Embodied Theory of Meaning: A Critique of Representationalism

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CERTIFICATE

This is to certify that the dissertation entitled **"Embodied Theory of Meaning: A Critique of Representationalism"** submitted by **Himanshu Jaysawal**, in partial fulfillment of the requirements for the degree of**Master of Philosophy** of Jawaharlal Nehru University, New Delhi – 110067, is his original work. It has not been submitted, in part or in full, for any other degree or diploma of this or any other University, to the best of our knowledge and belief.

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Contents

Introduction

One of the puzzling problems in philosophy of cognitive science is how meanings of linguistic expressions come about. The problem is traditionally dealt using representational approach. The representational approach faces what is known as the symbol grounding problem. A new approach taking support from advances in embodied cognitive science deals this problem. According to this approach, meaning comes through mental simulation of content of the linguistic expressions in the brain. The approach is often termed as embodied theory of meaning or embodied theory of language comprehension. The dissertation attempts to analyse this approach. The dissertation aims to see whether embodied approach can explain linguistic meaning.

The Problem of Meaning-Making

Words and sentences refer to objects or events in the world. More directly linguistics expressions have meanings. An important question is how do these expressions get the meaning that they have. There are two aspects of any linguistic expressions – formal aspect and semantic aspect. Linguists and psychologists easily deal with the formal aspect of the linguistic expressions such as, syntax and grammar. Semantic aspect is what can be said to be an expression's feature of referring. This is also called meaning.[1] Meaning is not something that is there in the expressions themselves; but it is what we do in our mind. For example, the word 'cat' refers to the 'animal cat' in the world. The question is what it is in the word itself that makes it refer to a particular object in the world. Certainly, it cannot be form of the word alone that makes meaning of the word. There must be something more other than just the form.

There are different approaches to deal with this question. Philosophers, linguists, and psychologists all deal with this question differently. However, in cognitive science one particular approach is quite popular. This is often known as traditional approach or representation-based approach or translation approach of language.

[1] Evans Vyvyan and Melanie Green, *Cognitive Linguistics: An Introduction* p. 6.

Traditional Approach of Meaning Making in Cognitive Science

Although this approach has no specific name, this is known as the traditional approach or translation approach of meaning. As meaning making is an act that we do in our mind, it becomes important to relate the word's meaning to the language processing in the mind. This approach does the same thing. It attempts to explain how language processing happens in the mind. In this dissertation, we discuss this approach as the representational approach of meaning. If one must know how language is processed in the mind, one has to first know the nature of the mind.

Representationalism is one of the most influential theory in cognitive science about the nature of mind.[2] According to this approach, all mental activities could be explained as computations over mental representations. This theory regards mind as having its own system. This system is language-like. Language is a system because it functions according to certain rules. The mental system known as *mentalese* or language of thought contains symbols just as language consists of symbols. This system has combinatorial syntax and compositional semantics. As we said as representational theory regards mind as a computational system, it is possible that all its mental activities could be explained like the activities of a computer are explained. The computer performs different kinds of activities like computation, multiplication, etc. These activities are explained in terms of computation over symbols. Likewise, the mental activities could be explained in terms of computation over symbols. There can be questions like how computations can happen in the mind. The language of thought hypothesis answers by positing that the mentalese symbols are run by the combinatorial syntax of the language of thought.

This is the general explication of representational theory of mind. However, we are interested in knowing the simple mechanism of cognitive activities. When we hear something or see something, we use our sense organs. According to representationalism, the information coming from these sources is converted into mentalese symbols; and the internal processing in the mind is guided by the mentalese system over these symbols producing certain result. The result is then decoded back

[2] Thaggard Paul, *Mind: Introduction to Cognitive Science*, p. 11.

by the mind so that body could take appropriate actions. In this way, cognition happens in the mind in terms of computations over these symbols.

Language processing and other cognitive activities are taken to happen this way. As we said that for knowing the meaning of any word, we have to know how it is understood by the mind. We get the meaning of words and sentences because of computational processes over symbols in the mind. Thus, knowing meaning of words or sentences is to translate them into mentalese symbols and then processing over these symbols lead to their meaning. However, the words and sentences stand for objects and events in the world. How could representational theory explain this? It was already said that apart from combinatorial syntax the language of thought also contains compositional semantics. The mentalese symbols stand for objects and events in the world because they have semantic features. This is like binary symbols in computers standing for objects in the world. For example: in computer language 01101 and 01101 might stand for cat and dogs. Thus, traditional view of meaning in cognitive science is that meaning comes through symbol manipulation in mentalese. Consider a sentence 'ELVIS IS DEAD'. According to representational theory, this sentence is understood because computational procedure operates on mentalese symbols possibly TH#$, I9, and ER4S (just as an example, as one doesn't know what mentalese symbols are like). They stand for what the sentence refers to because it could be that they are defined in the said way.

In cognitive science, many theoretical models of meaning mimic the principle of this traditional theory. For example, HAL and LSA are models of meaning. These models posit that knowledge in human mind can be represented in propositional form.[3] Based on such assumptions, such models are created. It is regarded that a word's meaning can be determined through computational mechanism. These models contain thousands of words in matrices. To determine a particular word's meaning, the word may be correlated with other words. Each word is assigned a value. The word that has approximate value is determined to be meaning of the word. The same mechanism is followed with respect to sentence meaning. Thus, meaning in such models is analysed through semantic relatedness.

[3] Gibbs Raymond, "Embodied Experience and Linguistic Meaning", p.2.

Apart from this, the traditional theory has been confirmed in other disciplines also. For example, in AI Roger Schank has developed causal dependency theory of language understanding, in linguistics Jackendoff has done through conceptual semantics, and in philosophy Katz and Fodor's semantic theory is based on the traditional theory assumption.[4]

Difficulties in Representational Theory of Meaning

Thus, according to the representational theory, meaning comes from computation over symbols in the mind. However, there seems something missing in this idea. How could symbols through mere computation lead to language processing and other cognitive processing given that symbols become detached from the world knowledge.[5] This idea is suggested by Steven Harnad's famous symbol grounding problem. According to Harnad, representationalism is a defective theory about mind. Because what it regards are constitutive of mental activities (thought and beliefs) i.e. symbols, that are ungrounded, and computation over ungrounded symbols does not lead to meaning or thinking. For him, the symbols within the representational mind or in any computational system are like symbols in any book. Symbols or words in the book do not mean anything by themselves. In any book the meaning is not intrinsic to the text. It is the reader who decipher the meaning of texts in the book. Unless the reader grounds the words of the book to his experiences (in some form), he doesn't understand the ideas present in the book. If meaning was intrinsic to the texts in the book, then by mere looking at the shape of the words (the way the words and sentences are structured, their forms), it would be possible for the reader to understand. But this is hardly the case. Suppose an English reader tries to understand a book written in Chinese, being unaware of the Chinese language. Will he be able to understand the book by mere looking at the Chinese words?

But in the representational mind and in the computational system, it is supposed that meaning is intrinsic to the symbols or symbol system, because it is a basic feature of mentalese symbols to stand for object and events of the world, as the mentalese has compositional semantics. In computers also,

[4] Wang H. & Pan Y., "A Brief Review of Embodied Language Comprehension", p. 46.
[5] It is a fundamental doctrine of representationalism that all information coming from body's perceptual system is transduced into mentalese symbols.

the symbols are defined to stand for objects. It appears that such a criterion is arbitrary. Because words are affixed with specific objects or events arbitrarily and not because of any necessary relation between them. Some thought experiments are prominent which refutes rule-based manipulation of symbols as model of meaning. e.g. Searle's Chinese Room Argument, Harnad's Chinese dictionary thought experiments, and so on. Central to them is that 'Syntax is not sufficient for Semantics'.

Another shortcoming of the representational theory of meaning is its account that spoken words and sentences are translated to mentalese symbols. First, there is no scientific evidence of the translation process.[6] Second, such an account makes mentalese symbols amodal and arbitrarily related to their referent. Amodal symbols are opposite to modal symbols. Modal symbols[7] retain the perceptual and motor content which they get at the time of experience by the agent. However, due to transduction, mentalese symbols lose these contents. Hence, they bear no connections with the external world and hence what is claimed as semantic feature of the symbols i.e. standing for external objects, seems nothing but an arbitrary relationship. Consider the mentalese concept of 'chair'. This concept will no longer be like concept of a real chair, that is, having a specific colour or retaining experience of sitting on it, etc. It will represent a chair that has four legs, a back and a seat etc. However, even this will be determined by its relations with other words which themselves are amodal. Thus, the traditional model of representational model of meaning suffers from the symbol grounding problem. Mere computation over symbols does not lead to linguistic meaning.

Embodied Cognition and Meaning

As the traditional theory suffers from symbol grounding problem, the reason linguistic meaning does not come from symbol manipulation is because symbols are amodal and arbitrarily related to their referents. Why is this so? And what could be a solution to this? The reason is the representational approach. It defines mental activities in terms of symbol manipulations. In doing so it ignores that the physical system in which symbol manipulation happens, has any role on mental activities. For representationalism, cognition is an abstract process. It can be characterized in any

[6] This problem has been highlighted by Lawrence Barsalou in his paper, "Perceptual Symbol System", p. 578.
[7] Also known as perceptual symbols. These symbols constitute perceptual symbols system which is different from amodal symbols system. Barsalou calls representational theory as theory of amodal symbol system.

medium.[8] Computers perform intelligent activities assisted by rules and symbols, from this reasoning it is held that humans also implement cognitive activities in a similar way. It is the fundamental argument of representationalism. The bodily system of perception and action acts merely as transducer of information and do not play any causal role in the internal processing of cognition.

However, the abstract model of cognition has been strongly criticized. One such trend is seen in the development of embodied cognition. Embodied cognition came about in the decades of 70s that attacks the above dominant theory of cognition. It sees human cognitive processes as not detached from human body and its interaction with the environment. Rather both the human body and its interaction with its external environment shape the cognitive processes. The content of cognition is affected by bodily system and its interactions with the outside environment. Our internal thoughts are affected by the nature of our body and its interaction with the nature. For example: our concept of 'up', 'down', 'right', 'left' is dependent on the nature of our bodies and its allowed movements. Had our bodies been different many of these concepts would be absent or differently understood.

The roots of embodied cognition were found in the writings of continental philosophers like Heidegger, Sartre, Merleau Ponty, etc. The most radical view was introduced by Varela, Thompson and Rosch in their work *The Embodied Mind*. In this book, they highlighted the ignorance of human body in theories of cognition. Varela et al. emphasized that the domain of human cognition is not separate from that of the human body. In fact, the mind is embodied; the body shapes the cognition; and the mental concepts are dependent upon body's interaction with the environment.[9] Another two philosophers and cognitive scientists responsible for embodied trend in cognitive science were George Lakoff and Mark Johnson. In their book *Metaphors We Live By*, they posited that our

[8] It is not that physical medium is not important. Computation needs hardware. In the same way, cognition in humans happens in the human body. But the important point is that it is not thought that the physical systems can have causal role or influential role in the cognitive functioning. Supporting that human cognition is also an abstract process implies that human body and the brain system act merely as hardware or they act as information receiver. It is as if the software for human cognition is already designed and functions on a certain programs. The system of perception and action i.e. sensory organs and motor organs cannot cause any effect to the internal processing of the mind.

[9] Wilson A. Robert & Lucia Foglia, "Some Historical Anchors for Embodied Cognition" in *Embodied Cognition*, <https://plato.stanford.edu/entries/embodied-cognition/> accessed on 15 November 2020.

conceptual system is shaped by metaphors and metaphors are body based (dependent on the way the body experiences the world). Thus, our thoughts are shaped by our bodily experiences.[10]

Other disciplines also criticised the centralist nature of theories of cognition. In artificial intelligence, an effort was made to build systems that operates on real world interactions than on pre-defined programmes.[11] In psychology, J. J. Gibson[12] criticized the representationalism model of cognition. His criticism was centred on the cognitivist model of vision. According to this dominant model of vision, the two-dimensional image received on the retina is configured as three-dimensional image through internal operation in the brain. Gibson suggested that this model is not correct because it treats body as passively engaged in the visual process. That is, the organ eye is considered as a mere source of information and the rest of body also has no say in the internal visual processing. For Gibson, eyes and the rest of body are not passive elements in visual processing. Bodily motion (how image will be formed depends upon body's interaction in the world i.e. its motion or interaction with the visual object) etc. actively shapes visual processing. Hence, vision is embodied. Thus, the field of embodied cognition thrived from these thinker's efforts. Since 1970s the literature on embodied cognition has grown.

Some thinkers were influenced from growing research in embodied cognition. They tried to apply this approach on language processing. The problem with the traditional theory was that it could not explain how abstract and non-modal symbols could lead to understanding of linguistic expressions. The problem was due to the assumption of representationalism that the perceptual and motor systems do not have any causal role in cognitive processing. Apart from this, intuitively we also know that the meaning of linguistic expressions is very rich. It does not consist of mere abstract propositional relations as claimed by the representational theory. It contains much more information. For example, the understanding of the word 'USA' carries a lot of information. The information comes from our experiences with the referent (or referents) of this word. While, on the other hand, the representational theory merely proposes that this word denotes a category i.e. a country, or a strong economy, etc. The representational theory makes the meaning of this word very

[10] Ibid.
[11] Brooks Redney "Intelligence Without Representation", pp. 139-159.
[12] Gibson J.J., *The Ecological Approach to Visual Perception,* pp. 1-6.

fixed. We also noticed that this theory does not state why should a word stand for its referent if it is abstract and non-modal.

The embodied hypothesis supporters, like Lawrence Barsalou suggested that the meaning of linguistic expression is not constituted by abstract symbols but is influenced by perceptual and motor system of the human body. Sensorimotor system of the body shapes the representations of linguistic expressions and thus makes them modal and make them retain the form of their referents and therefore, analogically related to their referents.[13] In this way, the internal representations become attached to the bodily experiences and thereby connected with the external world. This was not possible in the representational approach. The representational symbols were not connected with the external world. Lawrence Barsalou called these grounded representations as 'perceptual symbols.' However, the question was if not through computation over abstract symbols then how does meaning of linguistic expressions comes about?

Researchers like Zwaan, Pulvermuller, Barsalou and Gallesse and Lakoff, some of whom were influenced from embodied cognition, developed *embodied simulation theory of language comprehension*.[14] According to this theory, meaning comes from mental simulation of content of linguistic expressions or what linguistic expressions describe. The background idea is that simulation during language comprehension uses the same sensorimotor system which is used for perception and action of actual object or events which the linguistic expressions describe.[15]

In simulation we construct mental experience of what it would be like to perceive or interact with the objects or situations described in the language. For example, what is it to understand the meaning of this sentence - "Ravi went to the school"? According to simulation hypothesis, we imagine or mentally create the situation of a student going to school. And when we comprehend the sentence,

[13] Lawrence Barsalou introduced the idea of perceptual symbols. For him, in cognitive processes perceptual symbols are used and these are not amodal symbols. These perceptual symbols are neural representations. Perceptual symbols are multimodal, componential and flexible.

[14] Each one of these researchers have their own version of simulation theory. But all of them regard that sensorimotor system is directly involved in language processing.

[15] Vigliocco G. & Meteyard Lotte, "The Role of Sensory and Motor Information in Semantic Representation: A Review", in *Handbook of Cognitive Science: An Embodied Approach*, p. 293

respective perceptual and motor system of the body gets activated. The verb 'went' evokes a particular brain region that is for foot actions and the word 'school' activates another brain region that is for vision and in the same way other words evoke respective (dedicated) areas of the brain. On this basis, the theory claims that language processing necessarily requires simulation or sensorimotor system activation. Thus, language comprehension is not internal representations of words or sentences, which traditional theory of meaning supposes, but is a situated activity. In language comprehension, we do the action internally and not just represent objects and events.

The embodied approach of language comprehension is supported by empirical researches. Two research methods are prevalent on embodied language processing – neuroscientific studies and behavioural studies.[16] These researches show that people simulate content of linguistic expressions when they comprehend any piece of language. They simulate colour, shape, orientation, taste, and other properties of the objects or events mentioned in the sentences or words. Apart from properties of objects, participants in these researches simulate felt physical actions or movements also, given that the linguistic expressions mention physical actions. These studies check simulation at both level, words as well as sentence level. At both level, simulation is observed. Banking on these evidences, embodied thesis supporters claim that language processing is related with perceptual and motor system of the brain and hence embodied.

The behavioral studies infer whether people simulate or not by observing and manipulating participants' behaviour. In various studies, subjects are asked to read words or sentences and then to respond to certain percepts. Researchers observe participants' behaviour, for example, frequency of response to certain percepts, their eye movements, body movements, etc. The idea is that if people simulate during language comprehension, then they will be able to match percepts faster that are related with the content of linguistic expressions than percepts that are unrelated. In one study[17] some participants were asked to read the sentence 'the eagle is in the sky'. Then they see two images on the screen in succession- one image depicts an eagle with stretched wings and the second image depicts an eagle with unstreched/non-extended wings. When participants are asked to choose the

[16] Ibid, p. 303.
[17] Zwaan, R.A., Stanfield R.A., Yaxley R.H., "Do Language Comprehenders Routinely Represent the Shape of Objects?", p. 168.

picture that matches the given sentence, they choose the first image faster than the second image, despite there being no mention of shape/position of the eagle in the sentence. It emerged that people simulate shape during language comprehension. Thus, similar to this, other behavioural studies find that simulation is specific. People simulate colour, shape, modality etc.

In neuroscientific studies, various brain mapping techniques, i.e. fMRI or EEG techniques are used to investigate whether modality specific system for perception and action activate during language processing. For example, Hauk et al.[18] using fMRI technique noticed that comprehending words like *kick, pick,* and *lick* evokes motor activity in hand, foot, and mouth areas of the motor cortex. Similar to this, there are many other neuroscientific studies on language processing. It is also seen that neuroscientific studies complement behavioral studies. Thus, the researchers who are influenced by embodied cognition thesis, neuroscientists and psychologists, develop the embodied theory of language understanding based on these studies. They hold that sensorimotor system activation is necessary for language processing.

Indexical hypothesis by Arthur Glenberg is another embodied approach of language comprehension. The indexical hypothesis is based on the hypothesis that cognition is for/involves action. That is, we use cognition to survive and in cognitive processes we act mentally. In language comprehension, we simulate to act mentally and not just for the sake of understanding. According to indexical hypothesis, the sentences or linguistics expressions are understood only when their comprehension results in simulation of meaningful situation. The hypothesis proposes that any sentence is understood in three steps. In the first step, words are indexed to perceptual symbols[19], in the second step, affordances[20] are derived from indexed symbols and in the last stage, afforded sentences are integrated based on the syntax of the sentence for the simulation of meaningful situation. If by

[18] Hauk O., Johnsrude I., Pulvermüller F., "Somatotopic Representation of Action Words in Human Motor and Premotor Cortex", pp. 301-307.

[19] Perceptual symbols are neural patterns in memory. They get stored during experience of the referents of the words. They are multimodal because they retain information from every sense modality. Perceptual symbols can be reused during simulation of the experience by activation of sensorimotor system. The concept of perceptual symbols was established by psychologist Lawrence Barsalou.

[20] A term used by J.J. Gibson. Affordances are features of interaction between organisms and environment. They are based on embodiment of organisms. Each organism interacts with the objects of environment differently and thus due to this interactions, different features emerge. Chairs affords 'sitting' to humans but not to elephants because of body constraints. The sandy beach affords breeding ground to turtles. The same sandy beach might afford home for a crab. We see that from different interactions different affordances emerge. Shapiro Lawrence, *Embodied Cognition,* p. 100.

integration of affordances, meaningful situation is not simulated then the sentences are declared as nonsensical, otherwise taken as sensible. Sentence understanding implies simulation of meaningful situation described in the sentence. In this way, indexical hypothesis emphasizes role of embodiment and simulation in language processing.

Thus, in this way, we see that simulation is thought to be crucial for language understanding.

The embodied approach of language understanding seems to be way better than the traditional idea of meaning in cognitive science. In the above section, we saw that the problem in the representational approach was that it explained the meaning-making process as syntactic manipulation over mentalese symbols in the mind. The symbols were abstract, non-modal, and arbitrarily related to their referents. This happened due to the assumption of representationalism that cognition is an abstract process detached from the bodily system of perception and action. The effect of which was that mentalese symbols became ungrounded and unconnected with the outside reality. The symbol grounding problem by Harnad suggests that symbols must be grounded to one's experience. Only in that condition, they would generate meaning.

The embodied approach, on the contrary, suggested that linguistic processing is not abstract symbolic manipulation in the mind. Rather, linguistic processing is mediated by the perceptual and motor system of the body. The embodied approach is influenced by the thesis of embodied cognition that cognition is the dynamic interaction of organisms with the environment. Not only the body influences cognition but also it shapes cognition. Similar to other cognitive processes, language processing is also affected by the bodily experience. How we feel or how we move in the environment affects language processing. The experiences that we store at the time of perceiving or interacting with the objects in the environment are reactivated when we comprehend the piece of language that refers to those objects. This happens because of the simulation. In the simulation, we enact the same sensorimotor system which we do at the time of perceiving the actual object. In language comprehension too, we do the same thing, we simulate. If we hear the word *lemon* and if we have experienced the object lemon previously, then the visual system for simulating colour of the object and the motor system, probably the region that is for hand action, for simulating the grasping feeling of the lemon is activated during comprehension of the word *lemon*. The condition is that words or pieces of language must be grounded to our experiences. The perceptual symbol

system hypothesis of Barsalou says representations of words are grounded in our brain as neural patterns. These patterns, termed as perceptual symbols are used for simulation. In understanding any word, we reactivate these perceptual symbols by evoking the attached perceptual and motor system.

