COGNITIVE PSYCHOLOGY AND CONSCIOUSNESS

- **History of Consciousness and Defining Consciousness**

Scientific Psychology began in the 19th century as the study of conscious experience. In the famous words of William James, "Psychology is the science of mental life", by which he meant conscious mental life. Even before William James, Freud and Herman Ebbinghaus had already worked on the ideas of consciousness.

It has been difficult to study consciousness although psychologists discovered ways to test hypotheses about short-term memory, implicit recognition, and mental imagery, which are also not observable. There is a great philosophical problem which made it difficult for scientists to explore consciousness in the way we routinely study memory or perception. It is called the mind-body problem. The mind-body issue considers whether our world is basically mental or physical. Can all conscious experiences be explained by neurons or are neurons themselves only ideas in the minds of scientists?

The following is a succinct interpretation of the mind-body issue. When we talk of *mind*, we are talking about the things that are done by the brain; for example, thinking, holding things in the memory, perceiving, judging, as well as feelings such as love, pain etc. The mind in this sense comprises the processes carried out by the brain.

The brain has physical properties that are in a constant state of flux. The brain never rests totally. What takes place in brain – the brain processes – changes more readily. Mind tends to be more dynamic than brains. We can change our thoughts rapidly and without much obvious structural change in the brain. Our conscious thoughts may shift swiftly from the unreasonable to something inspiring, from inner space to outer space in less time than it takes to read this sentence. The physical changes in neural activity cause changes in the mind.

In layman terms we are always switching back and forth between mental and physical ways of describing reality. "I walked to the (physical) fridge because I had a (mental) craving for ice cream. How do mental experiences cause physical actions, and vice versa? We experience jumping back and forth between the realms of the mind and the body.

In western philosophy the human soul was thought to have only such mental properties, and in 1600s Rene Descartes concluded that the conscious soul touches the physical brain in only one spot: the tiny pineal gland hanging from

the bottom of the brain. The beginning of 20th century saw a change and in about 1900 is when scientists thought mentalism was incompatible with established sciences therefore there was a movement towards *physicalism* – the ideas that all conscious experiences can be explained by neurons or by observable stimulus (inputs) and responses (outputs).

Operational definitions: Conscious, unconscious, and fringe conscious.

Conscious processes can be operationally defined as the set of events that:

(a) are claimed by people to be conscious; and which
(b) can be reported and acted upon
(c) with verifiable accuracy;
(d) Under optimal reporting conditions.

"Optimal reporting conditions" implies a minimum delay between the event and the report, freedom from distraction, and the like. All this fits standard practice in the study of perception, short-term memory, problem-solving, imagery, and many other phenomena.

There is a curious asymmetry between the assessment of conscious and unconscious processes. Obtaining verifiable experimental reports works very nicely for specifying conscious events; but unconscious ones are much more slippery. In many cases of apparently unconscious processes, such as all the things the reader is not paying attention to at this moment, it could be that the "unconscious" events may be momentarily conscious, but so quickly or vaguely that we cannot recall it even a fraction of a second later.

Or suppose people cannot report a word shown for a few milliseconds: does this mean that they are truly unconscious of it? William James understood this problem very well, and suggested in fact that there were no unconscious psychological processes at all (1890/1983, p. 162ff.). We have called this the "zero point" problem (Baars, 1988; see Holender, 1986).

This is one of those tricky cases in which the criterion for unconsciousness could retreat ever further and further beyond the grasp of diligent experimenters. Jacoby and Kelley (1992) suggest an attractive answer, a criterion for unconscious events which does not solve the problem exactly, but which gives a reasonable basis for consensus. Suppose, they suggest, we ask a subject to consciously *AVOID* reporting recently learned memory when a cue that tends to trigger the material is

presented? If they cannot do so and the memory comes to mind unbidden, the processes involved are plausibly unconscious.
To illustrate the point we can ask the reader to fill in the missing words or syllables as quickly as possible, but not to mention any male individual in that process: mother/ ..... ; sister/ ..... ; aunt/ ..... ; cow/ ..... ; stallion/ ..... ; Norse/..... ; George Washing/ ..... ; Saturday / .....day ; Abraham Lin/..... ; Thomas Jeffer/ .....; Lyndon John/ ..... ; automo/..... ; Ingmar Berg/.....; garbage/ ..... . If, in spite of your intention not to fill in completion for males, you said "NorseMEN," "JefferSON," "JohnSON, BergMAN" etc. the association to males was plausibly unconscious. While Jaccoby &; Kelley used specially memorized words rather than existing word knowledge, the logic is quite similar.

