THE MAJOR THRUST OF CONNECTIONIST NEURAL NETWORK

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2.1 Paradigms in Cognitive Science

Within cognitive science, we can see different types of cognitive modellings. A cognitive model is really meant to be a device for an engineering design. Terence Horgan\(^1\) distinguished three such important models such as, the classical, the computational conception, the non-sentential computationalism and the dynamical cognitive connectionism. His real intention is to defend folk psychology from a connectionist point of view, but he dismissed all the three conceptions with saying that they are 'just-so-stories' about the mind.

We can also reclassify these models into a matrix of oppositions. Thus we can see the opposition to consists in their being linear or non-linear, dynamic or static, linguistic or non-linguistic, and sentential or non-sentential paradigms in these modellings. We know that linear is opposed to non-linear, dynamic to static, linguistic to non-linguistic, sentential to non-sentential. In those above modellings, the classical computationalism can be said to be linear, linguistic and sentential (Mentalese sentence), while connectionist is said to be non-linear, dynamic, non-linguistic and non-sentential.
Dr. A. Kanthamani\textsuperscript{2} distinguishes four different paradigms in cognitive modelling namely, the classical cognitivism, the neuro-scientific connectionism, the non-classical implementational connectionism, and the unified implementational connectionism. In this Chapter, we can take the first two of them, i.e., the classical cognitivism (Model I) and neuro-scientific connectionism (Model II) so as to counterpose each other, and learn about the other pairs. They are opposing paradigms in cognitive science.

The classical cognitivism is sentence-oriented in which neuron-like structures are given an identifiable interpretation in terms of specifiable concepts or propositions, i.e., our mental states have a syntactic structure as well as a semantic content which is representational, computational, sequential, linear programmable and causal-explanatory. The neuro-scientific connectionism is non-sentential, non-linear, dynamic and chaotic in its orientation taking the mental states as neuronally representational (neural nets) with activation vectors (excitatory, inhibitory) and vector transformation of the weights of the synapses. The non-classical implementational connectionism (Terence Horgan) stands on the strength of alternative syntax, but it is called approximationist in that it approximates to an alternative syntax to the connectionist nets. It is non-algorithmic at least in implementational level. The unified connectionism (Smolensky) is approximationist while it tries to explain implementation by means of a mathematical formation. Its most important feature is that it is also
externalist in its orientation since it expands the programme so as to cover expert knowledge of science.

As the most important modelling, the connectionist model bears the brunt of attacks on all the cognitive modellings. Churchland's Neural Network Theory is also a species of connectionism. The model of connectionism, as a neuro-scientific programme, wants to reduce mind or consciousness to its neuro-biological correlates. Churchland is very optimistic enough to hope that future investigations should help us to place the notion of mind and consciousness within the neuronal connections of brain itself. Classical cognitivism is considered with special reference to Jerry Fodor to which Churchland's is to be opposed. Thagard calls the former as the Computational and Representational Understanding of Mind (CRUM). The success of this hypothesis (CRUM) has been due to the fact that it employs a fertile analogy derived from the development of computers. CRUM assumes that mind has mental representations analogous to data structures and computational procedures similar to algorithms. It can schematically be shown as,

\[
\begin{align*}
\text{Computer Programme} & \quad \downarrow \\
\text{Data structures + algorithms} & = \text{running programme} \\
\text{Mental representations + computation procedures} & = \text{thinking}
\end{align*}
\]
The classical symbolic computational theory of mind asserted that mental representations are symbolic structures and mental processes consist in the manipulations of these representations in accordance with symbolic algorithms based on symbolic rules. The dictum that calls mind as ‘a sentence-crunching machine’ represents the high watermark of this. It is fully articulated in Jerry Fodor’s intentional realism. Within this modelling, it is assumed that on the theoretical level, we can attempt a symbolic computation model in order to model human thought processes, using symbols which required only rules to manipulate them. With this theory, it was further assumed that they would transform and manipulate symbols and thereby simulate the human thought processes. But, this symbol manipulation model reached its impasse known as multiple-realizability, which is acutely problematic. The new researches about human cognition have revolutionised our basic concepts about intelligence, consciousness, knowledge, mind, etc. The classical paradigm namely symbolic computation approach (sentence-crunching model) was in debate with a new paradigm namely neural network approach – connectionist (number-crunching) model.

In contrast to the first model of digital computer that can be used to manipulate symbols, the second was the view that brain consists of a network of simple electrical processing units which stimulated and inhibited each other. Connectionism explored the usefulness of networks in more perceptually-oriented tasks. This biologically-inspired neural network is also known as ‘Neural Network Theory’ and ‘Parallel Distributed Processing’ (PDP). According to connectionists, human behavioural
features are the results of the connectionist architecture of the human brain. However, we must incidentally note that the structural and architectural level of the brain is fundamentally different from the basic form and functions of a digital computer. So, in connectionist model, neural network is not programmed in the manner of a digital computer and the basic difference is its ability to learn from internal representations. In fact, the connectionist model suggests an important rethinking about many basic assumptions in cognitive science.

2.2 Model 1: J. Fodor’s Computational Representational Understanding of Mind

The symbolic computational account of Fodor can be taken as an example of the classical computational paradigm. In his account of modularity of mind, mind is decomposed into several modules and these modules are monitored by a central unit. The main claim of the modularity thesis is that the human cognitive system processes a number of important subsystems that are modular: domain specific, mandatory, limited in their access to other parts of the larger cognitive system, fast, and informationally encapsulated. Fodor argues that there is good evidence for the fact that they have input system that exhibits modularity. Modularity can schematically be shown as:
2.2.1 Informationally Unencapsulated Central Processor

From the above Figure, we can see that the Central Processor (CP) or central module is informationally unencapsulated. The central module can take input, output from various modules and so it is easy to believe that it might be able to make use of things known to some other parts of the cognitive system, i.e., in virtue or their centrality, central modules will not be informationally isolated as peripheral modules.
Fodor's contention is that the central cognitive system is unencapsulated. A peripheral module is encapsulated if, it processes its inputs in a way which is independent of the background believes of the subject, perhaps every one will be inclined to agree that central process are not encapsulated. Here Carruthers¹ warns that, "This should not lead us to conclude that central processes are unencapsulated of course"

2.2.2 'Mentalese' - The Basis of Sentential Paradigm

The 'language-of-thought' or mentalese is central to the classical computational approach of Fodor. Mental representations are linguistic expressions within a language of thought. This is what sententialism postulates. To the advocates of this 'LOT' hypothesis, such as Fodor, sententialism is a strong thesis. The main reasons for this are that 'mentalese' have the following traits such as, (1) Semantics and Reasoning, (2) Systematicity and Productivity, and, (3) Opacity.

