elicits an increased BOLD signal response (Price & Devlin, 2011).

Predictive coding: Estimation scheme developed in engineering and instantiated in hierarchical generative models of brain function. Here, cortical regions receive bottom-up input encoding features present in the environment as well as top-down predictions. Predictions attempt to reconcile sensory input with one's internal knowledge of how input is generated. Thus, the function of any region is to integrate these two sources of input dynamically onto a coherent, consistent, stable pattern of activity (Price & Devlin, 2011).

Procedural memory: Procedural memory can be described as implicit, automatic or not consciously accessible. It's the part of memory that facilitates procedural skills and has to be established by repeated practice, e.g. learning to ride a bike. The main underlying structures are the striatum and the cerebellum (Diekelmann & Born, 2010).

Pure alexia: Pure alexia is a severe visual reading impairment. This selective deficit in word recognition can be global or with letter-by-letter reading. It includes the loss of the ability efficiently to identify strings of letters whereas speech production, speech comprehension and writing abilities should be unimpaired (Dehaene & Cohen, 2011).

Raclopride: A radioligand used in positron emission tomography that binds competitively with dopamine receptors (Zatorre & Valimpoor, 2013).

Rapid eye movement (REM) sleep: according to the rules of classification of sleep course in human - The AASM manual for the scoring of sleep and associated event REM sleep occurs when we can observe: low amplitude, mixed frequency EEG, low chin EMG tone, rapid eye movement (Iber et al., 2007). During the night people have usually three to five episodes of REM sleep, which tend to increase in length as the night progresses. REM stage is associated with physiological changes, such as widespread skeletal-muscle hypotonia and sleep-related erections. Dreams typically occur during REM sleep. - EEG: Stage REM sleep is characterized by a low-voltage, mixed-frequency EEG, a Sawtooth waves also may be present (Geyer, et al., 2009). - EOG: conjugated, episodic, sharply peaked, eye movements with an initial deflection < 500 msec. - EMG: relatively low-amplitude chin EMG – baseline EMG activity is no higher than in any other sleep stage, usually is at the lowest level of the entire recording. (Iber et al., 2007).

Rapid eye movement sleep behavior disorder (RBD): is a sleep disorder (parasomnia) which involves abnormal behavior during the REM sleep. In this pathologic state muscle tone is present, what is more can occur body movements and even violent behavior. It is caused by the lack of skeletal-muscle hypotonia, which should occur during REM sleep. Skeletal-muscle hypotonia is a protective mechanism to prevent the acting out of dreams (Geyer et al., 2009).

Region of interest (ROI) analysis: The first reason to perform an ROI analysis is simply to explore one's data. In complex designs, such as factorial designs with multiple levels, it can often be difficult to discern the pattern of activity across conditions from an overall map. It is often useful to see the signal in areas of interest plotted for each condition or plotted against other variables of interest. The second reason is to control for Type I error by limiting the number of statistical tests to a few ROIs. The third reason is to limit testing to a region that is functionally defined on the basis of some other information, such as a separate 'localizer' scan or condition (Poldrack, 2007).

Regional specificity: The approach of regional specificity searches for specific functions, which activate a region more than another region (Kanwisher, 2010).

Resting state: Viewed as highly active, involving free association, autobiographical recollection, daydreaming, creativity, and planning (Binder, 2012).

Reverse inference: Inferring the presence of a particular cognitive process given activation in a voxel (Poldrack, 2011).

Riddoch syndrome: an ocular impairment usually caused by lesions in the occipital lobe with simultanously undamaged V5 cortex, which is responsible for perception of movement. As a result, patients can perceive only moving objects, whereas static ones become totally invisible for them (Zeki, 1998).

Sampling-based inference machine: A device or neural architecture for inferring future events and system states from previously acquired knowledge. Here, inference is synonymous to probabilistic inference as performed by the generative model. Sampling-based means that the inference is approximate and uses a sampling method. (Pezzulo et al., 2014)

Scanner drift: A source of data noise resulting from the imaging hardware, caused by the superconducting magnet's field drifting over time (Montag et al., 2011).

Selective Inference: Referred to selectively mapping mental processes onto a region that is engaged selectively (Poldrack, 2011).

Sensitivity encoding (SENSE): Used to enhancing the performance of magnetic resonance imaging (MRI) by means of arrays of multiple receiver coils. Sensitivity encoding (SENSE) is based on the fact that receiver sensitivity generally has an encoding effect complementary to Fourier preparation by linear field gradients. Thus, by using multiple receiver coils in parallel scan time in Fourier imaging can be considerably reduced (Pruessmann et al., 1999).

Sensory (primary) consciousness (PC): literally 'living in the moment', the most primitive variant of consciousness based upon presence of a multimodal scene. So-called 'remembered present'. The crucial criterium for PC is the ability to make complex discriminations, which can suggest a deep reciprocal link between perception and memory (Edelman D., 1989).

Sharp-wave ripples: Sharp-wave ripples are high-frequency network oscillations (approx. 200 Hz), occurring in the hippocampus during slow wave sleep. They reflect burst of CA1 pyramidal

cell activity and can last from 30ms to 200ms. Sharp-wave ripples provide ideal physiological conditions for the induction of synaptic plasticity processes (i.e. LTP and LTD) and are thus linked to memory (reactivation) processes (Siapas & Wilson, 1998; Mölle et al., 2009).

Sleep paralysis: Describes the inability to move while falling asleep or shortly after waking up. During sleep paralysis the person is conscious and aware of his surroundings. One can be snapped out of sleep paralysis by being touched or by hearing the own name called out. (Carlson, 2010)

Sleep spindles: a train of distinct waves with frequency 11-16 Hz, most common 12-14 Hz with a duration ≥ 0.5 seconds, they are generated in the reticular nucleus of the thalamus (Iber et al., 2007). Sleep spindles are a composed of a group of rhythmic waves which progressively increase and then gradually decrease in amplitude (Silber et al., 2007). Spindles with K-complexes are the hallmarks of N2 sleep stage, they may be also present in N3 stage, but it happens rarely (Geyer et al., 2009).

