NEURO-EPISTEMOLOGY: A POST-MODERNIST ANALYSIS OF THE NEURO-SCIENCES

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ABSTRACT

This paper examines the theoretical framework in which we construct our terms of reference when examining patients from an integrated Meyerian biopsychosocial perspective. We coin the term "neuro-epistemology", defining the frame for scientific inquiry into the nature and status of knowledge in neuro-sciences, drawing on a post-modernist, social constructionist framework. The framework is then applied in a review of defining what can be 'co-created' with patients, given the inter-subjective nature of knowledge, the self-reflexive relationship between meanings and behaviour in mental illness and the relationship between knowledge and power. The role of mental frameworks, or presuppositions, in guiding one's choice of research methodology, protocol, experimental tools and hypotheses is explored. The analysis points to the closed nature of the scientific domain in mental health, and the exploration of consciousness and emotions. These principles are applied to the field of neuro-science, including the assumptive framework upon which the dominant discourse in this field is based, which ultimately serves to maintain the hegemony of that status quo. Case examples are used to demonstrate how the application of an integrated approach to mental health draws on an informed, co-created neuro-epistemology.

ABSTRAK

Hierdie artikel ondersoek die teoretiese raamwerk waarin ons, ons terme van verwysing konstrueer met verwysing na die ondersoeking van pasiënte vanuit 'n geïntegreerde Meyeriaanse biopsigososiale perspektief. Ons ontwikkel die term "neuro-epistemologie" wat die raamwerk vir wetenskaplike studies na die aard en status van neurowetenskappe omvat en op 'n post-moderne, sosiaal-konstruktiewe raamwerk gebaseer is. Die raamwerk word dan in 'n oorsig toegepas, om te definieer wat ko-konstruksie met pasiënte kan behels, gegewe die intersubjektiewe aard van kennis, die self-refleksiewe verhouding tussen betekenisse en gedrag in geestesversteuring en die verhouding tussen kennis en mag. Die rol van kognitiewe raamwerke, of vooronderstellings, in die keuse van navorsingsmetodologie, protokol, eksperimentele toerusting en hipoteses word ondersoek. Die ontleding dui op die geslote aard van die wetenskaplike domein in geestesgesondheid en die ondersoeking van bewussyn en emosies. Hierdie beginsels word toegepas in die veld van neurowetenskap, insluitende die aangenome raamwerk waarop die dominante diskoers in hierdie veld gebaseer is, wat uiteindelik tot die instandhouding van die hegemonie van daardie status quo bydra. Gevallestudies word voorgehou om aan te dui hoe die toepassing van 'n geïntegreerde benadering tot geestesgesondheid op 'n ingeligte neuro-epistemologie wat deur ko-konstruksie gekenmerk word, gebaseer is.

BACKGROUND AND ORIENTATION TO THE STUDY

If "epistemology" can be described as the study of *how* we know *what* we know, and *how* we know *that* we know what we know (Keeney, 1983:126), then we may define "neuro-epistemology" as an inquiry into the nature and status of knowledge in the neuro-sciences, and how this knowledge constitutes a co-creation between living systems in the setting of the clinical interview. A useful theoretical basis for such an inquiry is a post-modernist, social constructionist framework that points to the observer-biased nature of all theory. In this paper an overview of this framework is presented, before applying its principles to the realm of neuro-science.

Knowledge and epistemology: Theoretical underpinnings of diagnosis

The Nature of knowledge

The school of social constructionism views ideas and knowledge as a social construction arising in social interchange and as mediated through language (Fruggeri, 1992:39; Hoffman, 1992:10). In short, this implies a co-creation of reality between two (or more) persons in discourse around a subject, such as history taking and diagnosis. Diagnosis, as a description, from this perspective, is seen as a social product emerging in a context of communal construction between specialist and patient (Gergen, 1985:270; Gergen & Kaye, 1992:172; McNamee, 1992:188), rather than as objective accounts which would fit into neat nosological criteria. Such 'descriptions' are both guided by and limited to shared conventions of discourse, or "textual histories" (McNamee & Gergen, 1992:4) and may emerge not as 'diagnosis' (literally: via knowledge) but as an attempt to place the patient into a fixed, predetermined category. By contrast, these co-constructions, or "narratives" are seen not as being independent of people but as products of relationships. Thus, human action is viewed as taking place in a reality of understanding which is created through social construction and dialogue. For Anderson and Goolishian (1992:31), we live and understand our living through these narratives that give meaning and organisation to our experience. Further, the development of a narrative is a recursive process of defining who we are in interaction with others' perceived understanding of us, perhaps coloured by the ICD or DSM nosology in the specialists' case, or by culture, stigma, or fear in the patient's case. Sluzki (1993:218) maintains that our social world is constituted in and through a network of multiple narratives "within which we become aware of self and others ... establish priorities ... attribute meanings, and order events in time". From this perspective, what we call "reality" is seen as residing in one's simulations, or descriptions of events, people, ideas, feelings, and experiences, and these descriptions "evolve through social interactions that are themselves shaped by those descriptions, shaping our view of reality" (Sluzki, 1993:228), and therefore what we would define as real.