The Challenges for the Embodied View of Meaning

The central problem that we are discussing in this dissertation is how linguistic meaning comes about. What leads to words or sentences mean what they mean? The embodied approach would say that it is simulation through sensorimotor activations that words or sentences mean what they mean. But there are challenges to this view. How could the activations of the sensorimotor system be necessarily related to language processing? Could these effects not be mere co-occurrences with language processing?

Apart from this, the studies on which simulation hypothesis is based study concrete words and sentences i.e. the expressions that seem directly related to bodily experiences. For example: *kick, pick, man, orange,* etc. They do not mention abstract words. Words like democracy, time, justice do not seem to be related to bodily experiences. How would their meaning be decided? How would embodied theory identify sensorimotor patterns in the brain as the meaning of these words?

Some thinkers oppose the embodied theory's assumption that abstract representations do not exist in the mind, rather abstract symbols do exist in the mind. For them this assumption is necessary because for a category there can be a number of experiences, and not all of them can be simulated. Hence, at any given point of time, one has to abstract common elements in those experiences for setting a category. For example, we experience too many breeds of dogs in our life. To recognize the word 'dog' with all experiences of dogs is not possible. There must be abstract representations in the brain that can identify all these instances as a single abstract concept of 'dog'. However, they do not deny that sensorimotor activations do not arise during language processing. A weak embodiment is proposed according to which language processing happens in the separate module in the brain, while sensorimotor activations are just epiphenomena. The question arises on how an embodied view of language comprehension would answer these challenges. Would this theory be able to explain linguistic meaning?

The dissertation attempts to analyze these questions. Normally the question of meaning has been analyzed by philosophers and linguists. They try to analyze meaning through the analysis of language alone. But language has a connection with mind. In philosophy of cognitive science, the semantics is discussed in terms of mental representations. Here also, the traditional approach is the representational approach. Its flaws were shown in the above section. The embodied approach is scientific because it is based on laboratory researches. It involves contribution from studies in neuroscience, psychology, and cognitive psychology. Thus, this view seems more plausible for a theory of meaning. The dissertation attempts to analyze the embodied view of language comprehension, to see whether the embodied theory is effective for the concept of linguistic meaning.

The present dissertation has been subdivided into three chapters. The first chapter discusses the concept of 'meaning' from the representational approach as discussed in philosophy of cognitive science and the problems of this approach. The second chapter talks about meaning or language comprehension from an embodied cognition perspective and its potentiality. The final chapter attempts to look at its viability and thus analyses the embodied view of meaning.

The first chapter 'Representationalism and Meaning' is a general discussion on linguistic meaning from the representational perspective. In this chapter, we discuss the doctrine of representationalism. Representationalism was an influential approach in cognitive science for explaining cognitive processes and language. To understand this approach better we discuss what we understand by representationalism. It is shown that it explains cognition in terms of syntactic manipulation of mental representations. Three major theories have been discussed - the Representational theory of mind (RTM), the Computational Theory of Mind (CTM), and the Physical Symbol System Hypothesis (PSS). These theories help us to know the treatment of mind that was adopted. Furthermore, we discuss some semantic theories in cognitive science like, HAL, LSA, Kinstch's Construction Instruction model in brief. These theories are influenced by the computational model of mind of representationalism. These semantic theories hold that meaning of words or sentences can be explicated by their relation with other words and sentences. The idea is that the human mind processes language and cognitive processes through inner manipulation of codes or symbols received through sense organs. In the same way, these semantic models hold that meaning can be

analyzed through semantic relatedness. The chapter also chalks out criticism of this approach. The major criticisms being the Chinese Room Argument by John Searle, Symbol Grounding Problem by Steven Harnad, and Regress problem by Steven Horst.

The second chapter 'Embodiment and Meaning-Making: A Critique of Representationalism' starts with the discussion of embodied cognition. The embodied view of language is influenced by embodied cognition. It overcomes the difficulties faced by the traditional approach of linguistic meaning, i.e. the symbol grounding problem. Under the embodied approach of language comprehension, two hypotheses have been analyzed - the simulation hypothesis and the indexical hypothesis. Apart from them, the role of gestures is also explicated as some thinkers believe that gestures also facilitate meaning-making. The empirical evidence in support of embodied meaning are also important for the analyses of embodied meaning and we discuss some of these studies. Overall, the chapter attempts to touch on the important claims made by the embodied theory of linguistic expression.

The final chapter 'The Scope and Implications of Embodied View of Meaning' attempts to look at the viability of the embodied approach in explaining the linguistic meaning. To do so, it addresses some key criticisms against this approach. The attempt is to see whether the criticisms are reasonable. The prominent criticism refer to the inadequacy to determine the meaning of abstract words and sentences, rendering sensorimotor activations as epiphenomena, etc. Addressing these issues can lead us to analyze the theory better.

Chapter 1

Representationalism and Meaning

Introduction

One of the interesting and complex philosophical problems in the history of philosophy is the concept of meaning. In philosophy of language, meaning is analysed in terms of truth-conditions and reference. In this dissertation/chapter, we will look into the concept and treatment of meaning in philosophy of cognitive science and philosophy of mind.

A commonly held view in cognitive science is that meaning arises from syntactic manipulation of symbols in *mentalese*.[21] This view is influenced by representationalism, an influential doctrine about the nature and working of the mind in philosophy of cognitive science. The view is called representational approach of meaning, which we analyse in our current chapter. Representationalism regards mind as information processing system. It explains cognitive processes as syntactic manipulation over mental representations. Representational approach of meaning explains that language is processed in the mind through manipulations of symbols. Thus, linguistic meaning comes from this process. Many semantic models in cognitive science follow the representational approach to explain meaning. The theory and some of its related issues are discussed in brief.

Representationalism

Representationalism is the view that the human mind is an information-using system, and that human cognitive capacities are to be understood as representational capacities.[22] According to this approach cognitive processes can be described in terms of representations. In cognitive science,

[21] A term used by Jerry Fodor to denote language of the mind.
[22] Egan Frances, "Representationalism" in *Oxford Handbook of Philosophy of Cognitive Science*, p. 250.

representationalism has been popular, but in recent decades, it has been substituted by connectionist and embodied approaches. Under doctrine of representationalism we can count three theories of mind or models of mind that are influential: Computational Theory of Mind, Representational Theory of Mind and Physical Symbol System Hypothesis. These three models are instances of strong representationalism, according to Egan. Computational theory of mind (henceforth, CTM) is a specific variant of representational theory of mind (henceforth, RTM).

Jerry Fodor, Zenon W. Pylyshyn, and Steven Pinker are some important names who advocate representational thesis in cognitive science. Until recently before the rise of connectionism and embodied cognitive science, in cognitive science the dominant methodology was to regard mind as a representational system whose processes are computational and which has combinatorial syntax and compositional semantics.

Alex Morgan writes,

> Behaviorists disparaged the introspection-based methodologies of earlier 'mentalistic' traditions in psychology as unscientific, and held that talk of internal mental states is explanatorily vacuous. The computer metaphor helped dislodge this attitude, and thereby set the cognitive revolution in motion, by providing a way of understanding how something like mental states — namely, symbolic representations — could play a causal and explanatory role within a purely mechanistic, scientifically explicable system. The cognitivist's appeal to representations betokened a return to mentalism, since although such representations were conceived of as 'sub-personal' and inaccessible to introspection, they were also regarded as intentional and somehow internal to the mind. While specific conceptions of computation and representation have changed with the fashions in cognitive science, a broad commitment to explaining cognitive capacities by appealing to the manipulation of mental representations has remained constant.[23]

Computer metaphor set cognitive revolution in motion. This provided a way of understanding how something like symbolic representations could play a causal and explanatory role within a purely mechanistic, scientifically explicable system. The cognitive revolution also boosted the status of mental states. Earlier behaviourists doubted if there are such states. They rejected introspection-based method or ‘mentalistic tradition’ that claimed existence of internal mental states. They dubbed

[23] Morgan Alex, “Representation Gone Mental”, p. 214.

anything unobservable as non-existent. The computer metaphor has disrupted all of them, most importantly behaviourism. The metaphor provided the way that mental states in the mind could be explained as manipulation over symbolic representations. This in a way marked the representationalist tradition in cognitive science.

In this section, we will limit ourselves to important theories of mind that concerns with mental representations. Representationalism is not without criticisms. We will analyze them and know how far representational approach is sufficient.

a. Representational Theory of Mind

The representational theory of mind explains mind and mental processes. It was developed by American philosopher and cognitive scientist Jerry Fodor. The theory had influence across many disciplines. Fodor even called this theory as the foundation of cognitive science. According to this, common mental states like, thoughts, beliefs, desires, perception etc. are intentional states, and intentional states are representational states. The representational states are physically realized in the brain and mental processes are computational processes.

This theory makes the following two claims:-

1. Mental processes are computational processes, and
2. Intentional states are representational states, because they are relations to mental representations.

RTM was an attempt by Fodor to combine Turing style computation with the thesis of intentional realism.[24] He attempted to show that mental states are real states and mental processes can be explained as computation over such mental states.

Before we move to analyze this theory, let us first understand the reasons why Fodor had to explain cognition in such terms. We need to go back at some older theories on mind. As Fodor claimed, this was the only 'game in the town'.[25] A brief discussion can help us know the plausibility of Fodor's claim and comprehend the reasons behind the development of this theory.

[24] Because it says that cognitive processes are computational processes and intentional states are physical states. Rives Bradley, "Representational Theory of Mind", <https://www.iep.utm.edu/fodor/#H4>, accessed on 4 March, 2020.
[25]Fodor argued that only RTM was plausible cognitive theory among others. *Language of Thought*, p.27.

Mental states such as thinking, believing, perceiving etc. are considered as acts of mind. Whether mind is a material or immaterial object has been a heated question in the history of philosophy. This debate remained inconclusive due to which explaining mental states always remained challenging. Many theories attempted to explain the nature of mental states. Let us see in detail, why explaining mental states remains to be a daunting challenge for many theorists.

i. Challenges in Explaining Mental States

How do we know that there are other minds? How do we know for sure that other people are also capable of thinking or taking decision or planning? Can we become aware of the presence of other minds over and above one's own individual mind? This question is important because if we have known what mind is then we can explain mental processes. However, this is not easy. Some theories, such as, physicalism regard that mind is brain and mental states are physical states of the brain. However, if mind is brain, the question is how matter can be or explain a mental state of thinking or believing. The other problem is representation/intentionality. We know that mental states reveal objects of world or situations. They cannot do so in virtue of being just a physical state in the brain. There must be something more to this. Physicalism can't answer this.

There is another way to answer this. How do we talk about mind and mental states generally? (One central question is how such intentional states exist in physical world?) One may say that just as we know about our minds, similarly we can know other minds. This is argument by analogy. According to this, there are bodies in the world similar to my body. If I happen to know about my mental states, then there must exist mental states in other's body. The method one adopts to know one's own mind is introspection. But, can introspection help to know other's mental states?

> The way we know about the states of mind of others is not, so to speak, symmetrical to the way we know our own states of mind. This 'asymmetry' is related to another important asymmetry: the different ways we use to know about the position of our own bodies and the bodies of others.[26]

[26] Crane Tim, *The Mechanical Mind*, p. 34.

In knowing whether your legs are crossed I need to observe them. But in case of knowing whether my legs are crossed I do not need to observe that. I know that through introspection. I can also know about what I think without caring about my words and utterances. I do not need to observe my words and utterances to know about my thinking. However, what you are thinking I cannot tell unless I hear you.

> In order to know whether your legs are crossed, I have to look, or use some other form of observation or inspection (I could ask you). But I don't need any sort of observation to tell me whether my legs are crossed. Normally, I know this immediately, without observation. Likewise, I can typically tell what I think without having to observe my words and watch my actions. Yet I can't tell what you think without observing your words and actions.[27]

Thus, introspection is helpful to know my mental states and mind but not the minds of others. Hence, the argument by analogy seems insufficient. We can know only others' behavior and not their mental states. In normal life, we talk about others mental states through their behavior and actions. For example, we observe someone crying and then say that the person is in pain. We do not infer his pain by introspecting his internal physical state. Therefore, introspection is not right tool to know about other's minds.

In this way, where minds of others are concerned, we have to rely on what people say and do - their words and behaviours. It seems that knowing other's mind is dependent on other people's report and behaviour. There seem some shortcomings in this explanation. Can we go from observation of behaviours to knowledge of other's mind?

Philosophical Scepticism holds that it is not possible. It says that we can't know people's mind. People's behaviour is a not trustworthy source for inference of mental states. It is possible people may display fake behaviour to mislead. Thus, their behaviour does not necessarily account for having a mind. For example, it is possible that the bodies around us are robots designed by a mad scientist to fool us. Therefore, in absence of evidences for internal mental states, philosophical scepticism holds that we cannot know that other people have mind. This is epistemological problem about mind.

[27] Ibid, p. 34.

However, a popular view at one time was to explain mental states in terms of what was observable to senses, namely behaviour. This view reduced minds to observable behaviour. It was known as behaviourism.[28] Crane says,

> […] How do we get from the observable behaviour to knowledge of others' minds? One answer that was once seriously proposed is that the observable behaviour is, in some sense, all there is to having a mind: for example, all there really is to being in pain is 'pain-behaviour' (crying, moaning, complaining, etc.). This view is known as behaviourism.[29]

In this way, the proposed idea by Behaviourism with regard to knowing other's mind was to know other's behaviour. Mental states like pain etc. are nothing but 'pain behaviour' (crying. moaning). Behaviourism was good theory for explaining mind. as It reduced mental states to observed behaviours. However, behaviourism faced many challenges. One challenge was the question of how we know about our own mind or mental states. How to explain content of our own mental states in terms of behaviour?

Our minds think about many kinds of events, stores facts or details. But not all of them are revealed in our behaviour. How can behaviourism account for those mental events? Would behaviourism deny those mental states?[30] For example: I believe that Beijing is capital of China. This belief is not expressed through any of my behaviours. However, it is true that I hold this belief. Would behaviourism say that this belief is untrue or non-existent because it is unobservable? Crane says,

> No. Behaviourism would say that belief does not require actual behaviour, but a disposition to behave. It would compare the belief to a disposition such as the solubility of a lump of sugar. A lump of sugar can be soluble even if it is never placed in water; the lump's solubility resides in the fact that it is disposed to dissolve when put in water.

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[28] Behaviorism was a movement in philosophy and psychology in early 20th century that emphasized that psychological phenomena should be studied objectively i.e. in terms of behavior. It rejected introspection-based method for psychological phenomenon, used earlier in psychology. John B. Watson, a famous psychologist coined the term 'behaviourism'. George Graham, "Behaviorism", in *Stanford Encyclopedia of Philosophy* <https://plato.stanford.edu/entries/behaviorism/#WhatBeha> accessed on 16 November, 2020.

[29] Crane Tim, *The Mechanical Mind*, p. 35.

[30] This objection is also about problem of representation. From this objection, it can be seen that behaviourism is unable to account for the representational feature of mind.

> Analogously, believing that Riga is the capital of Latvia is being disposed to behave in a certain way. This seems more plausible until we ask what this 'certain way' is. What is the behaviour that relates to the belief that Riga is the capital of Latvia as the dissolving of the sugar relates to its solubility? One possibility is that the behaviour is verbal: saying 'Riga is the capital of Latvia' when asked the question 'What is the capital of Latvia?' (So asking the question would be analogous to putting the sugar in water.)[31]

To counter the argument of belief-desire states, behaviourism answers that observable behaviour is not the only pre-condition for explaining belief-desire type mental states, the other condition is that an individual's dispositions to behave in certain ways are sufficient. Salt's solubility is its feature. It need not be necessary that only when it's put into water and it dissolves then only one can say that salt is soluble. Salt's disposition to dissolve in water explains its solubility. Similarly, someone's disposition/ability to behave in a certain way is sufficient to explain their underlying beliefs and desires.

The question is - what is that 'certain way'? Behaviourists reply that verbal report from occupier of mental state is the 'certain way'. On this view, behaviourists' assumption is that belief or desire like states are like salt's property (disposition) of solubility. Only in the presence of adequate conditions, these mental states (dispositions) are expressed. To know what someone believes or thinks is to ask him certain questions. This way of verbal reporting reveals the mental states that the user has.

However, this response can easily be countered. A parrot can learn to speak certain words, but does a parrot think about the words he speaks? A person may speak to the audience about certain things to make them believe in them, but this is also possible that he himself doesn't believe the same. Will it be correct to say that what he spoke to his audience is what he believes? No. Therefore, to say that thoughts can be disposed through verbal behaviour or through any other behaviour is not right justification by behaviourism. All we can say is that thoughts cannot be fully defined in terms of behaviours.

Now, introspection as well as observance of behaviour fails to explain mental states. Should we stop hoping that we can succeed? There are theories who are not very optimistic. One pessimistic account

[31] Ibid, p. 35.

is the theory of eliminative materialism. According to this theory, mental states such as thinking, believing, etc. are folk psychological notions. Folk psychology[32] is wrong/false and therefore, such kind of mental states do not exist.[33] For example, folk idea of *phlogiston*. In medieval society, it was believed that *phlogiston* was sort of a thing that went up when wood burnt and which was responsible for fire. We know today that there are no such things as *phlogiston*. The cause of fire is oxygen and not *phlogiston*. Similarly, eliminative materialism holds that mental notions are folk notions. Just as folk idea of *phlogiston* was untrue the same way mental notions like belief, desire, pain, etc. are untrue or non-existent.

Eliminative materialism was a reaction against physicalism. Some endorsers of physicalism held that a time will come when neuroscience will achieve one to one match up of mental states with neural states of brain and open way for stating mental states in scientific terms. Eliminative materialism proposed that this would not be possible because thought, desire, worrying are themselves poorly defined categories or they are incomplete representation of our inner states. Any reduction into neural terms will be futile.

In this section, we discussed some of the positions of traditional theories of mind that hold that:

1. It is not possible to know mental states. (Philosophical Skepticism)
2. Mental states are behavioural dispositions. (Behaviourism)
3. Mental states do not exist and are mere folk psychological concepts. (Eliminative Materialism)
4. Mental states are physical states of brain. (Physicalism or Reductionism)

ii. Intentional Realism

In the previous section, we saw that some theories are sceptical about the existence of mental states and the mind. Behaviorism believed that there is no mind and no internal mental states. These mental

[32] Also known as common-sense psychology. Ordinary people in their routine lives successfully predict and explain other person's behavior and mental states without having any scientific knowledge about mind. This ability of people to predict and explain behaviour and mental stares is often termed as folk psychology in philosophical literature.

[33] Churchland Paul, *Matter and Consciousness*, p. 74.

states are nothing but observable behaviours. Eliminative materialism argued that mental states as commonly used in folk psychology do not exist.

Against these prevailing scepticisms about mind and mental states, Fodor argued that mental states are real states and they exist in the physical world. He defended the core elements of folk psychology. For him, belief-desire like folk notions are not wrong categories.[34] They exist and can be explained. We can note that behaviourism failed to explain how 'aboutness' which is the special feature of mental states can be revealed in different behaviours. Intentional realism claims that it can account for the intentionality or 'aboutness' of mental states too. It does so by admitting that mental states which are physical states have intentionality as an intrinsic property. Thus, intentional realism is the thesis that folk concepts of thinking, belief, or desire are real states because they are physical states and they have intentionality as intrinsic feature.

He then talks about scientific psychology. He hopes that this scientific psychology will give a reasonable explanation of mental states. Folk notions in this way are covered scientifically by scientific psychology.[35] Scientific psychology will posit mental states that will have these features:

a. Intentional features
b. Causal features

That is, mental states are intentional, they are about objects and events in the world. By causal is implied that interaction between mental states is causal. The interaction between belief-desire states causes behavior or action. (on account of their content, the interaction between belief-desire states happen through 'causation by content') In this way, intentional realism solves two difficulties that were faced by previous cognitive theories,

a. How to explain the representational feature of mind? (it says that belief- desire states are intentional states. they represent the objects and events in the world because these states are intentional.)
b. Skepticism on the status of mental states. (The other theories were sceptical about existence of mental states. intentional realism holds that mental states exist and can be explained.)

[34] Bradley Rives, Intentional Realism, <https://www.iep.utm.edu/fodor/> accessed on 17 November, 2020.
[35] Fodor believes that his cognitive theory is a hypothesis whose clear exposition will be given by research in sciences.

iii. Functionalism

Functionalism was another influential theory of mind. It became an alternative to type-physicalism and behaviorism. Type physicalism is a version of physicalism. It proposes that any type of mental state, for example, pain is a type of neural states in the brain. This theory faces problem. According to this, mental states are uniquely realized with particular kinds of neural firing. For example, pain is explained by a certain kind of neural firing, let's say, C-fibre firing. Not all species will have C-fibres in their neural system. It might be that in octopus, some other neurons fire when it feels pain. If pain states are identified with only a distinct kind of neural firing, the species that do not have that distinct kind, say C-fibres, will be denied of having pain states, leading to what is known as species chauvinism. Type physicalism crumbles down here. How will it explain mental states of a type in different systems or creatures? It simply cannot. Multiple realizabiltiy is the thesis that mental states can be multiply realizable in different kinds of systems. Mental states of a kind can be realized in all physical system i.e. other animals, or artificial systems. Type physicalism was not able to find this solution. However, functionalism finds a way with this problem and proposes that mental states can be multiply realizable.

We also noted that behaviourism denied existence of internal mental states. Functionalism does not accept this position. It regards that internal mental states exists in the mind but not in the way physicalism explains. Let us know more about functionalism.