Slow Oscillations (Sleep): Slow oscillations reflect low-frequency oscillations in the membrane potential of cortical neurons and consist of a depolarizing up and a hyperpolarizing down state (Born, Rasch, & Gais, 2006). While cortical neurons are globally silent during the down state, the up state is associated with heavily increased neuronal firing (Steriade, 2006). Synchronization of the slow oscillations of many neurons leads to the characteristic slow waves that can be seen in EEG recordings during sleep stage N3 (Esser, Hill, & Tononi, 2007). In humans, slow oscillations are generated in the neocortex and appear with a peak frequency of about 0, 75 Hz (Steriade et al, 1993; Mölle, Marshall, Gais, & Born, 2002). More specifically slow oscillations are traveling waves (speed: 1,2 -7,0 m/sec.) with an anterioposterior direction, usually originating between dorsolateral prefrontal cortex (DLPFC) and orbitofrontal cortex (OFC) (Massimini, Huber, Ferrareli, Hill, & Tononi, 2004). In addition, slow oscillations seem to be generated primarily within neocortical networks that were activated during encoding in previous wakefulness, and are thus partly related to pre-sleep events (Huber, Ghilardi, Massimini, & Tononi, 2004; Mölle, Marshall, Gais, & Born, 2004).

Social brain hypothesis: also known as ’social intelligence hypothesis’ or ’machiavellian intelligence hypothesis’. It states that demand of efficiency in social interactions was the main reason that caused so fast human brain evolution.

Spatial attention: Selective attention that is based on location in the sensory world. For example, visuospatial attention is attention to one location while simultaneously ignoring another location (Bestmann et al., 2007).

Spatial smoothing: Data points are averaged with their neighbors. It improves the signal-to-noise-ratio. Mostly used is the Gaussian smoothing kernel described by a parameter of full width at half maximum (FWHM) (Mikl et al., 2008).

Stage wake (stage W): according to the rules of classification of sleep course in human - The AASM manual for the scoring of sleep and associated events, stage W shows the waking state, which is ranging from full alertness through stages of drowsiness (Iber et al., 2007). The wake stage is characterized by: - EEG: During eyes-open wake, the EEG shows high-frequency, low-voltage activity (Beta 12-25 Hz). During eyes-closed drowsy wake, the EEG is characterized by prominent alpha activity (8-12 Hz), minimum 50% of the epoch. - EOG: Blinks at a frequency of 0.5 - 2 Hz. Fast and slow eye movements are present. - EMG: The chin EMG activity during stage W is of variable amplitude, usually higher than during sleep stages (Iber et al., 2007). The level of muscle tone is usually relatively high (Geyer et al., 2007).

Startle reflex: is an involuntary reaction to a sudden unexpected stimulus, which involves flexion of most skeletal muscles, a blink, and a variety of visceral reactions die to activation of the midbrain paleocircuits. Buzsaki (2006).

Statistical Parametric Mapping (SPM): Statistical Parametric Mapping refers to the construction and assessment of spatially extended statistical processes used to test hypotheses about functional imaging data. These ideas have been instantiated in software that is called SPM. The SPM software package has been designed for the analysis of brain imaging data sequences. The sequences can be a series of images from different cohorts, or time-series from the same subject. The current release is designed for the analysis of fMRI, PET, SPECT, EEG and MEG (http://www.fil.ion.ucl.ac.uk/spm/).

Strabismus or "squint-eye" condition: is a developmental impairment, in most cases due to problems in eye muscle control. As a result, incongruent spatial information is projected from the two retinas to the brain. During development one of the eyes becomes dominant, and information from the nondominant eye is "suppressed". Attebo et al., (1998).

Stress: Stress can be described as the reaction to subjectively perceived, potentially negative, dangerous or unpleasant changes (i.e. stressors) in the environment. It leads to the release of different molecules in the brain and body (e.g. noradrenalin, dopamine, serotonin, corticosteroids) resulting in a complex stress response that enables the subject to adapt to the environmental changes and reinstate homeostasis (Selye, 1950; Joels & Baram, 2009; Schwabe et al., 2012).

Stress response: The exposure to potential threats or stressors initiates a cascade of actions mainly involving two systems (Schwabe et al., 2012).

1. The fast acting "fight-or-flight" sympathetic nervous system response which prepares the body to react by increasing the heart rate or enhancing blood flow to skeletal muscles via release of catecholamines (e.g. adrenaline, noradrenaline).
2. The slow acting hypothalamus-pituitary-adrenal (HPA) axis which leads to the release of glucocorticoids (i.e. cortisol) and initiates a memory formation mode with enhanced

attention, perception, and encoding for the ongoing events, i.e. all cognitive capacities are concentrated on coping with the current stressor and its storage into memory.

Subject Own Name paradigm (fSON): Is widely used in the area of disorders of consciousness research. We can distinguish two conditions of fSON: an active and a passive paradigm. The passive condition required just listening the subject own name (fSON) or other unfamiliar names spoken by a familiar or unfamiliar voice. In the active condition subject is asked to count a target name. The active ERP paradigm induced by Caroline Schnakers at al. (2008) forces subjects to voluntary following the command and counting the target stimuli. Participant has to focus his / her attention on his / her own target's name or an unfamiliar target name. The point is that in the active counting condition non – target stimulus must be ignored, we expect reaction only in case of the target name – it give us quite reliable evidence for obeying the rules. Obeying the instruction is a sign of unsolicited, conscious command – following. The active ERP paradigm was create because of weaknesses passive paradigm – concerning diagnosis in area of disorders of consciousness.

Subliminal perception: Subliminal perception refers to the phenomenon of when a presented stimulus is not perceived consciously but is nevertheless affecting behavior (Kouider & Dehaene, 2007).

Subtraction model: The subtraction of the processes going on during the baseline from the processes going on during the active task resulting in those values which are central for your hypotheses (Binder, 2012).

Subthreshold synaptic inputs: Activity of synapses in the absence of somatic action potentials (Grienberger et al., 2015).

Surface-based analysis: The two-dimensional nature of the maps as well as their topographic arrangement strongly suggest that a two-dimensional surface-based metric is more appropriate for analyzing functional properties than the more typically used volume-based metrics. However, the highly folded nature of the cortical surface makes it difficult to view functional activity in a meaningful way (Fischl et al., 1999).

Synaptic plasticity: The ability of synapses to change their structure or biochemistry in response to their own activity or through activity in other pathways, e.g. due to learning or memory related processes (Hughes, 1958; Carlson, 1986). The most important mechanisms of synaptic plasticity are long-term potentiantion (LTP) and depression (LTD).