For these authors, evolution has continuously defined a process whereby our brains are modified by confronting others in interaction with ourselves, each bearing in their turn the burden of a lifetime of cultural experience, coming to use language that colours descriptions and explanations for what is observed. Thus, one confronts the world with "codes in hand, pre-eminent templates of understanding" and "we do not relate to life 'itself' but to our understanding of it" (Andersen, 1992:61). This brings into question what we indeed see as reality (ontology), and what we will regard as the object of study (reflecting an epistemology). As a result of this internal simulation, different observers will have a propensity to draw different distinctions from the same background of experience, based on their prior history of social interaction, their training, formal or otherwise. These internal discourses are not fixed and immutable, and there is a degree of ambiguity and uncertainty that may not be recognised, even in the sciences of neurology and psychiatry. Anderson and Goolishian (1990:157, 1992:31) emphasise the continually changing, evolving and dialogical basis of these internal stories themselves (simulations of outcomes). Notions of empirical validity and mental representations are jettisoned in favour of the notion of knowledge as social construction, given these subtle inferences, leading us to abandon the concept of brain underlying mind, a 'mistaken neuro-epistemology', leading to epistemological confusion between patient and observing system (Bateson, 1972:102; 1978:52; 1979:67).

Each narrative or text, once embraced, "invites certain

actions and discourages others" (Gergen & Kaye, 1992:173) and hence formulations of nosology in mental illness are limited to co-constructions between the bodies that formulate opinion and specialist, and not necessarily between patient and specialist in an evolving interview or mental status exam, as intended by the trainers.

From the social constructionist perspective, then, diagnostic communication is viewed as a relational process in which information is socially embedded and constructed, and understanding arises through interaction between individuals (Cecchin, 1992:88; Lax, 1992:70) in a process of co-construction as noted before. The recognition of the active role of the observer in any description constitutes according Fruggeri (1992:40) the foundation for "unbinding scientific discourse from mechanistic elements" and leads to the conclusion that there are no incontrovertible "truths", but only stories about the world that we tell ourselves and others. Furthermore, different views are available to each listener based on his/her idiosyncratic perspective (Hoffman, 1992:11). Knowledge is seen here as neither objective nor subjective, but as participatory (Efran, Lukens & Lukens, 1990:82). In this sense, criteria of accuracy or objectivity are of questionable usefulness in judging the relationship between representation and its object DSM/ICD criteria and the actual presentation (Gergen & Kaye, 1992:172), since the definition of knowledge as an operation of discovery (diagnosis) is dismissed and the distinction between knowing and acting is clouded, hence the failure to penetrate the phenomenology of the patient's illness in an Anderson and Goolishian (1992:29) sense. This means we run the risk of no longer extracting diagnostically meaningful information, but perhaps arriving at some directed, predictable test result which creates a unilateral reality, so that normal variance is described as pathological and out of context.

Social constructionism posits an evolving set of meanings emerging from interaction as part of a socially derived, fluid flow of constantly changing narratives (Hoffman, 1990:10) akin to the Vygotskeian process of dynamic assessment. Once in operation, these meanings act to determine behaviour, which then feeds back to confirm or validate those original meanings in a self-reflexive, internally consistent manner, binding events across time to enhance the positive nature of future outcomes for the organism. There is a suspicion therefore that we see only what we look for, and recognise only what we know.

Knowledge and power

For post-modernism, which typically values diversity, plurality and choice, knowledge is conceived of as multiple, fragmentary, context-dependent and local, rather than in terms of "master narratives and universalizing claims" (Hare-Mustin, 1994:20). There are many different and competing discourses or viewpoints of the world circulating in any culture, each discourse existing as a system of statements, practices and institutional structures sharing common values. The cultural narratives that we are familiar with, are generated by the intersecting and interacting of these many discourses that are ultimately historically constructed and negotiated in communities of persons and in the context of social structures and institutions (Redekop, 1995:310). As such the knowledge that is constituted by these discourses is relative, and perhaps only relevant, to those communities and contexts. The nosological entity created by diagnostic and statistical manuals is, after all, useful in creating a common language, with good inter-rater reliability between psychiatrists with resulting consensus on medication, but fails to comfort the patient, as they may not have read such as manual, and it may not tell their story adequately, leading to a dehumanising experience.