Functionalism was first introduced by Hilary Putnam. Its main thesis is that mental states are not determined by what they are made up of but by the function they perform in any system. For instance, a pen is not identified by the material of which it is made up of, but by the function it performs, i.e. to write. What matters for something to be pen is its function and not the material it is made up of at the end of the day. Consider also the example of mouse traps. A mouse trap contains a wooden structure and a coiled spring. By the release of the pin inside the mouse trap, a mouse can be caught. However, there are mouse traps that contains adhesives, boxes etc. These additions do not make any difference to the utility of mouse traps. As long as a mouse trap can be used to catch rats, it is mouse trap. Otherwise, it is not. In both cases, we see that what matters ultimately is the function these devices can perform and not its constitutive materials. Functionalism adopts the same approach. It does not try to identify mental states with the physical states of the brain or with the

outward behaviours, rather it defines them by the function they perform in any system. These systems can be anything, like human beings, animals, artificial systems, etc. These systems can realize mental states if certain conditions are satisfied. For functionalism, mental states are functional states.

Paul Churchland writes,

> According to functionalism, the essential or defining feature of any type of mental state is the set of causal relations it bears to (1) environmental effects on the body, (2) other types of mental states-, and (3) bodily behavior. Pain, for example, characteristically results from some bodily damage or trauma; it causes distress, annoyance, and practical reasoning aimed at relief; and it causes wincing, blanching, verbal outbursts, and nursing of the traumatized area. Any state that plays exactly that functional role is a pain, according to functionalism. Similarly, other types of mental states (sensations, fears, beliefs, and so on) are also defined by their unique causal roles in a complex economy of internal states mediating sensory inputs and behavioral output.[36]

A mental state is identified by the functions it performs in the human body by being in causal relationship with other mental states and behaviours. Pain results from pricking and causes annoyance or distress. Any organism that can realize an internal state in this way, will be said as having pain according to functionalism. Thus, functionalism defines mental states in terms of functions.

According to Ned Block,

> All functionalists claim that there are functional states and that each mental state is identical to a functional state (or that there are functional properties and that each mental property is identical to a functional property).[37]

We find that functionalism does not reduce type mental states to token physical states of the brain. Rather, it defines them by their functional role in any mental system. Functionalism advances

[36] Churchland Paul, *Matter and Consciousness*, p. 63.
[37] Block Ned, "Troubles with Functionalism", p. 262.

behaviourism by positing that functional systems have a mind. Functionalism is not skeptic about mental states as eliminative materialists are.

Functionalism was influenced by Turing computation. In fact, its first proponent Putnam had talked about machine functionalism according to which any creature with a mind can be regarded as a Turing machine and his mental processes as machine states.[38] But machine functionalism faced its own share of difficulties. It equates mental states with machine states of probabilistic automaton but in a Turing machine only finite number of machine states can emerge. Human mind produces infinite number of thoughts which are also systematic. This productivity and systematicity of thoughts cannot be explained by Machine functionalism. Hence, machine functionalism fails.[39]

iv. Turing Computation

An important breakthrough of the 20th century was the discovery of Turing machines. The human mind does many kinds of activities. It thinks, plans, solve problems, predicts future events, and so on. How does it carry out all of them? Can systems other than the human brain implement such kind of acts?

In 1936, Allen Turing built a machine which he called "a-machine" (Automatic machine).[40] This machine was capable of doing simple mathematical operations. In general, a Turing Machine was an abstract model of an idealized computing device. This device manipulated symbols much as a human agent manipulates pencil marks on paper. The idea behind was that human intelligent processes can be replicated by a Turing Machine.

[38] Levin Janet, "Machine state functionalism", <https://plato.stanford.edu/entries/functionalism/#VarFun> accessed on 18 November, 2020.
[39] Block N. & J. Fodor, "What Psychological States Are Not", pp. 159-181.
[40] Liesbeth De Mol, "Turing Machines" in *Stanford Encyclopaedia of Philosophy*, https://plato.stanford.edu/entries/turing-machine/ accessed on 20 November, 2020.

Physical Description of a Turing Machine:

A Turing machine has an infinitely long tape with "cells" divided on it and a central processor. Cells act as memory locations. The central processor can move one cell at one time left or right. The central processor can perform four elementary processes,

i. Write a symbol at a cell.
ii. Erase a symbol from a cell. /overwrite a symbol.
iii. Access the next cell on the tape. (move to the right on the tape)
iv. Access the previous cell on the tape. (move to the left on the tape)

The device also has a machine table. Machine table is much like an algorithm. Algorithm is a finite, step by step procedure for solving a problem. The machine table dictates which elementary operation the central processor performs, given its current machine state and the symbol it is currently accessing. The machine table enshrines a finite set of routine mechanical instructions governing computation.[41]

The ability of the machine to perform any computation can be understood from following computational exercise. Suppose we want a machine to add 1 to any number.[42] For this, we should suppose that machine can use only two symbols 0 or 1. That is, only 0 and 1 can be read by the machine.[43] Apart from this, we also need to interpret the symbols on the tape. Assume that symbol 1 stands for numbers and symbol 0 stand for space between two numbers. This will be like 111 standing for number 3, 111111 standing for number 6 and so on. Symbol 0 is used for separating numbers from each other. For example, the series …1111000011111000110111… represents …4, 5, 2, 3…. Numbers of 0s are irrelevant to the above notation. The above representations just stand for a series of numbers. The dots symbolize that tape is infinitely long. We need to specify the machine table i.e. algorithm for adding 1 to any number.

[41]Rescorla Michael, "Turing Machines", <http>s://plato.stanford.edu/entries/computational-mind/#TurMac> accessed on 18 November 2020.
[42] I have borrowed this example from Tim Crane's book. *The Mechanical Mind*, p. 65.
[43] 0 and 1 are symbols and not numbers.

When the machine reads any symbol, it is receiving input, and when it performs or acts upon the cell by overwriting symbols or moving the tape or both, which is its execution state. The output is obtained when the machine gets the instruction of STOP. Let us specify the machine's internal states. Our simple machine has two states. State A and State B. The considered machine makes move from the following instructions,

1. If the machine is in state A, and reads a 0, then it stays in state A, writes a 0, and moves one square to the right.
2. If the machine is in state A, and reads a 1, then it changes to state B, writes a 1, and moves one square to the right.
3. If the machine is in state B, and reads a 0, then it changes to state A, writes a 1, and stops.
4. If the machine is in state B, and reads a 1, then it stays in state B, writes a 1, and moves one square to the right.

The machine table will look like this,

	INPUT	
	1	0
A	Change to B; Write a 1; Move tape to right	Stay in A; Write a 0; Move tape to right
B	Stay in B; Write a 1; Move tape to right	Change to A; Write a 1; STOP

Suppose that machine has to add 1 to this part of tape

00011000

This part of the tape represents number 2. We want the machine to add 1 to this number by applying the rules in the machine table.

This is how it does it. It starts from state A, reads the square of the tape at the foremost right. It reads the symbol 0. It will remain in the same state, write 0 over the tape and move the tape to right. Again, it finds the symbol 0. It follows the same step. After moving the tape thrice and getting symbol 1 on the fourth cell, the machine will change to state B write 1 and move the tape right. The process will go like this

(i) 0 0 0 1 1 0 0 0 . . .
(ii) . . 0 0 1 1 0 0 0 . . .
(iii) . . 0 0 0 1 1 0 0 0 . . .
(iv) . . . 0 0 0 1 1 0 0 0 . . .
(v) . . . . 0 0 0 1 1 0 0 0 . . .
(vi) . . . . . 0 0 0 1 1 0 0 0 . . .
(vii) . . . . . 0 0 1 1 1 0 0 0 . . .[44]

At line (vi), the machine is in state B, it writes a 1, changes to state A, and stops. The output is on the line (vii). This number represents the number 3, so the machine has succeeded in its given task of adding 1 to its input. Just by following instructions blindly and manipulating symbols it reads or receives on the tape. By following instructions from the machine table and manipulating symbols machine can do the operation of adding.

There is now a need to discuss how Fodor's RTM defines cognition. Fodor's representational theory of mind was influenced from the theory of functionalism and Turing computation.

v. Cognition as Symbol Manipulation- The Representational Theory of Mind (RTM)

The Theory of Belief-Desire:

Just as the Turing machine was capable of implementing intelligent acts, mind must be in the same way capable of performing mental tasks. Fodor grounded RTM hypothesis on this assumption. He believed that the mind has symbol like structures also called representations. These representations are complex as well as primitive. The mind must be manipulating these symbols. However, the mind

[44] Crane Tim, *The Mechanical Mind,* p. 66.

cannot process these symbols randomly. So, he thought that mental processes are causal. One thought leads to other thoughts in a necessary way. This is almost same like Turing machine. One unanswered question in the previous section was how the mind represents facts of the world just by being a physical object. Fodor answers that by saying that mental representations have semantical properties because they are part of mentalese. Mentalese is the language of mind. We can think of mentalese as a system of mind. Mentalese is like natural languages. In natural languages, words and sentences combine in a certain fixed way. This way of combining is known as the syntax of the language. The words and sentences communicate something when they have some configured form. The feature of communicating something is known as the semantics of words or sentences. Much as language, mentalese symbols possess these two properties too. This way, by having semantic properties mental representations represent objects or situations of world.

The interactions between mental states are truth-preserving. Turing machine manipulates symbols in truth-preserving way i.e. it respects the meaning of symbols. No matter, what symbols stand for, if they follow the algorithm, they will give right result. Mental processes also take place in truth-preserving way. We can understand representational theory in the following way. The representational theory makes following claims,

1. The mind is a representational system.
2. The mind contains representations. Complex as well as primitive.
3. Mental processes are computational processes over various intentional states.
4. Intentional states are called propositional attitudes.
5. Propositional states are relations to propositions that signify some facts or situations. For example, my belief that Paris is the capital of France. I have the belief state whose content is the content of the proposition to which it is related.
6. Thinking takes place in a language. This language is called *mentalese*.

RTM explains that thoughts are syntactically structured representations. ,

> […] RTM claims that thoughts themselves are syntactically-structured representations, and that mental processes are computational processes defined over them. Given that the syntax of a representation is what determines its causal role in thought, RTM thereby

> serves to connect the fact that mental processes are truth-preserving with the fact that they're causal. On Fodor's view, "this bringing of logic and logical syntax together with a theory of mental processes is the foundation of our cognitive science."[45]

RTM is a plausible theory because it does away the systematicity problem of machine functionalism. This theory is improvement over machine functionalism of Putnam. It takes the idea that mental states are functional states. With the LOTH, RTM specifies the systematicity of thoughts which was lacking in functionalism. The problem that the machine functionalism faces is the following:

> Another problem for machine functionalism, also highlighted by Block and Fodor (1972), concerns the systematicity of thought. An ability to entertain one proposition is correlated with an ability to think other propositions. For example, someone who can entertain the thought that John loves Mary can also entertain the thought that Mary loves John. Thus, there seem to be systematic relations between mental states. A good theory should reflect those systematic relations. Yet machine functionalism identifies mental states with unstructured machines states, which lack the requisite systematic relations to another. For that reason, machine functionalism does not explain systematicity. In response to this objection, machine functionalists might deny that they are obligated to explain systematicity. Nevertheless, the objection suggests that machine functionalism neglects essential features of human mentality. A better theory would explain those features in a principled way.[46]

RTM explains this problem by introducing the language of thought hypothesis,

> The language of thought hypothesis (LOTH) is the hypothesis that mental representation has a linguistic structure, or in other words, that thought takes place within a mental language.[47]

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[45] Katz Mathew, "The Language of Thought Hypothesis", < https://iep.utm.edu/lot-hypo/>, accessed on 12 October 2020.

[46] Roscerla Micheal, "Computational Theory of Mind",<https://plato.stanford.edu/entries/computational-mind/>, accessed on 10 October 2020.

[47] Katz Matthew, "Language of Thought Hypothesis", *The Internet Encyclopedia of Philosophy,* <https://www.iep.utm.edu/lot-hypo/> accessed on 13 October 2020.

Thus, language of thought hypothesis posits that the structure of thought is linguistic. Thoughts in the mind are in the form of propositions or sentences. The reason for supposing that thoughts are language-like is because language is productive and systematic and these two properties found in thoughts as well. Therefore, Fodor thinks that mental thought is linguistic. Let us see how language is productive and systematic and why thoughts are supposed to be language-like.

In a language, infinite number of sentences can be produced from finite number of words for example, in English language. Similarly, our mind also entertains an infinite number of thoughts. Therefore, it is proper to assume that thoughts work like natural languages. Why language and not any other system? Consider for example a simple system, street light. This system has only three representations green, red, and yellow. This system is not productive because it can perform only a finite number of jobs. But language is a productive system. It has the potentiality of performing complex operations.[48] **Systematic** thought is systematic when it can understand that *Bill is boring and Fred is funny* and *Fred is funny and Bill is boring* are not two different sentences. Languages contain this property too.[49]

A theory that has explained how such states are governed is a plausible psychological theory. Physicalism, behaviorism and eliminative materialism, etc. had mentioned that belief-desire states are not real states. So, either they tried to reject these states or reduce them to physical states of the brain or dispositional behavior. But it was seen that such approaches were problematic. In this sense, these theories were insufficient. Influenced by Turing machines and machine functionalism, Fodor developed his representational theory of mind. Ultimately RTM is a theory about belief-desire mental states. It believes that human actions and behaviors are caused by belief-desire like states. For example, my actions of going to the refrigerator may be a consequence of my belief that ice cream is in the fridge and my desire of eating ice creams. The representational theory believes that common mental processes are constituted of such states. The main task of any psychological theory should be describing how such mental states occur in the mind.

To describe so, this theory supposes that such mental states like belief or desire are real states. These mental states are intentional and are causally connected to each other. Apart from this, intentional

[48] Fodor and Pylyshyn, "Connectionism and Cognitive Architecture", pp. 3-71.
[49] Ibid.

mental states are relational states. When speakers entertain such states, they have a specific attitude towards propositions. For example, Elvis believes that France is part of the European Union. Here, Elvis has a belief state with respect to the proposition that France is part of the European Union. Intentional mental states are also known as propositional attitudes as these are speakers' or thinkers' attitudes concerning any proposition. The intentionality of mental states is defined by the content of the proposition to which they are connected. In the last example, Elvis's belief state was intentional and content of her belief was the fact that France is part of the European Union.[50]

The causal relation between mental states follows computational rules. The transformation from one mental state to another mental state is like the transformation from one machine state to another machine state. On the question of rules, according to which such kind of transformation takes place in the mind, Fodor takes recourse of the Language of Thought hypothesis. We discussed in previous sections that mental activity takes place in a language called *mentalese*. This tells that mental processes are governed by rules of language like system called *mentalese*. Therefore, the transformation rules are defined by *mentalese*. On account of being part of a language system, mental representations have syntactic and semantic properties. As it is known that the syntax of any linguistic expression explains how the words are arranged in that expression. Therefore, the similar way syntactic properties of representations decide the combinatoriality of mental states. In other words, mental states combine because their relational proposition i.e. mental representations have syntactic properties. The semantic properties describe what things or situations the mental representations stand for.

It should be noted that *mentalese* does not dictate the rules of transformation. What it does is that it provides mental representations language-like features. The transition from one mental state to another mental state takes place because of the formal or syntactic properties of mental representations. The transition from one mental state to other mental states takes place in a truth-preserving way. Rives writes,

> Turing demonstrated how to construct a purely mechanical device that could transform *syntactically–individuated* symbols in a way that respects the semantic

[50] Pitt David, "Representational Theory of Mind", in *Stanford Encyclopedia of Philosophy* <https://plato.stanford.edu/entries/mental-representation/#Representational> accessed on 7 November, 2020.

> relations that exist between the *meanings*, or *contents*, of the symbols. Formally valid inferences are the paradigm. For instance, *modus ponens* can be realized on a machine that's sensitive only to syntactic properties of symbols. The device thus doesn't have "access" to the symbols' *semantic* properties, but can nevertheless transform the symbols in a truth-preserving way. What's interesting about this, from Fodor's perspective, is that mental processes *also* involve chains of thoughts that are truth-preserving.[51]

While describing Turing machine we had mentioned one example of adding one to any given number. In the example, we found that the machine was working entirely on just two symbols 0 and 1. Whereas it had to deal with natural numbers like 3, 4, 5, and so on. Irrespective of what numbers it had been given, it computed by working on just 0 and 1 symbols, and machine table instructions. Nonetheless, the machine was able to give the correct results.

Similar to this operation, the machine can implement many other types of calculations. For example, formal proofs of mathematics, logic, algebra, etc. formal proofs, modus ponens and modus tolens can be performed by the machine. The machine is sensitive to only formal properties of symbols in the implementation of formal proofs but it makes them in such a way that it respects the meanings of those symbols. Fodor thought that mental operation must be like machine operations.

On such a hypothesis, he thinks that transition from belief mental state to desire mental state in one's mind happens in truth-preserving way. If the premises are true, the conclusion must be true. Fodor writes,

> [I]f you start out with a true thought, and you proceed to do some thinking, it is very often the case that the thoughts that thinking leads you to will also be true. This is, in my view, the most important fact we know about minds.[52]

Now we have known that mental processes are computational processes. However, mental processes are not just symbolic processes. They are also about facts or objects; or situations of the world. How 'aboutness' is expressed by representational theory? The answer to this lies in the previous

[51]Rives Bradley, "The Representational Theory of Mind", *The Internet Encyclopaedia of Philosophy*, ,<https://www.iep.utm.edu/fodor/#H4>, accessed on 16 November 2020.
[52]Fodor Jerry, *The Elm and the Expert: Mentalese and Its Semantics*, p. 9.

discussion. It was said that machine manipulates symbol preserving truth. What is truth? Truth is content of the symbols or statements. In formal logic logical statements have truth value. Either they are false or true. The modus ponens is valid argument because of its form. Its argument form is as follow,

$A \supset B$

A

$\therefore B$

In this argument if the both premises are true, then the conclusion cannot but be true. The machine implements this argument in truth preserving way. It respects the meaning or truth of the symbols. The mental processes also run the same way. As causal interaction between mental states (belief-desire states) happen because of syntactic feature of underlying mental representations, it can be said that cognition is entirely matter of mental representations. Therefore, mental processes are nothing but syntactic manipulation of mental representations.

b. The Computational Theory of Mind (CTM):

CTM is a version of representational theory. Its main thesis is that mind is a computing device. The first attempt to compare mind with computer was made by McCulloch and Pitts in 1943. They suggested that brain's neuron operation is comparable to logical connectives in logical gates[53] They did not provide any systematic theory. Nevertheless, the idea was quite useful for the future thinkers in developing computational account of mind. In philosophy, Putnam introduced this idea first. He gave the idea of machine functionalism. Machine functionalism endorses that mind is like an imaginary functional machine whose internal functional states are mental states. The basic idea is that mental states must be like internal states of this imaginary device. In his machine functionalism, Putnam conceptualizes an automaton which is similar to Turing machine. From this, he proposes

[53] Logic gates are the foundation of any digital system. In a logic gate there are one or more than one input and one output only. For example:- A.B is known as AND gate in a digital system. It can receive two input and give one output through the logical connective and or ".". McCulloch and Pitts thought that neurons can be compared with logic gates because neurons take input signal, processes signal and give an output. In this way, they suggested the idea that brain can be treated like a digital computational system. Milkowski Marcin, "Classical CTM", in *Internet Encyclopedia of Philosophy*, <https://iep.utm.edu/compmind/#SH1a>, accessed on 20 October 2020.

that mental activity uses the probabilistic automaton and the particular mental states are machine states of the automaton.

After Putnam, Jerry Fodor combined classical CTM with LOT hypothesis and developed a consistent account of computational mind. He argued that "cognitive representations are tokens of the Language of Thought and the mind is a digital computer that operates on these tokens."[54] Zenon Pylyshyn was also one staunch supporter of CTM. He did not consider LOTH. But he admitted that mind manipulates symbols on certain rules to initiate mental process. Fodor and Pylyshyn developed the CTM together in 1968.

CTM is in many ways similar to representational theory that's why it is variant of RTM. It just combines computational account of reasoning with representational theory. RTM is the theory that mental states are intentional states and intentional states are relational states. The thoughts are causal sequence of such relational states. Computational account of reasoning tells that processes of reasoning are performed in ways responsive to only the syntax of symbols. Intentional states involve mental representations. Mental representations have both syntactic and semantic properties. Therefore, the thoughts are operations over mental representations in computational way.[55] How this happens we have already seen in the discussion about representational theory of mind section.

c. The Physical Symbol System Hypothesis

This theory also holds that thinking is manipulation of symbols in any physical system. PSS was proposed in 1975 by computer scientists Herbert Simon and Allen Newell. According to this hypothesis, intelligent systems transform physical symbols to generate behavior or intelligent actions, e.g. thinking, counting, computing, etc. Thus, thinking or intelligence comes from the manipulation of physical symbols. We will first know about the physical symbol system and then deal the way hypothesis defines intelligence. This hypothesis claims that,

> A physical symbol system [such as a digital computer, for example] has the necessary and sufficient means for intelligent action.[56]

[54] Ibid.
[55]Horst Steven, "Computational Theory of Mind" in *Stanford Encyclopedia of Philosophy*, <https://plato.stanford.edu/archives/sum2015/entries/computational-mind/>, accessed on 20 October 2020.
[56]Allen Newell and Herbert A. Simon, "Computer Science as Empirical Inquiry: Symbols and Search," pp. 113-126,

For Simon and Newell, the means for intelligent action in a physical system are physical symbols and rule-based transformations of symbol and symbol structures. Only physical systems are capable of producing intelligent behavior. The human mind and computer are physical system on this account. Bermudez feels that this hypothesis makes two claims,

> The first (the necessity claim) is that nothing can be capable of intelligent action unless it is a physical symbol system. Since humans are capable of intelligent action, this means, of course, that the human mind must be a physical symbol system. In this sense, then, the physical symbol system hypothesis comes out as a constraint upon any possible mental architecture. The second (the sufficiency claim) is that there is no obstacle in principle to constructing an artificial mind, provided that one tackles the problem by constructing a physical symbol system.[57]

Therefore, according to this hypothesis, intelligence is the mark of only physical symbol systems. On this basis, human mind is also a physical symbols system because humans perform intelligent actions. What are the characteristics of such systems? How can symbol transformation lead to intelligence? We can deal with these questions in the following discussions.