Task-induced deactivation: The deactivation of those processes going on during the baseline while performing the explicit task. Task-induced deactivation should not occur, or should be much weaker, when the explicit task engages the same processes that are engaged during "resting" (Binder, 2012).

Testing effect: The psychological effect, which shows that testing individual's memory will strengthen it more than additional study of the material, even when testing does not include a feedback (Roediger & Karpicke, 2006).

Thalamus: The thalamus is a midline symmetrical structure, within the vertebrate brain, located between the cerebral cortex and the midbrain. It has been implicated in the relaying of sensory and motor signals to the cerebral cortex. Moreover, it may be involved in the regulation of consciousness, sleep, and alertness (Harris et al., 2009).

Theory of Mind (ToM): A central component of human social cognition is the ability to attribute mental states to ourselves and others. This ability is often referred to as 'mentalizing', 'mindreading' or 'theory of mind' (Schurz et al., 2014b).

Threshold Free Cluster Enhancement (TFCE): Threshold Free Cluster Enhancement is a successful attempt to avoid the problem of selecting a cluster forming threshold in topological inference procedures. In this transformation, excursions sets are integrated over all the possible thresholds resulting in a new set of values reflecting both cluster height and support (Smith, 2009).

Top-down predictions: Automatic input a region receives from areas above it in the anatomical/functional hierarchy. Connections try to predict bottom-up inputs based on the context and active features. In case of word recognition in vOt important sources of top-down input are pyramidal cells in cortical areas that contribute to representing sound, meaning and actions associated with a given stimulus (Price & Devlin, 2011).

Transcranial alternating current stimulation (tACS): A non-invasive neuroscientific method which uses alternating currents that can either be sinusoidal or rectangular. This allows us to induce specific frequencies into the brain. (Herrmann et al., 2013)

Transcranial direct current stimulation (tDCS): A non-invasive neuroscientific method which uses a constant low current to stimulate (anode) or inhibit (cathode) specific brain regions. (Herrmann et al., 2013)

Transcranial Magnetic Stimulation (TMS): Transcranial magnetic stimulation is a method by which a single or series of brief magnetic pulses that are applied externally to the skull focally modulate brain function through the generation of intracortical electrical currents (Groppa et al., 2012). Effects can be stimulatory or inhibitory depending on the approach.

Unihemispheric slow-wave sleep (USWS): the slow-wave sleep (SWS) that occurs only in one hemisphere, when simultanously the second hemisphere exhibits intermediate state between SWS and wakefulness (Ball et al., 1988). It is associated with unilateral eye closure - the closed eye is operated by the sleeping hemisphere. Unihemispheric slow-wave sleep has been observed only in several avian orders and in some marine mammals (cetaceans, seals in the Order Otariidae, walruses, and manatees) (Lyamin et al., 2008). It has evolved convergently as a necessary trait for a survival in specific environment. In case of birds, it seems helpful in

maintaining antipredatory vigilance and during prolonged nonstop flights (Rattenborg et al., 2006). Marine mammals, on the other hand, must always be able to reach a water surface in order to take a breath, even during sleep. Unihemispheric sleep has never been noticed during REM phase.

Univariate analysis: Considers only single-decision variables at any one time, each individual voxel separately. Studies probe whether the average activity across all task trials during one condition is significantly different from the average activity across all time points during a second condition and acquire a large number of samples of brain to maximize statistical sensitivity (Haynes & Rees, 2006).

Up state: A period of excitation during slow-wave sleep. The neurons located in the neocortex fire briefly at a high rate. (Carlson, 2010)

Valence asymmetry model: This is a dimensional theory for differential contributions of left and right cortical regions in positive and negative emotions (Davidson, 1984). Specifically, frontal brain regions are involved in this model which has been linked to the expression and experience of emotion as well as individual differences of affective style (Davidson, 1998).

Value of information: The amount an agent should pay (or otherwise provide) to obtain new information prior to making a decision. In the current context, it indicates how many (computational) resources the agent should spend to refine prior value estimates using IGSs and model-based evaluation. Thus, the value of information can be considered a part of the trade-off between the costs and benefits of producing Internally generated sequences. (Pezzulo et al., 2014)

Vertex sharp waves: Vertex sharp waves appear during the light sleep stage N1. They have a high amplitude (up to 200 µV) with a very short duration (<0.5sec) and appear primarily over the central areas in the EEG (Iber et al., 2007).

Visual masking: Visual masking takes place when the visibility of a target stimulus is reduced by the presentation of another stimulus, termed the 'mask' (Breitmeyer & Ogmen, 2000).

Visual word form area (VWFA): The visual word form area (VWFA) is a site of the left lateral occipitotemporal sulcus which is involved in reading processes. It is reproducible across individuals/scripts and partially selective for written strings (compared to e.g., line drawings). Lesions of this area cause pure alexia (Dehaene & Cohen, 2011; Kronbichler et al., 2009; Ludersdorfer et al., 2013; Schurz et al., 2010).

von Economo neurons (VENs) also called spindle neurons: disproportionately big and thin, sparsely branched neuron cells. 50-200% bigger than average human neurons (Cauda et al., 2012). Apart from humans, VENs have been found only in other Hominidae species, whales and elephants. Concerning the fact that they are present just in the highest developed mammalian brains, spindle neurons are thought to express neuronal adaptation for evolution of large brains

and be responsible for high-level cognitive functioning (Williams, 2012). Spindle neurons were discovered by Austrian neurologist Constantin von Economo.

Voxel: A voxel is the three-dimensional (3D) equivalent of a pixel and corresponds to the smallest distinguishable, box-shaped element measured in a 3D anatomical or functional brain image volume. The signal measured in each voxel reflects local changes in oxygenated and deoxygenated hemoglobin that are a consequence of neural activity (Haynes & Rees, 2006).

Voxel-Based Morphometry (VBM): At its simplest, voxel-based morphometry (VBM) involves a voxel-wise comparison of the local concentration of gray matter between two groups of subjects. The procedure is relatively straightforward and involves spatially normalizing high-resolution images from all the subjects in the study into the same stereotactic space. This is followed by segmenting the gray matter from the spatially normalized images and smoothing the gray-matter segments. Voxel-wise parametric statistical tests which compare the smoothed gray-matter images from the two groups are performed (Ashburner & Friston, 2000; Richlan et al., 2013b).