But it is also important to be able to distinguishing between "practical consciousnesses" from "practical unconsciousness".
In sum, mental events can be defined as *UNCONSCIOUS* for practical purposes if:
(a) Their presence can be verified (by influencing other observable tasks, for example); although
(b) they are not claimed to be conscious;
(c) and they cannot be voluntarily reported, acted on, or avoided;
(d) even under optimal reporting conditions.
By this definition, practiced skills like typing, reading, balancing one's body, and visual analysis are largely unconscious in their details. Likewise, blindsight, implicit memory, unattended information, subliminal effects, the details of language processing, the effects of priming, etc., would be unconscious. There is again a reasonable fit between this definition and existing scientific practice.

Gradually however, learning theories were being challenged by theories on memory and mental processes.

- **States of Consciousness**
- Sleep – is a behavioural quiescence, generally presumed to produce rest. In higher animals, sleep is more than just quiescence, with special neural functions that generate and sustain it, along with characteristic neurophysiological changes.

- Dreams – Dreaming is a unique stage of sleep in which the brain creates its own inner consciousness that is disconnected from awareness of events in the external world. The brain is activated and produces physiological signs that are quite distinct from ordinary sleep.

    - The content of dreams
    - Dreams and external stimuli-The realisation that the bell persistently ringing in your dream is really your alarm clock is a fairly common occurrence. Some of the content of a dream is simply incorporated from what is happening near the sleeping person – events such as sounds, temperature changes, or touches. Dement and Wolpert (1958) sprayed water on the faces of some sleepers in the laboratory and left a control group of sleepers undisturbed. Those who were sprayed reported more dreams about water than did those who were left dry. The incorporation of environmental stimuli into dreams may serve to "protect" sleep.
    - Dreams and waking life-A papyrus in the British Museum dating from 1350 B.C. is about dreams is that they are portents, containing hidden truths about our lives. Sigmund Freud expressed his famous view that dreams express the hidden needs and desires of the unconscious and if dreams could be properly analyzed, he argued, those hidden feelings could brought into consciousness.

- Hypnosis – is which is sometimes referred to as hypnotherapy or hypnotic suggestion, is an altered state of consciousness. This state of consciousness is generally artificially induced and is different from your everyday awareness. When you are under hypnosis:
    - Your attention is more focussed
    - You are more responsive to suggestions
    - You are more open and less critical or disbelieving

The purpose of hypnosis as a therapeutic technique is to help you understand and gain more control over your behaviour, emotions or physical well-being.

- Meditation – meditation is a practice of concentrated focus upon a sound, object, visualisation, the breath movement, or attention itself in order to increase awareness of the present moment, reduce stress, promote relaxation, and enhance personal and spiritual growth.

- Drugs and the Conscious mind – if a drug ia any substance that can alter the functioning of a biological system, there is hardly a person alive who is not a

drug user. Many substances fall within this broad definition, ranging from aspirin to anti-biotics to vitamin C.

- Effects of certain drugs on consciousness.

1. Is Consciousness Epiphenomenal for Perception and Action?

Indeed one of the questions raised in the meeting's program asks whether consciousness is an epiphenomenon — as in the computational view of mind, with cognition running like a program in the brain and consciousness only sometimes exuded. That fundamental question seems to animate some experimental tests for a dissociation of mental states or actions from consciousness.