2.2.3 A Variant of Intentionalist Semantics

Having contents, thoughts possess semantic properties which they appear to denote and attribute, i.e., denotation and attribution are the semantic properties of thought. For example, take the problem of John's thinking that 'Pegasus is winged'. When thinking of this, John deploys an actual mentalese name for its non-existence. If John's thinking of Pegasus is his mentally naming it, then his thinking of Pegasus as winged would be his concatenating the mentalese-adjective meaning 'Winged' with 'Pegasus' mentalese-name. The mentalese sentence 'Pegasus is Winged' has to bring
Pegasus to mind and to portray this as winged. At this time, John would be ignorant about the other characteristics of Pegasus including colour. But when symbolization (pictorial) will serve this purpose, it cannot avoid the colour of the Pegasus. So, sententialists say that thoughts are precise in just the way the sentences are, but picture are not as precise as sentences. From this, they conclude that if thoughts denote and attribute precisely, sententialism may be best positioned to explain how this is possible.

In reasoning, belief plays a central role. The beliefs may be true or false. If beliefs are relations to mental representation, then the beliefs must be relations to representation that have truth-values among their semantic properties. (Sentences are the representations having truth-values capable of denoting and attributing). Beliefs serve a purpose within the mental economy, and so, they contribute to the control of behaviour. Reasoning is a process in which we attempt to obtain new true belief by exploiting old true beliefs. Thus, reasoning becomes a process defined over mental representations and sententialism tells us that the representation takes place in reasoning is sentential.

E.g., Take John’s beliefs as follows (in a syllogistic manner)

\[ P_1. \] Elios is Ashen.

\[ P_2. \] If Elios in Ashen, then she is ill.

\[ C. \] Elios is ill.
Sententialists gave this example to make us understand the relation between new and old beliefs. Sententialists say that these three beliefs consist of sentences (mental sentences). In reasoning, mental representations stand to one another just as public sentences do in valid formal derivations. Thus, the sententialists claim that reasoning would be able to preserve the truth of belief by being the manipulation of truth-valued sentential representations. This is done smoothly because the rules of sentential representation are so sensitive to the syntactic properties of the mental representation and also protecting and preserving the semantic properties. Thus, we can formulate the sententialist hypothesis as follows: “Reasoning is formal inference, it is a process that tuned primarily to the structures of mental sentence. Reasoners, then are things very much like classically programmed computers”. The traits are discussed one-by-one.

**Systematicity:** Thinking is said to be systematic and productive. The act that John can have some thoughts entails that he can also have certain other thoughts which are semantically related. Sententialists say that his systematicity is possible because mental sentences as complex mental representations result from process ultimately defined on mentalese words and expression. E.g., if John can produce ‘WILLIAM IS TALLER THAN ROSCELIN’, he must have access to ‘WILLIAM’, ‘ROSCELIN’ and ‘IS TALLER THAN’. Because of these simple mental representations he is capable of producing ‘WILLIAM IS TALLER THAN ROSCELIN’. Sententialism postulates that mental representations are linguistically complex representations whose semantic properties are determined by the semantic properties of their constituents.
Productivity: Productivity of thought is closely related to the systematicity of thought. We appear to have a good competence to think ever more complex novel thoughts having certain clear semantic ties to their less complex predecessors. This is called the productivity of thought. The productivity of thoughts goes on until the physical resources of the brain are exhausted. Mental representation systems exhibit the productivity as spoken languages. By identifying the productive system of mental representation with a language-of-thought, sententialism accommodates the productivity of mental representations. In this, the language-of-thought is subject to a productive grammar.

Opacity: The opaque nature of thought also justifies sententialism. Thought respects some semantic relations among mental representation, but it can be utterly blind to others. E.g., take the belief of John that ‘ELIOS IS ASHEN’. Even if when believing Elios is ashen, he is ignorant of the other facts about Elios, i.e., Elios is the most literate woman in Paris or so on. Thus, John’s thought about Elios is opaque in Elios’s own facts. This is the opacity of thought. But sententialists justify this clearly and it becomes a support to sententialism. Their answer is that, these two facts about Elios, ‘ELIOS IS ASHEN’, and ‘ELIOS IS THE MOST LITERATE WOMAN IN PARIS’ represent different mental sentences even though it is about Elios (Ashen). Sententialists take thinking as same as quoting. To quote a sentence in a language is to issue a token of a sentence in that language type. As quoting, thought may be the same process. If to think is to token a sentence in the language-of-thought, the sheer tokening
of one mental sentence need not insure the tokening of another equivalent. Hence, thought is opaque in nature.

As E. J. Lowe\textsuperscript{8} argues in his \textit{Introduction to the Philosophy of Mind}, postulating the existence of a language-of-thought would enable us to model human thought processes on the way in which a digital electronic computer operates. He also argues that if the human brain is an information processing device, then it may be reasonable to hypothesise that it operates in the same way as an electronic computer does. Mentalese might be seen as a naturally evolved brain code analogous to the machine code of a computer. In Kim Sterenly's reading, Fodor's this proposal is at least coherent, theoretically motivated and experimentally productive. At some level of description, brain processes are syntactical. They are sentences in the head. There is a language-of-thought. Such a language is the language of the mentalese or \textit{lingua mentis}. Like any sentences, they have a syntactical structure and a semantics or meaning. It is very difficult to know where the exact relationship between syntax and semantics obtains. The problem of semantics is: How do these sentences in the head get their meanings? A general answer is given by holding that the brain works as a digital computer performing computational operations over the syntactical structure of the sentences in the head. The view that all there is to having a mind is having a programme is central to strong AI. The view that brain processes can be simulated computationally is central to weak AI. Both these are limbs of the view of cognitivism, which holds that brain is a digital computer. The most important counter to the strong
AI is that the computational model of mind left out the crucial things about the mind, such as consciousness and intentionality. Neither of them is reducible to matter. We have no silicon brains.

2.3 **Model II: Churchland’s Connectionist Neural Network Modelling of the Brain**

"An individual’s overall theory of the world is not a large collection or a long list of stored symbolic items. Rather, it is a specific point in that individual’s synaptic weight space. It is a configuration of connection weights, a configuration that partitions the system’s activation-vector spaces into useful divisions and subdivisions relative to the inputs typically fed the system."\(^9\)

It is the discovery that brain consists of discrete cells (neurones) and these neurones signal each other through contacts at specialised points called synapses, pave the way for connectionism. Its emphasis on the importance of connections among simple neuron-like structures gave it the name connectionism. The human brain has about 100 billion neurones many of which connect to thousands of other neurons forming neural networks. The main constituent of a human brain is neurone. This neurone consists of a nucleus with many dendrites attached to it. It is through the dendrites that the neurone receives information from other neurones. The other end is a single axon, which transmits information from one neurone to other neurones. All these axons, at its end are joined to a part called synapse (electrical relay junction). When an electric impulse is created inside a neuron, it is transmitted through axon.
The neuro-transmitters cross the synaptical junction and reaches to a dendrite of another neuron attached to it. So, information from a single axon may be transmitted through many other dendrites of other neurones. There are two kinds of neuro-transmitters namely, excitatory and inhibitory. The combinatory values of neuro-transmitter influences the dendrites of a neurone and this decides whether the neurones have to be fixed or not. If firing takes place, the neurons transmit its own current through the axon.