Voxel-based Quantification: Voxel-based Quantification (VBQ) provides a more sophisticated alternative to VBM, allowing for a systematic and unbiased exploration of the interaction between imaging parameters and the detection of neurodegenerative processes in the brain. VBQ provides a parameter-specific distribution pattern that offer detailed insights into brain structure in vivo and its changes (e.g. with age or in patient groups). VBQ can provide essential baseline data for studying a patient group compared to healthy subjects. Parameters for the parameter distribution pattern can be e.g. the fractional anisotropy (FA, an index of fibre coherence), mean diffusivity (MD), magnetisation transfer (MT), R1 or R2* relaxation times (Draganski et al., 2011).

References:

Ashburner, J. (2007). A fast diffeomorphic image registration algorithm. *NeuroImage, 38,* 95–113. doi:10.1016/j.neuroimage.2007.07.007

Ashburner, J., & Friston, K. J. (2000). Voxel-based morphometry--the methods. *NeuroImage, 11,* 805-821.

Attebo, P. Mitchell, R. Cumming, et al. Prevalence and causes of amblyopia in an adult population. *Ophthalmology, 105* (1998), pp. 154–159.

Bailey, D. L., Townsend, D. W., Valk P. E., Maisey, M. N. (2005). *Positron Emission Tomography: Basic Sciences*. Springer-Verlag.

Ball, N. J., Amlaner, C. J., Shaffery, J. P., Opp, M. R. (1988). Asynchronous eye closure and unihemispheric quiet sleep of birds. InW. P. Koella, F. Obal, H. Schulz, P. Visser (Eds.), Sleep.

Bauer, G., Gerstenbrand, F., Rumpl, E. (1979). Varieties of the locked-in Syndrome, Journal of Neurology, 221.

Bestmann, S., Ruff, C., Blakemore, C., Driver, J., & Thilo, K. (2007). Spatial attention changes excitability of human visual cortex to direct stimulation. *Current Biology, 17*, 134-139.

Binder, J. R. (2012). Task-induced deactivation and the "resting" state. *NeuroImage, 62*, 1086-1091. doi:10.1016/j.neuroimage.2011.09.026

Blake, R. (2001). A primer on binocular rivalry, including current controversies. Brain and Mind, 2, 5–38.

Born, J., Rasch, B., & Gais, S. (2006). Sleep to remember. The Neuroscientist, 12(5), 410-424.

Braun, M., Hutzler, F., Münte, T. F., Rotte, M., Dambacher, M., Richlan, F., & Jacobs, A. M. (2015). The neural bases of the pseudohomophone effect: phonological constraints on lexico-semantic access in reading. Neuroscience, 295, 151-163. doi: 10.1016/j.neuroscience.2015.03.035

Braun, M., Jacobs, A. M., Richlan, F., Hawelka, S., Hutzler, F., & Kronbichler, M. (2015). Many neighbors are not silent. FMRI evidence for global lexical activity in visual word recognition. Frontiers in Human Neuroscience, 9, 423. doi: 10.3389/fnhum.2015.00423

Breitmeyer, B. G., & Ogmen, H. (2000). Recent models and findings in visual backward masking: A comparison, review, and update. Perception & Psychophysics, 62(8), 1572–1595.

Bressloff, P. C., Cowan, J. D. (2003). Spontaneous pattern formation in primary visual cortex. In: Hogan J., Krauskopf A.R., di Bernado M., Wilson R.E. (Eds.) *Nonlinear dynamics and chaos: where do we go from here?* Institute of Physics Publications.

Brett, M., Christoff, K., Cusack, R., & Lancaster, J. (2001). Using the Talairach atlas with the MNI template. *Neuroimage, 13*, S85.

Brodmann K. (1909). Vergleichende Lokalisationslehre der Grosshirnrinde. Leipzig: Johann Ambrosius Barth.

Burns D., & Ciurczak E. (2007). Handbook of Near-Infrared Analysis, Third Edition (Practical Spectroscopy). pp. 349–369.

Bush, D., Barry, C., & Burgess, N. (2014). What do grid cells contribute to place cell firing. *Trends in Neuroscience, 37*, 136-145.

Butler P. (2000). Reverse Othello Syndrome Subsequent to Traumatic Brain Injury. Psychiatry 63 (1) Spring.

Buzáki G. (2006). *Rhythms of the Brain*. New York: Oxford University Press.

Carlson, N. (2010). Physiology of behavior (10th ed.). Boston: Allyn & Bacon.

Cauda, F., et al. (2012). Functional Anatomy of Cortical Areas Characterized by Von Economo Neurons. Brain Structure and Function nr 218 (1): 1-20.

Chard, D. T., Griffin, C. M., Parker, G. J. M., Kapoor, R., Thompson, A. J., & Miller, D. H. (2002). Brain atrophy in clinically early relapsing–remitting multiple sclerosis. *Brain, 125*, 327-337.

Cordi, M., Schlarb, A., Rasch, B. (2014) Deepening Sleep by Hypnotic Suggestion. SLEEP, 37, 1143–1152.

Davidson, J. R. (1984). Affect, cognition and hemispheric specialization. In C. E. Izard, J. Kagan & R. Zajonc (Eds.), *Emotion, cognition and behavior*. (pp. 320-365). New York: Cambridge University Press.

Davidson, R. J. (1998). Affective style and affective disorders: Perspectives from affective neuroscience. *Cognition & Emotion, 12*, 307-330. doi:10.1080/026999398379628

Dehaene, S., & Cohen, L. (2011). The unique role of the visual word form area in reading. *Trends in Cognitive Sciences, 15*, 254-262.

Diekelmann, S., & Born, J. (2010). The memory function of sleep. Nature Reviews Neuroscience, 11, 114-126.

Draganski, B., Ashburner, J., Hutton, C., Kherif, F., Frackowiak, R. S. J., Helms, G., & Weiskopf, N. (2011). Regional specificity of MRI contrast parameter changes in normal ageing revealed by voxel-based quantification (VBQ). *NeuroImage, 55*, 1423–1434. doi:10.1016/j.neuroimage.2011.01.052

Edelman D. (1989). The Remembered Present. Basic Books.

Edelman, D., B. J. Baars, et al. (2005). Identifying hallmarks of consciousness in non-mammalian species. Consciousness and Cognition 14: 169-187.

Elliot, A.J., Devine, P.G. (1994). On the motivational nature of cognitive dissonance: Dissonance as psychological discomfort. Journal of Personality and Social Psychology, 67, 382–394.