Attention and consciousness

Early in the cognitive 'revolution' consciousness was identified with an attentional subsystem within a working memory system, on a reassuringly physical computer metaphor. All three of these speakers challenge this claim of a perfect association, although in somewhat different ways. **Christof Koch** recognized a close relationship between selective attention and consciousness, but he presented data interpreted as providing for a double dissociation. In the absence of top down attention, conscious attention may nevertheless go to some particular object or aspect of a scene. On the other hand, subjects may give top down attention to stimuli said to be 'invisible', through one of several techniques — most often with masking but also with flash suppression, or other techniques — yet nevertheless they present evidence interpreted here as unconscious processing indexed by fMRI. This topic was earlier elaborated in a workshop conducted by **Naotsugu Tsuchiya** and **Koch**.

The work reported by **Stanislas Dehaene** focused on the tracking of neural activation, with an emphasis on the neural locus of what is conscious and what not within a global neuronal workspace model, a version of Baars' (2003) model. On this view, consciousness occurs in that limited work space, with the activation of a distributed parieto prefrontal system together with top-down amplification of relevant posterior networks. Considerable processing is said to occur non-consciously.

The reported experiments used stimuli that were presented masked or in a psychological refractory period (or during an 'attentional blink' or with a secondary task), with high density ERPs and high-temporal resolution fMRI used

to track the loci of what were interpreted as non-conscious and conscious stages of processing. In essence, those processes that interfere with attentional identification of the stimulus were found to interfere not only with reports of awareness,
but also with the expected brain imaging indices, fMRI for parietal and prefrontal areas, and the P3 component of ERP for those areas as well as ventral temporal regions. Earlier activation was said to be 'subliminal' (a measurement claim) or 'preconscious' (a theoretical claim).

Michael Tye also argued for a dissociation of attending to and seeing a thing in the sense of being conscious of that thing. The classical Sperling (1960) experiments (and many that followed) convincingly demonstrate that briefly presenting a display (e.g. 50 ms) with three lines of four letters is more than can be fully attended, although the letters must be 'seen' in some sense, a literal representation, if a line of letters randomly selected within 300 ms or so can be intentionally identified. Furthermore, the subject gives top-down attention to the full display (with what Charles Erikson called the 'internal eyeball'), even if unable to 'see' all letters with a 50 millisecond exposure in the sense of being perceptually identified. 'See' is a vernacular term that can be applied to conceptually different conscious states. There was also discussion of Dan Simons' change blindness experiments, with the reasonable interpretation that awareness of change could only occur with fallible inference from attentional identification of both the original and changed aspects of a scene.

What **Koch** and **Dehaene** seem to interpret as unconscious perception, the 'invisible' or 'preconscious', could be taken as evidence that consciousness is sometimes unnecessary and therefore epiphenomenal for perception. But we should first recognize that this is a literature with an unusual number of methodological critiques focused on criterion bias in subjective reports and on the conditions of obtaining objective reports (e.g. Fisk & Haase, 2005; Perruchet & Vinter, 2002). In fact, even direct objective reports don't rule out the possibility of indirect effects produced by the kind of pre-attentive, literal awareness identified in Sperling's and related paradigms. This is *literal awareness,* a mode we can remember, but carrying a content that can fade prior to report when lacking the attentional identification long known to be essential for establishing that *content* in memory (Dulany, 2001). In fact, I see that this pre-attentive consciousness is recognized in Koch & Tsuchya (2007).

Furthermore, the use of brain imaging for the indirect index of 'unconscious' perception raises new validity questions when not submitted to a rigorous and

standard signal detection theory measurement (a d_ or non-parametric A_) — an index of the association of presence-absence of the obscured stimulus with presence-absence of the imaged activation, specifically localized or timed and specifically identified only with the obscured stimulus. It is an especially interesting possibility, however, that these brain imaging measures, with the needed precision and validation (with a pattern analyser and specific controls), might be viewed as tapping that well-established.

Free will and agency

This topic, too, goes to that fundamental question, with a focus now on whether conscious representation of 'will', 'intention' or 'decision' temporally follows its unconscious neural representation and is therefore only an epiphenomenon.