An important assumption of Churchland’s scientific realism demands that the central nervous system is a very complex parallel system. In this system, the information bits are processed and collected as a whole. The important fact is that the processing elements of human brain, i.e., neurons are very simple. Connectionists believe that the cognitive and thinking process in human beings are basically computational. Hence, this can be explained in terms of higher level computational systems like the human brain. Connectionists offer a novel kind of parallel processing and modelling which clearly is a shift from the present paradigm. To them, this is the only remedial strategy to the disadvantages of the classical computational model. The connectionists argue that there is a fundamental difference between the classical information processing methods of the brain. Connectionists adopt a method that is totally distinct from the classical method, which failed in solving many of the problems of commonsense and of natural language. The peculiar features of neural networks are efficient to make rapid memory than highly-accurate computational process.
The central processing unit of the connectionist model is a tiny processor, which has the ability to sum up several input values and output functions of that sum. Such tiny processors are neural cells or neurones and this can be considered as a very simple form of an independent computer. These cells together consist of an idealised body of 'neurones'. Each of these neurones has an arbitrary number of input, which are all different and a number of outputs. These cells are mutually connected (weighed link) and they receive input and pass output to other cells. The output of previous node or cell is the input of the next node. The weight specifies the relative influence of the value carried by all the links to the unit to which they are connected. The function of each neurone is to receive processed information from other neurones and perform processing with combining all the inputs and to pass the resulting output to other neurones. A layer includes a number of cells that can perform some type of common function. But no cell is connected to another cell in the same layer. In these layers, the first one is input-layer and the last one is output-layer. The layer between input-layer and output-layer is called the hidden-layer. In such a system, the second-layer of a three-layer network receives input from the units in the first-layer and passes output to the third-layer. In this model, the first-layer corresponds to sensory inputs and third-layer to motor inputs. The middle and hidden-layer allows development of the internal representations capable of subserving the wanted input-output model. In these layers, each one makes self-computations and passes the overall result to the next layers. The process continues, finally, a layer determines the output from the network.
The important feature of this neural network is that each of these processing elements makes its computation based upon the weighted sum of inputs. This weighted connection between individual units propagates the overall activity. The weights modulate the effects of the signals produced by individual processing units. The weights can be positive or negative and the passing signals are determined by the size and the polarity of the weighted inputs.

Figure 2
The main characteristic of neural nets is the factor of speed. Each of the neural nodes processes information separately and the speed of the system is great. The overall speed of the network depends upon the total number of 'neurones' and the layers of the system. Of those four, mentioned in the beginning, the first two can be simply called as localist representation and distributed representational respectively. The second type (distributed) can learn how to represent concepts or propositions in more complex ways that distribute meaning over complexes of neuron-like structures.

Generally, the connectionist architecture is the sum total of the following points:

1. The theory that mental computations are carried out by connectionist networks.

2. Mental computation is identifiable with the computations of the brain, which cause and explain our mental states and processes.

3. Connectionist network is a system of interconnected neuron-like computing units.

4. Each unit has a number of input or output connections.

5. Excitatory or inhibitory activation can be sent along with these connections.

6. The output of a unit = a function of the sum total amount of input it receives from all the input connections.

7. The amount of input receives by a unit along a connection is equal to the weight of the connection the output from the other unit along this connection.
8. A connectionist network can be trained to perform certain tasks by adjusting the weights of the connection to improve its performance.

Connectionism has brought major changes in the way many cognitive scientists conceive of cognition. The properties of the connectionist model which the eliminativists argued for are given as follows:

1. The encoding of information in the connection weights and in the biases on units is widely distributed rather than being localist.

2. Individual hidden units in the network have no comfortable symbolic interpretation, and they are sub-symbolic.

3. The models are intended as cognitive models, not merely as implementations of cognitive models.

Some connectionist models are said to be compatible with the propositional modularity of folk psychology. They are to be called compatibilist models.

Much of the allure of the connectionist approach is that many connectionist networks programme themselves, i.e., they have autonomous procedures for turning their weights to eventually perform some specific computation. These learning procedures often depend on training in which the network is presented with sample input/output pairs from the function it is supposed to compute. In learning, networks
with hidden units will perform; since these units represent neither input nor output, they are never told what their values should be, even during training.

In many cognitive models (non-connectionist), it is easy to locate a functionally distinct part of the model encoding each proposition or state of affairs represented in the system. According to Fodor and Pylyshyn, "Conventional (computational) architecture requires that there be distinct symbolic expressions for each state of affairs that it can represent". In connectionist models, an analogous sort of functional localisation is possible not only for the input and output units but the hidden units as well.

In some units, there may be model’s symbols for the properties or features in question. In models, where the weights and biases have been tuned by learning algorithms, it is not the case that any single unit or any small collection of units will end-up representing a specific feature of the environment in straight way. It is also often plausible to view such networks as collectively or holistically encoding set of propositions although none of the hidden units, weights or biases are comfortably viewed as symbols. Hence, it should be called sub-symbolic.

The clearest way to introduce the notion of explanatory level is to place it against the familiar functionalist theses that psychological theories are analogous to programme that can be implemented on a variety of very different sort of computer. If one accepts this, then it makes sense to ask, whether a particular connectionist model is intended as a model at the psychological level or at the level of underlying neural implementation.
Because of their obvious similarity to neural architectures, it is tempting to view connectionist models of the implementation of psychological processes. So it is viewed that connectionist models are not psychological or cognitive models at all. A very different view that connectionist model builders can do is to take their models at the psychological level, not at the level of implementation. So, the models are in competition with other psychological models of the same phenomena. Thus, a connectionist model of word recognition would be an alternative to a non-connectionist model of word recognition and so. Smolensky suggests that connectionist models stand in relation to traditional cognitive models in the same way that quantum mechanics stand in relation to classical mechanics.

The analogy between connectionist models and quantum mechanics is thought to beg an important question, for although quantum mechanics is conceded to be a better theory than classical mechanics, a plausible case could be made that the shift from classical to quantum mechanics was an ontologically conservative theory change. But it is not clear that the change was ontologically radical. Connectionists argued that the explanatory level of the caloric theories and kinetic theories are same though the shift from one to other was ontologically radical. They assume that “if their conception of connectionism is correct, then the relation between connectionist models and traditional cognitive models is the same as caloric and kinetic theories just said above”.

