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Invisible Adaptation: the effect of awareness on perceptual mechanisms

One of the most intriguing questions in sensory perception is the way awareness influences the processing of sensory information. Conscious access to the properties of physical stimulation is considered to be a crucial factor in determining perception, but what happens to sensory input that fails to elicit a conscious percept? Is it possible to find traces of its processing in behavioural experiments? There are two classic methods to test this: priming and adaptation-aftereffects. Here we choose the latter to investigate into the fate of visual motion information that is presented to the subjects without them being aware of its direction. We use random dot displays in which one can vary the percentage of dots moving in the same direction and thus the signal-to-noise ratio (coherence) of the motion stimulus. In this way we can manipulate the physical strength and thus the visibility of the motion stimuli during adaptation, and then test the effect of such manipulations upon the magnitude of the dynamic motion aftereffect (MAE). In this aftereffect, a random dot movie with 0% coherence (pure noise) presented after adaptation (test) is perceived to be moving in a direction opposite to the direction of the adaptation stimulus. In order to 'hide' the adaptation stimulus from awareness, the former is presented peripherally and crowding with similar flankers is used to make its direction of motion 'invisible' to the subjects. In this way we can manipulate both the physical strength and the awareness level of the stimulus independently, and thus investigate separately the effect of different levels of both, during adaptation, to the strength of the following perceptual aftereffect. In order to dissect the effects of the perceptual characteristics and the physical attributes of stimulation on the magnitude of the MAE, we use conditions in which suprathreshold adaptation stimuli are physically identical but perceptually discrete and vice versa. We also use conditions in which the adaptation stimulus is subthreshold, either because of its low physical intensity (motion coherence) or because of crowding. Our results show that crowding, which severely impairs direction discrimination, also reduces the strength of the MAE, which is quantitatively measured using a motion nulling technique. On the other hand, the strength of the MAE is also depended upon the strength of the physical stimulus, even in cases that are perceptually identical but physically different (due to crowding). Finally, the MAE still persists with perceptually subthreshold adaptation stimuli, both in cases of low coherence with no crowding as well as in cases of higher coherence with crowding. Our results indicate that the visual system indeed processes stimuli which are hidden from the awareness of the subject, and that the strength of adaptation is determined independently by both the physical intensity of the stimulus as well as the level of awareness that it invokes. The relevance of these

results to previous behavioural studies on the MAE and on crowding, as well as brain imaging studies on the role of visual area V5 (the 'motion' area of prestriate cortex) will be discussed.

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Implicit Learning: Its nature, properties and measurement

Implicit learning (namely, learning without conscious awareness) is a complex phenomenon, and therefore a hotly debated topic in cognitive psychology for almost fifty years since Arthur Reber (1967) first introduced the term. After defining this multifaceted phenomenon and providing some examples of its everyday manifestations, I will present some common experimental tasks that researchers use in order to study implicit learning, focusing mainly on the paradigm of artificial grammar learning, a fairly versatile paradigm that allows an instantiation of a wide variety of theories of learning, including theories based on rules, similarity, and associative learning. A brief discussion of the types of knowledge structures than can be acquired implicitly will follow. Next, I will discuss the fundamental issue of how we can detect implicit (unconscious) and explicit (conscious) knowledge using different measures, which are supported by different theories of consciousness. The particular way of defining conscious awareness is intrinsically related to the methodological issue of distinguishing between conscious and unconscious learning, and determines the methods for measuring the (un)conscious status of our knowledge. Among the measures that are based on different theories of consciousness are objective measures, free verbal reports, subjective measures based on confidence ratings, awareness reports of people's structural knowledge, and measures of strategic control. After describing the different methodological tools that researchers in the implicit learning field have used for distinguishing between conscious and unconscious learning, I will present some of the properties of unconscious knowledge confirmed by theoretical and experimental data. An issue that has aroused different viewpoints is whether implicit learning is a passive and unselective learning process (e.g. Hayes & Broadbent, 1988) or whether it may interact with people's prior knowledge, goals and expectations (e.g., Sun, 2000; Ziori & Dienes, 2008). Research data will be presented whereby implicit learning is shown to be elicited by meaningful stimuli activating prior knowledge as well as by rewarding and thus highly motivating stimuli. The particular research data will also provide evidence of another property of unconscious knowledge, namely its resistance to attention distraction by dual tasks and time pressure.