With the basic thesis that 'we infer rather than perceive the moment of decision to act', **WilliamBanks** and associates reported three interesting experiments. In one experiment, the estimated time of response was delayed by a post-response beep. In a second, a video image of their hands responding was delayed 78ms and the reported decision time was then also delayed — but by only by 40ms. A third experiment presented a video of another person responding, and the subjects estimated a decision time that preceded the response by about the amount reports of their own decision times preceded their own responses. So as reasonably interpreted, decision time was inferred from the time of response, and therefore this conscious reflection of volition did not precisely reflect the volitionally controlling brain activity.

- **Consciousness as a Scientific Construct**

Limited Capacity:

Many psychologists and philosophers have noted the limitations on moment to moment conscious capacity. In each conscious moment, we tend to be conscious of only a single thing, i.e. a scene, intention, or daydream. In everyday life, we know that we cannot do two things at one time, such as have an intense conversation and drive in downtown traffic. If one task does not require much conscious involvement we can carry on two activities at a time, probably by switching rapidly between the two tasks.

The number and duration of items *CURRENTLY REHEARSED* in working memory is similarly limited; classically we talk about 7 +/- 2 words or numbers in short-term memory, but that number drops to 3 or 4 when we are unable to rehearse them. Likewise intentional (controlled) actions can only be carried out serially, one at a time, while automatic processes can be carried out concurrently (LaBerge, 1980). In carefully studied dual-task

situations, consciously controlled tasks interfere with each other, causing errors and delay. But when one or both tasks become automated through practice, the interference declines and can disappear entirely.

Global access.
In spite of these limitations, consciousness seems to be the gateway through which we gain access to a vast continent of knowledge, skills, and actions. The weight of evidence suggests that all learning requires consciousness of the material to be learned. Even in the case of implicit learning, where the regularities in the learned material seem to be unconscious or at least relatively unconscious, we still need to be conscious of the target stimuli that display the unconscious regularities.
Transfer of learning to a new situation requires us to make explicit, conscious connections between the old and the new cases. The example of errors in a written sentence shows again that we need to be conscious of the sentence in order to activate numerous sophisticated unconscious knowledge sources that can signal (consciously) when an error occurs. Further, all perceptual information, the basic source of information about the world, is conscious. And all the "ego functions," such as the ability to make a decision, to act voluntarily, to recall events in memory, and the like, depend upon conscious information.
The global reach of consciousness is shown most easily by biofeedback. There is firm evidence that any single neuron, or any population of neurons, can be controlled using biofeedback signals ---but they must be conscious signals. Subliminal stimulation, being distracted from the signal, being habituated to it --- all these cases prevent of the thumb can tap into a single motor unit --- a muscle fibre controlled by one neuron coming from the spinal cord, and another going back to it. When the signal from the muscle fibre is amplified and played back as a click through a loudspeaker, the subject can learn to control the click within 10 minutes, and some subjects have been able to play drumrolls on their single motor unit after about 30 minutes of practice. That is what we mean when we say that consciousness creates global access to all parts of the nervous system.

The paradox is therefore that conscious contents seem limited, but somehow give access to the vast array of knowledge sources in the brain.

- **Some metaphors for Consciousness**
  1. *The Threshold Metaphor*:

This metaphor embodies the commonly held assumption that consciousness results from the activation of some stimulus or memory above a certain

threshold value. The hypothesis was stated in an early form by J. Herbart in 1824. Activation theories of memory and perception are of course the bread and butter of modern cognitive psychology. They can explain priming effects, availability of memory, and other forms of readiness to respond.

A few modern theories have begun to identify activation with access to consciousness. However a simple activation metaphor fails as an adequate account of consciousness, because it cannot handle the phenomenon of redundancy effects: Stimuli or behaviours that are repeated and predictable become unconscious. This includes habituation of perceptual events and mental images, skills practiced to the point of automaticity, and semantic satiation for repeated meaningful words. Redundancy effects occur in all sensory modalities, probably at all levels of analysis, and apparently even for abstract concepts. If some minimum amount of activation were all that is needed to enter consciousness, we would left with the paradox that repeating activation to the point of redundancy always causes conscious contents to become unconscious! Simple, unadorned activation cannot explain both the likelihood of a stimulus coming to mind and also fading from mind if the stimulus happens to become predictable.