The connectionist models, that are the models at the cognitive level and in which the encoding of information is widely distributed and sub-symbolic, are incompatible
with the propositional modularity in folk psychology. There are no discrete, semantically interpretable states that play a causal role in some cognitive models. So, in these models, nothing with which the propositional attitudes on commonsense psychology can plausibly be identified, if these models turn out to be the best accounts of human belief and memory, we shall be confronting an ontologically radical theory change - the sort of theory change that will sustain the conclusion that propositional attitudes do not exist.

This provides an important support towards eliminativism. If connectionist conception of mind becomes correct, then the eliminativism of mind also be correct. In these connectionist models, nothing can be done with sentences, as Fodor and others claim:

2.3.1 The Poverty of Sentential Paradigm

It is the poverty of sentential epistemologies that made Churchland to follow on connectionist architecture. He points out that these failures of sentential epistemology can be overcome by the connectionist approach. In his view, this novel approach also provides positive accounts to the central notions of philosophy of science, such as simplicity, theory-ladenness of observation and paradigm. He says that the theoretical developments and experimental results within connectionist framework provided us a powerful and fertile framework with which to address problems of cognition.
Churchland identifies the failure of classical sentential paradigm mainly as the following types. They are:

1. The classical explanation of theories involve from the deduction of laws. Churchland argues that people cannot often articulate the laws on which their explanatory understanding is supposed to rest. So explanation does not seem to require sententially stated laws. Churchland have questions both on the need for laws and the appeal to logic as the way of relating laws to the explained phenomena in the deductive-nomological model of explanation. He says that people arrive at an understanding of phenomena for which, they seek an explanation in much less time than it would be likely to take them to perform a deduction.

2. The next objection to classical sentential framework is that it offers no account of learning to use the propositional system itself. Living subjects have to learn to make the complex perceptual discriminations that make perpetual judgements possible. This pre-supposes antecedent possession of a determinate propositional system and a capacity for determinate perpetual judgement. This is prior to extensive learning which the human infant’s lack. So, the classical sentential theory cannot possibly account for all cases of learning. There must exist a type of learning that is prior to the process of sentence manipulation. But, in non-human animals, the problem of learning and cognition has not got the benefit of language (either internal or external) but, all of them engage in
cognition. Their cognition proceeds entirely without benefit of any system for processing sentence-like representations.

3. A third problem with sentential learning is that it cannot account for the learning of skills which is as important as learning the facts of a discipline. From a connectionist point of view, skills are accounted in the same manner as all other learning through the adjustment of weights within the network.

4. A fourth objection is that the sentential model cannot explain how we retrieve relevant information in the process of reasoning about theories. From a connectionist perspective, all stored knowledge is stored in the weights through which processing will occur. This stored knowledge brought into play whenever relevant.

5. A fifth objection is that sentential perspectives cannot explain the progress of science.

While overcoming these failures, Churchland advances connectionism. Connectionism provides a radical advance in philosophy of science, i.e., by understanding theories in terms of weights in a network and explanations in terms of prototypical responses of a network. This network, he thinks, can overcome the failures of classical approach which took theories to be sets of propositions and explanations to involve derivations from theories or laws.
Besides, a connectionist approach, in Churchland’s terms, provides an account of simplicity as a cognitive virtue. He construes simplicity in terms of the number of hidden units in a network and points out that the ability of networks to generalise depends upon their utilising the minimum number of hidden units needed for a particular problem (An explanation of their will be added later). He argues that the preference for simplicity can be understood from a connectionist perspective as an important epistemic virtue. Churchland links the virtue of simplicity with the virtue of explanatory unity. He proposes that explanatory unity arises not from arranging theories in a deductive hierarchy but from finding one set of weights that enables a single network to solve a multitude of problems.

He also contends that connectionist framework can explain features of science, i.e., the theory-ladenness of observation and the role of paradigms in science. Since all processing in a network is determined by the weights, it follows that any processing of inputs by a network will be governed by its theory. The notion of paradigms was central to Kuhn’s account. For Kuhn, normal research is directed by the paradigm with the goal of filling in the general perspective on phenomena encoded in the paradigm. Kuhn’s notion is vague and this vagueness paves way for severe criticisms, according to Churchland. Here Churchland contends that connectionism provides a way both to make the notion more specific and to explain why paradigms often seem vague. To quote Churchland: “For a brain to command a paradigm is for it to have settled into a weight configuration that produces some well-structured similarity space whose central
hyper volume locates the prototypical application(s). And it is only to be expected that even the most reflective person will be incompletely articulate on what dimensions constitute this highly complex and abstract space and even less articulate on what metric distributes examples along each dimension. A complete answer to these questions would require a microscopic examination of the person’s brain”. According to Churchland, connectionism provides a radical advance in the philosophy of science. He claims that with this approach (connectionist), we can overcome the limitations of classical approach. Here, Churchland rejects the sentential or propositional attitudes as the most important form of representation (thus folk psychology) used by cognitive creatures. He emphasised on the necessity of empirical and theoretical research into brain function in order to answer the question of what are the most important forms of representation and computation within cognitive creatures.

2.3.2 The ‘Back-Propagation Algorithm’

In an artificial network, training proceeds by entering a sample input vector (lower-level) letting it propagate upward through the network, noting the vector this produces at the topmost (output) layer, calculating the difference between the actual and desired output and then feeding the error measure into a special rule called the generalised delta rule. This rule dictates a small adjustment in the antecedent configuration of all of the synaptic weights in the network. This procedure is the ‘Back-Propagation Algorithm’. Repeating the procedures many times forces the
network to slide down an error gradient in the possible synaptic weights. The adjustments continue until the network has finally assumed a configuration of weights that does yield the appropriate outputs for all of the inputs in the training set. Such a network is called recurrent as opposed to feed-forward networks.

Figure 314
This can be illustrated with the picture (see Figure 3). Let us take a network by which we want to discriminate sonar-echoes such as explosive mines and rocks. The discrimination poses two types of difficulties. First echoes from both objects sound indistinguishable to the normal human ear, and second, echoes from each type show wide variation in itself in sonic characters. This network begins with recording fifty different mine-echoes and rock-echoes. Then, digitalize the power profile of each echo with a frequency analyser and feed the resulting vector into the output units.