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Behavior, Mind, Consciousness, Value: The old and the new riddle of consciousness

The ancient mythological-theological-metaphysical mystery of the soul and its relations to the body becomes well defined during the Scientific Revolution as a paradox of contradictory beliefs concerning the brain, the mind and their interaction. Cartesian dualism bequeathed to philosophy two epistemological-ontological problems and to psychology its first subject matter (consciousness) and a constant objection that questions any attempt to develop a truly scientific psychology, which led to the point of total abolition of mind and consciousness by behaviorism. The Cognitivist Revolution was founded theoretically on proposing a credible solution to the brain-body interaction by the well known computationalism doctrine that the mental consists of inner representations with enough syntactical structure to be manipulated formally by a computing machine. This view of the mind as a set of routines/programs learned and executed by the biological computer of the brain starts the Cognitive Science program as an interdisciplinary attempt to explain mind with AI at the center and neuroscience on the periphery. Consciousness was left to be treated after the other cognitive functions as lacking special procedures and objects specific to it. The initial Cognitive Science program was variously criticized for technical and theoretical reasons. Chief among the later were the problems of the grounding of knowledge and of the selection of the appropriate program for employment depending on the problematic situation presented to the organism by the environment. It was then thought that perhaps the forgotten function of consciousness, which is both a biological and a cognitive function, might be employed to handle both problems. Consciousness in its turn because of its dual nature (biological and cognitive/intentional) presented serious methodological problems especially in view of its objective subjectivity and its qualitativeness. Biological functions are to be isolated and observed functioning in the nervous system, but a series of philosophical arguments (by Nagel, Kripke, Jackson, Chalmers, Levine) were proposed to show that no 3rd person observation of neural function will ever come close to revealing or explaining 1st person qualitative, subjective experience. This argument which has its origins in Leibniz is best summarized in the Explanatory Gap Argument: Levine has shown that there are limits to reductive explanation of elements of consciousness considered as essential characteristics of consciousness. It would appear then that the old

ontological psychophysical interaction riddle was resurrected in another form as the epistemological riddle of consciousness, or what we will call the old Riddle of Consciousness. We accept the finds of Levine and agree that there will always be an explanatory gap which will be always growing narrower. We argue however that instead of blocking research, this step allows us to locate with precision the source of the problem "in us" and opens the way for a more complex set of riddles in which behavior, mind, consciousness and value are recognized as complex notions with multiple interrelations to be explored piecemeal within an epiphenomenalist view of consciousness.

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Neuroimaging evidence for a deviance in the control of intra-subject variation of reaction time in schizophrenia

The deficit of information processing speed reflected in the increase of reaction time (RT) in sensorimotor speeded decision-making tasks is among the most replicated findings in schizophrenia. In a series of studies focusing on intra-individual variability of RT in patients with schizophrenia, a specific increase of intra-individual variability (ISV) was observed for those patients that separated them from patients with other psychotic disorders. In this study we present results from a neuroimaging study from our group investigating the hypothesis that the increase in RT-ISV in schizophrenia stems from a deficit in the executive control of attention. We used a two-choice reaction time task with varying degrees of attentional demand and confirmed that patients had increased RT-ISV compared to controls. This increase though was not related to the attentional demand of the task. The increased attentional demand in this task resulted in the activation of a network of prefrontal and parietal cortical areas. The activity of this network was not different between patients and controls and more importantly the activity of these areas was not predictive of the differences in RT-ISV between patients and controls. This difference was successfully predicted by the activity of a different area in the dorsolateral prefrontal cortex that has been related to inhibitory motor control. We thus conclude that the increase variability in RT in schizophrenia is not related to the executive control of attention but might be related to the control of motor behavior in these patients.

IRINI SKALIORA
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Social transmission on fear: the effect of social interaction of fear conditioning by-proxy

Reacting promptly in the presence of threats is critical to survival, and the ability to identify cues that predict danger greatly supports us in this direction. Learning about potentially harmful events permits us to establish associations between external cues and emotional/motivational states such as fear. Fear can be acquired through direct experiences or indirectly, through social transmission. Much of our knowledge regarding the neurobiological mechanisms of fear learning comes from an extensive animal literature on Pavlovian (classical) fear conditioning - an established model of direct fear learning. The consistency in the physiological expression of conditioned fear elicited by the basic protocol indicates that mechanisms of emotional learning are analogous across species (LeDoux, 1996). More importantly, neuropsychological and neuroimaging techniques in the research of human fear conditioning have replicated the existing animal models (Delgado et al., 2006).