For Foucault (1971:58, 1975:29) statements are not only historical, in that they appear in a specific context with a specific status, but are also inherently the object of political struggle, in that they contain the power to influence the affairs of human beings by altering the terms of their self-understanding. In this way the language of mental health professionals create a hierarchy at the bottom of which, and outside of which, exists the lay patient. Foucault has focused, for example, on the ways in which political practices have taken part in the formation and evolution of the discourses of psychiatry and madness, particularly in terms of the dividing practices that isolate and marginalise the unconventional. The history of madness is then a history of the exclusion of one part of society by another in such a way that a particular social order is maintained, even marginalising

psychologists, who then become the 'handmaidens' of medical disciplines. The discourse of madness thus becomes a judgement of power and it is as a specialised knowledge, indeed, inevitably bound up with power in the form of a medical/nursing hierarchy. Through these practices of exclusion and isolation, based on particular discourses of madness such as the pathologising discourse of DSM (American Psychiatric Association, 1994), the armature of power diagnostic knowledge is sustained (Cooper, 1981:93; Cousins & Hussain, 1984:28; Sedgwick, 1982:65). As Foucault (1977:29) puts it, "power produces knowledge ... there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations".

Thus, while different and competing discourses circulate, not all are of equal importance. Some have a privileged and dominant influence on language, thought and action, and others are obscured and marginalised from the mainstream view, leaving consumers out of the loop, and disempowering specifically those with severe mental illness. While all realities are social constructions, some are more influential than others (Hare-Mustin, 1994:22-34). For instance, once certain designations in language become accepted, the user of that language becomes constrained by those terms in the generation of ideas, as they act to structure one's experience in a way that both reflects and reinstates the dominant discourse, (which, in turn, reflects and is part of the prevailing ideology). If one is working with the mind, which one cannot see, ideology is king, but when brain is invoked as the object of investigation, the argument becomes less prone to power relations, or at least may be settled one way or another, as between psychiatry and neurology.

The objective of inquiry then becomes the identification of the context and history of the ideas in which our knowledge practices are situated, with the aim of deconstructing the privileged knowledge frameworks by focusing on how those meanings were constructed and are presently being maintained at the expense of other subjugated meanings. Given that "decontextualized theories legitimize, justify and perpetuate current arrangements of privilege and power" (Hare-Mustin, 1994:32), exposing the 'truth' behind discourses and knowledge involves a questioning of their self-understanding as truths, as well as a concern with their relation to certain social practices and forms of social organisation (Cousins & Hussain, 1984:31).

Having now considered the social constructionist perspective on the nature of knowledge, its relation to behaviour and its political underpinnings, these concepts will be applied to the field of scientific inquiry in general and of neuro-scientific inquiry in particular. As a prelude to this application, the next section delineates these concepts in the form of an assumptive framework.

THE ASSUMPTIVE FRAMEWORK OF A CLINICAL NEURO-EPISTEMOLOGY

It is necessary, at this point, on the basis of the social constructionist framework, to state the set of assumptions that are seen as fundamental to any neuro-epistemological inquiry. These include:

a) The importance of bringing out into the open the assumptions/presuppositions/premises which guide and are guided by one's behaviour (the self-reflexive relationship between meaning and behaviour).
b) The broader socio-politico-historical contextual influences on one's personal assumptions.
c) The power relations inherent in and practiced by the dominant discourses in a field and their subjugating effect on alternative modes of thought.
d) The inevitably context-dependent and thus ontologically arbitrary nature of all theory, as opposed to objective forms of validity.
e) The importance of questioning implicit, tacit assumptions and of focusing on the logical relationship between theory and context.
f) The assertion that contextual determination of theory and theorising is an inevitability of our nature as languaging observers, and that far from promoting a "value-free" science in the search for increasing approximation to "truth", this notion is an ethical one, pointing theorists in the direction of increasing awareness of their constitutive role.
g) The assertion that the notion of utility, rather

than objective validity should be the linchpin in the evaluation of theory, and that there are better and worse ways of creating a system, based on relative utility.

In the next section the role of such assumptions or frames in guiding the choice of research methodology, protocol, experimental tools and hypotheses, and their role in ultimately determining the observations and findings in a way that confirms or perpetuates the original assumptions, is explored. In essence, all of these point to the closed nature of the scientific domain and of scientific explanations in general, regarding which types of explanation are deemed acceptable by the community of scientific observers and the consumer.