According to Bermudez, the hypothesis involves four basic ideas,

1. Symbols are physical patterns.
2. More complex symbol structures can be created by combining individual mental symbols.
3. The PSS contains processes for manipulating complex symbols structures.
4. The processes themselves can be represented by symbols and symbol structures.[58]

A physical symbol system is made up of physical symbols. These symbols are physical objects. Just as letters of computer alphabets are physical objects the same way symbols are physical objects. This should not be taken too literally. We know that 0 and 1 notations are off and on states of any electric circuit in the computer. In this sense, these notations are physical objects. We should treat symbols of PSS as physical objects the same way.

[57] Bermudez Jose Luis, *Cognitive Science: An Introduction to the Science of the Mind*, p. 142-43.
[58] Ibid.

The second property of physical systems is that its symbol can combine to form more complex structures. How is this done in PSS? Newell and Simon think that there are combining rules in the physical system. The combining rules in the symbols system are like combining rules in any natural language. We know that language is also a symbol system. In any language, the words combine on certain grammatical rules and form sentences. Physical symbol system also involves such type of rules. Bermudez writes that such rules are recursive,

> These rules are likely to be recursive in form. That means that they will show how to get from an acceptable combination of symbols to a more complex combination that is still acceptable. The definition of a well-formed formula in the branch of logic known as sentence logic or propositional logic is a useful example of a recursive definition.[59]

The symbols of physical system combine to form complex structures in this way. There is significant use of forming complex symbol structures. We will see how is this so later. According to this hypothesis, intelligence can be taken as the ability to solve problems.[60] Bermudez writes,

> Newell and Simon's fundamental claim is that the essence of intelligent thinking is the ability to solve problems. Intelligence consists in the ability to work out, when confronted with a range of options, which of those options best matches certain requirements and constraints.[61]

Problem solving can be manifested through symbol transformation. In any problem, there is a start state and a goal state. From the start state, there are many possible moves. Problem solving is identifying a solution state. Any agent solves the given problem when he can choose the correct move that is crucial for his goal. Consider this with the example of the chess game. When any player is halfway through the chess game, he has many possible moves. The moves of the game are fixed by the rule of the chess game and he has option to choose the moves according to the rule of the game the player in the any state aims to checkmate the opponent. Therefore, in the current position problem before the player is to find the correct move that helps him to win the game.

[59] Ibid, p. 144.
[60] Thinking can also be taken as symbol manipulation. But only those thoughts that has to do with intelligence. Day-dreaming etc are not things Newell and Simon are interested.
[61] Ibid, p. 145.

In the physical system, the problem-solving activity is depicted through symbol transformation. To do so, the current state and goal state are represented in terms of symbols. Then, the possible moves that are also named as Search space are created by symbol transformations. We know that symbols can combine according to rules. In this way, the search spaces are generated through symbol manipulation. Problem solving is a matter of identifying the correct move. This can be done checking moves that help to reach the goal. But going through all search spaces can take a much longer time and it makes the strategy much more complicated. However, there are many types of search techniques. For example, one technique to find a solution state is to go through all search spaces and then pick the correct move. The other technique is to continue through spaces in serial. Just when the correct move is identified the search is stopped. The second search strategy seems economical. It saves the system to check all moves. In this way, the solution state is identified. Newell and Simon talk about the General Problem Solver technique. In Bermudez's words,

> The basic idea behind the GPS program is relatively straightforward. It uses the problem-solving technique known as means–end analysis. Means–end analysis is a three-stage process that is intended to converge on a solution state by reducing the difference between the current state and the goal state.[62]

The first stage evaluates the difference between the current state and the goal state. The second state identifies the transformation that reduces the difference between the current state and goal state. In the third stage, it is checked whether the transformation of the second stage can be applied to the current stage. If it can be applied, then the transformation is applied, and then again the first stage is processed. If the transformation cannot be applied to the current state then stage 2 is continued until the solution state is identified. Thus, problem solving happens through GPS technique in physical systems in this way. GPS is algorithmic; in physical systems, these instructions are blindly followed. In this way, by transforming physical symbols according to given rules, a physical system performs intelligent activity. In this way, intelligence is simply symbol manipulation.

However, PSSH is just a model of intelligent system. It does not actually deal with human mind. It does not describe how the human mind works. What it claims is all that intelligent systems are symbol manipulators. Human mind is PSS. Computers are also PSS. The detailed account of how

[62] Ibid, p. 148.

mind is processed is given by Fodor's LOT hypothesis. About this, we have already talked in the representational theory section. A special point about the LOT hypothesis is that it considers human thinking as linguistic; i.e. mental system is like a language system. Thoughts are nothing but sentences in the mind. Human behaviour is a consequence of computational operations over such thoughts.

Meaning-Making in Representationalism

Till now we discussed representational theories of cognition. Our main motive in this chapter was to highlight problems in the representational approach of meaning. To address this, we had decided to first know about representational theories of mind or the representational approach to cognition. Our discussion has shown that such theories hold that cognition is syntactic manipulation of symbols in the mind or more directly, cognition is a computational process over mental representations. Now in this section, we shall explain about the representational approach of meaning, then moving on to discuss the efficiency of this approach.

a. Representationalism and Problem of Meaning

Language is a symbol system. By the use of language, we convey messages or thoughts. The message cannot be conveyed just by use of symbols. Words have meanings. What are these meanings? Is meaning just messages or something else? Where do words or linguistic expressions get their meaning from? There is a vast literature on meaning and different approaches to understand what is meaning. In this section, we will adopt just one approach.[63] The approach that links meaning with the mind.[64] Semantic theories based on this approach are known as mentalist theories. Some prominent theories are HAL, conceptual semantics of Jackendoff, etc.

[63] As this approach is dominant in philosophy of cognitive science. In this approach, language and other cognitive processes are discussed in terms of mental representations. Semantic theories are known as mental representation-based theories of meaning. Jeff Speaks, "Theories of Meaning" in *The Stanford Encyclopedia of Philosophy* <https://plato.stanford.edu/entries/meaning/#MentReprBaseTheo> accessed on 20 Nov 2020.

[64] Gricean program is also counted as mentalist theory. But we will deal here only the theory which adopts representational approach.

We can ask this question in another way. How does representationalism define meaning? First, let us know the relation between language and cognition. Is language part of cognition? Andy Clark writes,

> There is a popular view stemming from the work of Jerry Fodor that says that knowing a natural language is knowing how to pair its expressions with encodings in some other, more fundamental, and at least expressively equipotent, inner code ('Mentalese' or the Language of Thought). Language influences thought, on such accounts, in virtue of a process of translation: one that fully transforms the public sentence into the content-capturing inner code. This is a prime example of what might be dubbed a 'Pure Translation' view of language.[65]

In this way, Clark supposes that language understanding is a cognitive process. He writes,

> What is the cognitive role of language? Are words and sentences merely vehicles for the communication of preformed ideas, or are they part of the process of thinking itself? In what follows I suggest that words and sentences form part of the process of thinking.[66]

If language is part of cognition then it is possible to define meaning. Accordingly, meaning is defined in the following way,

> […] meaning is supposed to arise from abstract symbol manipulations in mentalese, the hypothesized language of thought.[67]

Arthur Glenberg also shares this idea,

> […] meaning in cognitive psychology has been co-opted by a particular approach: Meaning arises from the syntactic combination of abstract, amodal symbols that are arbitrarily related to what they signify.[68]

[65] Clark Andy, "Language, Embodiment and Niche", p. 370.
[66] Ibid.
[67] Galetzka Cedric, "The Story So Far: How Embodied Cognition Advances Our Understanding of Meaning-Making", p. 1.
[68] Glenberg Arthur and Robertson David, "Symbol Grounding and Meaning: A Comparison of High Dimensional and Embodied Theory of Meaning", p. 379.

In this way, meaning comes from the manipulation of abstract symbols. Jeff Speaks writes,

> A common view in the philosophy of mind and cognitive science is that the propositional attitudes of subjects are underwritten by an internal language of thought, comprised of mental representations. One might try to explain linguistic meaning directly in terms of the contents of mental representations, perhaps by thinking of language processing as pairing linguistic expressions with mental representations; one could then think of the meaning of the relevant expression for that individual as being inherited from the content of the mental representation with which it is paired.[69]

The linguistic expressions are paired with the mental representations and it is supposed that meaning comes from these representations. We can assume that meanings are concepts in the mind and these concepts are made up of mental representations.

b. Representational Semantic Theories:

Many semantic theories have come up in cognitive science and philosophy of mind which discuss meaning in terms of mental representations. The *MIT Encyclopaedia* mentions about these semantic theories,

> Many linguists think of semantics in terms of a "level of representation" of expressions analogous to a syntactic or phonological level. Psychologists generally think of semantics as relating expressions to concepts, regarding concepts as something like elements of a LANGUAGE OF THOUGHT. In AI, semantic interpretation is sometimes expressed in a language of KNOWLEDGE REPRESENTATION. A representational view of semantics is quite congenial to the popular COMPUTATIONAL THEORY OF MIND.[70]

Psychologists and linguists think of semantics as relating expressions to concepts, concepts are regarded as constituents of language of thought. Claudia says,

> The classical propositional view of concepts and meaning proposes that concepts are generated by abstract, arbitrary and amodal symbols. [71]

[69] Theories of Meaning, <https://plato.stanford.edu/entries/meaning/#MentReprBaseTheo>, accessed on 20 November, 2020.
[70] Partee Barbara, "Semantics", in *MIT Encyclopedia of Cognitive Science*, p. 740.
[71] Scorolli Claudia and Borghi Anna, "Language and Embodiment", p. 1.

The researchers think that computational models of cognition process semantic analysis of linguistic words in terms of linkages with other primitive terms. Apart from this, the approach of explaining cognition in terms of symbols manipulation has led to the development of semantic models that analyze meaning in terms of semantic relatedness. LSA, HAL and Kinstch's construction-based models are some of the prominent models. In such models, it is assumed that knowledge is propositional. This assumption is influenced by Fodor's LOT hypothesis that human cognitive processes are linguistic in nature. That is, they can be described through relation between propositions. Following representational approach, these semantic models represent meaning by statistical computations applied to a large corpus of texts. For example, in HAL and LSA "word meaning is represented as vectors, detected in matrices which describe the co-occurrence of terms in documents".[72] In such models the objective is to calculate mathematically the words that co-occur with the target word. For example, the meaning of cat is represented by calculating the word that has highest value of similarity. On this basis, its meaning would be 'a feline'. For other words meaning is represented in the same way. Claudia writes,

> That is: the meaning of a word is derived by its relations to other words and other abstract symbols. In this way it is possible mathematically / spatially calculating if two or more words/sentences are equivalent, namely if people represent them as semantically comparable or not. A low estimated parameter indicates that two words appear in different, orthogonal, contexts. The meanings of words are considered as fixed, so the understanding of a sentence would be pretty the same for everyone. LSA models outputs fit various experimental results: they fit human word sorting judgments and word-word lexical priming; they also successfully predict text learnability.[73]

The computer is fitted with the dictionary like data structures. The underlying assumption is that meaning can be analyzed by semantic relatedness. Explain 'dog' as a canine animal, you have given its meaning. There are many models of such data structures for example HAL or LSA. Any word's meaning is represented by its relations with other words and other abstract symbols. Some prominent mental representation based semantic theories are as follow,

[72] Ibid, p. 2.
[73] Ibid, p. 2.

i. HAL and LSA

Hyperspace Analogue to Language developed by Burges and Lund and Latent Semantic Analysis Models developed by Landauer and Dumais are statistical models of semantic memory. There are other models in cognitive science literature. These models describe meaning of linguistic expressions on the basis of lexical co-occurrences and semantic relatedness. For example, Latent Semantic Analysis represent and obtain meaning of words by statistical computations applied to a large corpus of text. The basic assumption is that words that are closer in their meaning are found frequently together in any given text. Hence, they will carry higher value than the words that are not closer.[74] Suppose a given text mentions the word-pair (snow, winter) frequently than the word-pair (alpine, winter), then LSA will associate winter with the snow more closely than with the alpine. Furthermore, snow will more be semantically related with the winter than the Alpine. Thus, we see that LSA determines meaning by semantic relatedness. The HAL model adopts the same method. It is seen that such models assume that meaning can be analysed by computations over abstract symbols.

ii. Kinstch's Construction Integration Model

In this model, semantics is discussed as knowledge representation. Knowledge representation is done through textual representation on the assumption that meaning can be analyzed by such representations. Construction integration model is model of text comprehension. Text understanding or 'meaning-making' is supposed/termed as text comprehension. In this model, it is supposed that through computations and inferences over units of text, any text can be comprehended. The model use information from the given text only and does not need pre-existing knowledge. According to this model, comprehension takes in two processes – construction and instruction. In construction, smallest units are generated. Knowledge net is activated. With continuous inferences and additional propositions, knowledge net is refined. Propositions representing local meaning are organized as microstructure and propositions of higher-level relationships form macrostructure.

[74] Landauer K Thomas et al., "An Introduction to Latent Semantic Analysis", p. 260.

Integration is the second process. Integration takes place when knowledge net is constructed. In integration, text networks from semantic level, syntactic level, discourse level, are involved. Integration occurs in repeated level. "As the new network of text meaning is formed, it is integrated with the previous circle from the working memory. Integration circle operates until all incongruities are diminished and coherent interpretation is formed."[75]

The core idea of the theory is that comprehension is generated from the textual information instead of knowledge outside the text. From construction and integration perspective, knowledge is constructed from all textual levels, and refined through reading processes. [76] In this model, it is supposed that text comprehension can be done through computations and inferences over units of any text, the model is indifferent towards what units of text, namely, words refer to. For this, only thing that matters is computations and refinement of texts by removing incongruities so that coherent interpretation of text is obtained. Thus, this model adopts the representational theory's thesis that understanding is achievable by syntactic manipulations of abstract symbols. In this way, we find that these semantic theories analyze meaning in terms of relations among representations. However, as our objective was to know the representational approach of meaning and not the analysis of semantic theories, for the present it is sufficient to move ahead with the supposition that meaning is a matter of syntactic symbol manipulation. There are many criticisms of this theory. We will look at them.

Criticism of Representational Approach of Meaning

The representational approach of meaning-making was dominant in cognitive science. However, - this approach is not without criticisms. We discuss some of the key ones.

a. Chinese Room Argument

This argument was presented by John Searle to oppose Strong AI. Strong AI holds that computers are literally like human minds and they are capable of thinking. In what sense computers are mind? Searle writes,

[75] Wenqi Xiao, "Schema theory, Construction-Integration Reading Model and Reading Pedagogy", p. 187.
[76] Ibid, p. 185-89.

> ….in the sense that computers given the right programs can be literally said to understand and have other cognitive states. In strong AI, because the programmed computer has cognitive states, the programs are not mere tools that enable us to test psychological explanations; rather, the programs are themselves the explanations.[77]

This implies that programs are not just tools for test of thinking[78] rather they themselves are explanations of cognitive states, i.e. programs are cognitive states. Searle refutes this claim of AI from his Chinese room thought experiment. The claim can be formulated in an alternate way. Searle's thought experiment aims to contradict this claim,

> […] Instantiating a computer program is never by itself a sufficient condition of intentionality. The main argument of this paper is directed at establishing this claim. The form of the argument is to show how a human agent could instantiate the program and still not have the relevant intentionality.[79]

Searle's thought experiment attacks the claim that implementing program is sufficient for intentionality. Searle's thought experiment attacks *representational meaning* too. The thought experiment goes like this:

> A computer is given a story followed by some questions. Its name is Schank. This computer runs on a pre-installed programme. Its programme is set such that it can hear any story and by using the information in the story can answer if questions are asked. Now, if Schank - the computer can answer the questions, then it is claimed, that Schank understands or thinks, according to strong AI's claim. This is tested and it is found that the computer gives right answers. Nonetheless, Searle claims that despite successful answers the computer has not understood the story. To claim this, he asks to imagine oneself implementing the given program and then tell if he has understood the story.

Suppose that I am locked in a room and given large chunks of Chinese writings. I have no knowledge of Chinese and I am not even capable of making difference between Chinese and Japanese scripts.

[77] Searle John, "Mind, Brains and Programs", p. 418.
[78] Turing test is thinking test. According to which if a machine built on strong program is able to fool one that it is not different from any human being then machine is said to be thinking.
[79] Searle John, "Minds, Brains and Programs", p. 417.

Having received the first batch of Chinese writing, I am then given the second batch of Chinese writings together with a set of rules (in a language that I follow). According to the set of rules, I have to correlate the first batch of Chinese symbols with the second batch of Chinese symbols. The rules are written in English. I can correlate only by seeing the shape of the symbols. Here I am only performing some formal operations. Formal here implies manipulation based on the shape of symbols. The correlation is, entirely made by recognizing the shape of the symbols. I am also given a third batch of Chinese symbols together with the instructions, and these rules instruct me "how to give back certain Chinese symbols with certain sorts of shapes in response to certain sorts of shapes given me in the third batch."[80] I am unaware of that the people who are giving me these symbols call the first batch "A script", the second batch "story" and the third batch "questions". The response that I am giving them back after receiving the third batch of symbols they call answers to the question of story.

Let us complicate the story. Imagine that this time these people give me stories in English, which I understand, and then they ask questions in English about these stories and I give them back the answers. What results are drawn from this? Searle says,

> Suppose also that after a while I get so good at following the instructions for manipulating the Chinese symbols and the programmers get so good at writing the programs that from the external point of view that is, from the point of view of somebody outside the room in which I am locked -- my answers to the questions are absolutely indistinguishable from those of native Chinese speakers. Nobody just looking at my answers can tell that I don't speak a word of Chinese.[81]

But I know that I am not a Chinese speaker. Have I understood the Chinese by implementing the program? Thus, the thing that is necessary for understanding English is clearly not formal manipulation, because I can answer questions of the story without implementing the program (the rules of manipulation). From the thought experiment, it also comes out that symbol manipulation or implementing the program doesn't help me understand Chinese, which is claimed as sufficient for understanding.

[80] Ibid, p. 420.
[81] Ibid, p. 419.

For Searle,

> As regards the first claim, it seems to me quite obvious in the example that I do not understand a word of the Chinese stories. I have inputs and outputs that are indistinguishable from those of the native Chinese speaker, and I can have any formal program you like, but I still understand nothing. For the same reasons, Schank's computer understands nothing of any stories. whether in Chinese. English. or whatever. Since in the Chinese case the computer is me and in cases where the computer is not me, the computer has nothing more than I have in the case where I understand nothing. [82]

The obvious thing is that what is supposed 'necessary' demonstrates that the programming cannot generate understanding. Although I formally manipulate symbols, I am not able to understand Chinese. This is the crux of the Chinese room argument.

In the same way, machine Schank (or the Schank program) understands nothing of the stories despite implementing the program. Therefore, Symbol manipulation is not efficient for generating intentionality. In this way, implementing programme is not sufficient for intentionality, which also implies that symbols manipulation based on shape of symbols is not enough for meaning-making.

b. Symbol Grounding Problem

Steven Harnad argued that mental symbols of the sort that is presented in representational theories are like letters on a page, which are meaningless in themselves. Therefore, meaningless symbols cannot bring meaning just by virtue of rule-based transformation. It is also said that it is because these symbols are ungrounded, that they fail to generate any meaning. Only grounded symbols can bring meaning.

Let us discuss the argument in more detail. For Harnad, the doctrine of cognitivism that cognition is symbol manipulation is false. This is because formal symbols are ungrounded. Meaning-making happens through grounded capacities. In his article 'The Symbol Grounding Problem', Harnad talks about real meaning-making process in humans. His explication of cognitivism is,

[82] Ibid, p. 420.

> […]which became the prevailing view in cognitive theory for several decades in the form of the "symbolic" model of the mind: The mind is a symbol system and cognition is symbol manipulation. The possibility of generating complex behavior through symbol manipulation was empirically demonstrated by successes in the field of artificial intelligence.[83]

What is a symbol system? From Fodor, Pylyshyn and Fodor's works, Harnad brings forward the following features of any symbol system. A symbols system, according to Steven is,

1. A set of arbitrary "physical tokens" scratches on paper, holes on a tape, events in a digital computer etc. that are
2. manipulated on the basis of 'explicit rules' that are
3. likewise, physical tokens and strings of tokens. i.e. the rule governed symbol token manipulation is based
4. purely on the shape of the symbol tokens(not their "meaning") i.e. it is purely syntactic and consists of
5. "rulefully combining" and recombining symbol tokens. These are
6. primitive atomic symbol tokens, and
7. composite symbol token strings. The entire system and all its parts –the atomic tokens, the composite tokens. The syntactic manipulations both actual and possible and the rules – are all
8. "semantically interpretable" ; the syntax can be systematically assigned a meaning e.g. as standing for objects, as describing states of affairs.[84]

So, symbols system is made up of symbols. These symbols can be combined and recombined according to explicit rules. Finally, the symbols and symbol structures are semantically interpretable.

Fodor and Pylyshyn, according to Harnard, think that symbol-strings of this sort capture what mental phenomena such as belief and thought capture. Cognitivism holds that mental phenomena are

[83]Harnad Steven, "The Symbol Grounding Problem", p. 335.
[84] Ibid, p. 2.

semantically interpretable symbolic phenomena. This is untrue. The first vindication is by Chinese room argument which we have already discussed.