Hence, applying models of observational fear learning to genetically modified rodents would facilitate the study of the neural mechanisms underlying the social transmission of fear-related information. Here, we examined fear conditioning by-proxy (FCbP) in normal animals and animals lacking the β2 subunit of the nicotinic acetylcholine receptor (nAChR). Naïve C57BL_6 and $\beta 2^{-/-}$ mice (FCbP) were exposed to a previously fear-conditioned (FC) cage-mate during the presentation of the conditioned stimulus (tone; Day 2). On the following day, FCbP mice were tested for fear reactions to both tone and context (Day 3) and we assessed the contribution of several factors to the estimated fear response. Although FCbP animals of both genotypes displayed no contextual fear, they showed significant differences in cued-fear: 30% wild-type mice froze to the stimulus, while none of the $\beta 2^{-/-}$ mice did. Interestingly, only wt mice that exhibited enhanced social interaction with the FC animal during tone presentation (Day 2) expressed fear to the tone (Day 3). These results suggest that (i) mice are able to acquire information about possible danger through social interaction; (ii) the efficiency of social transmission of fear depends on the interaction pattern between animals during cue presentation; and (iii) $\beta 2^{-/-}$ mice display different interaction pattern compared to wt mice and are unable to acquire such information. These data further indicate that $\beta 2$-containing AChRs influence observational fear learning indirectly, through their effect on social behavior.

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Cortical dynamics and mechanisms of predictive coding

It is proposed that the evolution of cortical structures in the vertebrate brain (neocortex and hippocampus) introduced novel computational principles that differ radically from those realized in the nervous systems of molluscs and insects and those exploited in contemporary AI systems. A hall mark of cortical architectures is recurrence, the dense and reciprocal coupling among distributed feature specific neurons. Such networks engage in high dimensional non-linear dynamics exhibiting oscillatory activity in widely differing frequency ranges and complex correlation structures. Analysis of massive parallel recordings of neuronal responses in cat and monkey visual cortex suggests that the cerebral cortex exploits the high dimensional dynamic space offered by recurrent networks for the encoding, classification and storage of information. Evidence is presented that the recurrent connections among cortical neurons are susceptible to activity dependent modifications of their synaptic gain, which allows the network to store priors about the statistical contingencies of the outer world. Matching of sensory evidence with stored priors is associated with fast transitions towards substates of reduced dimensionality that are well classifiable by linear classifiers. In addition the network dynamics allow for the superposition and fast read out of information about sequentially presented stimuli, facilitating the encoding and storage of information about sequences. It is proposed that computations in high dimensional state space can account for the ultra-fast integration of sensory evidence with stored priors and the subsequent classification of the results of this matching operation.

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Oh, that evil artificial intelligence

There is much discussion going on these days on the perils, threats and evils of artificial intelligence, more than in any other domain of scientific and/or technological endeavour. We are briefly reviewing these views and their arguments as they appear mainly in popular press

and media, as well as in general or popular science fora. We also review the admittedly fewer voices of defense from the experts point of view. Next, we attempt an evaluation of these views along three axes, the historical, the social and the political. Historically, artificial intelligence is by far not the first scientific or technological endeavour or artifact that is accused of presenting such dangers. We bring forward the psychological roots of such behaviors as well as the specificities of the current historical context that nourish them. We also discuss how the cybernetic origins and the actual objectives of artificial intelligence provide additional arguments against itself. At the social level, we review the current concerns and we show that they are in general not too different from earlier concerns about other fast-expanding human activities. We especially insist on the modern times fear of "takeover" of humans by machines. From a political point of view, we unravel the relationship and the interactions between some current political debates or views and the role of artificial intelligence as a discipline. We also discuss how the politics of science influence and are connected to all of the above. A further non-negligible consequence is the impact of the big audience image of artificial intelligence on the discipline itself and on the shaping of its objectives and methods. We claim that this impact is overall negative.