SCIENTIFIC INQUIRY

Bateson (1978:44; 49) has argued that empirical research is sometimes a method of "torturing nature" to give an answer in terms of the researcher's own life view, rather than in terms of some epistemology imminent in nature. Kuhn (1970:24) has pointed out that research defined within a given paradigm will self-reflexively produce data that support that paradigm. Normal science, he states, is "an attempt to force nature into the … relatively inflexible box that the paradigm supplies", ignoring the lab rats that do not perform on cue.

Atkinson and Heath (1987:13) see the preconception of categories to organise raw data into statistically analysable chunks, as inevitable. These conceptual categories may be seen as equivalent to the researcher's epistemological framework through which observations in the experiential world are made (Griffith, Griffith & Slovik, 1990:21). Further, this stance selects the range of observations possible from that position and delimits what will constitute the domain of description. In this way, all descriptions are based on theories and this implies a theory of how to describe (Keeney, 1979:119), based on the individual's interaction with the context (Efran, Lukens & Lukens, 1990:82). This also implies that what researchers can perceive is always limited by thresholds of their available means of perception, namely their own presuppositions (Bateson, 1979:69; Sluzki, 1993:218) and the linguistic forms in their repertoire (Andersen, 1992:66). Keeney (1983:126) and Popper (1969:59) maintain that the method of investigation determines the data collected.

Further, as noted earlier, the form of theoretical description is to a great extent determined by the conventions of discourse (Gergen, 1985:268) which are inherently ambiguous and continuously evolving. Scientific formulations are not "an impersonal application of decontextualised methodological rules" (Gergen, 1985:262), but the responsibility of persons in a particular fluid context of discourse. From this perspective, at best one may speak of the "relative value of empirical evidence" (Colapinto, 1979:427) and at worst, that scientific claims are "a pious hope if not a downright lie" (Hoffman, 1992:9).

NEURO-EPISTEMOLOGY APPLIED

Having now pointed to the closed nature the scientific domain in general terms, the next section expands on these concepts and applies them to the neuro-sciences, particularly with regard to the determinant effect of assumptive preconceptions on the initial operations of distinction performed by the theorist/researcher with regard to choice of methodology and level of analysis. These distinctions will be considered as shaping the research 'findings' in a way that reinforces the original assumptions that constituted that choice. The historical socio-religious influences on the current status quo in the field will then be explored, together with the manner in which its assumptions have enabled it to maintain its hegemony, revealing its operation as political practice.

Certain theorists in the field of neuro-science have acknowledged the general principles noted above. Brown (1990:197) for example has noted the "tacit bias" in any observation, which is rooted in "assumptions on the nature of mind" which shape the research, and for Hanlan and Brown (1989:9) similarly, theory does not arise from data alone. Crick (1994:33) has stated that it is impossible to pursue a difficult programme of research in neuro-science without some preconceived ideas, seen as inevitable by Churchland (1986:405). Stein, Brailowsky and Will (1995:102) have opined that such preconceptions about the central nervous system have tended to hamper research in certain areas.

Most theorists see that it is necessary to at least minimise the biasing that they see occurring, toward the end of a "value-free science", calling not for a theory-free science but instead for a science based on testable and coherent assumptions (Churchland, 1986:407). Given the above discussion, however, the assumptive influence on theorising and research is here seen as both necessary and inevitable when one moves away from traditional Modernist premises. The task of the (neuro) epistemologist, then, is to make such guiding biases explicit.

INITIAL OPERATIONS OF DISTINCTION AND THEIR DETERMINANT INFLUENCES ON NEURO-SCIENTIFIC DATA

The following sections explore the role of the initial operations of distinction made by the individual researcher and their shaping influences on the data ultimately produced. These distinctions manifest as choices regarding the phenomenon to be researched, the methodology to be applied, and the appropriate level of analysis for such research.

Assumptive and pragmatic concerns and the problem of ecological validity

The first task of a researcher in any experiment is to make an 'operation of distinction' by separating the essential from the inessential among the multitude of potentially significant regions, circuits or transmitters. Given the highly inter-connected nature of the central nervous system, any such distinction will necessarily be a heuristically mutilating fractionation of an ecology, resulting in what Reitman (1970:82) calls the "decoupling problem". Any attempt to explore executive functioning or memory, for example, will necessitate the decoupling of the memory system from other cognitive systems. It has been noted by some researchers that over-analysing this content may lead to fractioning of the dysexecutive syndrome, such as the differential loading of some tests on the factors of inhibition, intentionality and executive memory.