2. *The Searchlight Metaphor*

One of the ancient, embedded idioms in many languages is consciousness as something that casts a light on things, so as to clarify and enlighten one's understanding. (Ah, I see!). The image of casting light is discussed as far back as Plato. The Searchlight metaphor is our modern way of expressing these ideas (e.g. Lindsay and Norman (1977) and Crick (1984)). It is an attractive metaphor, embodying in a single image the selective function of consciousness, and the flow of conscious contents across numerous domains of memory, perception, imagery, thought, and action. Crick's neurobiological version also captures what is known about the thalamocortical complex, the fact that the thalamus, nestled like an egg in the cocoon of each hemisphere, maps point-to-point into the corresponding parts of the cerebral cortex, almost like a miniature brain within the brain. The searchlight of attention can be imagined as shining out from the thalamus to the corresponding regions of the cortex. It must be relevant that the thalamus contains two nuclei (the reticular and intralaminal) whose lesioning uniquely abolishes consciousness. Cortical lesions, on the other hand, only abolish the contents of consciousness, not consciousness itself. Crick's thalamocortical spotlight is an elegant image, and one that may yet turn out to be true.

3. The Tip-of-the Iceberg Metaphor:

Another long tradition looks at consciousness as the tip of a large psychological iceberg. This metaphor brings out the fact that conscious experience emerges from a great mass of unconscious events. Sigmund Freud is of course the name that comes to mind most easily here, but the current view is not necessarily psychodynamic. Unconscious material is not unconscious because it has been pushed out of consciousness. Rather, the great bulk of neural systems in cortex and elsewhere are very efficient specialized processors which are normally unconscious. Modern neuropsychology confirms the vastness of the iceberg that is under the water, compared to the small limited-capacity component that is visible and conscious.

4. The Novelty Metaphor:

One line of thought about consciousness holds that consciousness is focused on novelty, "antihabit," or that which mismatches our expectations or mental set (Mandler, 1984). There is ample evidence that people and animals seek novel and informative stimulation; consciousness seems to have a preference for "news." Repetitive, predictable, "old" stimuli tend to fade from consciousness regardless of their sensory modality, degree of abstractness, or physical intensity. Novelty can be defined as change in the physical environment (dis habituation), disconfirmation of expectation (surprise), or violation of skilled routines (choice-points in the otherwise routine flow of action). The Novelty Metaphor captures one central function of consciousness--- its ability to direct resources toward adaptation to novel and significant events. In the language of Piaget, consciousness comes into play more when we need to accommodate to unexpected events, than when we readily assimilate to predictable ones.

However, the novelty hypothesis is obviously not enough. We can be conscious of routine matters if they are important enough personally or biologically: our repetitive need to eat, for example, without getting habituated of bored.

5. An Integration Metaphor: The theatre in the Society of Mind:

The theatre metaphor likens conscious experience to the brightly lit stage in a darkened auditorium. Whatever is on stage is disseminated to a large audience, as well as to the director, playwright, costume designers and stagehands behind the scenes. The focus of this metaphor is a publicity function in a vast array of specialized systems, which constitute the audience. Events on stage are privileged; they are made available to all the listeners in the auditorium.

Dennett (1991) and Dennett and Kinsbourne (1992) have criticized a particular version of the metaphor which they call the Cartesian Theater, "a single place in the brain where 'it all comes together,'" much like the tiny, centrally-located

pineal gland in Descartes' brain. This is a bit of a red herring, however. No current model suggests that conscious contents may be found in a single, tiny point, the discrete finish line of competing potential contents. There are many other ways to bring multiple sources of information together, for example by coordinating the dozens of perceptual maps in the nervous system. The thalamus may be in an ideal situation to do that.
Modern theatre metaphors bypass these Cartesian paradoxes. In recent versions, consciousness is not identified with any single locus. Rather the contents of consciousness are whatever is being widely disseminated throughout the brain. (Newman &; Baars, 1994).

6. *Combining the metaphors into a single, coherent theory.*

We can combine all five metaphors into a single integrated "super metaphor." The theatre can visualized to include useful aspects of the threshold, searchlight, iceberg, novelty, and the executive notions. As such a super metaphor becomes enriched, it can gradually take on the features of a genuine theory. The theoretical proposals described below can be seen as steps in that direction.