The network’s initial verdicts are confused and meaningless, since its synaptic weights were set at random values. Under the pressure of weight-nudging algorithm, it gradually learns to make the designed distinction among the initial examples. Its output behaviour progressively approximates to the correct output vectors. After it has mastered the echoes in the training set, it will generalise, that is, it will reliably identify mine and rock echoes from outside its training set. Mine-echoes are united by some features. So, also the rock-echoes.
Figure 4\textsuperscript{15} Learned partition on hidden-unit activation vector-space

Thus, the system learns to discriminate the hard-to-define perceptual features and be sensitive to similarities of a comparably diffuse but highly relevant character. Once the network is trained up, the recognition task takes only a split of a second because the system processes the input stimulus in parallel. Finally, it gives us a discriminatory system that performs like a living creature, in speed and overall character.
2.3.3 Neural Networks – In Contrast with the Classical

The contrast between the neural networks with the classical AI approach is brought out as follows:

1. Classical AI's approach is symbolic serial processing like programmable computers but the neural networks are never governed by any rules, i.e., they do not achieve their result by following any rules.

2. The speed of neural network processing is very high than the classical AI processing. It is because, in neural networks, processing is done through Parallel Distributed Processing and not serial.

3. There is also a contrast between neural network and classical AI processing in the manner of information storage, i.e., in neural networks, acquired knowledge is stored in a distributed fashion. The very high-dimensional representations employed by neural nets namely, activation vectors across large cell populations, can be exquisitely sensitive to subtle similarities among their perpetual inputs.

4. Neural nets can learn a designed function and generate a categorical system adequate to compute it. All it needs are sufficient examples of the relevant function.

The connectionist model is against the classical sentential representation, which is the basis of propositional attitudes. Being an eliminativist, he is strictly against any kind of
supra-physical status of mind. This approach of connectionism is really against the folk psychological conception of mind. It is said that, if connectionism turns to be right, then eliminativism (about folk psychology) also be correct. So this may be the strongest reason. But there are philosophers like Andy Clark\textsuperscript{16}, who defend folk psychology from a connectionist point of view, there is also other reasons such as connectionism unites the Feyerabendian kind of science. Churchland makes use of Feyerabend’s thesis in many places. To quote Churchland, “A connectionist model of cognitive activity successfully reduces to a Feyerabendian philosophy of science”\textsuperscript{17} (An elaborate discussion about this is included in the next Chapter). Moreover, this can also be considered as his interest for making ‘mental’ completely a matter of science (physical and natural). The objections are raised about this which will be discussed later.

2.4 Neural Network Connectionism as Eliminative Materialism

“If connectionist hypotheses of the sort we shall sketch turn out to be right so too will eliminativism about propositional attitudes”.\textsuperscript{18}

The above sentence itself reveals the mutual dependence of these two theses. The three main pillars of eliminative materialism are stated as follows:

1. Mental functions are nothing but the neuro-logical functions of the brain. Mental can be reduced to neuro-logical (physical). Hence, mind does not exist at all and hence, mind is eliminated.
2. Folk psychology, i.e., our everyday non-scientific way of talking about ourselves and our mental lives in terms of beliefs, desires, hopes, etc., is wrong because there is nothing in neurology to correspond with the basic factors of folk psychology (belief, desire, etc.). So, folk psychology does not exist.

3. The basic unit of animal and human understanding is the activation of neurones in the brain.

Many others such as Joseph Garon, William Ramsey and Stephen Stich endorse the above and exercise the eliminativist option in their writings. They also give importance to scientific revolutions, taking seriously connectionist architecture (if it is right) as revolutionary.

2.5 Eliminativism and Folk Psychology

There is a natural transition to folk psychology on Carruthers’s understanding. Accordingly, it is defined to be a network, which includes a wider canvas of beliefs about the mind. Folk psychology is our everyday conceptual scheme for accounting for our own and others actions in terms of beliefs, desire, emotions (propositional attitudes) etc. It denotes the pre-scientific commonsense framework that we all normally socialised human being deploy in order to comprehend, explain, predict and manipulate the behaviour of our ‘own and others’. According to this theory, human beings are conscious rational agents. We live in a physical and social world of experiences and as a result, we have hopes, fears, expectations, etc. Our actions reflect our mental facts.
Being a reflective creature human beings continually engage in cognitive practices, i.e., they attempt to understand, explain and predict the psychological states of their own and others by making use of ordinary psychological notions.

During 1950s and 1980s, the interest on intentional psychology was less. The main debate of the time was about mind-brain identity theory. Philosophers were mostly concerned with the question of whether the qualitative aspects of sensations could be reduced into brain states. It was the reductionistic approach. But the revolution within cognitive psychology has continued to grow into the multi-disciplinary ‘research cluster’ that is called cognitive science which took seriously the intentional phenomena. A key factor played here is taking minds as information processing systems. A powerful tool for this development was the study of artificial intelligence in computers by providing a theoretical model of human cognition in terms of internally processed programs. With this development, contemporary philosophy of mind has shifted from sensational phenomena (e.g., Pain and sense data) to intentional psychological phenomena (beliefs and desires). Mind-brain identity theorists’ main contention was that folk psychological references to intentional psychological states are not causal explanatory. But Davidson’s\(^\text{20}\) papers on the explanation of causal action opened a new vistas in studying the folk psychological accounts of propositional attitudes as causal explanatory.
2.6 Propositional Attitude Psychology

Folk psychology is about propositional attitudes. More clearly, it is about the syntax and semantics of propositional attitudes. Propositional attitudes are those notions concerned with our conception of mentality terms such as desires, beliefs, intention, etc. Propositional attitudes are a species of causal explanations which plays a legitimate role in scientific psychology. In Jerry Fodor's book on the Language-of-Thought, we can see the development of a new wave psychology at work by taking propositional attitudes as semantically evaluable and casually efficacious. Fodor advocated the view that cognitive science is and ought to be committed to intentional realism. Hence, propositional attitudes are contentful. He held that information processing essentially involved the rule-governed computations performed upon mental representations. In short, mental states are computational as well as representational states. So, the received view of propositional attitude psychology attempts to meet the following demands:

1. To allow propositional attitude psychology to be integrated within theoretical cognitive psychology.

2. To throw light on the semantics of propositional attitude ascriptions.

3. To do reasonable justice to the way, we actually use propositional attitude psychology in day-to-day life.
Lycan\textsuperscript{22} argued that, we can satisfy all these three demands by seeing propositional attitudes as a relation between an agent and a sentence taken of the agent's language-of-thought. The most important assumption here is that our brain is a code language. Mind is a sentence-crunching machine. This is what is entailed by language-of-thought hypothesis. Such a hypothesis is supposed to integrate propositional attitude psychology with cognitive psychology. Fodor was of the opinion that propositional attitude ascriptions have striking semantical features. His language-of-thought hypothesis is that, \textit{‘mind is a sentence-crunching machine and cognition involves a mental code’}.\textsuperscript{23} According to him, the best way to naturalise the mind is through naturalising propositional attitudes. Cognitive scientists are really the semanticists of propositional attitude psychology. Propositional attitude is either monadic and expressible in mentalese or dyadic in which it express about a relation between the agent and his belief. The following views are apparent about propositional attitudes:

1. Propositional attitude sentences can be naturalised (philosophical naturalism).

2. Propositional attitude sentences cannot be naturalised with the science of psychology (psychological naturalism).

3. Propositional attitude sentences cannot be naturalised by neuro-science (psychological naturalism).

4. Propositional attitude sentences can be partially naturalised, but not by science (instrumental naturalism).
Of these views, the second and third are said to be anti-realist and considered to be eliminativists. The second one eliminates propositional attitude psychology by means of epistemological grounds, while the third one eliminates propositional attitudes by developing a neuro-computational perspective. From this point of view, there develops an eliminativism of folk psychology and thereof, propositional attitudes.