Moreover, in order to minimise the impact of emotional and motivational factors on memory performance, it is necessary to separate this system's reciprocal, homeostatic interactions with other functional systems and to study it in isolation. Similarly, the study of colour sensitivity as an element in object perception independent of shape or spatial perception involves a decontextualisation of the former. Brown (1990:202) sees such attempts as being based upon an assumption which implies that object formation is a process of combining such separable components as elemental constituents in the construction of the perceived object. This in itself is based upon the assumption that objects are built up from the raw sensory material provided by an external world. Thus, from this perspective, the initial choice of focus occurs as directed by one's prior assumptive framework.

Dudai (1990:20) appears to make the choice on a more pragmatic basis. He states that processes involving complex internal representations are "naturally more interesting" than non-associative learning processes. On the other hand the more complex the process, the more difficult the neuro-biological fractionating and analysis. Thus many efforts in research on the neurobiology of learning are devoted to relatively simple learning "mostly because [it] is easier to study in laboratory animals"; thus much research is extant on the more simple habituation and sensitisation processes - the most elementary form of learning, occurring in every studied eukaryote.

Given such decontextualisation and artificial simplification, Eysenck and Kearne (1993:500) have decried the lack of ecological validity in the current state of experimental cognitive psychology, rarely being directly relevant to cognition and behaviour under naturalistic conditions. They claim that one aspect of this "weakness" is the reluctance to take individual differences seriously. The typical research strategy is to use analysis of variance to statistically assess the effects of various experimental manipulations on cognitive performance, while relegating individual differences to the error term. Moreover, in contrast to naturalistic conditions in which an object is encountered as only part of a visual scene, which provides contextual information and which can influence object recognition, the focus in object recognition research is usually on recognition of single objects perceived in isolation (Eysenck & Kearne, 1993:500). Varela, Thompson and Rosch (1991:70) have also noted the artificial situation of laboratory or computer modelling in which each discrete physical or functional item is made to correspond to an external

item, thereby assigning particular referential meaning to particular symbols. In contrast, the real, lived world of humans has no such predefined semantic boundaries.

Crick (1994:259;159) in his choice of the visual system as the phenomenon to be studied, states that this choice was based on the fact that "it would yield most easily to an experimental attack". He makes the point that although the majority of visual research has been on the macaque monkey (pragmatic expediency), "for all we know the human being may differ in detail and complexity".

Hubel and Wiesel's (1959:579) choice of anaesthetised rather than aware, alert cats, was based on the fact that the latter are harder to study. Indeed, when research on alert organisms does occur, the animal's head and ocular movements must be restrained to prevent confounding movement. Research on outcomes following brain injury has tended to use rodents. Stein, Brailowsky and Will (1995:105), however, note that points of divergence are seen even within rodents of the same species (Blumbergs' group found the same in Merino sheep). Further, virtually all such research has depended on the use of males, again for pragmatic purposes, given the absence of the confounding influence of oestrus cycles. Yet sex differences do occur both in response to injury and in recovery of function, female rats in normal oestrus showing less oedema following frontal cortical contusions than males, and more severe oedema than females who are not in oestrus (Stein *et al.* 1995:105).

Methodological concerns and the determination of research data

The choice of the experimental system and behavioural task is also instrumental in determining the observed results. As Dudai (1990:33) states, animals usually excel in tasks that have ecological significance and that are related to innate response tendencies, such as maze learning in rats and landmark learning in bees. In many cases animals appear not to learn, "not because they cannot do so, but because the experimenter does not ask the right questions". Lashley's (1950:455) conclusion that memory is not localised to any one brain region has been explained by Le Doux (1998:37) in a similar fashion based on his choice of maze learning tasks in rats. Assuming that any task that measures a change in behaviour at some point in time as a result of some earlier experience is as good as any other task for the purposes of measuring memory, Lashley ignored the fact that maze learning tasks have multiple solutions. Given that multiple memory systems are thus engaged in the learning of these tasks, it follows that no single brain lesion will interfere with the performance. In other words, Lashley (1950:477) was led to the conclusion that memory is widely distributed precisely because his assumptions led him to use behavioural tasks that can be carried out by several memory systems located in different brain regions. Bursen (1978:121), after presenting a philosophical critique of Engram theory in general, notes that Lashley's conclusions that the memory trace must be diffusely stored, rather than giving up the notion of Engram in toto, are "typical of research". These experiments are designed only to test particular hypotheses about particular types of trace mechanisms, rather than questioning the existence of traces themselves.