The second vindication is by the Chinese dictionary argument, i.e. learning Chinese by Chinese dictionary alone. In both, it is argued that mere symbol manipulation doesn't bring meaning. So, what is the reason for this? The reason is that symbols of symbol systems are ungrounded. They are manipulated purely on the shape of the symbols and these symbols are implemented detached from the body or the hardware.

> A computational theory is a theory at the software level; it is essentially a computer program. And software is "implementation-independent." That means that whatever it is that a program is doing, it will do the same thing no matter what hardware it is executed on. The physical details of the implementation are irrelevant to the computation; any hardware that can run the computation will do.[85]

What really is symbol grounding problem? Harnad writes,

> It is evident that Searle (who knows no Chinese) would not be understanding Chinese under those conditions -- hence neither could the computer. The symbols and the symbol manipulation, being all based on shape rather than meaning, are systematically interpretable as having meaning -- that, after all, is what it is to be a symbol system, according to our definition. But the interpretation will not be intrinsic to the symbol system itself: It will be parasitic on the fact that the symbols have meaning for us, in exactly the same way that the meanings of the symbols in a book are not intrinsic, but derive from the meanings in our heads. Hence, if the meanings of symbols in a symbol system are extrinsic, rather than intrinsic like the meanings in our heads, then they are not a viable model for the meanings in our heads: Cognition cannot be just symbol manipulation.[86]

Interpretation should be intrinsic to the system. But they are not really. Therefore, meaning-making is incomplete.

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[85] Harnad Steven, "Symbol Grounding Problem", *Scholarpedia*, < http://www.scholarpedia.org/article/Symbol_grounding_problem> accessed on 21 November, 2020.
[86] Ibid.

c. Horst's Regress Argument

Horst thinks that computational theory fails to explain the intentionality of thoughts. Thoughts and desires are intentional states. The computational theory holds that cognition can be explained by purely formal properties. Therefore, thoughts and desires are mere symbolic processes. The *aboutness* of thoughts is expressed by the idea that symbols have semantic properties and because of which these mental states represent objects and facts.

This method of explaining the intentionality of thoughts is criticized by Horst. Horst writes that Fodor thinks semantic properties of symbols of natural language to be genuine properties of them. This is not true. The symbols of natural language are meaningful because people give them that meaning. Therefore, the semantic property is not intrinsic property of symbols. To explain the representational feature of mind, Fodor compares mental symbols with natural symbols and claim that just as natural symbols stand for objects, the same way mental symbols stand for objects. But this way of explanation falls into a regress. The linguistic symbols get their meaning from use by a community. They are mind derived. Horst writes,

> One important line of criticism that has been developed against CTM is based upon an intuition that there is something fundamentally flawed in the strategy of explaining the meaningfulness of mental states by appealing to meaningful symbolic representations. The problem, simply stated, is that CTM has the relationship between mental meaning and symbolic meaning precisely reversed. For when one is required to give an account of the meaningfulness of the symbols employed in a language, one cannot do so except by appeal to the conventions of communities of language-users, the intentions of speakers and writers, and the interpretive acts of readers and listeners. But if the meaningfulness of symbols in a language can only be explained in a fashion that invokes meaningful mental states, then CTM's strategy for explaining the meaningfulness of mental states by appeal to meaningful symbols is doomed to circularity and regress.[87]

How does one explain the meaningfulness of words in a natural language? He cannot do but appeal to the conventions of communities of language users, the intentions of speakers, etc. and all these invoke mental states. In this way, meanings of symbols themselves are dependent upon mental

[87] Horst Steven, "Symbols and Computation: A Critique of the Computational Theory of Mind", p. 354.

states. In turn, to say that mental symbols themselves are dependent on linguistic symbols is to fall into a regress. The representational approach of meaning commits this error.

> It is doomed to *circularity* because the meaningfulness of mental states is explained by reference to the meanings of symbols while the meaningfulness of symbols must in turn be explained by reference to conventions and intentions of symbol-users.[88]

Conclusion

The chapter looked at linguistic meaning as analysed in the philosophy of cognitive science. The representational approach is one of the popular approaches. According to this approach, linguistic expressions are translated into *mentalese* symbols in the mind and linguistic meaning comes from syntactic manipulations of mental representations. However, some criticisms suggest that this approach is not feasible because manipulation based on syntax of mental symbols is not sufficient for generating meaning of linguistic expressions. In the next chapter, we will see whether embodied approach of language comprehension tackles problems faced by representational approach.

[88] Ibid, p. 355.

Chapter 2

Embodiment and Meaning Making: An Alternative of Representationalism

In the last chapter, we talked about representational approach of meaning-making. Embodied cognition is a new thesis that says that the body plays an important role in cognition. The body also affects language processing. In this chapter, the main claims of embodied cognition on language processing will be discussed.

Representational View of Meaning Reconsidered

In the first chapter, we had investigated the dominant approach of meaning in cognitive science i.e. representational approach. According to this view, meaning comes from the manipulation of abstract symbols in mentalese, the hypothesized language of the mind. The question it attempted to answer was that in virtue of what facts linguistic expressions get the meaning that they have. The representational approach held that in language comprehension linguistic expressions are translated into codes or symbols in mentalese or the language of thought.[89] It was claimed that LOT had combinatorial syntax and semantics. At the time of meaning-making, the mental symbols are manipulated based on syntactical rules. Thus, linguistic meaning in this sense comes from manipulation over mentalese symbols or representations. In this way, linguistic expression in virtue of being translated as codes in the mind and being syntactically manipulated get the meaning that they have. It is also supposed that mental concepts are meanings of the linguistic words. How? because mental concepts stand for their referents in real world on account of having semantic properties.[90] For example, the meaning of the word 'Dog' is mentalese abstract concept DOG. The meaning of longer expressions like sentences or texts comes from combining the meaning of individual words. Thus, the meaning of 'Elvis is dead' comes from syntactically combining mentalese concepts ELVIS, IS, and DEAD. In the language of thought hypothesis, it had already

[89] Translation occurs because representational view of cognition holds that cognition is an abstract process. Perception is low level process and is distinct from cognition. All perceptual information is transduced into codes and cognitive activity is performed on these codes. On this view, not only language but also other information like how object looks or smell are transformed into representations or codes. Barsalou Lawrence, "Perceptual Symbol System", p. 578.

[90] See the p. 41 and p. 33 of this dissertation.

been suggested that similar to natural language, representations in LOT also possess syntax and semantics. Therefore, mentalese representations combine according to the syntax of inner language, or the *language of thought*.

In the first chapter, we had discussed that influenced by representationalism, many semantic models had also been constructed in cognitive science. These semantic models were prepared for artificial machines so that they could communicate like humans. The prominent models were HAL and LSA. The founders of these model supposed that knowledge is propositional and can be represented in a propositional way. Also, since meaning depends upon semantic relatedness, a model can be created in which there are thousands of matrices for spacing individual words, and the meaning of a word is determined by finding words that are approximate to it. Claudia Scrolli and Anna Borghi write that

> […] in *such models* (my words) word meaning is represented as vectors, detected in matrices (spaces with dimensions) which describe the co-occurrence of terms in documents. That is: the meaning of a word is derived by its relation to other words and other abstract symbols. In this way, it is possible mathematically / spatially calculating if two or more words/sentences are equivalent, namely if people represent them as semantically comparable or not.[91]

It is seen that such models portray meaning as the interrelation between words. Based on mathematical calculation, a word's meaning is determined by finding its synonym or the word that is semantically represented by people as same. To determine so, these models check the frequency of words used in larger texts. They assign value to every word and based on these values determine meaning. Thus, Snow will be more associated with winter than with white because the former occurs often with the word 'Snow' in texts.

Troubles with Representational View of Meaning

The representation view of meaning is not without problems, which we have discussed in the previous chapter. The claim that meaning can come from just formal symbols manipulation (i.e. by

[91] Scrolli Claudia and Borghi Anna, "Language and Embodiment", p. 2

applying syntactical rules considering only the shape of symbols) is not without criticisms. Chinese room argument, Chinese dictionary argument, Horst's regress argument, were all critiques of this view. Some of these arguments consisted of thought experiments in which the main idea of the representational theory was applied. The results of these experiments showed that despite attempts of manipulating symbols in the said way the understanding or meaning could not be generated; subjects could not understand the meaning of symbols. For example, in Chinese room experiment the person although exchanges Chinese symbols with the help of instructions and looks intelligent to people outside Chinese room, we find that there is no understanding of the Chinese language by the subject, because he makes exchanges of Chinese symbols just by looking at the shape of the given symbols matching them with other symbols and not by internalizing them in his mind. Similar to this, in Harnad's Chinese dictionary argument, there is mention of a person who arrives in a foreign country and gets into difficulty at the airport. The instructions at the airport are written in Chinese symbols. To understand the meaning, he looks at the definition of one of those instructions in his Chinese dictionary. But this complicates the problem more as the definition itself is written in Chinese. Now, no matter how many times he repeats this process i.e. by repeatedly looking for the meaning of the definition, he is not going to understand what those instructions convey. Harnad calls this problem *symbol grounding problem*. He proposes that the person is not able to understand instructions because the instructions are not grounded in some medium/in his mind. Now suppose, there had been a picture of a suitcase along with an arrow pointing down one corridor at the airport hoarding. In that case, the person would be able to understand the message as he could relate the pictures with his ideas. Harnad argues that just as Chinese instructions at the airport are not grounded, the symbols of LOT are also not grounded and thus are not able to convey any meaning. The crux of these thought experiments is simple. Formal symbol manipulation alone cannot give us the meaning.

Psychologist Lawrence Barsalou suggests that the reason for this failure is that symbols in representationalism are *arbitrary* and *amodal***.**[92] Abstract and arbitrary symbols cannot bring meaning. How do symbols become amodal and arbitrary and what is meant by being amodal and arbitrary? He explains that the doctrine of representationalism assumes that all cognitive functions such as thought, memory and language are processed in the mind in the symbolic or propositional

[92] Barsalou Lawrence, "Perceptual Symbol System", p. 578.

way. The information coming through bodily senses by the interaction with the environment is translated into the mind into representational structures or schemas, etc. Thus, information such as, what subjects see, touch, taste or speak is translated into symbols or codes. After the translation/ transduction happens the cognitive symbols become autonomous from their perceptual states. In this state the symbols lose all connections from perceptual states i.e. how the referents looked or smelled is lost and thus become amodal.[93] Barsalou calls symbols amodal because they lose modal features i.e. sensorimotor information. We also know that after transduction, symbols form a symbol system called language of thought that has combinatorial syntax and semantics, all cognitive processing is nothing but arranging of these symbols based on syntactical rules of symbol system.

The representational theory claims that mentalese symbols have semantic features because of which they stand for their referents. We know from Steven Horst's regress argument[94] that this is untrue. The representational claim that mental symbols have semantic features does not hold good because it compares mental symbols with linguistic symbols and says that just as linguistic expressions have semantic features the same way mentalese symbols have semantic features. Horst's argument proposed that this way of explanation is circular and thus is incorrect. Now if the symbols do not have semantic features (as Horst claimed), we do not know how representationalism can provide the answer to how symbols are related to their referents. There is nothing left for it but to say that symbols arbitrarily stand for their referents.

On this analysis we find that symbols or representations or concepts in representationalism are arbitrary (stand for referents arbitrarily, no connection between symbols and what they refer), and amodal (modal or perceptual features are absent in them. We observe that the representational view of meaning fails to explain how meaning is generated. The reason is that formal manipulation alone is emphasized; apart from this, the symbols are ungrounded, amodal, and arbitrary.

Representationalism and Embodiment

[93] Barsalou Lawrence, "Perceptual Symbol System", p. 578
[94] Refer to p. 51, Chapter 1 of this dissertation

Representationalism is mainly a doctrine about how mind functions. But in this doctrine, the physical medium in which it is implemented i.e. the body, is ignored. Embodied cognition is a new stance that improves upon representationalism. It proposes that the body actively participates in cognition and cognition must not be studied ignoring the physical details as doing so detaches mental processes from the real experiences.

As discussed in the earlier chapter, representationalism regards mind as a representational system. It proposes that the mind receives information from the sensory systems, translates them into representations, and then processes these representations. Thus, it treats body as input-output mechanism and brain as information processor. The cognitive actions, for example, thinking, planning, remembering, etc. are nothing but computational procedures over mental representations. In this way, the mind is considered as an information processing system. We can understand this from the following figure:

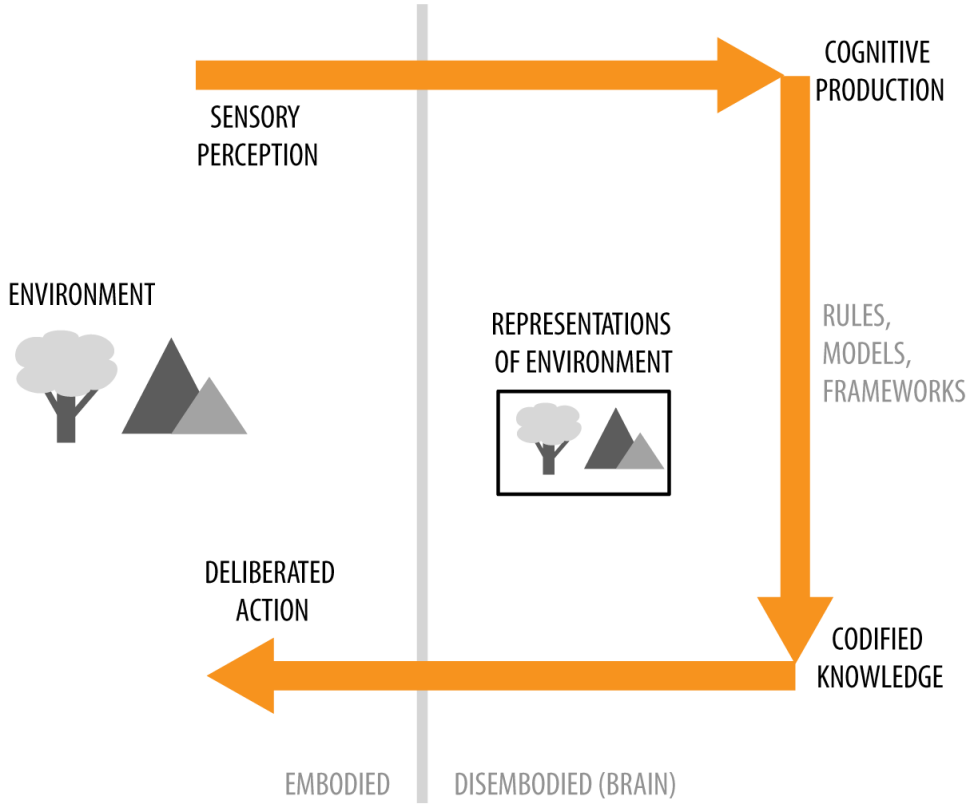

Fig 1. Mainstream Model of Cognition[95]

[95] Diagram represented from Hinton Andrew, *Understanding Context*, p. 40

The following points seem to be indicated in the above diagram:

1. The brain gathers information about the world through the body's senses.
2. It then works with *abstract representations* of what is sensed.
3. The brain processes the representational data by using disembodied rules, models, and logical operations.
4. The brain then takes this disembodied, abstract information and translates it into instructions to the body.[96]

Further points emerge:

1. Cognition seems to be an abstract process. The information achieved through senses is converted into abstract representations and the all cognitive functions happens in terms of mental representations;
2. perception and action are separate from cognition (perception and action are peripheral to cognition);
3. the body is just a source of information; and
4. the brain is a centralized place where the cognitive activities take place. This makes the rest of the body insignificant.

In this way, we find that in explaining cognition, representationalism considers abstract processes as important. The physical medium or locus, 'the physical body', where cognition happens is not taken into account and cognition is thought as an abstract process that happens in the brain.

Representationalism was influenced by famous analogy and understanding of mental functions as computational processes, that MIND is COMPUTER and Turing's computational thesis.[97] These views disregard the role of body in cognition. Appropriating Descartes's idea that mind and body

[96] Ibid, p.40
[97] Turing's computation theory has been discussed in details in Chapter 1.

are different and should be studied differently Alan Turing, the inventor of Turing thesis, drew a sharp line between a person's physical capacity and intellectual capacity. Affected by Descartes' idea, Turing proposed that intelligent acts can be described in terms of logical operations over symbols and systems that can implement and perform such symbolic operations is said to have mind or mental functions. Thus, models in cognitive science on mind appropriated this and explained cognition as autonomous, logical, and disembodied.

a) The Brain as Centre of Cognition

Representationalism is considered as a dominant view in cognitive science. Although the physical medium is not regarded as a constitutive feature of cognition it is believed that the seat of cognition is the brain. Quite often we see that cognitive scientists, psychologists, and philosophers normally pick the brain to study cognitive behaviour of people. The belief is that brain is the centre of cognition and the rest of body does not have much role to play. Raymond W. Gibbs writes that many cognitive scientists reduce mind to brain and in doing so they reduce the body to brain. In this way, they study only the brain to understand the mind. This undermines the role of the body.

> In some cases, the reduction of mind to brain carries with it the reduction of body to brain. Neuroscientists, for instance, seldom acknowledge the role played by the body as a whole in the cognitive operation of the brain. The body is reduced to its representation in the somatosensory cortex and is considered important only to the extent that that it provides the raw sensory input required for cognitive computations.[98]

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b) Embodiment Thesis

Embodied cognition is a recent development in cognitive science. It attacks the representational view that cognition is a disembodied, abstract, and autonomous process and cognitive activities can be explained through logical rules, theorems, propositions, and mathematical models. In cognitive processing, the body and its experiences are considered to have a secondary role only. However, pieces of evidence suggest that the way the body interacts with the environment and the structure/features the body has shape our cognition. In this way, cognition is not taken as an isolated

[98] Gibbs W. Raymond, *Embodiment and Cognitive Science*, p. 5

process. The problem in the representationalism/representational approach of cognition is that it does not involve these factors in their explanation of cognition and cognitive processes. The embodied thesis proposes that body and its interaction within the environment have a causal and constitutive effect on cognition and in this sense, cognition is "embodied".

Some of the common definition of embodied cognition are:

> Embodied cognition is the theory that many features of cognition, whether human or otherwise, are shaped by aspects of the entire body of the organism. The features of cognition include high level mental constructs (such as concepts and categories) and performance on various cognitive tasks (such as reasoning or judgment). The aspects of the body include the motor system, the perceptual system, bodily interactions with the environment (situatedness), and the assumptions about the world that are built into the structure of the organism.[99]

> Cognition is embodied when it is deeply dependent upon features of the physical body of an agent, that is, when aspects of the agent's body beyond the brain play a significant causal or physically constitutive role in cognitive processing.[100]

> To say that cognition is embodied means that it arises from bodily interactions with the world. From this point of view, cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capabilities that are inseparably linked and that together form the matrix within which reasoning, memory, emotion, language, and all other aspects of mental life are meshed.[101]

From the above definitions, few points that emerge are the following:

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[99] "Embodied Cognition" (n.d.), *Wikipedia: The Free Encyclopedia*. Wikimedia Foundation, <en.wikipedia.org/wiki/Embodied_cognition#:~:text=Embodied%20cognition%20is%20the%20theory,entire%20body%20of%20the%20organism.> accessed on 20 November, 2020.

[100] Wilson A. Robert, "Embodied Cognition", < https://plato.stanford.edu/entries/embodied-cognition/> accessed on 20 November 2020.

[101] Thelen E., Schöner, G., Scheier, C., and Smith, L. "The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching,", p. 1.

i. Cognitive aspects like concepts, reasoning, language, memory, emotion depend upon bodily aspects e.g. perceptual and motor system of organisms, the interaction of the body with the environment;

ii. Brain is not the only centre of cognition;

iii. Organisms' body features and interaction with the environment play causal and constitutive role in cognition. Thus, perception and action are not divorced from cognition;

iv. Cognition is situated; and

v. Phenomenal experiences ignored in cognitivism play a crucial part in cognition.

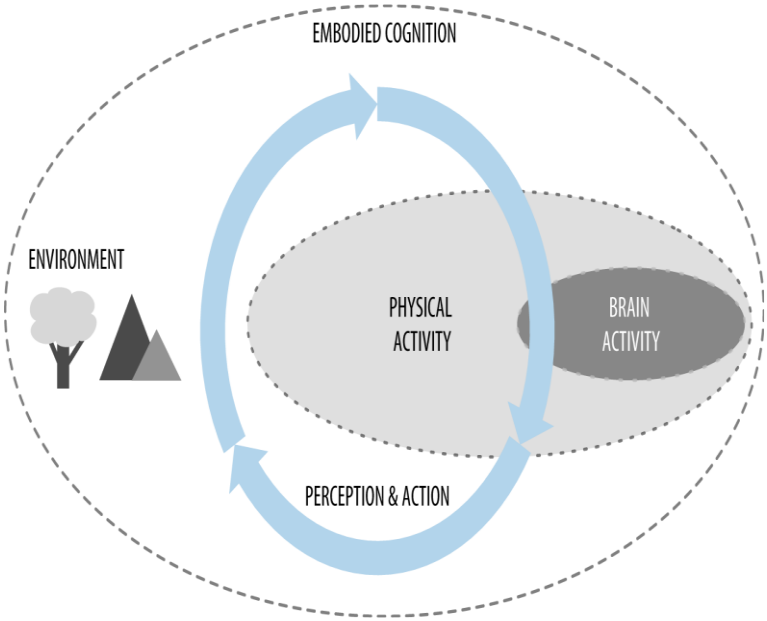

Fig. 2 A Model for Embodied Cognition[102]

We can consider few examples that suggest that cognition is embodied:

i. **Visual Perception-:** The classical idea of vision was that vision is an indirect process. The eyes receive an inverted image and brains correct the inverted picture into a straight

[102] Diagram represented from Hinton Andrew, *Understanding Context: Environment, Language, and Information Architecture*, p. 45.

picture through an internal process. J.J Gibson the pioneer of ecological psychology suggested that there happens no such correction. Rather, vision is a direct process. Eyes and brain together process visual data. The whole aspect of the reality (which is in the eye's range) is not processed in the visual process. The selection happens according to what is useful for the perceiver. Thus, perception is for action and is not an abstract process.[103]

ii. **Developmental psychology –** Researches in developmental psychology suggest that people's adaptive behaviour emerges from continuous interaction between brain, body and world and not through inner representations. For instance, infants do not have concepts like agency, cause and effect, etc. since birth. Rather they develop understanding of these concepts through phenomenological sense of their own bodies' interaction with objects and other people.[104]

iii. **Concepts -** Concepts are thought to be abstract and amodal symbols. Research reveals that concepts are grounded in sensorimotor system of the body. e.g. processing words 'anger' or 'fear' recruit emotional system of the body.

iv. **Memory-** Generally it is believed that information storage and retrieval are independent of sensorimotor system. But experiments suggest that embodied experiences facilitate remembering. For example, some behavioural researches have shown that people retrieved past experiences successfully when they assumed the same body posture which they had assumed at the time of experience.[105] In one study, subjects were first asked to remember locations and details of objects in a room. After this they were asked to point at objects without seeing them (they were blindfolded). It was found that pointing was accurate.[106]

[103] Gibson J. J., *The Senses Considered as Perceptual System*, p. 267.
[104] Raymond Gibbs, *Embodiment and Cognitive Science*, p. 8.
[105] Djiksta K., Kaschak P. & R.A. Zwaan, "Body Posture Facilitates Retrieval of Autographical Memories", pp. 139-149.
[106] Presson, C.C., D.R. Montello "Updating after Rotational and Translational Body Movements: Coordinate Structure of Perspective Space", pp. 1447-55.