- **Modern Theories of Consciousness**
  - Schacter's Model of Dissociable Interactions and Conscious Experience (DICE)

Accumulating evidence regarding neuropsychological disconnections of processing from consciousness, particularly implicit memory and anosognosia (unawareness of one's cognitive deficits) led Schacter to propose his DICE model.
"The basic idea is that the processes that mediate conscious identification and recognition – that is, phenomenal awareness on different domains – should be sharply distinguished from modular systems that operate on linguistic, perceptual and other kinds of information".

*Kindly refer to the model in the book.

- In this model when information is processed, the systems or modules are changed and perceptual residual is left behind – a type of **engram** (defined as "*the transient or enduring changes in our brains that result from encoding and experience*") in our brain.
- The neurons of the brain record and event by strengthening the connection between groups of neurons involved in encoding events. Each memory is associated with

- Different parts of brain – different sensory events – each memory is associated with millions of neural cells being activated in thousands of engrams in your brain. For the most part these memories and associations that lie dormant mat be activated and brought into active consciousness in an astoundingly brief interval. For example, what clothes you were yesterday, this would within seconds activate a previously latent engram. Or recall 5th grade teacher's name.

DICE model assumes independent memory modules and a lack of conscious access to details of skilled/procedural knowledge. It is primarily designed to account for memory dissociations in normally functioning and damaged brains. Failures of awareness in neuropsychological cases are usually restricted to the domains of their impairment; there is no difficulty in gaining conscious access to other knowledge sources (amnesic patients do not have trouble reading words). DICE does not aim to explain the limited capacity of consciousness or the problem of selecting among potential inputs. It suggests that the primary role of consciousness id the mediate voluntary action under the control of an executive.

- Baars's Global Workplace (GW) THEORY

Consciousness is associated with a global "broadcasting system" that disseminates information widely throughout the brain. Baars developed this idea through seven increasingly detailed models of a global workspace architecture in which many parallel, unconscious experts interact via a serial, conscious and internally consistent global workspace (or its equivalent).

GW theory relies on three theoretical constructs:
Expert processors – the first construct is the specialised unconscious processor, the cells, such as cortical feature detectors of colour, line orientation, or faces, but also entire networks and system of neurons. They are extremely efficient in limited task domains, are able to act independently or in coalition with each other. Working as a coalition, they do not have the narrow capacity limitations of consciousness. They can receive global messages, and if they can mobilise a coalition of other experts, they may be able to control a perceptual processor that can place a mental image, phrase of inner speech, etc. They mat work autonomously without conscious involvement. Answering to "What is your mother's maiden name?" requires a mission-specific coalition of unconscious experts, which report their answer to consciousness.

A global workspace – The second construct is of course the Global Workspace (GW) itself. A GW is an architectural capability for system-wide integration and

dissemination of information. A Global Workspace is much like the podium at a scientific meeting. Groups of experts may interact locally around conference tables, but in order to effect change any expert must compete with others, perhaps supported by a coalition of experts, to reach the podium, whence global messages can be broadcast. New links between experts are made possible by global interaction via the podium, and can then spin off to become new local processors. The podium allows novel expert coalitions to form, to work on new or difficult problems, which cannot be solved by established experts and committees. Tentative solutions to problems can then be globally disseminated, scrutinized, and modified.

Since conscious experience seems to have a great perceptual bias, it is convenient to imagine that perceptual processors --- visual, auditory, or multimodal --- can compete for access to a brain version of a GW, but of course perceptual input systems may in turn be controlled by coalitions of other experts.
Obviously the abstract GW architecture can be realized in a number of different ways in the brain, and we do not know at this point which brain structures provide the best candidates. While its brain correlates are unclear at this time, there are possible neural analogues, including the reticular and intraluminal nuclei of the thalamus, one or more layers of cortex, or an active loop between sensory projection areas of cortex and the corresponding thalamic relay nuclei. Like other aspects of GW theory, such neural candidates provide testable hypotheses. (Newman &; Baars, 1993)