Milner and Goodale (1995:162) provide further support for the argument that experimental methodology has a determinant role in the resultant data. They claim that evidence for Ungerleider and Mishkin's (1982:24) "Two Cortical Visual Systems" model has been gathered with the use of the visual discrimination paradigm as the methodological "linchpin" of their research. Given this paradigm, behavioural experiments are based on stimulus attributes and the animal's decision about the stimulus array, thus on input rather than on visuomotor output. As such, the findings that infero-temporal lesions and posterior parietal lesions impair visual pattern recognition and landmark discrimination, respectively, have provided evidence for the existence of two separable neural circuits. In fact, the tacit assumption underlying such research is that vision has a single function, being the provision of a unified internal representation of the external world so as to serve as the perceptual foundation for visually based thought and action. Following from this assumption, the task of visual science becomes the analysis of processes involved in parsing the array of discrete objects and events comprising one's perceptual experience. In other words, the focus is entirely on the input side of visual processing, on the analysed array, rather than

on the nature of the outputs that are controlled: hence the focus on the geniculo-striate rather than tecto-pulvinar pathways and the choice of the visual discrimination paradigm - both of which serve to confirm the original assumption.

Stein *et al*. (1995:102) have presented a striking example of the guidance of scientific behaviour by ideological assumptions and the way these shape the decision about what is to be considered "data" as opposed to "anomalies".

Le Doux (1998:71) has also questioned the traditional conclusions regarding the limits of unconscious processing by referring to the methodological influences on these conclusions. Much of the work in this area has involved subliminal processing which involves exceedingly brief stimulus exposures, thereby limiting both the amount of information that can be presented at one time and the amount of cognitive resources available to process the task. Further, most studies of the processing "limits" have used verbal, rather than non-verbal pictorial stimuli, the verbal system being evolutionary new relative to the non-verbal, which is the "coin" of unconscious processing. These methodological choices have thus resulted in a highly inaccurate model of the level of sophistication of human unconscious processes.

Choice of level of analysis

Another dimension of the influential nature of our initial operations of distinction concerns the level of analysis chosen. Restak (1995:92) claims that our understanding of the brain will vary according to whether we impose a neuro-chemical, -anatomical or -behavioural frame to highlight our observations. Further, the choice of frame will depend on a personal bias anchored in philosophical attitudes, professional expertise and pragmatic considerations. For example, the different classification systems and notions about the structure, organisation and location of memory are a function of the different levels of description of the phenomenon chosen. A focus, such as that of Matthies (1989:388), on the molecular or cellular level, including aspects of signal processing and intracellular changes, has resulted in theoretical distinctions between short-, intermediate-, and long-term memory. Squire (1993:490) held this distinction to be less compelling, focusing on interneuronal relationships, synaptic pathways, and organism-environment interaction instead. Oden (1987:122) has lamented the fractionation of the field of cognitive psychology into well-developed sub-fields based on differing theoretical paradigms, with no detailed, coherent, unified account of general thought mechanisms. Jordaan (1989:199) notes that the prevailing paradigmatic presuppositions regarding the phenomena dictate the chosen classification system and level of analysis by virtue of their becoming assimilated into the operation of the theorist/researcher, guiding both the research methodology and the meaning attributed to the findings. The "diagram-makers" of the last century, for example (Rosenfeld, 1988:3), tended to single out neuronal connections to fit their prior models of brain processes, and the general patterns exhibited by these pathways then act to constrain the subsequent development of models of brain function, the question being "what anatomical models are suggested by the theory" (Deacon, 1997:307). Such constraints have further reinforced static models of the cortex and have led to the under-representation of alternative theories on the dynamic nature of cortical representations (Merzenich & De Charms, 1996:72).

Even the very concept of representation and mapping of perceptual space has been determined by methodological considerations, being derived largely from electro-physiological studies in which the receptive fields of single cells or groups of cells are plotted (Cook, 1986:207). Such recordings have dominated the field (Greenfield, 1995:7), despite the fact that they do not provide a faithful index of global brain events. The choice of such methodology, as discussed above, is based on pragmatic foundations - single cells succumbing most easily to the classical electrode (Dudai, 1990:22). Moreover, as Stein *et al*. (1995:103) have claimed, models such as localisation theory have been successful precisely because modern techniques have been developed to provide experimental verification of the concepts.

Thus far we have examined the determinant effect of assumptive preconceptions, the pragmatic experience based on those assumptions, on the initial choices performed by the theorist/researcher with regard to choice of methodology and level of analysis, and the

manner in which these operations of distinction determine the "findings" of the research - ultimately reinforcing the initial distinctions which constitute that choice. In the following section this neuro-epistemological analysis is extended to the current status quo or Dominant Discourse in the field of neuro-science, presenting the assumptive framework upon which it is based, in terms of its religio-philosophical background, and which serves to maintain its dominance.