Embodied View of Meaning: An Alternative of Representational Approach

The representational theory of meaning which holds that meaning comes from manipulation over symbols in language of thought was considered as insufficient and problematic. The reason why symbol manipulation could not convey meaning was that symbols in representational theory were ungrounded which made them amodal and arbitrary. By arbitrary it implies that they connect to their referents arbitrarily or randomly. There was also no necessary link between symbols and to what they referred. For example: mentalese concept DOG stands for dogs in the real world. This happens because mentalese concepts have semantic properties. In the previous chapter it was shown that semantic feature is not intrinsic to mentalese symbols. Apart from this, it was also seen that mentalese symbols lose perceptual features after transduction, for example, information like touch, taste, sound etc is lost. If the mentalese symbols lack this information, this implies that they stand for what they refer arbitrarily and not necessarily. Thus, the mentalese symbol DOG will be without information such as how a dog looks, or barks or runs etc. And it stands for its referents arbitrarily and not necessarily. Symbols are amodal as they lack modality or perceptual properties. We also looked at how representationalism ignores the role of body in cognition. Embodied cognition, on the contrary, shows that aspects of cognition are shaped by aspects of the body as well. The perspective of embodied cognition is applied to language processing also. Based on some experiments[107] it is claimed that language as well as language comprehension is also embodied to some extent.

Taking motivation from the embodied thesis, researchers in this area have developed embodied approach of language comprehension or meaning.[108] According to this approach, the symbols or mental concepts are not ungrounded and arbitrary rather they are embedded in sensorimotor states of the body and analogically related to their referents. Understanding the meaning of linguistic expressions is reactivating sensorimotor experiences that are described by those expressions. The embodied perspective of language is not a simple, singular view and contains many enmeshed ideas.

[107] I have explained experiments related to this in the Evidence Section. pp. 71-91.
[108] Barsalou L.W. "Perceptual Symbols System", pp. 209-228.
Zwaan R.A. "The Immersed Experiencer: Toward an Embodied Theory of Language Comprehension", pp. 35-62
Glenberg, A., "Language and Action: Creating Sensible Combinations of Ideas", in *Oxford Handbook of Psycholinguitics,* pp. 361-370.
Fisher M.H. and Zwaan R.A. "Embodied Language: A Review of the Role of the Motor System in Language Comprehension", pp. 825-850.

There are many assumptions in this approach but we point few of the common ones. The embodied view of meaning holds that:

i. Concepts are embodied/grounded in sensorimotor states;
ii. Understanding meaning of linguistic expressions sentences or words is a matter of simulating situations/actions involved in the language or retrieving stored experiences as described by those expressions;
iii. Linguistic expressions do not have merely literal meaning. Many expressions are metaphorically understood. These metaphors are not just poetic tools but they are linguistic tools as well. Metaphors have basis in bodily experience;
iv. Indexical hypothesis that meaning comes from indexing words to perceptual symbols and meshing affordances derived from perceptual symbols; this point needs more elaboration
v. Gestures are tightly linked to language comprehension.

In the following section, I will focus on two main claims of embodied language, grounded and analogical symbols, followed by the idea of mental simulation. After that, I will explain empirical experiments on which these claims are based.

a) Symbols are grounded

In the representational theory, we had asked in virtue of what facts linguistic expressions have the meaning that they have. We had found that it regarded meaning to be a matter of logical operation over mental symbols. These symbols had come from the transduction process, hence detached from the outside reality. It assumed that mere logical operation over mental symbols was sufficient to explain the linguistic meaning. The embodied approach rejects the idea of transduction. Representational theory only assumed that transduction occurs and cognitive processes happen in the mind in terms of abstract mental representations or symbols. It did not give any reason why should this happen? In the words of Barsalou,

> Another shortcoming of amodal symbol systems is their failure to provide a satisfactory account of the transduction process that maps perceptual states into amodal symbols. The lack of an account for such a critical process should give one pause in adopting this general framework. If we cannot explain how these symbols arise in the cognitive system,

> why should we be confident that they exist? Perhaps even more serious is the complete lack of cognitive and neural evidence that such a transduction process actually exists in the brain.[109]

Not only Barsalou shows that transduction assumption as flawed but also questions whether amodal symbols exist in the brain.

Contrary to the representational idea of ungrounded symbols, the embodied approach holds that symbols or concepts are grounded in sensorimotor processes. For instance, concept of DOG is traditionally explained through abstract proposition like, 'It barks' rather than the acoustic property of barking. The embodied approach proposes that this concept is stored in a multimodal way in our brain or the way we have interacted with this entity i.e. acoustic property of barking, colour, or experience of being bitten by dog, etc. are retrieved while comprehending this concept.

It can be a matter of confusion at times whether words/linguistic expressions are grounded or the concept of those expressions are grounded. Embodied view regards that it is mental representations or mental concepts associated with those expressions that are grounded and not the actual linguistic expressions. Linguistic expressions like words or sentences are just vehicles for these concepts. Understanding or meaning of linguistic expressions is grasped by language users when they succeed in retrieving sensorimotor information or modal concepts associated with those expressions. Claudia Scrolli has nicely captured the difference between the representational idea of concepts and the embodied idea of concepts through the following figure in her paper "Language and Embodiment", and removed confusion over the question of what is grounded - concepts or linguistic expressions.[110] She uses the Hjelmslev sign traid[111] and shows in what way the two views are different. The figure below shows how the format of signifier, signified and referent differ in representational and embodied view respectively. The figure contains a triangle. Its three corners stand for signified, signifier and referent. The sides depict whether the format of any two of the three (either signified or signifier, or signifier or referent, or signified or referent) matches or differ. By format it is implied

[109] Barsalou Lawrence, "Perceptual Symbol Systems", p. 580.
[110] Scorolli, Claudia & Borghi, Anna, "Language and Embodiment", p. 3.
[111] An evolution of linguist de Saussure's concept of sign.

whether the representations are embodied or propositional. Embodied representations are perceptual. Propositional representations are symbolic.

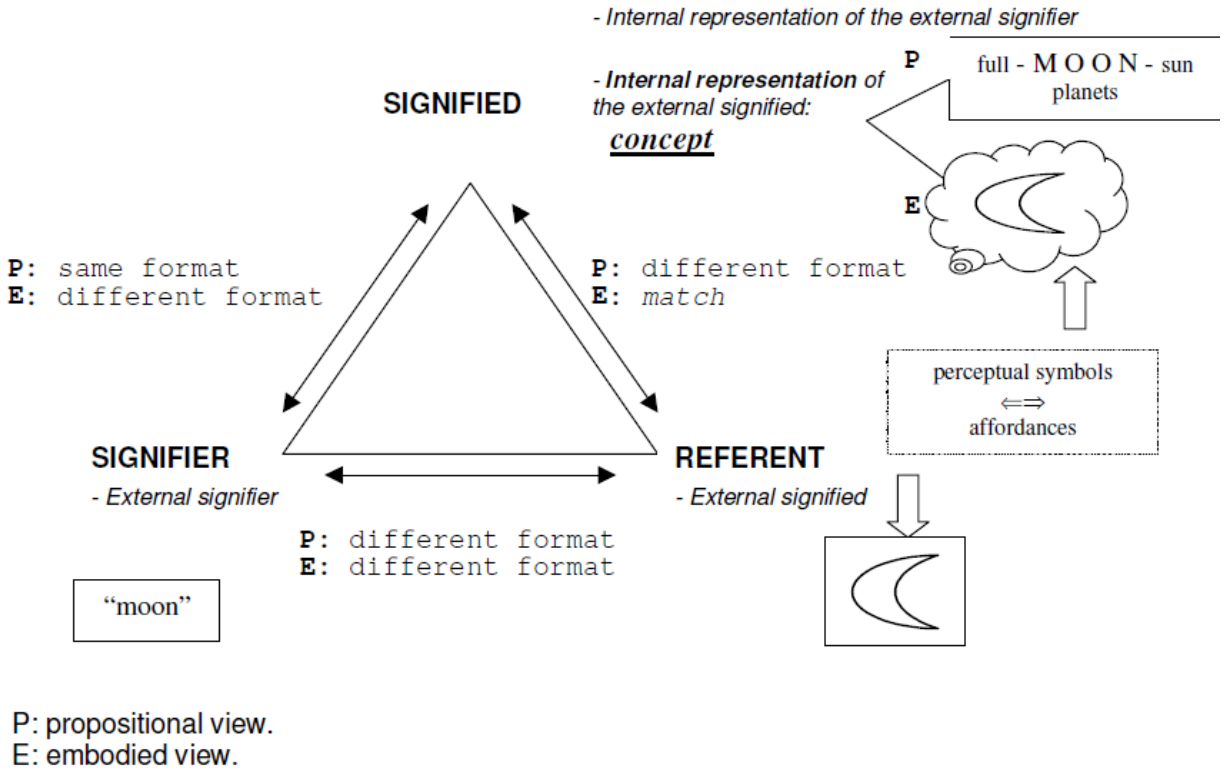

Fig. 3 Format of the Linguistic Units in Representational and Embodied Approach [112]

[112] Diagram Taken from Borghi Anna and Scrolli Claudia, "Langauge and Embodiment", p. 3.

Figure 3 can be described through the following table:

	Format of signifier and referent	**Format of signifier and signified**	**Format of signified and referent**
Propositional view[113] or classical view or representational view	Different	Same	Different
Embodied view	Different	Different	same

Table 1

According to Hjelmslev,

A linguistic unit i.e. sign is made up of two elements signifier and signified.

Signifier is image or sound of the unit.

Signified is concept (mental concept) of the unit.

Referent is real object in the environment, also called *external signified* or reality.

Sign signifier and signified together constitute a sign.

The word 'dog' together with its concept is the sign. The word 'dog' or sound 'dog' without its concept is a signifier and the concept of the word 'the dog' is signified.

What changes do we see in the embodied view? It is that the format of signified i.e. the concept, and that of the referent are the same. The concept or the internal representation of the word or the signifier is embodied, it retains the feature of its referent. For example, the internal mental representation of the word 'cat' is grounded or embodied. Thus, the internal representations bear the resemblance with their referents, which in propositional/representational view was different (internal representations or the concepts were symbolic and did not match with their referent.)[114] Apart from this, in propositional/representational view, it was supported that the syntactical rules that apply on signifier or linguistics signs (words, phrases, etc.) apply also on signified i.e. the concepts or internal representations (the same grammatical rules for internal representations, etc.). In embodied view, this view is rejected. It is proposed that although

[113] Claudia calls representational approach as propositional approach in her paper.
[114] Representational view is called by Claudia the propositional view.

syntactical rules may apply, the format is different, it is not propositional; it is modal. The mental concepts have all modal properties i.e. auditory, visual or gustatory, etc.

On embodied view, the internal activity in the mind is not propositional but experiential during language processing. This means that at the time of language comprehension, modal information related to words, phrases, or propositions which those expressions describe are retrieved or simulated. Claudia talks about traditional or representational approach of concepts in the following way:

> […] the propositional classical view of concepts assumes that the mental representations of the external signified has the same format and syntactical rules of the external signifier, intended as the linguistic sign. So, language is mentally represented in terms of linguistic symbols and the relationship with the external referent is not taken into account.[115]

She says that in representational approach, format and grammatical rules for the external signifier and for internal representation/signified/mental concept are same. For example, the word 'dog' and its concept DOG has the same format and syntactical rules. This is because in representationalism it is supposed that cognitive processes take place in a *language of thought*. Similar to other cognitive processes language is also represented mentally in terms of linguistic signs. It is ignored in this approach that to represent external referent, the internal representation or the concept should have some linkages with its referent. Since the format of internal representation is different from that of its referent, there seems difficulty in making any linkages between the two.

Furthermore, she describes -

> […] instead the embodied theory states that the format of concepts *matches* the format of their referents', i.e. our experience with/in the extra-linguistic reality to which they refer. In keeping with this view, the Indexical Hypothesis – that relates the general theory of embodied cognition to language comprehension – claims that language refers to objects and situations, or to the affordances of a situation.[116]

[115] Scrolli Claudia, Borghi Anna, "Language and Embodiment", p. 3.
[116] Ibid, p. 3.

Contrary to representational view, the format of concepts matches with that of referents and thus, the two are not arbitrarily linked in the embodied view. The embodied view is supported by the indexical hypothesis which holds that language comprehension is about simulation of objects and situations described in the language. .

> The link between the mental representation of the signifier and the representation of the signified is arbitrary (for example, a "dog" is called "cane" in Italian). However, the internal representation of the referent is neither arbitrary nor abstract, but is rather grounded. Namely, in this view objects are represented in terms of perceptual symbols that are not arbitrarily linked but are rather analogically related to them (Barsalou, 1999). Perceptual symbols are multimodal, because they activate different motor and sensorial information tightly linked to the interaction with the world, pertaining vision, audition, taste, touch, motor action etc.[117]

In the embodied view, the internal representation of the referent is grounded and it is not arbitrarily connected to its referent or abstract. For instance, internal representation of DOG is grounded (Internal representation of dog contains information from every modality i.e. colour, shape, barking sound of the dog etc.). The internal representation is also termed as perceptual symbol. Thus, according to embodied view objects are internally/mentally represented in terms of perceptual symbols. These symbols are multimodal as they activate the different motor and sensorial information during language comprehension and which are the result of speaker's interaction with the world, pertaining to vision, audition, taste, touch, motor action etc.

b) The Idea of Simulation:

It has been observed from experiments that people mentally simulate[118] situations or actions as described by any linguistic expression when they are comprehending that expression. Based on this, the embodied approach proposes that mental simulation is a crucial part of language understanding.[119] The basic idea is that the sensorimotor process that is involved in perception and physical action is also involved during the use of words or sentences, which refer to those

[117] Ibid, p. 4.
[118] Mental simulation is actually reactivating experience which words or sentences refer to.
[119] Cedric Galetzka, "The Story So Far: How Embodied Cognition Advances Our Understanding of Meaning-Making", p. 1.

perceptual or physical acts. Like, the neural mechanism which gets activated during the taste of lemon also gets activated during comprehending or producing the word 'lemon'. When any language user thinks of this word, his experience of interacting with the referent of this word also gets activated. This happens also with sentences that involve any physical action. Kashchak and Zwaan remarks,

> […] understanding a sentence about removing an apple pie from the oven would involve the retrieval of trace of motor experience (lifting the pie and feeling its weight) and perceptual experience (seeing and smelling the pie, feeling the heat coming out of the oven). The relevant memory retrieval occurs by probing the same sensorimotor processing mechanisms that would be involved if one were actually lifting, seeing, and smelling the pie.[120]

It is believed that mental simulation is a common mechanism in language understanding without which understanding would not be possible. The embodied proposal entails that "understanding the meaning of words involves activating modality-specific representations or processes."[121] The idea of mental simulation is effective because of the following reasons,

a. Symbols grounding problem – It grounds symbols to one's experience and attempts to solve symbol grounding problem.
b. Parsimony- The hypothesis does not need to suppose a separate *language of thought.* The simulation hypothesis posits that information received through senses is directly retrieved during cognitive processing. Thus, information does not have to be converted into symbols before any cognitive processing, as representationalism holds, and which is more economical. Because of this reason also, the simulation hypothesis is plausible.
c. Introspection- One can introspectively notice that while processing language, something like simulation is happening in his mind.[122]

In this way, we see that mental simulation is essential for language understanding.

[120] Kashchak M & Zwaan R.A., "Language in the Brain, Body and World", in *Handbook of Situated Cognition,* p. 368.
[121] Bergen Benjamin "Embodiment, Simulation and Meaning" in *Routledge Handbook of Semantics*, p. 142
[122] Ibid, p. 144.

Evidence for Embodied View of Language

In this section, we explore the experimental evidences in support of embodied view of language. These studies suggest that mental simulation, metaphors, gestures, embodied experience etc. play important roles in aspects of language, like, language comprehension and production; discourse and communication; text comprehension; concepts; etc.

A. Simulation Experiments for Concrete Words and Sentences

In this section, we will discuss two types of experiments: behavioural and neuropsychological. Behavioural experiments involve reaction-time studies, etc. as they check whether people simulate actions described in the language or not by observing their response behaviour. Some behavioural studies notice that people's simulation is specific. People simulate colour, shape, size of the objects or the orientation of actions, etc. In reaction time studies, researchers check the frequency of response to a given percept by subjects during online language processing. Similarly, other studies have been mentioned which measure participant's behaviour. The neuropsychological experiments measure brain activities during language comprehension by participants.

Both studies are sub-divided into perceptual and motor simulations. Studies that track simulations related to perceptions (colour simulation, shape, etc.) are under perceptual simulations while studies that track simulations related to motor activity (physical movements like kicking, walking, etc.) are under motor simulations.

1) Behavioural evidence:

a) Perceptual simulation

i) Shape Specific

In this experiment, subjects had to read a sentence (The eagle is in the sky) after which they were shown a picture. Then they had to respond if the seen picture was similar to the picture of the sentence. People chose the picture whose orientation matched with the orientation of the picture implied by the sentence (i.e. participants chose the picture of an eagle with stretched wings). The importance of this study was that although the tested sentence had not mentioned the orientation of the object (i.e. an eagle is in the

sky.) Still, participants chose the picture of an eagle with stretched wings more quickly than a picture of an eagle with closed wings. This experiment suggests that speakers simulate the shape of objects in the situation mentioned by the sentence.[123]

ii) Modality Specific

Another experiment was to check whether concrete words activate perceptual representations. Subjects in this experiment had to verify various judgments (they were presented with sentences which described an object with its properties.). The results showed that participants were faster in verifying properties of objects when subsequent items remained in the same modality. Subjects verified that lemon is sour more quickly after verifying that an apple is tart than after verifying that a lime is green. In another experiment, similar results were observed. Participants were slower in verifying an auditory property of an object (e.g. blender-loud) when they had just verified a gustatory one (e.g. cranberries-tart), than another auditory property (e.g. leaves-rustling). [124]

The results seem to indicate that people mentally simulate auditory as well as other perceptual properties when comprehending words related to those properties.

iii) Mental imagery

Participants were asked to write properties of object designated by noun 'watermelon' and then noun-phrase 'half watermelon'. It is seen that in the latter case people often list internal properties like red, sweet, seeds, etc. but not in the former case. This indicates that people use mental imagery during the processing of noun-phrases.[125]

iv) Colour Specific

In an experiment, participants were given a sentence that implied colour of an object (e.g. John looked at the steak in his plate). Then they were shown two pictures: a brown and a red steak picture. After the presentation, the participants had to reply whether

[123] Stanfield R & Zwaan, R.A., "The Effect of Implied Orientation Derived from Verbal Context on Picture Recognition", pp. 153-56.
[124] Pecher D., Zeelenberg R. & Barsalou L., "Verifying Different Modality Properties for Concepts Produces Switching Cost", pp. 119-24.
[125] Barsalou L., W. Solomon K, & Wu L, "Perceptual Simulation in Conceptual Tasks", pp 209-228.

shown picture matched with the picture implied in the sentence. It was found that participants selected the picture that contained the colour which the object described in the sentence implied. In this way, it was claimed that people simulate the colour of objects also during sentence processing. Note that in this experiment, participants were asked to choose the object implied by the sentence and not the colour. But they chose the picture of the respective colour.[126]

b) Motor simulation

i) Action Specific

This experiment suggested that comprehension of sentences retrieve motor traces (they get stored after performing any physical activity) also. Participants had to read sentences describing motion towards the body or away from the body (open the door; close the door, etc.). They were asked to tell the sensibility of the sentences by making hand movements (by making arm movement towards or away from one's body). Among sensible sentences, people made judgments more quickly when the response direction matched with the sentence implied direction. They were slower in making judgments for mismatch conditions. This shows that motor traces were activated during sentence comprehension apart from sense involved locations.[127]

ii) Orientation Specific

This experiment supported that perceptual simulations that arise during language processing have dynamic components as well. Participants were asked to read sentences about objects moving towards them or away from them ("the first baseman threw you the ball." or "you threw the ball to the first baseman."). After this, they had to see two images in rapid succession and then decide if the images were the same. These images were aligned in two ways: the first image was a big dot and the second image was a small dot. The small dot followed by the bigger dot was first way and the bigger dot followed by the smaller dot was the second way of representation indicating the motion

[126] Connell L., "Representing Object Colour in Language Comprehension", pp. 476-485.
[127] Glenberg A.M. & Kashchak M.P., "Grounding Language in Action", pp.558-565.

towards or away. The results showed that responses were faster when the direction of motion implied by the dots matched the direction of motion described in the situation.[128]

iii) Motor simulation involving Perceptual Simulation

This experiment supported that the actual mechanism involved in auditory and visual processing are engaged during language comprehension. Participants were asked to listen to sentences describing motion in one of four directions: towards, away, up, and down (the car approached you, the car left you in the dust, the rocket blasted off, the confetti fell on the parade). At the same time, participants viewed black and white stimuli depicting motion in either the same direction as that described in the sentence (e.g. viewing a *toward* percept while hearing a *toward* sentence) or in the opposite direction as that described in the sentence (e.g. viewing an away percept while hearing a *toward* sentence). Participants made sensible judgments more quickly for the critical sentences when the direction of the motion in the percept mismatched the direction of motion in the sentence. Kaschak explained this in the following way:

> [this is] ……the result of a competition for resources within the visual system. The *toward* percept is engaging the parts of the visual system that respond to *toward* motion, and thus it is difficult to use these parts of the visual system to simulate the *toward* motion described in the sentence. When the direction of motion in the percept and sentence mismatch, there is no such competition, and comprehension is more facile.[129]

The reason for the mismatch is the engagement of the part of the perceptual system for motion check of the percept. Therefore, participants were quicker in judging sensibility in the mismatch condition.