Erlacher, D., Schädlich, M., Stumbrys, T., Schredl, M. (2014) Time for actions in lucid dreams: effects of task modality, length, and complexity. Frontiers in Psychology, 16, 4 -1013.

Esser, S.K., Hill, S. L., & Tononi, G. (2007). Sleep homeostasis and cortical synchronization: Modeling the effects of synaptic strength on sleep slow waves. Sleep, 30(12), 1617-1630.

Ferrer, E., Shaywitz, B. A., Holahan, J. M., Marchione, K., & Shaywitz, S. E. (2010). Uncoupling of reading and IQ over time: empirical evidence for a definition of dyslexia. *Psychological Science, 21*, 93-101. doi:10.1177/0956797609354084

Festinger, L. (1957). A theory of cognitive dissonance. Stanford, CA: Stanford University Press.

Fischl, B., Sereno, M. I., & Dale, A. M. (1999). Cortical surface-based analysis: II: Inflation, flattening, and a surface-based coordinate system. *Neuroimage, 9*, 195-207.

Fox, P. T., Parsons, L. M., & Lancaster, J. L. (1998). Beyond the single study: function/location metanalysis in cognitive neuroimaging. *Current Opinion in Neurobiology, 8*, 178-187.

Fox, M. D., & Raichle, M. E. (2007). Spontaneous fluctuations in brain activity observed with functional magnetic resonance imaging. *Nature Reviews Neuroscience, 8*, 700-711.

Frahm, J., Bruhn, H., Merboldt, K. D., & Hanicke, W. (1992). Dynamic MR imaging of human brain oxygenation during rest and photic stimulation. *Journal of Magnetic Resonance Imaging, 2*, 501-505.

Friston, K. J., Fletcher, P., Josephs, O., Holmes, A., Rugg, M. D., & Turner, R. (1998). Event-related fMRI: characterizing differential responses. *Neuroimage, 7*, 30-40.

Gagl, B., Hawelka, S., Richlan, F., Schuster, S., & Hutzler, F. (2014). Parafoveal preprocessing in reading revisited: evidence from a novel preview manipulation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 40*, 588-595. doi:10.1037/a0034408

Geyer, J., Carney P., Payne, T. (2009) Atlas of Polysomnography. Philadelphia: Wolters Kluwer Health, 258-280.

Grienberger, C., Chen, X., & Konnerth, A. (2015). Dentritic function in vivo. *Trends in Neuroscience, 38*, 45-54.

Groppa, S., Bergmann, T. O., Siems, C., Mölle, M., Marshall, L., & Siebner, H. R. (2010). Slow oscillatory transcranial direct current stimulation can induce bidirectional shifts in motor cortical excitability in awake humans. Neuroscience 166, 1219–1225. doi: 10.1016/j.neuroscience.2010.01.019

Groppa, S., Oliviero, A., Eisen, A., Quartarone, A., Cohen, L. G., Mall, V., Kaelin-Lang, A., Mima, T., Rossi, S., Thickbroom, G. W., Rossini, P. M., Ziemann, U., Valls-Solé, J., Siebner, H. R. (2012). A practical guide to diagnostic transcranial magnetic stimulation: Report of an IFCN committee. *Clinical Neurophysiology 123*, 858–882.

Hagoort, P., Brown, C., .& Swaab, T. (1996). Lexical semantic event-related potential effects in patients with left hemisphere lesions and aphasia, and patients with right hemisphere lesions without aphasia. *Brain, 119*, 627-649.

Hajnal, J. V., Bryant, D. J., Kasuboski, L., Pattany, P. M., De Coene, B., Lewis, P. D., ... & Bydder, G. M. (1992). Use of fluid attenuated inversion recovery (FLAIR) pulse sequences in MRI of the brain. *Journal of computer assisted tomography, 16*, 841-844.

Hamani, C., Neimat, J., & Lozano, A.M. (2006). Deep brain stimulation for the treatment of Parkinson's disease. *Journal of Neural Transmission, 70*, 393-399.

Harris, S., Kaplan, J. T., Curiel, A., Bookheimer, S. Y., Iacoboni, M., & Cohen, M. S. (2009). The neural correlates of religious and nonreligious belief. *PLoS ONE, 4*, e7272. doi: 10.1371/journal.pone.0007272

Haselton, M.G., Nettle, D., Murray, D.R. (2014). The Evolution of Cognitive. In Buss, D. M. (Ed.). The Evolutionary Psychology Handbook, 2nd Edition, Hoboken: Wiley.

Haynes, J. D., & Rees, G. (2006). Decoding mental states from brain activity in humans. *Nature Reviews Neuroscience, 7*, 523-534.

Helms, G., Draganski, B., Frackowiak, R., Ashburner, J., & Weiskopf, N. (2009). Improved segmentation of deep brain grey matter structures using magnetization transfer (MT) parameter maps. *NeuroImage, 47*, 194–198. doi:10.1016/j.neuroimage.2009.03.053

Herrmann. C., Rach, S., Neiling, T. Strüber, D. (2013) Transcranial alternating current stimulation: a review of the underlying mechanisms and modulation of cognitive processes. Front Human Neuroscience, doi: 10.3389/fnhum.2013.00279

Huber, R., Ghilardi, M. F., Massimini, M., & Tononi, G. (2004). Local sleep and learning. Nature, 430(6995), 78-81.

Hughes, J. R. (1958). Post-tetanic Potentiation. Physiological Reviews, 38 (1),91–113.

Hutzler, F., Fuchs, I., Gagl, B., Schuster, S., Richlan, F., Braun, M., & Hawelka, S. (2013). Parafoveal X-masks interfere with foveal word recognition: evidence from fixation-related brain potentials. *Frontiers in Systems Neuroscience, 7*, 33. doi:10.3389/fnsys.2013.00033

Iber, C., Ancoli-Israel, S., Chesson, A., Quan, S. for the American Academy of Sleep Medicine. (2007) The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications, 1st ed., Westchester, Illinois: American Academy of Sleep Medicine.

Jasper, H. (1958). The ten-twenty electrode system of the International Federation. In: Electroencephalography and clinical neurophysiology. 10, p. 371–375.

Jentschke, S., Koelsch, S., Sallat, S., & Friederici, A. D. (2008). Children with specific language impairment also show impairment of music-syntactic processing. *Journal of Cognitive Neuroscience, 20*, 1940-1951. doi:10.1162/jocn.2008.20135

Joels, M., & Baram, T. Z. (2009). The neuro-symphony of stress. Nature Reviews Neuroscience, 10(6), 459-66.