NEURO-EPISTEMOLOGY AND THE DOMINANT DISCOURSE

Philosophical and religious influences

One principal foundation point for current theories of mind, relative to which these theories position themselves, is Descartes' dichotomy between *res extensa* and *res cogitans*, resulting in the current form of the dualist/materialist debate based on contentions of the reducibility or irreducibility of consciousness and of mental phenomena. Descartes' theory itself was grounded in the theory of matter popular in the early 17th Century. As Shalom (1985:201) has maintained, the Cartesian conception of pure mind was a direct consequence of the Cartesian concept of pure, substantial matter which led him to postulate a corresponding mind-substance conceived on the analogy of matter understood as pure extension. This was in contrast to Aristotelian idea of the soul as the form of the body, which itself was the direct consequence of the concept of physical objects as composed of both matter and form.

A second fundamental influence on Descartes' theorising was the influence of the Church, particularly in regard to the dichotomy between human and animal minds. Deacon (1997:9) believes that the classical dichotomy between consciousness and unconsciousness has been linked from the beginning with the human/animal-mind dichotomy, and that religious tradition has historically played a significant role in guiding Western science and philosophical theory about the unique nature of human consciousness. Given the assumption that the immortal soul is unique to humans, the traditional categorical distinctions between animal and human minds have been strongly entrenched, and theories such as the Cartesian distinction between physical reality and that of the soul were a necessary consequence of this restraint. As Searle (1997:162) puts it, Descartes' dualism "kept the religious authorities off scientists' backs" by placing mental phenomena outside the realm of natural science.

In more recent times dualistic notions, with their assertion about the irreducibility of consciousness, have become unfashionable and deemed anti-scientific. The current dichotomy between dualism and materialism has defined the boundaries of most debates, particularly with regard to the assumption that accepting the real existence of consciousness necessarily entails a dualist ontology. Searle (1997:162) maintains that we have inherited "an obsolete Cartesian vocabulary [and] set of categories", with the assumption that our questions and answers must be asked and answered in these terms, leading most theorists who operate within an empirical framework to accept materialism as the only viable alternative. Indeed, the history of the philosophy of the mind over the past century has been in large part an attempt to reduce mental phenomena to physical phenomena.

This type of eliminative or explanatory reductionism, then, as the prevailing standard in current orthodoxy, may be seen to have its roots in the original Cartesian set of presuppositions, which has defined the categories and alternatives in terms of which the questions can be posed. This inherited tradition itself was constrained by philosophical and religious influences.

Empiricism

The current tradition of empirical science has been as influential as its religious predecessor in determining the parameters and vocabulary in which phenomena-to-be-explained can be explained, and in limiting what may be considered as "data". This paradigm of knowledge characteristic of Western science has been termed the Newtonian epistemology, with its primary tenets being lineal causality, reductionism, and Realism (Furman & Ahola, 1988:31). This mechanistic and atomistic view is based on the assumption of neutral and rational objectivity and the premise that reality can be reduced to elementary units (Sarbin, 1986:91; Schwartzman, 1984:231). In this "modernist" paradigm, truth is held

to be a function of precision (Tjersland, 1990:377) and sufficient rigour of observation in order to obtain an accurate, objective map of reality. The general trend in contemporary neuro-science is what Varela *et al*. (1991:72) term "scientific imperialism", the tendency to shunt questions about the mind and consciousness to the brain and depending on neuro-science to validate experience. The major tool of this imperialist hegemony is that of reductionism and particularly "bottom-up" type methodologies. For Medawar (cited in Crick, 1994:107) the art of research is the art of "making difficult problems soluble by devising means of getting at them". Indeed, as Dudai (1990:50) notes, the neural architecture of simple organisms is more amenable to neuro-physiological experimental analysis, and such techniques are well developed. While the pragmatic motivations for such choices have been discussed above, it is important here to note that such methodologies are based on the empirical paradigm that validates the use of "reductive and simplifying steps".