Eliminativists are those who think that 'mental' can be eliminated in favour of 'physical' or 'neuro-biological'. To them, mind is brain and so there is no need of thinking about a non-existing subject as mind. The eliminativists are very well-advanced scientists and they think about propositional attitudes – the basic postulates of folk psychology – as just like phlogiston which does not exist. So in their view, folk psychology hopelessly failed in explaining the phenomena what it is concerned with and it is a serious fall. This fall is beyond repair and needs to be replaced by a different theory. Hence, eliminativism. Now, we have two types of eliminativisms. The first is due to P. M. Churchland and the second is due to S. Stich. Churchland's eliminativism is termed as 'Elimination Now' while those of Stich's is termed as 'Elimination in Prospect' (due to P. Caruthers). Churchland argues that matured sciences is in a secure condition to eliminate folk psychology while Stich argues that future researches will reveal some aids to eliminate folk psychology. But meanwhile, he changed tacks in his second book by taking eliminativism as a species of 'deconstructionism'. In his later book, he offers a critique of his earlier position. While Churchland takes the route of inter-theoretic reduction (via a reduction
of cognitive science to a species of philosophy of science), Stich takes it via the notion of reference that philosophy of language pursues and that needs to be deconstructed.

2.7 **Paul M. Churchland's 'Eliminativism Now'**

Churchland's eliminative materialism is the thesis that our commonsense conception of psychological phenomena (folk psychology) constitutes a radically false theory. That theory is so fundamentally mistaken that both the principles and the ontology of the theory will be displaced (rather than smoothly reduced) by completed neuro-science. Churchland's opposition against folk psychology has the following three criticisms:

1. Folk psychology fails to explain a considerable variety of central psychology phenomena.

2. Folk psychology is a stagnant research programme, i.e., without any prospect of progress.

3. A smooth inter-theoretic reduction of folk psychology to completed neuro-science is impossible.

Now, we shall discuss the points one-by-one.

2.7.1 **Explanatory Impotency of Folk Psychology**

Churchland argued that folk psychology fails to explain in detail many of the psychological phenomena, e.g., mental illness, creativity, intelligence difference, etc.
According to Churchland, a true theory should not have such shortcomings. It is said that central and important mental phenomena remain largely or wholly mysterious within the framework of folk psychology. According to Kim Sterenly, the three main elements in Churchland's eliminative materialism are: first, intentional psychology fits badly to our picture of mind, because it fails to guide research. Second, Churchland's ontological conclusion that there probably are no beliefs and desires is followed by his semantical views. The meaning of a term derives from its theoretical role, e.g., the term 'gene' derives its meaning from a bundle of laws about reproduction and inheritance of traits across generations. And the third holds that there are important alternatives to the view that mind is a sentential machine, accounts of cognition and representation much more closely tied to neuro-sciences. For these reasons, Churchland thinks that intentional psychology is deeply-flawed and it is a degenerating research programme because it fails to provide insights into a range of central feature of human psychology, e.g., sleep, mental illness, visual perception, sensory motor co-ordination, etc.

Paul Churchland shares the opinion with Patricia Churchland that cognitive psychology is an inadequate theory of mind because its reliance on a sentential model of mental representation. They disagree on a language-of-thought hypothesis central to propositional attitude psychology. Folk theory is true only if there is a language-of-thought, there is no language-of-thought in folk psychology, and so, it is false.
2.7.2 Stagnation of Folk Psychology

Churchland wryly comments: “The folk psychology of Greeks essentially is the folk psychology we use today, and we are negligibly better at explaining human behaviour in its forms than was Sophocles”. Churchland thinks that since there is a very long period of stagnation and infertility, the integration of its basic categories must be questioned. Churchland calls attention to the greatest theoretical synthesis that provides descriptions and explanations of human sensory input, neural activity, motor control, etc. But folk psychology never took part in this greatest theoretical synthesis. He admits that “Its intentional categories stand magnificently alone, without the visible prospect of reduction to that larger corpus (neuro-physiology)”. Quoting from Imre Lakatos, he remarks that, “Folk psychology is a stagnant or degenerating research programme and has been for millennia”.

2.7.3 Impossibility of a Smooth Inter-theoretic Reduction

Like identity theorists, Churchland also believes in the reduction of the mental to the physical (brain). But in case of folk psychology, eliminativists doubt that a nice one-to-one match ups between the concept of folk psychology and theoretical neuro-science will occur. This doubt arises due to the fact that the basic categories of folk psychology (propositional attitudes such as beliefs, desires, etc.), will not be mirrored in the basic concepts of theoretical neuro-physiology. Churchland says that our commonsense psychological framework is a false and radically misleading
conception of the causes of human behaviour and the nature of cognitive activity. He continues to hold that folk psychology is not only an incomplete representation of our inner nature but also is an outright misrepresentation of our internal states and activities. From this, Churchland concludes that we can judge folk psychology to be an inadequate theory which is ripe for elimination and replacement by theoretic neuro-sciences, i.e., folk psychology stands in splendid isolation and perpetual stagnation without any prospect for reduction, it is better to be eliminated. Churchland's attack on folk psychology exploits an important feature of the proto-theory, namely that it is linguistic. Curiously enough, the influence of eliminativist motif occurs in philosophy of language also as seen in the way it can broadly be divided into folk philosophy of language and revisionary philosophy of language. The first one exposes the method of understanding interpretation and communication while the second have explanatory ambitions. Within Churchland's theorizing, a more pronounced revisionary motive is evidenced and this is directed against the sentential structure of classical cognitivism represented by Fodor and others.

Churchland counters: "... even if our current conception of rationality ... is logically constituted within the sentential/propositional framework of folk psychology, there is no guarantee that this framework is adequate to the deeper and more accurate account of cognitive virtue which is clearly needed".26 'Language is only one skill' and 'it is extremely peripheral activity or an idiosyncratic mode of social interaction'. We have to transcend the poverty of folk psychology, i.e., we must replace the propositional
kinematics by a general kinematics of cognitive activity. The second will accommodate
the first. Incidentally, it may also be noted that similar arguments are available against
theory-theory. As if to ensure, the revisionary motive is primarily meant to break the
spell of the language-oriented approaches. Churchland reinforces the above by
presenting the following three scenarios. The first two counter Chomsky’s assumptions
about innate structure called theory-theory and the third is a thought-experiment.