[128] Kaschak M. & Zwaan R.A., "Language in the Brain, Body and World", in *Cambridge Handbook of Situated Cognition,* p. 373.
[129] Ibid, p. 374.

iv) Motor effects during online language processing

This was first of its type to investigate motor effects during online language processing. In this experiment, participants were presented with the sentences in segment. For example, "he/realized/that/the music/was/too loud/so he/turned down/the/volume." Subjects had to turn a knob clockwise/anticlockwise each time with a five-degree rotation for one segment of the sentence. It was found that reading time was shorter when the direction of rotation and direction implied by the sentence matched (turn down volume means counter-clockwise rotation.)[130]

v) Simulation for emotion involving word

It is observed that people engage emotional system during comprehension of emotion involving expressions. In one experiment, participants are given emotion involving sentences and then they are induced into certain emotive conditions. After which they are asked some questions. To induce smiling posture, participants are asked to hold a pen in their teeth and to induce frowning posture, participants are asked to hold a pen in their lips. After which they read sentences that involve emotions of either positive or negative valence. It is observed that if the forced posture and emotion implied by the sentence match then participants reply faster to the sentences than when the two do not match. This shows that participants activate emotional system when they comprehend emotion involving words.[131]

2) Neuroscientific evidence

a) Perceptual simulation

i) Sound and Taste specific

Using fMRI technique Julio Gonzalez have shown that comprehending odour related words such as *jasmine*, *garlic* or *cinnamon* etc. produces activation of olfactory cortex.[132] In another research, it was observed that words related to sound activate

[130] Zwaan R.A. & Taylor L., "Seeing, Acting, Understanding: Motor Resonance in Language Comprehension", pp. 1-11.
[131] Glenberg A.M., Havas D., Becker R. & Rinck M., "Grounding Language in Bodily States: The Case for Emotion", in *The Grounding of Cognition: The Role of Perception and Action in Memory, Language, and Thinking* edited by R.A. Zwaan & D. Pecher, pp. 115-128.
[132] Julio Gonzalez et al. "Reading Cinnamon Activates Olfactory Brain Regions", pp. 906-12.

superior temporal cortex region of the brain.[133] Olfactory cortex and Superior temporal Cortex are for smell and sound perception respectively.

b) Motor simulation

i) Action specific

Motor systems activate during comprehension of action verbs like *kick* or *give*. Motor systems (somatotopic activation of motor and premotor cortex) are activated by subjects to simulate the actions implied by these words. In another study, Marco Tettaminti using fMRI technique found that processing sentences of mouth and hand actions such as "I bite an apple", "I grasp a knife" activate pars triangularis of the left inferior frontal gyrus known as Broca's area and hand region in the left precentral gyrus.[134] These brain regions activate when any hand or mouth action is performed by the participants.

ii) Processing of emotion involving words

The simulation is also observed for emotive words. N. Isenberg found in one study that people's emotional system is activated when they comprehend words of threat valence. In his study, some subjects were asked to name the colour of words of either threat or neutral valence. *Destroy, mutilate,* etc. were threat words while *cups, reside,* etc. were neutral words. During the response, using a lab method subjects' neural activity was checked. It was found that bilateral amygdala activation was greater in case of threat words than in case of neutral words. It is well known that amygdala plays important role in emotional processing.[135] Thus, this study established that comprehension of emotive words evokes emotional system of people.

This supports the view that words are grounded. The behavioural studies showed that people simulate semantic content of linguistic expressions like words and sentences. Evidences suggested that words which denote objects or events in the world, their comprehension leads to simulation by subjects. Subjects simulate colour, taste, sound, physical actions of the objects

[133] Kiefer M. & Pulvermüller F., "Conceptual Representations in Mind and Brain: Theoretical Developments, Current Evidence and Future Directions", pp. 805-825.
[134] Marco Tettamanti et al. "Listening to Action-related Sentence Activates Fronto-Parietal Motor Circuits", pp. 273-281.
[135] Isenber N., "Linguistic Threat Activates the Human Amygdala", pp. 10456-10459.

and situations which linguistic expressions describe. The behavioural studies were based on participant's verbal response and external behaviour. Since they do not check the internal processes in the brain, they remain incomplete evidence for semantic grounding. For this, neuroscientific studies were also presented. These studies complemented the behavioural studies. They supported behavioural studies that people simulate during language comprehension as lab-based studies pointed at internal processes during comprehension in participants' brain. There it was seen that brain region that are for perception and action get activated when subjects comprehend sentences or words that involve information related to perception and actions. These evidences do indicate that linguistic expressions are grounded in body's perceptual or motor system.

B. Embodied Concepts: Perceptual Symbol System Hypothesis and Neurophysiological Research

Traditional Idea of Concepts

The representational view assumed that concepts are generated by abstract, arbitrary and amodal symbols and abstract symbols lead to abstract concepts. In philosophy and psychology also, the traditional assumption on concepts is that they are stored as mental representations and used to identify objects or events in the real world. The concepts are defined by abstracting common features of objects that come under it. Thus, concepts capture the essences of objects.

Some traditional theories regard that rules determine which objects will be categorized into a particular concept. For instance, to identify what objects are chairs it is said that objects that have four legs and made up of woods (can be made of other materials as well) are chairs. It is also held that concepts are conventional and not ad-hoc. That is, they cannot be created at will. Clearly, lot of counterexamples can be presented against this criterion. Like, the category "things to take on camping" is ad-hoc and experience-based.

It should be noted that concepts vary from person to person. In one study, it was found that people's idea of conventional categories like bachelor, bird, or chair are not the same. Only 47% of the features in one person's definitions for a category existed in another person's definitions. Even a single person's definition of a category changes with time. When

participants in a study returned two weeks later and defined the same category again, only 66% of the features produced noted in the first arrival were produced again in the second session.[136] In this way, the traditional idea is that concepts are mental objects, disengaged from reality, representable in terms of logical rules and propositions; and thus disembodied, abstract and arbitrary.

Embodied Concepts

Embodied approach holds that concepts are embodied. In thought and communication, we use concepts. We have already seen that concrete concepts are grounded in sensorimotor system of the body. There are some abstract concepts e.g. virtue, justice, liberty, which are thought to be extra-sensory and requires conceptual analysis o understand. But research in cognitive linguistics suggests that even these concepts are embodied. Neurophysiological evidence suggest that people activate sensorimotor areas of the brain for the comprehension of abstract concepts of this type. Linguistic analysis suggests that these concepts are understood through image schemas and metaphors. Image schemas and metaphors are basic level concepts and they have basis in embodied experience. The mental simulation occurs in people for these concepts due to the embodied nature of metaphors. There is a popular perceptual symbol system hypothesis that systemically explains how grounded symbols in the human mind give way to embodied concepts. We will look at this hypothesis in brief.

Perceptual Symbols

A key question is how abstract and concrete concepts are constructed. We have seen that traditional theories on concepts do not give adequate answers. However, perceptual symbol system hypothesis by Lawrence Barsalou is a paradigm in this area. It proposes that concepts are perceptual/multimodal, flexible and reside in sensorimotor areas. It also explains how they are constructed in the human mind.

[136] Gibbs R.W., *Embodiment and Cognitive Science*, p. 84.

Some features of the perceptual symbols:

a. **Analogical or Non-arbitrary:** Given their similarity to the objects they represent, symbols are analogical. That is, symbols arise from perceptual states and thus retain properties that they had apprehended during the experience of their referents.

b. **Componential:** Normally we think that concepts capture whole objects or events. But this hypothesis tells that perceptual symbols do not necessarily capture every aspect of the thing or the event from whose perception they arise. A person's concept of cakes might carry only its sweetness while that of someone else may retain the lightness of cakes. In this way, people's concept formation depends upon what feature of object or event they attend.

c. **Specified by Neural Representations:** Perceptual symbols are not necessarily conscious images rather they are neural representations in sensory-motor areas of the brain. For example, perceptual representation of chair may not be a conscious image of it but can be specified as the configuration of neurons in the visual system.

d. **Multimodal:** Perceptual symbols can retain information from all modalities. *They are multimodal, arising across the sensory modalities, proprioception, and introspection*. Barsalou claims that symbol formation process can operate on any aspect of perceived experience. It operates on vision, audition, haptics, olfaction and gustation that are sensory modalities. It also operates on proprioception[137] and introspection. Selective attention focuses on some aspect of perceived experience and stores records of them in long term memory. In this way, wide variety of symbols are stored like, from perceptual symbols for speech, from touch perceptual symbols for texture and temperatures, from proprioception perceptual symbols for hand movements and body positions Each type of symbol becomes established in the respective area.

[137] Proprioception is perception or awareness of the position and movement of the body.

Perceptual experiences are received through various channels or sensory organs. Selective attention captures relevant information at the time of perception and stores them in memory. In this way, symbols of various modalities get formed.[138]

Empirical Support for Perceptual Symbols

Neuroscientific studies also show that symbols are modal. The damage in sensorimotor areas affects respective concept processing, like, damage to visual area disrupts the conceptual processing of categories specified by visual features e.g. birds. The damage to motor and somatosensory areas affects the processing of words that involve motor and somatosensory features (e.g. calculator, tap, etc.)[139] Neuroimaging studies also show that visual areas are active during the processing of nouns.[140] Imagery examples suggest that processing words concerned with manmade objects activate the left ventral cortex. Concepts are claimed to be multimodal, which are shown in different experimental studies. Some patients with certain disabilities could not recognize a thing with its name but when they were told its use they retained the name. This shows that concepts are not disembodied. They retain embodied experience audial, visual as well as motor experience.

C. Metaphors and Abstract Words

Linguistic expressions like verbs, nouns, or prepositions or adverbs normally seem to be related to bodily experience, there are abstract words or concepts, e.g. rationality, virtue, justice, inflation, argument, etc. which do not appear to be grounded in bodily experience. There are also polysemous words that have multiple meanings e.g. stand, open, etc. These expressions pose a challenge for the embodied approach.

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[138] Barsalou Lawrence, "Perceptual Symbol System", p. 585.

[139] A. Martin et al. "Discrete Cortical Regions Associated with Knowledge of Colour and Knowledge of Action",1995; pp. 102-105 ; Pulvermüller "Words in the Brain's Language", pp. 253-279.
1999; Rösler et al. "Distinct Cortical Activation Patterns During Long-Term Memory Retrieval of Verbal, Spattal and Color Information", 1995, pp. 51-65.

[140] DeRenzi & Spinnler. "Impaired Performance on Color Tasks in Patients with Hemispheric Lesions", pp. 207-217.
1967; Levine et al. "Two Visual Systems in Mental Imagery: Dissociation of "What" and "Where" in Imagery Disorders due to Bilateral Posterior Cerebral Lesions" 1985; pp. 1010-8 Rösler et al. 1995, pp. 51-65.

However, metaphor theory in cognitive linguistics developed by thinkers like George Lakoff, Mark Johnson provides a response for this problem. The theory posits that abstract concepts and words have bodily basis. They say that those words are understood through metaphors and metaphors originate from bodily experience. In this way, they are embodied. People use metaphors because they are nearer to their understanding. We will discuss it in brief. What are metaphors? and how do they help understand abstract and complex words?

In their book, *Metaphors We Live By*, Lakoff and Johnson propose that metaphors are linguistic tools that are used to understand one concept in terms of another.[141] For example, understanding concept ARGUMENTS in terms of concept WAR. To know how abstract concepts are comprehended, one needs to analyse how people think and act on these concepts normally, because how one thinks and acts is not exposed in the literal language i.e. spoken and written language. Furthermore, analysis of written or spoken language is not sufficient to understand abstract concepts. Lakoff and Johnson are suggesting that we have to analyse the conceptual system. Conceptual system is the system used when people think and act. They believe that people's conceptual system is mostly metaphorical and therefore, metaphors are pervasive in conceptual processing. To quote Lakoff and Johnson,

> Metaphor is for most people a device of the poetic imagination and the rhetorical flourish-a matter of extraordinary rather than ordinary language. Moreover, metaphor is typically viewed as characteristic of language alone, a matter of words rather than thought or action. For this reason, most people think they can get along perfectly well without metaphor. We have found, on the contrary, that metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature.[142]

What is implied from the sentence that metaphors are pervasive in conceptual processing? Lakoff and Johnson hold that people's conceptual processing are mediated by metaphors most of the time. People think in terms of metaphors. Concepts such as virtue, rationality, beauty, which do not have strict definitions; which are not based on and given in our direct experience

[141] Lakoff G., Johnson M., *Metaphors We Live By*, p. 5.
[142] Ibid, p. 3.

are comprehended in terms which are more accessible to them, i.e. more concrete terms. Lakoff and Johnson writes,

> [M]etaphor pervades our normal conceptual system. Because so many of the concepts that are important to us are either abstract or not clearly delineated in experience … we need to get a grasp on them by means of other concepts that we understand in clearer terms …[143]

A nice example is the concept of love. People understand LOVE in terms of JOURNEY.[144] In a journey, we travel some distance, face difficulties, and attempt to reach our destination. Love is, in the same way, understood as a journey. Another example is TIME. People understand time in terms of money. As if time is a valuable commodity. We don't give everybody our precious time. Time is not spent wastefully.

TIME IS MONEY
You're *wasting* my time.
I don't *have* the time to *give* you.
How do you *spend* your time these days?
I've *invested* a lot of time in her.
You're *running out* of time.
You don't *use* your time *profitably.*
Thank you for your time.

It was claimed earlier that abstract concepts are embodied because the metaphors in terms of which they are understood have physical or bodily basis. That is, they originate from our bodily experiences. For example, the words UP and DOWN. UP is associated with positive emotions while DOWN is associated with negative emotions. Thus, HAPPY is UP and SAD is DOWN. This association seems to stem from our bodily understanding of postures and its relation to certain moods, activities that we perform in different situations. Concepts are claimed to be embodied. Lakoff and Johnson list some metaphors, for example, *orientational* and *ontological* metaphors that are in some way experience or body-based.

[143] Ibid, p. 115.
[144] This concept can be understood in many other ways also. But for the time being, it is being explained through LOVE is JOURNEY metaphor.

Orientational Metaphors

These metaphors have to do with spatial orientation. Orientational metaphors give a concept its spatial orientation. These metaphors are not arbitrary. These spatial metaphors arise from the nature of our bodies and experience with nature, according to Lakoff and Johnson. We can look at some orientational metaphors and see how these metaphors have bodily basis.

a. MORE IS UP, LESS IS DOWN: My income rose last year. His income fell last year.
   Physical basis: If you add more of a substance or of a physical object, the level goes up.
b. CONSCIOUS IS UP, UNCONSIOUS IS DOWN— Wake up. I'm up already. He sank under coma.
   Physical basis: Humans sleep lying down and stand up when they awaken.
c. HAPPY IS UP, SAD IS DOWN: I'm feeling up. My spirits rose. I fell into a depression. My spirits sank.
   Physical basis: drooping posture goes along with sadness and depression, erect posture with a positive emotional state.

If something is more, it is considered to be higher. But this should not be always the case. Because MORE can be used for things that are not higher, for example, more water. But common usage such as "his income rose last year", or "his income fell last year" points that people associate more with higher level and less with lower level. Lakoff and Johnson does not say that this happens always, but suggest that it happens often. He just shows that people understand concepts in more concrete terms that are close to their physical experience or bodily experience. When we stand, the posture is said to be more energized, when we sit, the posture is said to be less energized. However, this need not be true always. They suggest that such usage are conventional and these examples suggest that people understand concepts in terms of their experience. In this way, we see that orientational metaphor are body or experience based.

Ontological Metaphors

Some concepts are understood in terms of objects and substances. Lakoff and Johnson call them ontological metaphors. For instance, he broke down (as if mind is machine and some damage caused it to break down). Let us look at some examples:

INFLATION IS AN ENTITY
Inflation is *lowering* our standard of living.
If there's much *more inflation,* we'll never survive.
Buying land is the best way of *dealing with inflation.*
Inflation makes me sick.

THE MIND IS A MACHINE
We're still trying to *grind out* the solution to this equation.
My mind just isn't *operating* today.
Boy, the *wheels are turning* now!
I'm *a little rusty* today.
We've been working on this problem all day and now we're *running out of steam.*

These examples suggest people do not take the literal meaning of concepts often. They comprehend them in terms of concepts that are more familiar to them, which they can relate to their experience. In this way, the analysis of ontological and orientational metaphors suggests that concepts are embodied.

D. Indexical Hypothesis: Embodied Experience and Language Comprehension

Developed by Art Glenberg and David Robertson, this hypothesis too supports that meaning is embodied. This hypothesis explains how linguistic expressions become meaningful to someone. It does so by applying the general theory of embodied cognition to language comprehension. It is a basic hypothesis of embodied cognition that cognition is for action.[145]

Animals take action to survive in the wild world. They have to know what is helpful for them to survive in the environment. The type of actions that they can perform is constrained by the kind of body they have. Elephants cannot jump, crows cannot creep and humans cannot fly, etc. in a given situation, each creature has to adopt a different strategy for survival. Thus, a given situation has varying significance to each animal. For a particular animal, a situation's meaning is dependent on what he can do in that situation. Gleberg proposes that a situation is meaningful when the set of actions available to the animal mesh or cohere. For him, the set of actions depends upon three components.

[145] Wilson M., "Six Views of Embodied Cognition", p. 626.

Affordances: Affordances are properties that arise from the interaction between a creature and objects of the environment. The properties that arise are constrained by the nature of the animals's body i.e. bodily abilities. We can say that affordances are based on the relation between body and environment. Like a chair affords 'sitting' to a person at a conference. But the chair may afford the man as a 'hitting tool' when the person is in an isolated street and encounters a thief. A chair at the same time does not afford 'sitting' to elephants because their bodies do not support this action.

Learning history: it involves personal experiences of actions and learned cultural norms for acting. Like a chair on display in a museum affords sitting but that action is blocked by cultural norms.

Individual's goals: "A chair can be used to support the body when resting is the goal and it can also be used to raise the body when changing a light bulb is the goal". In every context, organisms have some goals which define their actions. Hence, goal is important.

Thus, it is seen that three components - affordances (embodiment), past experiences, and individual's goal determine the set of actions available to animals/humans in a given situation. A meaningful situation is that in which set of actions are coherent. These components should integrate in such a manner that a coordinated set of actions emerges for meaningful construal of the situation. Suppose I am in a jungle. In this situation, I would like to either wander in the jungle, or in case any threat appears I would like to save myself from the predators or do something else depending upon the situation I am in. So, the goal is important. My action taking ability depends also upon my bodily abilities, in order to save myself from predators I cannot fly like birds, though I can run or use my hands to attack the animal. Apart from this, my learning history also matters to the fact of what can I do in that given situation. In this way, situations' meaning for someone is a coherent set of actions that one can do in that situation. If I have to save myself from a predator attack, the situation meaning is that in which affordance of my body i.e. attacking by hand, and affordance of the predator i.e. his jumping off to my body mesh. Thus, the situation's meaning emerges from the meshing of affordances.

Glenberg applies the general thesis of embodied cognition that cognition is for action to language comprehension and develop indexical hypothesis. On this view, just as we understand the meaning of a situation by cognitively construing meshed set of actions; similarly in understanding a linguistic sentence, we cognitively simulate actions implied by that sentence. In a meaningful sentence, derived actions created through affordances mesh. If the derived actions do not mesh, then the sentence is thought to be non-sensical.

According to Glenberg's indexical hypothesis[146], understanding is a three-stage process. People come to understand any linguistic expressions in the following steps:

a. In the first step, words are indexed or mapped to actual objects or analogical perceptual symbols. E.g. while reading a sentence involving the word 'chair', the word is mapped to an actual chair in the environment or the prototypical representations of the chair in the mind of the listener.
b. In the second stage, affordances are derived from the indexed objects or perceptual symbols.
c. In the last stage, affordances are meshed under the guidance of the syntax of the sentence.