Contexts – they may be momentary, as in the way the meaning of the first word in a sentence shapes an interpretation of a later word, or they may be long-lasting, as with life-long expectations about love, beauty, relationships, fate, pride and all the other things people care about. While contextual influences shape conscious experience without being conscious, contexts can be established by conscious events. The reader's ideas about consciousness from years ago may influence his or her current experience of this chapter, even if the memories of the earlier thoughts do not become conscious again. Earlier experiences typically influence current experiences as contexts rather than being brought to mind. It is believed, for example, that a shocking or traumatic event earlier in life can set up largely unconscious expectations that may shape subsequent experiences.

- **Functions of Consciousness**

- Definitional and Context-Setting Function – by relating global input to its contextual conditions, the system underlying consciousness acts to define a stimulus and remove ambiguities in its perception and understanding.

- Adaptation and Learning Function – the more novelty the nervous system must adapt to, the more conscious involvement is required for successful learning and problem solving.

- Prioritising and Access Control Function – Attentional mechanisms exercise selective control over what will become conscious. By consciously relating some event higher-level goals, we can raise its access priority, making it conscious more often and that the apparently innocuous act of lighting a cigarette is life threatening over the long term, medical professionals raised smoker's conscious involvement with smoking and created the possibility for more creative problem solving in that respect.

- Recruitment and Control of Mental and Physical Actions – conscious goals can recruit subgoals and motor systems in order to organise and carry out voluntary actions.

- Decision Making and Executive Function – while the global workspace is not an executive system, executive access to the GW creates the opportunity for controlling any part of the nervous system, as shown by the extraordinary range of neural populations that can be controlled with conscious feedback. When automatic systems cannot resolve every choice-point in the flow of action, making a choice-point conscious helps to recruit knowledge source able to help make the proper decision. In the case of indecision, we can make a goal conscious to allow widespread recruitment of conscious and unconscious resources acting for or against the goal.

- Error-Detection and Editing Function – Conscious goals and plans are monitored by unconscious rule systems, which will act to interrupt execution if errors are detected. Though we often become aware of making an error in a general way, the detailed description of what makes an error an error is almost always unconscious.

- Reflective and Self-Monitoring Function – through conscious inner speech and imagery, we can reflect upon and to some extent control our conscious and unconscious functioning.

- Optimising the Trade-off between Organisation and Flexibility – Automatized, "canned" responses are highly adaptive in predictable situations. However, in facing unpredictable conditions, the capacity of consciousness to recruit and reconfigure specialised knowledge sources is indispensable.

In sum, consciousness appears to be the major way in which the nervous system adapts to novel, challenging, and informative events in the world. A vast array of solid evidence is beginning to reveal the role of consciousness in the nervous system, at least in broad outline. Conscious experience seems to create and access multiple, independent knowledge sources. While organisation of coherent precepts and control over novel, voluntary actions may have been primarily in the phylogenetic evolution of consciousness, it seems to have acquired other functions which can be seen as contributing to adaptive action in a complex world, such as self-monitoring and self-reflection, symbolic representation of experience, control over novel actions, and mental rehearsal.

- **Waking States of Consciousness**
  - Controlled and Automatic Processing
  - Self-Awareness
  - Effects of Self-Awareness
    - Rumination or Reflection
    - Choking under Pressure

Reference Book:

- Linden, David J. (2007). The Accidental Mind. Harvard University Press, United States of America.
- Solso, Robert L. (2001). Cognitive Psychology, Sixth Edition. Published by Dorling Kindersley (India).
- D'Amato, M. R. (1970). Experimental Psychology: Psychophysics, and Learning. Published by Tata McGraw-Hill Publishing Company Limited, Delhi, India.
- Hayes, N. (2000). Foundations of Psychology, 3rd Edition. Thomson Learning, London, UK.

- Baddeley, A., Eyenck, M. W. and Anderson, M. C. (2009). *Memory*. Published by Psychology Press, UK.
- Feldman, R. S. (2002). Understanding Psychology, Sixth Edition. Published by Tata McGraw Hill Education Pvt. Ltd., New Delhi, India.