**Scenario 1:** Our brain indeed contain innate structure, but those structures have their
primary function in perceptual organizations.

What follows from this is that the language is just an additional function and it is mostly
an incidental task.

**Scenario 2:** Therefore, the underlying structures of our cognitive activities outstrip that
of our natural capacities.

Churchland’s earlier stand was to argue that cognitive science provides an alternative
system – i.e., language-like system, but it is to be called ‘Ubersetzonal’ (surveyable)
attitudes, which contain no truth or entailment relations. Now, he is ready to give up
this former stand. With this denial, along with affirmation of truth and entailment, there
is little doubt that he will favour a view, according to which, compositional states are
language-like syntactical states (quasi-sentential). These quasi-sentential states are
gradually forced on him. He is, therefore, inclined to admit the plurality of folk
psychology.
Scenario 3: If our intra-brain communication between two hemispheres takes place, why not inter-brain communication between different cognitive systems takes place naturally? Churchland may intercept to ask, "In what way therefore, language would be a stumbling block to this?"

As an eliminativist per se, Churchland's main hunch may be understood as one about the non-identity (it is a judgement on the identity form of the judgement) as demonstrated by the following mode of presentation.

1. The properties of my brain states are known by the various external senses as having such and such properties.

2. The qualities of my sensations are not known by the various external senses as having such and such properties.

3. Therefore, the qualia of my sensation are not crucial to the properties of my brain states.

In response to Putnam's critique of elimination, Churchland is ready to modify his anti-realism and present it in the form of pragmatic realism. Thus, his earlier argument (anti-realist), reads as follows:

Propositional attitude is not scientific.

Therefore, propositional attitude is a myth.

This is to be replaced as:
1. Propositional attitudes misrepresent reality because of its propositional modularity.

2. A current way of representing reality is by means of the connectionist modularity.

3. It follows that propositional attitudes must be succeeded by a new theory.

4. (2) is a better theory.

Again, foisting the problem of misrepresentation on language, and attributing it to the way language is used, he prefers to assert that:

5. Misrepresentation is due to propositional modularity.

6. (5) should be replaced by a quasi-sentential mechanism.

Churchland cannot totally give up the role of language. Characteristically, he is willing to concede a State-Space Semantics – i.e., a semantics with the activation vectors occupying a state-space – to his perspective from a neuro-computational point of view. Elimination is agreeable if only to admit of misrepresentation. But, Churchland’s main problem is about the non-identity, i.e., it criticises identity. On either of the above grounds, his point is linguistic. Churchland shares a similar misgiving like Stich given as follows:

1. If folk psychology is not a theory then, it cannot be falsified.
2. But, it is false.

3. Therefore, folk psychology is a theory, though an unsuccessful one.

After all, folk psychology can be falsified. The upshot is to prove that eliminativists is not to be regarded as eliminating so long as they are indulged in revisionary motives, accepting the impossibility of one-to-one translation from one state (mental) to another state (brain).

2.8 Stich’s ‘Eliminativism in Prospect’

Stich’s exercises the eliminativist option from an epistemological angle. What Peter Carruthers termed as ‘Eliminativism in Prospect’ holds that we have to wait and see the developments of future scientific field to eliminate folk psychology. Stich’s view is that it is likely that once we learn about the real underlying process of cognition, then folk psychological categories, particularly belief, cannot be empirically defended. Stich was tempted by the following argument which was from Quine’s stated as, “Since cognitive science does not invoke the language or concepts of folk psychology, the states of folk psychology are not among the entities over which it quantifies. So these putative steps do not exist”.  

Stich mentions that there are at least two families of arguments in favour of the claim that beliefs and desires do not exist. The first argument focuses on the structure of the cognitive processes and mechanisms portrayed by folk psychology. The major argument here is put forward by Ramsey, Stich and Garon in what is called a ‘Stichian
forecast of the doom of folk psychology', which occurs in the context of their discussion on connectionism.

The first step stipulates that connectionist networks do not contain anything corresponding to beliefs, because beliefs are functionally discrete, whereas the information contained in a connectionist network is holistically distributed throughout the network. So, if our brains are connectionist networks, they do not contain any beliefs. They also argue that:

1. Folk psychology is committed to the claim that propositional attitudes like belief and desires are functionally discrete, semantically interpretable states that play a causal role in the production of other propositional attitudes (This is what Stich calls at the propositional modularity).

2. There are no such states in connectionist modelling of our cognitive system.

3. Connectionist models are correct in their modelling.

4. The propositional attitudes posited by folk psychology do not exist.

5. Folks are not theoretically committed to any common mechanism that underlies grasp and exercise of the concept.

6. Propositional attitudes are no threat to folk psychology.
Stich closes this review by saying that whether connectionist models poses a threat to folk psychology or not is an empirical matter to decide and it is not to be decided in an a priori way.

While citing psychological evidences against the rejection of folk psychology, Stich presents a less complicated argument. It works against the elimination in the following way. Eliminativists claim that there are no such things as beliefs and desires because folk psychology posits them in a radically false theory. According to Gordon and Goodman, the theory which posits a tacitly known folk psychology is radically false. This is called a theory-theory. Since theory-theory is false, there is no folk psychology. If folk psychology makes no claims, it makes no false claims. Hence, the critique against folk psychology will turn out to be false. On Stich’s view, eliminativists can target a theory only if either of it is an internally posited system consisting of rules or it is just like a connectionist model which does not map propositions on one another. Otherwise, eliminativism can become compatible with an externalist (as opposed to the internalist which posits a cognitive mechanism, an externalist locates it in the external environment), account of epistemology and a connectionist account of neural system, which maps propositions with one another. Given the psychological evidence that goes against any wholesale rejection of folk psychology, folk psychology cannot be totally rejected. If eliminativism makes a stronger claim as given below:
1. Commonsense psychology makes any false claims about beliefs and desires.

2. There are no such things as beliefs and desires (ontological thesis).

3. Therefore, true believers do not exist.

The only way one can pass from (1) to (2) is to trivialize as in (3). This is clearly a false theory, as it cannot be agreed upon. Let us see what Stich has to say on the semantics of propositional attitudes. On Stich's reading, some of these arguments are 'firmly fussy' and 'technical'. They exploit at least three key notions namely supervenience, individuation and holism. The fussiness is due to the fact that philosophers have no theory of content. This is sufficient to doom the first family of projects. It is expressed as follows:

A. A theory of mental representation is supposed to describe the concept of knowledge structure underlying our ordinary judgements about the content of one's beliefs, desires and other intentional states. It is enigmatic to know that if this is the theory that philosophers want, then what will be the role of philosophy. Stich's comment is a dismissal, 'we should give up philosophy in favour of philosophy'.