Joels, M., Karst, M., DeRijk, R., & de Kloet, E. R. (2007). The coming out of the brain mineralocorticoid receptor. TRENDS in Neuroscience, 31(1), 1-7.

Kalat J. (2008). Biological Psychology. Tenth edition,Wadsworth.

Kanwisher, N. (2010). Functional specificity in the human brain: a window into the functional architecture of the mind. *Proceedings of the National Academy of Sciences of the U S A, 107*, 11163-11170.

Ketz, N.A., Jensen, O., & O'Reilly, R.C. (2015). Thalamic pathways underlying prefrontal cortex-medial temporal lobe oscillatory interactions. *Trends in Neuroscience, 38*, 3-12.

Keretsz, A., & Hooper, P. (1982). Praxis and language: The extent and variety of apraxia in aphasia. *Neuropsychologia, 20*, 275-286.

Klein, R. M. (2000). Inhibition of return. Trends in Cognitive Sciences, 4(4), 138–147.

Knyazev, G. (2006). Motivation, emotion, and their inhibitory control mirrored in brain oscillations. Neuroscience Biobehavioral Review.31, 377 – 395.

Kok A. (1997). Event-related potential (ERP) reflections of mental resources: a review and synthesis. Biological Psychology, 19–56.

Kouider, S., & Dehaene, S. (2007). Levels of processing during non-conscious perception: A critical review of visual masking. Philosophical Transactions of the Royal Society of London, Series B, 362, 857–875.

Kronbichler, M., Klackl, J., Richlan, F., Schurz, M., Staffen, W., Ladurner, G., & Wimmer, H. (2009). On the functional neuroanatomy of visual word processing: effects of case and letter deviance. *Journal of Cognitive Neuroscience, 21*, 222-229. doi:10.1162/jocn.2009.21002

Kuramoto, Y. (1984). *Chemical Oscillations, Waves, and Turbulence*. Dover Publications.

Kurzban R. (2012). Why Everyone (Else) Is a Hypocrite: Evolution and the Modular Mind. Princeton Press. Chapter 7.

Kwong, K. K., Belliveau, J. W., Chesler, D. A., Goldberg, I. E., Weisskoff, R. M., Poncelet, B. P., . . . et al. (1992). Dynamic magnetic resonance imaging of human brain activity during primary sensory stimulation. *Proceedings of the National Academy of Sciences U S A, 89*, 5675-5679.

Lacoume, J.-L. (1992). Higher-Order Statistics, Elsevier, pp.29-38.

Laureys, S., Pellas, F., Eeckhout, P., Ghorbel, S., Schnaker, C., Perrin, S., Berré, J., Faymonville, M., Pantke, K., Damas, F., Lamy, M., Moonen, G., Goldman, S. (2005). The locked-in syndrome: what is it like to be conscious but paralyzed and voiceless?. Progress in Brain Research, 150.

Laureys, S., Perrin, F., Brédart, S. (2007). Self-consciousness in non-communicative patients. Consciousness and cognition, 16, 722-741.

Ludersdorfer, P., Schurz, M., Richlan, F., Kronbichler, M., & Wimmer, H. (2013). Opposite effects of visual and auditory word-likeness on activity in the visual word form area. *Frontiers in Human Neuroscience, 7,* 491. doi:10.3389/fnhum.2013.00491

Ludersdorfer, P., Wimmer, H., Richlan, F., Schurz, M., Hutzler, F., & Kronbichler, M. (2016). Left ventral occipitotemporal activation during orthographic and semantic processing of auditory words. NeuroImage, 124, 834-842. doi: 10.1016/j.neuroimage.2015.09.039

Lyamin, O. I., Shpak, O. V., Nazarenko, E. A., Mukhametov, L. M. (2002). Muscle jerks during behavioral sleep in a beluga whale (Delphinapterus leucas L.). Physiology and Behavior, 76: 265-270.

Mac, L. P. (1949). Psychosomatic disease and the visceral brain; recent developments bearing on the Papez theory of emotion. *Psychosomatic Medicine, 11*, 338-353.

Maclean, P. D. (1952). Some psychiatric implications of physiological studies on frontotemporal portion of limbic system (visceral brain). *Electroencephalography and Clinical Neurophysiology, 4*, 407-418.

Martin, A., Kronbichler, M., & Richlan, F. (2016). Dyslexic brain activation abnormalities in deep and shallow orthographies: a meta-analysis of 28 functional neuroimaging studies. Human Brain Mapping, 37, 2676-2699. doi: 10.1002/hbm.23202

Martin, A., Schurz, M., Kronbichler, M., & Richlan, F. (2015). Reading in the brain of children and adults: a meta-analysis of 40 functional magnetic resonance imaging studies. Human Brain Mapping, 36, 1963-1981. doi: 10.1002/hbm.22749

Massimini, M., Huber, R., Ferrareli, F., Hill, S., & Tononi, G. (2004). The sleep slow oscillation as a traveling wave. The Journal of Neuroscience,24(31), 6862-6870.

May, A. (2011). Experience-dependent structural plasticity in the adult human brain. *Trends in Cognitive Sciences, 15*, 475-482. doi:10.1016/j.tics.2011.08.002

Mikl, M., Marecek, R., Hlustik, P., Pavlicova, M., Drastich, A., Chlebus, P., . . . Krupa, P. (2008). Effects of spatial smoothing on fMRI group inferences. *Magnetic Resonance Imaging, 26*, 490-503. doi:10.1016/j.mri.2007.08.006

Mölle, M., Eschenko, O., Gais, S., Sara, S. J., & Born, J. (2009). The influence of learning on sleep slow osciallations and associated spindles and ripples in humans and rats. European Journal of Neuroscience, 29, 1071-1081.

Mölle, M., Marshall, L., Gais, S., & Born, J. (2002). Grouping of spindle activity during slow oscillations in human non-rapid eye movement sleep. The Journal of Neuroscience,22(24), 10941-10947.

Mölle, M., Marshall, L., Gais, S., & Born, J. (2004). Learning increases human electroencephalographic coherence during subsequent slow sleep oscillations.PNAS, 101(38), 13963-13968.