A case in point

A classic example of this empirical tradition in action may be seen in the study of the habituation of the Gill Siphon Withdrawal Reflex of the Aplysia, a methodology promoted by Dudai (1990:54-57). The first simplifying step in such studies requires the immobilisation of the organism in a small aquarium by pinning it to a sub-stage (since "the freely moving Aplysia is not a convenient starting point for cellular analysis"), and then externalising the abdominal ganglion and its nerves via an incision in its neck, pinning these on a lucite stage, thereby permitting electrical stimulation and recordings. To unveil synaptic input, which is normally masked by confounding spike activity in the motor neuron, the latter is artificially hyperpolarised. To facilitate the analysis further, the effector and affector organs are removed and immobilised in a perfusion chamber, reducing the Aplysia to a piece of siphon skin connected to the gill via the appropriate nerves and the externalised ganglion, thereby simplifying the reflex to its central component. Next, the siphon nerve is electrically stimulated to simulate pressure to the skin. Given the absence now of the effector organs, the output of a single identified motorneuron is monitored as a substitute, permitting "easier and better quantification". Next, the electrical stimulus is adjusted so as to generate a single action-potential in the sensory neuron, representing a further simplification. Finally, the polysynaptic component of the circuit is ignored and focus is placed intentionally on only the monosynaptic component, being, "simpler to analyze". Recordings are taken, not from the synapse but rather from the soma, given the "unfeasibility of recordings from terminals in the compact, dense neuropil, in vivo". Interestingly, on the basis of the results gleaned from such simplifying steps, Dudai (1990:74) concludes that "even a relatively simple learning system is more complex than might have been expected", and in an incredible understatement he states that "we may be seeing only the tips of the iceberg".

Leaving aside the mutilative decoupling and fractionation of highly interconnected systems entailed by such methodological guidelines, these are nevertheless quite consistent with the overall paradigm in which they arose and are confirmed by the very results of the research which it constrained in the first place. The method of investigation thus determines the data collected and the method of collection, which collection then validates the method and thus the hegemony of the paradigm in which it arose. This reductionistic, analytic concern has however been critiqued, even from those who adhere to empirical tenets, as having added little to the debate on consciousness given the predominant use of single cell recordings and its conceptualisation of consciousness in quantitative terms, which has required the study of simple brains, such as that of leeches, frogs and flies (Greenfield, 1995:8). Deacon (1997:101) has similarly seen the empirical approach as having impeded the study of language origins, such research having been banned in 1866 France to halt the flow of speculative, non-empirical papers - another example of the maintenance of hegemony through exclusion practices.

Metaphors

Another fundamental influence of the empirical paradigm has been the use of the computer as a metaphor for mind, as "a way of explaining ourselves that is in accordance with the scientific worldview" (Searle, 1997:190). McGuigen (1994:154) has pointed out that models of mind always reflect the technological frontier of their time, mediaeval descriptions utilising meta-

phors of hydraulic systems, pipes and valves, followed by steam engine, and then telephone switchboard metaphors. The current Computational Theory of Mind, representing a "technological will to power" (Searle, 1997:190), has itself been most influential in maintaining the hegemony of the orthodox discourse in the neuro-sciences. In a letter to Oliver Turnbull, Brown (1990:2) has decried the "strong anti-evolutionary sentiment" brought about by the computer metaphor, given that "computers are not evolutionary machines, they do not follow principles of evolutionary theory or expected breakdown patterns [nor are they] entrained in behaviour in relation to their evolutionary sequence". The result of this sentiment, he claims, includes the lack of interest in his own work, "antipathy" towards work in chimpanzees that showed links to human language, "attack" on Piaget's sensory-motor theory, and the focus on the acquisition of syntax in children at the expense of other functions. This philosophical-political "tyranny" has been self-reinforcing in that programs at Harvard and MIT on modular and componential theories "have attracted the best … who then went on to direct their own satellite programs, edit the top journals, and on and on".

CONCLUSION

In the previous sections some of the socio-religio-historical influences on the current status quo in the field of neuro-science have been traced together with the manner in which its own assumptions have enabled it to maintain and reinforce the hegemony of that Zeitgeist. This has been described as occurring through its specification of the appropriate vocabulary and set of categories within which research is to occur, as well as of the appropriate methodology to be used to answer the questions posed. The socio-politico-historico-religious context of assumptions is seen as acting as a tacit bias for the theorist, determining his/her initial operations of distinction and choice of research question as well as the terminology used in presenting the research question. This bias then acts to shape the research methodology, the manner of observation, the tasks to be observed, and what is to be considered data as opposed to anomaly. The "findings" of this research then feed back to confirm the original tacit bias and ultimately to validate the original contextually-based assumptive framework. In this light, science in general and neuro-science in particular is inevitably a closed informational domain, as well as a political activity. In the same manner that, for Foucault (1971:61, 1975:33) the advent of the asylum as a form of exclusion was upheld and legitimised by medical reason within a particular dominant discourse, we may note the manner in which the traditional model has served as such an instrument of exclusion, subjugating alternative, competing modes of thought.

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