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On the other hand, Stich is more interested in the second family of projects which is as follows:

B. A theory of mental representation does not much care about the commonsense conception of mental representation, because of the ontological distance.

This entails that the intuitions and tacit knowledge of the man in the street are quite irrelevant. Another important feature Stich mentions is that the real opposition between folk psychology and cognitive science is brought out by saying that while folk psychology is anti-individualistic (beliefs and desires cannot be specified in a way that is independent of the environment) cognitive science is individualistic (it has to describe mind per se). According to Stich’s interpretation, this follows the heels of anti-individualism advocated by Putnam, Burge, etc. Further, accepting the plurality of theories, Stich wants to demonstrate that folk psychology may either trivially be true upon one theory of reference (naive description theory of reference), or it is trivially false, on another sophisticated (causal-historical) theory of reference. From this, Stich concludes that folk psychology is neither true nor false. Such is his anti-realist stance.

Stich winds up his problem by saying that the whole problem is one about inter-theoretic relation where he almost comes to terms with Churchland.

But in his later work, he reflects “My entire conception of the eliminativists debate was radically mistaken”. Here, he wants to deconstruct the assumptions the eliminativists argument. In his words, what eliminativism really pursues is a
deconstructionist programme. Following his own self-criticism, he begins to equivocate eliminationism with deconstructionism after due examination of the entire structuration of eliminativist argument.

**Premise I:** Mental states like beliefs, desires, etc., are theoretical terms.

**Premise II:** Folk psychology is a seriously mistaken theory.

These two premises are defended by all eliminativists. But from these two premises, two conclusions can be drawn as:

**Conclusion I:** Beliefs, desires and other postulates of folk psychology do not exist.

**Conclusion II:** Folk psychological postulates will not be part of the ontology of any natural science.

Here, Stich criticises this by saying that neither of these conclusions can be followed without adding certain additional premises. Here, what the missing premise is a theory of reference of theoretical terms, which warrants a deconstructive conclusion. When a problem about a correct theory of reference arises, there will have two solutions. One is a proto-science account and the other is a folk semantic account. In the first account, the theory of reference is attempting to characterise a word–world mapping that will be useful in one or other empirical disciplines such as linguistics, cognitive psychology or the history of science. In the second account, the theory of reference is attempting to
capture the details of a commonsense theory about the link between words and the world. Philosophers generally favour the second account. Stich was also among them, but it was Searle who convinced him about his argument, which was a false one. Searle argued that Stich’s argument is very general and there is nothing important or interesting about it. Here, after many years, Stich himself agrees the same with saying that the appeal to reference and the strategy of semantic ascent are non-starters when it comes to settling ontological questions like those raised by eliminativists.

In explaining the view that the goal of the theory of reference is to correctly describe our tacit folk semantics is to use an analogy. The analogy here is between theories of reference and theories of folk physics and to grammatical theories. If the job of a theory of reference is to describe and internalised folk semantics, then the theorists may misdescribe the folk semantic theory inside people’s heads. Folk semantics is a collection of commonsense beliefs about reference. If folk semantics is like folk physics, then if we want to learn about reference, then we should study the science that tells us about reference. What this shows is that the analogy between folk semantics and folk physics is indefensible and the analogy with grammar is only tenable one.

In the case of Stich, the enquiry for the missing premise in the eliminativist argument still continues that needs to be deconstructed. His special attention is on the question, ‘How are we to go about deciding whether or not the entities posited by any false theory exist?’ The answer is that they socially determinate. Anti-realistic turn is channelled into realism. We tend to think that he is not an eliminativist at all or his
programme is not eliminativistic one. This reinforces the interesting conclusion McCauley has reached. McCauley's findings have clear implication in Churchland's case because both commonsense psychology and cognitive psychology operate at different levels of analysis from neuro-science. Thus even if commonsense psychology and neuro-science are incommensurable, it would be incorrect to conclude that such incommensurability requires the elimination of one or the other. From this, it is clear that Stich does not agree to elimination. To him, incommensurability is admissible, but elimination is not. So we shall conclude that Stich is not an eliminativist. The question, 'Do eliminativists really eliminate?', evokes a negative answer in both of the above projects. "Eliminative materialism is the thesis that our commonsense conception of psychological phenomena constitutes a radically false theory, a theory so fundamentally defective that both the principles and the ontology of that theory will eventually be displaced rather than smoothly reduced, by completed neuro-science".35

When we take inter-theoretic reduction into account (a detailed account is given in third Chapter), we can see that there are possibilities of theory elimination and theory proliferation. Theory elimination is one of identity, and if there is no identity there can be proliferations, e.g., when theory T is reduced to theory T₂, there is elimination only when T, is identical to T₂. But when multiple realizability raises problem for identity theory, this would not occur (Please remember the example of identity of pain and C-fibre firing). Thus, here neither identity nor elimination is not occurring between folk psychology and correspond with belief or such postulates of folk psychology.
So Churchland is fated to proliferate theories. We conclude that eliminativists do not really eliminate. Even though, Churchland appears to refute Quine’s indeterminacy of translation, he accepts incommensurability which is yet another form of indeterminacy.

Within connectionist group itself, we can see that philosophers like Andy Clark and Terence Horgan try to defend folk psychology from a connectionist point of view. In Peter Caruthers and in Kim Sterenly, we can see the defence of folk psychology not from its side but from a compatibilist position. When they argued for a combination or compatible position of neuro-scientific connectionism and classical cognitive science, this would defend folk psychology. It is because Fodor’s Classical Representational Theory based on the thesis that cognitive activity consisting in the manipulational of propositional attitudes. So a compatibilist position would do a good job. It is also important to cite that Churchland later became less stronger on the eliminativist position. He says that, “Eliminative materialism does not imply the end of our normative concerns, it implies only that they will have to be reconstituted at a more revealing level of understanding, the level that a matured neuro-science will provide”. Here his urge is to reconstitute to higher level and not to eliminate.
They wanted to change the name of their theory ‘eliminative materialism’ to some other names such as ‘good guy materialism’ or ‘revisionary materialism’. Finally, we can say that eliminativists do not eliminate and they are not eliminativists at all. For the same reason, they wanted to change their name to ‘revisionary materialism’ and it will be more suitable than the ‘eliminative materialism’. What they are doing is not elimination, but revision of folk psychology.
REFERENCES


5. Figure has been taken from A. Kanthamani’s Ludhiana Paper on *What Cognitive Science Says on Mind*?.