Montag, C., Reuter, M., & Axmacher, N. (2011). How one's favorite song activates the reward circuitry of the brain: personality matters! *Behavioural Brain Research, 225*, 511-514. doi:10.1016/j.bbr.2011.08.012

Näätänen, R., Paavilainen, P., Rinne, T., Alho, K. (2007). The mismatch negativity (MMN) in basic research of central auditory processing: a review. Clinical Neurophysiology, 118, 2544-90.

Neubauer, A. C., Grabner, R.H., Freudenthaler, H.H., Beckmann J. F., Guthke H. (2004). Intelligence and individual differences in becoming neurally efficient. *Acta Psychologica, 1*, 55-74.

Nishimoto, S., Vu, A. T., Naselaris, T., Benjamini, Y., Yu, B., & Gallant, J. L. (2011). Reconstructing visual experiences from brain activity evoked by natural movies. *Current Biology, 21,* 1641-1646.

Nishino, S. (2007). Clinical and neurobiological aspects of narcolepsy. Sleep Medicine, 8, 373-399.

Norton, M.I., Mochon, D., Ariely, D. (2011) The “IKEA Effect”: When Labor Leads to Love. Working Paper.

Nyhus, E. & Curran, T. (2010). Functional role of gamma and theta oscillations in episodic memory. *Neuroscience and Biobehavioral Reviews, 24*, 1023-1035.

Palmer, L.M., Stuart, G.J. (2009). Membrane potential changes in dendritic spines during action potential, and synaptic input. *Journal of Neuroscience, 29*, 6897-6903.

Pezzulo, G., van der Meer, M. A. A., Lansink, C. S., & Pennartz, C. M. A. (2014). Internally generated sequences in learning and executing goal-directed behavior. *Trends in Cognitive Sciences, 18*(12), 647–657. doi:10.1016/j.tics.2014.06.011

Pfurtscheller, G., & Lopes da Silva, F. H. (1999). Event-related EEG/MEG synchronization and desynchronization: basic principles. *Clinical Neurophysiology, 110*, 1842–1857.

Plihal, W., & Born, J. (1997). Effects of early and late nocturnal sleep on declarative and procedural memory. Journal of Cognitive Neuroscience, 9(4), 534-547.

Poldrack, R. A. (2007). Region of interest analysis for fMRI. *Social Cognitive and Affective Neuroscience, 2*, 67-70.

Poldrack, R. A. (2011). The future of fMRI in cognitive neuroscience. *NeuroImage, 62*, 1216-1220. doi:10.1016/j.neuroimage.2011.08.007

Polich, J. (2007). Updating P300: An Integrative Theory of P3a and P3b. Clinical Neurophysiology, 118, 2128–2148.

Pracki, T., Pracka, D., Ziólkowska-Kochan, M., Tafil-Klawe, M., Szota, A. (2008) Polysomnography — the rules of sleep scoring. Sen, 1, 57-60.

Price, C. J., & Devlin, J. T. (2011). The interactive account of ventral occipitotemporal contributions to reading. *Trends in Cognitive Sciences, 15*, 246-253.

Pruessmann, K. P., Weiger, M., Scheidegger, M. B., & Boesiger, P. (1999). SENSE: sensitivity encoding for fast MRI. *Magnetic resonance in medicine, 42*, 952-962.

Qin, P., Di, H., Yan, X., Yu, S., Yu, D., Laureys, S., Weng, X. (2008). Mismatch negativity to the patient's own name in chronic disorders of consciousness. Neuroscience Letters, 448, 24-8.

Ramachandran, V.S. (1999). Phantoms in the Brain: Probing the Mysteries of the Human Mind. New York: Harper Collins.

Richlan, F. (2012). Developmental dyslexia: dysfunction of a left hemisphere reading network. *Frontiers in Human Neuroscience, 6*, 120. doi:10.3389/fnhum.2012.00120

Richlan, F. (2014a). Functional neuroanatomy of developmental dyslexia: the role of orthographic depth. *Frontiers in Human Neuroscience, 8*, 347. doi:10.3389/fnhum.2014.00347

Richlan, F., Gagl, B., Hawelka, S., Braun, M., Schurz, M., Kronbichler, M., & Hutzler, F. (2014b). Fixation-related fMRI analysis in the domain of reading research: using self-paced eye movements as markers for hemodynamic brain responses during visual letter string processing. *Cerebral Cortex, 24*, 2647-2656. doi:10.1093/cercor/bht117

Richlan, F., Gagl, B., Schuster, S., Hawelka, S., Humenberger, J., & Hutzler, F. (2013a). A new high-speed visual stimulation method for gaze-contingent eye movement and brain activity studies. *Frontiers in Systems Neuroscience, 7*, 24. doi:10.3389/fnsys.2013.00024

Richlan, F., Kronbichler, M., & Wimmer, H. (2009). Functional abnormalities in the dyslexic brain: a quantitative meta-analysis of neuroimaging studies. *Human Brain Mapping, 30*, 3299-3308. doi:10.1002/hbm.20752

Richlan, F., Kronbichler, M., & Wimmer, H. (2011). Meta-analyzing brain dysfunctions in dyslexic children and adults. *NeuroImage, 56*, 1735-1742. doi:10.1016/j.neuroimage.2011.02.040

Richlan, F., Kronbichler, M., & Wimmer, H. (2013b). Structural abnormalities in the dyslexic brain: a meta-analysis of voxel-based morphometry studies. *Human Brain Mapping, 34*, 3055-3065. doi:10.1002/hbm.22127

Richlan, F., Sturm, D., Schurz, M., Kronbichler, M., Ladurner, G., & Wimmer, H. (2010). A common left occipito-temporal dysfunction in developmental dyslexia and acquired letter-by-letter reading? *PLoS One, 5*, e12073. doi:10.1371/journal.pone.0012073

Rizzolatti, G., & Craighero, L. (2004). The mirror neuron system. Annual Review of Neurosci-ence, 27(1), 169–192.

Roediger, H.L., Karpicke, J.D. (2006). The Power of Testing Memory Basic Research and Implications for Educational Practice. SAGE

Rosenbek, J. C., LaPointe, L. L., & Wertz, R. T. (1989). *Aphasia: A clinical approach*. Austin, TX: Pro-Ed.

Rosenblum M., Pikovsky A., & Kurths J. (1996). Phase synchronization of chaotic oscillators. Phys Rev Lett 76: 1804–07.

Schnakers, C., Perrin, F., Schabus, M., Majerus, S., Ledoux, D., Damas, P., Boly, M., Vanhaudenhuyse, A., Bruno, M.A., Moonen, G., & Laureys, S. (2008). Voluntary brain processing in disorders of consciousness. Neurology, 71, 1614-1620.

Schnitzler A., Gross J. (2005). Normal and pathological oscillatory communication in the brain. *Nature Reviews Neuroscience, 6*, 285–296.

Schultz, W., Dayan, P., & Montague, P. R. (1997). A neural substrate of prediction and reward. *Science, 275*, 1593-1599.

Schurz, M., Kronbichler, M., Crone, J., Richlan, F., Klackl, J., & Wimmer, H. (2014a). Top-down and bottom-up influences on the left ventral occipito-temporal cortex during visual word recognition: an analysis of effective connectivity. *Human Brain Mapping, 35*, 1668-1680. doi:10.1002/hbm.22281

Schurz, M., Radua, J., Aichhorn, M., Richlan, F., & Perner, J. (2014b). Fractionating theory of mind: a meta-analysis of functional brain imaging studies. *Neuroscience and Biobehavioral Reviews, 42*, 9-34. doi:10.1016/j.neubiorev.2014.01.009

Schurz, M., Sturm, D., Richlan, F., Kronbichler, M., Ladurner, G., & Wimmer, H. (2010). A dual-route perspective on brain activation in response to visual words: evidence for a length by lexicality interaction in the visual word form area (VWFA). *NeuroImage, 49*, 2649-2661. doi:10.1016/j.neuroimage.2009.10.082

Schurz, M., Wimmer, H., Richlan, F., Ludersdorfer, P., Klackl, J., & Kronbichler, M., (2015). Resting-state and task-based functional brain connectivity in developmental dyslexia. Cerebral Cortex, 25, 3502-3514. doi: 10.1093/cercor/bhu184

Schuster, S., Hawelka, S., Hutzler, F., Kronbichler, M., & Richlan, F. (2016). Words in context: The effects of length, frequency and predictability on brain responses during natural reading. Cerebral Cortex. doi: 10.1093/cercor/bhw184

Schuster, S., Hawelka, S., Richlan, F., Ludersdorfer, P., & Hutzler, F. (2015). Eyes on words: A fixation-related fMRI study of the left occipito-temporal cortex during self-paced silent reading of words and pseudowords. Scientific Reports, 5, 12686. doi:10.1038/srep12686

Schwabe, L., Joels, M., Roozendaal, B., Wolf, O. T., & Oitzl, M. S. (2012). Stress effects on memory: An update and integration. Neuroscience and Biobehavioral Reviews, 36, 1740-1749.

Selye, H. (1950). The physiology and pathology of exposure to stress. Montreal: Acta.

Siapas, A. G., & Wilson, M. A., (1998). Coordinated interactions between hippocampal ripples and cortical spindles during slow-wave sleep. Neuron, 21, 1123-1128.

Silber, M., Ancoli-Israel, S., Bonnet, M., Chokroverty, S., Grigg-Damberger, M., Hirshkowitz, M., Kapen, S., Keenan, S., Kryger, M., Penzel, T., Pressman, M., Iber C. (2007) The visual scoring of sleep in adults. Journal of Clinical Sleep Medicine, 15, 121-31.

Smith, S. M. (2009). Threshold-free cluster enhancement: Addressing problems of smoothing, threshold dependence and localisation in cluster inference. *NeuroImage, 44*, 83-98.

Stark D., & Bradley W. (1999). Magnetic resonance imaging. C.V. Mosby.

Stephan, K. E., & Mathys, C. (2014). Computational approaches to psychiatry. *Current Opinion in Neurobiology, 25*, 85–92. doi:10.1016/j.conb.2013.12.007

Steriade, M. (2006). Grouping of brain rhythms in corticothalamic systems. Neuroscience, 137, 1087–1106.

Steriade, M., McCormick, D. A., & Sejnowski, T. J. (1993). Thalamocortical oscillations in the sleeping and aroused brain. Science, 262, 679-685.

Szent-Györgyi A (1951) *Chemistry muscular contraction*. Academic Press, New York.

Takahara, T., Imai, Y., Yamashita, T., Yasuda, S., Nasu, S., & Van Cauteren, M. (2004). Diffusion weighted whole body imaging with background body signal suppression (DWIBS): technical improvement using free breathing, STIR and high resolution 3D display. *Matrix, 160*, 160.

Van de Kruijs, W. (2010). Effect of manipulating attention and voice familiarity on auditory P3: an ERP study. Bachelor thesis.

Van Valkenburg, M. E. (1974). *Network Analysis* (3rd edition ed.). 383–384.

Vignali, L., Himmelstoss, N. A., Hawelka, S., Richlan, F., & Hutzler, F. (2016). Oscillatory brain dynamics during sentence reading: A Fixation-related spectral perturbation analysis. Frontiers in Human Neuroscience, 10, 191. doi: 10.3389/fnhum.2016.00191

Vilares, I., & Kording, K. (2011). Bayesian models: the structure of the world, uncertainty, behavior, and the brain. *Annals of the New York Academy of Sciences, 1224*(1), 22–39. doi:10.1111/j.1749-6632.2011.05965.x.Bayesian

Williams, C. (2012). The Cells That Make You Conscious. New Scientist nr 215 (2874): 32-35.

Wimmer, H., Ludersdorfer, P., Richlan, F., & Kronbichler, M. (2016). Visual experience shapes orthographic representations in the visual word form area. Psychological Science. doi: 10.1177/0956797616657319

Wimmer, H., Schurz, M., Sturm, D., Richlan, F., Klackl, J., Kronbichler, M., & Ladurner, G. (2010). A dual-route perspective on poor reading in a regular orthography: an fMRI study. *Cortex, 46*, 1284-1298. doi:10.1016/j.cortex.2010.06.004

Worsley, K., & Friston, K. (2007). Statistical Parametric Mapping. *Statistical Parametric Mapping* (pp. 621–623). Elsevier. doi:10.1016/B978-012372560-8/50049-8

Zatorre, R. J., & Salimpoor, V. N. (2013). From perception to pleasure: music and its neural substrates. *Proceedings of the National Academy of Sciences of the U S A, 110*, 10430-10437. doi:10.1073/pnas.1301228110

Zeki, Semir; ffytche, Dominic H. (1998). The Riddoch syndrome: insights into the neurobiology of conscious vision.. Brain (Oxford University Press) 121 (1): 25-45.