If affordances mesh, then sentences are thought to be sensible that are otherwise non-sensical. Consider the sentence- "Jareb stood on the chair to change the light bulb". In this sentence, we first map words to perceptual symbols. We index Jareb to the perceptual concept of any human. The word 'chair' is indexed to the listener's perceptual concept of chair i.e. chair in a given environment and so on. In the next step, we derive affordances from the indexed objects, i.e. possible actions that can emerge from indexed objects 'Jareb', 'chair', or 'light bulb'. . Jareb can sit, stand or walk etc but noy fly or disappear. A chair can afford sitting but not cooling, light bulb can be changed but not flown etc. In the last stage, we mesh the affordances guided by the syntax of the sentence. Thus, we mesh the affordance of the chair and Jareb, so that Jareb is on the chair rather than under the chair, or he stands on the chair rather than fly with it (as his body restricts him to fly), and finally understand the sentence. Meshing simply means imagining a meaningful situation by integrating various components derived from indexed objects. Therefore, understanding the sentence involves construing meshed actions.

[146] Glenberg A.M., Robertson David A., "Symbol Grounding and Meaning: A Comparison of High-Dimensional and Embodied Theories of Meaning", p. 383.

Glenberg writes,

> A sentence is meaningful to a particular reader to the extent that the reader can mesh the objects and activities as directed by the sentence. If for a particular reader "Jareb" was a pet fish or a baby, the sentence would not make sense because chairs do not afford standing- on for fish or babies.[147]

Consider another sentence:

1a. After wading barefoot in the lake, Erik used his shirt to dry his feet.
1b. After wading barefoot in the lake, Erik used his glasses to dry his feet.

An abstract symbol-based theory will not be able to carve out the sensibility of the second sentence. Instead, it would check syntax and grammar of the sentence, and finding it in the required form would render sensible. But a human speaker will easily render its sensibility saying that the second sentence does not make sense or makes less sense, because the affordances of glass do not mesh with affordances of feet, i.e. you cannot use glass to dry your feet. But it is also possible that you may dry your feet by keeping the glass towards the sun and focusing the heat on your feet. However, it is only embodied agents who can think of novel, unexpected situations.

Testing the Indexical Hypothesis

Empirical experiments were carried out to test the indexical hypothesis. In one experiment, it was found that people judge sensibility of sentences based on mesh of affordances rather than on formal properties. In this experiment, participants responses were contrasted with that of HAL and LSA based techniques. It was done using statistical analyses. Human participants were asked to judge the sensibility of sentences, whereas, LSA and HAL models were processed mechanically for testing sensibility judgment. The responses were analyzed for the following sentences:

Setting: Merissa forgot to bring her pillow on her camping trip.
Afforded: As a substitute for her *pillow,* she filled up an old sweater with leaves.

[147] Glenberg A.M. & Robertson A David "Symbol Grounding and Meaning: A Comparison of High-Dimensional and Embodied Theories of Meaning", p. 384.

Non-afforded: As a substitute for her *pillow*, she filled up an old sweater with water.

Related: As a substitute for her *pillow,* she filled up old sweater with clothes.

Here, it was found that people judged afforded sentences to be more sensible than non-afforded sentences, i.e. they gave higher scores to the former sentence. However, in the case of HAL and LSA models, this difference was not found. These models judged both sentences to be sensible (which should not have been the case). The idea is that the semantic models emphasize more on similarity among words than on the context.

Participants understood that affordance of sweater can mesh with affordance of leaves but not with that of water. One does not know how the sweater can be filled with water and be used as a pillow. The implication of this study was that it showed that LSA and HAL techniques are inadequate accounts of meaning because the symbols in these techniques are not grounded.

E. Gestures, Speech and Communication – Neurophysiological Research:

It is often found that people move hands during a speech or use gestures to communicate something. Sometimes people nod instead of using words to answer something. Such behavioural patterns are not accidental. Studies show that gestures have sufficient connection with language comprehension and constitute an important aspect of language. Many common life examples suggest that gestures facilitate communication. For example, in one study McNiel[148] found that people in a conversation were using gestures to describe events of past or future or events in different places. When those people had to describe future events, they would use gestures in front of their body whereas while talking about events of past they would use gestures that are produced off to one side of the speakers' body. In this way, this study showed that back and front gestures facilitate people's understanding of the past and future.

In one experiment, participants were told stories that involved events that had horizontal and vertical movements. The eye movements of the participants were tracked when they heard the

[148] Mcneil, D. "Speech and Gesture Integration" in J.M. Iverson & Goldin-Meadow (Eds.) *The Nature and Functions of Gestures in Children;s communication: New Direction for Child Development*, pp. 11-27.

stories. It was found that for the events involving horizontal motion participants moved their eyes left or right; while for the stories involving vertical movements, participants moved their eyes downward or upward. It seemed that participants were directly observing those events.[149] Another experiment studied whether people actually personate actions or not. The assumption was that people copy the action mentally in discourses that involve actions. It was assumed that people should stop when any disruption happens in the continuity of events described through the language. It was found that people do 'stop' when an event occurs in the sentence which breaks the continuity. We do feel this in everyday life. When we are standing at the podium and reading a paragraph, if we find that the sentence implies changing from past to present we take a pause for some moment and then continue. Kashchak noted similar experiments:

> Another line of research has focused on cases in which the discourse structure deviates from everyday experience. If comprehenders process events conveyed though language the way they process actual events, then these deviations should bring about momentary disruptions of the comprehension process. For example, language allows us to deviate from the chronological and continuous flow of events we experience in real life. If we anticipate described events the way we anticipate actual events, then violations of temporal continuity should negatively affect on-line language comprehension. This has indeed been shown to be the case; reading times for sentences that violate chronology and continuity are longer than reading times for sentences that do not.[150]

These experiments suggest that gestures mediate understanding of language. Do gestures accompany language comprehension/communication just or they have also a causal connection with speech? According to Raymond Gibbs, there are three views regarding this[151],

1. Speech and gestures as separate communicative systems. Gestures support our speech e.g., when speech is temporarily disrupted people cough. Nevertheless, gestures don't influence speech production;
2. Cognitive linkages between speech and gestures;

[149] Spivey M & Geng J.J., "Oculomotor Mechanisms Activated by Imagery and Memory: Eye Movements to Absent Object", pp. 235-41.
[150] Kashchak, "Language in Brain, Body and World", p. 376.
[151] Gibbs Raymond, *Embodiment and Cognitive Science*, p. 166.

3. The two, speech and gestures, are complementary. One without the other hampers complete communication.

However, neurobiological studies support the third view. Some of the studies are as follows:

a. It is seen often that when speakers stammer or hesitate for a moment, their gestures also happen to be motionless until they continue their speech.[152]
b. Some experiments have shown that the brain mechanism for motor tasks and language tasks are common. This brain mechanism occurs in the perisylvian cortex of the dominant hemisphere. It has been observed from studies that damage to this area disrupts oral facial movements and speech production, which suggests that there may be a tight link between gestures, motor tasks, and speech production.[153]
c. When people are asked to read silently and if the text involves verbs it is found that EEG activity level remains high in motor areas of the brain.[154]
d. Broca's area that is specialized for language is activated when people think about moving the hand.[155]
e. Language and body movements are closely linked. Defects in brain regions dedicated for language comprehension also affect hand movements. In one study, right-hemisphere damaged patients did more poorly than left-hemisphere damaged patients in a copying hand movement task (e.g. closed fist, thump sideway, slap palms, etc.) and in tasks which involved using gesture when hearing verbal command (e.g. waving goodbye etc.)
f. Researches in developmental psychology have shown that infants learn speech together with gestures.[156]

Conclusion

Meaning comes from the manipulation of inner codes in *language of thought* according to the representational approach. This approach faces the symbol grounding problem. There is an

[152] Mayberry R & Jaques J., "Gesture Production during Stuttered Speech: Insights into the Nature of Gesture-Speech Integration" pp. 149-214.
[153] Ojemann G., "Cortical Stimulation and Recording in Language", pp. 35-55.
[154] Pulvermüller F, "Words in the Brain's Language", pp. 253-279.
[155] Tanaka S & Inui T, "Cortical Movement for Action Imitation for Hand/Arm Position versus Finger Configurations", pp. 1599-602.
[156] Iverson J. & Thelen E., "Hand, Mouth and Brain: The Dynamic Emergence of Speech and Gesture", pp. 19-40.

alternative approach of meaning, embodied approach. According to this approach, symbols are grounded in the sensorimotor system of the human body. On the problem of meaning, this approach holds that mental simulation, which is reactivation of sensorimotor information, is a crucial mechanism in meaning-making. In meaning-making people reactivate experience described by words or sentences. The empirical evidence analyzed in this chapter support the embodied view of language But, the embodied approach is not without problems. Researchers argue that simulation is not sufficient for explaining linguistic meaning. Many other criticisms are raised by thinkers. In the next chapter, we will address some of these criticisms.

Chapter 3

The Scope and Implications of Embodied View of Meaning

Embodied Meaning Reconsidered

In our previous chapter, we discussed the embodied theory of meaning which rejected the representational theory view that meaning comes from the manipulation of translated codes in the mind. It argued that representational theory encounter what is known as the symbol grounding problem. That is, syntactic processing over ungrounded and arbitrary symbols is not sufficient for meaning-making. On the contrary, it proposed the simulation hypothesis of meaning-making according to which meaning-making is a cognitive process in which people activate experiences as described in the language. This hypothesis also claimed that symbols are grounded in our experiences. Apart from this, symbols stand for their referents analogically and not arbitrarily because they keep the form of their referents. In support of the embodied view, we discussed some of the experimental studies providing evidence for the basis of embodied meaning. We further discussed the indexical hypothesis according to which meaning-making is the construal of a coherent set of actions (the actions emerge from indexing of words to perceptual symbols). For any sentence to convey meaning, it must give way to a set of actions that are coherent or meshed to the different contexts of the language user. Finally, we had discussed the experiments that supported the simulation hypothesis of the embodied approach. These behavioural and neuroscientific experiments show that people's simulation of semantic content when comprehending language was specific. That is, people imagined shape, colour, taste, shape, motor actions, etc. when comprehending verbs, nouns, or sentences.

The embodied hypothesis also posited that symbols, concepts, or representations of words in the mind were grounded in the sensorimotor system of the body. The perceptual symbols system hypothesis of Lawrence Barsalou subscribes to this perspective. The perceptual symbols system hypothesis proposed that symbols or representations or concepts in the brain are multimodal, that is, they contain information from each sense modality, analogically related to their referents, componential, flexible, and conscious neural representations. In this way, the concepts or representations are embodied because it is in virtue of being grounded in the sensorimotor system that they are multimodal, and retain other properties. By componential it

is implied that the embodied concepts retain a limited aspect of information because they are constructed from the perceptual or motor processes which capture not the entire experience of objects or events. The concepts are flexible implies that the content of concepts can change over time with the change in an agent's experience. A person's concept of dog may change given to the possibility of watching newer breeds of dogs. Lastly, the concepts are not conscious image type structures as is normally believed but they are neural representations in the brain.

The empirical studies for the simulation hypothesis that we had discussed were mainly concerned with concrete words or sentences that is, the words or the expressions that seemed directly connected to experience i.e. *kick, pick, watermelon, eagle,* etc. and those experiments that did not include abstract words e.g. *justice, grasp, time, virtue, economy, democracy,* etc. To look at whether people simulate situations or actions for the abstract words metaphor theory of George Lakoff was examined. The metaphor theory proposed that abstract words are comprehended differently. They are understood by people through metaphors. Metaphors are great tools for understanding complex or abstract words because they are nearer to people's experiences. For example, the Time is Money metaphor. Rather than going into details about the concept of time people understand the word in terms of the concept of money (and certain properties linked to the latter) which is easier to understand and closer to their experience. Abstract words comprehension also involves the simulation of experiences.

The empirical studies also reveal that comprehension of abstract words activates the sensorimotor system. However, the activation for abstract words is not specific. Thus, it is hard to correlate the sensorimotor pattern with the meaning of abstract words. But, when abstract words are analyzed through the metaphor tool, it gets easier to correlate the activation with the words. In one experiment, it is observed that the phrase 'grasp the idea' activates a specific motor location in the brain.[157] Why does this phrase activate the motor region and not any other region? The suggestion is that just as people understand the phrase 'grasp the ball' similarly as they understand 'grasp the idea'. They imagine that they are grasping the idea as if they are picking a ball in their hand. When they are comprehending this phrase, the motor location

[157] Boulenger V. et al, "Grasping Ideas with the Motor System: Semantic Somatotopy in Idiom Comprehension", pp. 1905-1914.

which is for hand movement gets activated, and this way people understand this phrase. In this way, many other experiments have been looked at. Thus, it emerged that the simulation hypothesis also works for abstract words or concepts.

Lastly, one influential hypothesis for embodied meaning, indexical hypothesis and some related empirical evidence were discussed in our previous chapter. According to this hypothesis, meaning comes after mapping words to an individual's experiences. It is only that when mapped symbols establish a coherent situation that understanding or meaning comes (in the sense of understanding) to subjects/people during language comprehension. Namely, the affordances should mesh if the sentences are to become meaningful. The studies that tested this hypothesis concluded that people termed non-afforded sentences as less sensical and afforded sentences more sensible. Overall, like the mental simulation hypothesis, this hypothesis also emphasized the role of imagination or simulation of bodily experiences in meaning-making or understanding.

From the entire discussion, it emerges that simulation is a crucial mechanism for language comprehension and simulation can be equated with the meaning of words or sentences, which the embodied view of meaning claims. However, the hypothesis is prone to susceptibilities because experiments show just this that the sensorimotor system is involved in language comprehension and not that the sensorimotor system is necessarily related to language use. Apart from this, the embodied view of meaning is also not a very formalized theory, thanks to the limited number of researches on language analysis from the embodied perspective. Some thinkers reject the claim that amodal or abstract representations do not exist in the brain. They claim that amodal representations are necessary for language comprehension. In this chapter, we will deal with such questions and also look at its implications.

Scope of Embodied View of Meaning

We discussed that simulation is a crucial mechanism for language comprehension and the embodied approach equates simulated activity with the meaning of linguistic expressions.[158]

[158] See discussion on embodied meaning in Ch. 2 of this dissertation, p. 69-70.

But this conclusion is based on the supposition that sensorimotor activation is causally connected to language use. Researchers attack this claim. For them, sensorimotor activation is an epiphenomenon and is not causally connected to language comprehension. They also attack the embodied thesis that abstract symbols do not exist. They posit that abstract symbols reside in some areas of the brain. The sensorimotor system activates sometimes during comprehension of language use because activation spreads to this area. However, the sensorimotor system has no direct involvement in language processing. Some researchers think that sensorimotor activation is a later stage process and therefore not linked to language processing. We will review these researcher's criticism and show that their criticisms are not justified.

Criticisms

a. Language processing involves abstract representations

One major claim of embodied thesis is that abstract and amodal symbols or representations do not exist in the brain,[159] and that sensorimotor representations are directly recruited during language processing. On the other hand, representational or disembodied theories suppose that representations of words or phrases are abstract and it is processing on these representations/concepts that the meaning of words or phrases comes by.

B. Mahon and M. Caramazza[160] oppose embodied thesis. Embodied thesis denies that there is any interface between words and sensorimotor activation, namely, any abstract format. But Mahon and Caramazza hold that postulating a separate interface or layer for abstract representations is necessary because many words cannot be explained in terms of sensorimotor activations. They write:

> […] Concepts of concrete objects (e.g., HAMMER) could plausibly include, in a constitutive way, sensory and motor information. But consider concepts such as JUSTICE, ENTROPY, BEAUTY or PATIENCE. For abstract concepts there is no sensory or motor information that could correspond in any reliable or direct way to their 'meaning'. The possible scope of the embodied cognition framework is thus sharply limited up front; at best, it is a partial theory of concepts since it would be

[159] Barsalou, "Perceptual Symbol System Hypothesis", p. 579.
[160] Mahon B.Z. & Caramazza, "A Critical Look at the Embodied Cognition Hypothesis and a New Proposal for Grounding Conceptual Content", p. 59.

> silent about the great majority of the concepts that we have. Given that an embodied theory of cognition would have to admit 'disembodied' cognitive processes in order to account for the representation of abstract concepts, why have a special theory just for concepts of concrete objects and actions?[161]

The concepts like JUSTICE, ENTROPY, BEAUTY, etc. are difficult to explain in terms of sensorimotor information. Therefore, to account for the meaning of these words, Mahon and Caramazza hold that there is a separate layer for processing these words. Even for concrete words, they believe that abstraction is required at some point. For example, the concept of a DOG must be abstracted and fixed because there are too many instances of dogs we encounter in our life. To use and understand the meaning of this word we cannot refer to all those experiences (which embodied thesis claims). They say:

> […] begun with the assumption that concepts are represented at a level that abstracts away from the specific sensory and motor events that have gone along with the instantiation of those concepts in the past (and which will go along with them in the future)The question is whether such sensory and motor events are nevertheless constitutive of the concept. So consider the concept DOG. And consider that one sees on Monday a Rat Terrier, and then on Tuesday, a Rodesian Ridgeback. On both Monday and Tuesday, the concept DOG has been instantiated. However, the particular sensory information that went along with the instantiation of the concept DOG on Monday and Tuesday was different. So, the question arises: Did the observer instantiate the same concept DOG on Monday and Tuesday? If the specific sensory and motor information that 'goes along' with instantiations of a concept is understood as being 'constitutive' of that concept, then different people cannot have the same concepts, and even the same person may not instantiate the same concept at different points in time.[162]

Hence, they consider that explaining abstract and concrete words from an embodied perspective pose too many difficulties. Therefore, the right strategy is to suppose that the representational thesis is true and that there is a separate abstract format in the brain. Language processing use concepts from this format.

[161] Ibid, p. 68.
[162] Ibid, p. 69.

Similarly, M. Louverse and L. Connell also suppose that language processing involves both abstract and sensorimotor representations.[163] According to their model of meaning, symbolic information is used earlier in language processing whereas sensorimotor information is used later.[164] In this way, we see that these thinkers oppose the embodiment thesis that language processing involves embodied representations only and not abstract representations. This is also a reason to say that the embodied hypothesis is incomplete.

b. Sensorimotor system activation as epiphenomena:

In our earlier chapter, we saw that the embodied approach of meaning had claimed that sensorimotor activations during language comprehension are essential for understanding the meaning of words. It proposed that it is the mental simulation of situations (situations/actions are imitated because while comprehending words or sentences, sensorimotor areas that those words relate, get activated giving rise to sensorimotor information and which leads to construal or imagination of experiences) in virtue of which words get the meaning that they have. In other words, specific sensorimotor activations are the meanings of the words (these sensorimotor activations lead to the formation of embodied concepts and which in turn are processed during language understanding). In support of this proposal, few experiments were discussed. But these experiments showed just that specific areas in the brain that are for perception and action activate when comprehending any sentence or words; and not that without such activations, language comprehension cannot take place. Many thinkers also hold that sensorimotor activation is not sufficient for language comprehension because sensorimotor activation is just epiphenomena. They also cite some cases that show that people understand language without sensorimotor activations.[165]

One such supposition comes from the 'grounding by interaction' view of Mahon and Caramazaa. According to this view, language processing is an abstract process. It happens in

[163] Louverse M. & Connell L., "A Taste of Words: Linguistic Context and Perceptual Simulation Predict the Modality of Words", p. 381-98.
[164] Ibid, p. 383.
[165] Evidence in favour of embodied meaning suggests that since sensorimotor activations are obtained during language comprehension, they can be thought of as an important factor for meaning. However, mere involvement of a factor in an event is not sufficient to show that factor is necessary for that event. One has to show also that without that factor the event cannot take place. Embodied meaning evidence highlighted only one aspect. Here I am arguing that although that can be set as a criticism against embodied meaning, there is evidence to the effect that without activations, language understanding is not possible.

the supposed 'abstract layer'. In this layer all language related activities take place. To deal with neuroscientific studies as to the reason for sensorimotor activations during language comprehension, they suppose that activations arise because activations in the abstract layer during language use spreads to these areas.[166] In this way, sensorimotor activations are not reasons for language understanding. However, they do not think that activations have no role in language processing. They think that that sensorimotor activations are used for colouring and dressing the content of concepts but not for constituting them. Since sensorimotor activations are not directly used for language processing Mahon and Caramazza argue that these effects are epiphenomena, hence do not contribute to meaning-making. Similarly, Papeo et al.[167] think that meaning processing is mediated by abstract representations leading to activations in the sensorimotor system.

c. Sensorimotor activation as contingent and not as constitutive of language comprehension

The simulation hypothesis is that sensorimotor activation is constitutive of language processing. However, some think that findings on which such claims are based just show that sensorimotor activation is a contingent factor and not a constitutive factor. D.A. Weiskopf is one such thinker who supports this. According to him, embodied thesis supporters draw an incorrect conclusion from the neurobiological and behavioural studies. Sensorimotor activations are intimately linked with language processing but do not constitute the latter. According to this author, from the embodiment evidence three positions can be taken:

> ELC (S): linguistic understanding just is an enactive simulation process;
> ELC (M): linguistic understanding requires, but is not identified with enactive simulation;
> ELC (W): Linguistic understanding can use, but does not require, enactive simulation.

[166] Caramazza & Mahon, "A Critical Look at the Embodied Cognition Hypothesis and a New Proposal for Grounding Conceptual Content", p. 68.
[167] Papeo et al., "The Origin of Word Related Motor Activity", pp. 1668-1675.

The author argues that defenders[168] of ELC[169] do not distinguish between these three positions. On the contrary, they frequently reach the first position without accepting that the rest two positions are also possible from the experimental evidence. The author then suggests that from the experimental supports the most plausible conclusion is position three. According to this, enactive simulation can be used for language understanding but cannot be supposed to be essential. The author's view is that the effects of sensorimotor activations on language use do not say something new. These effects can be explained through the disembodied proposals also. For example, the experiments that support the indexical hypothesis are about proving that afforded sentences are understood easily whereas non-afforded sentences are not. The implication of which was that mental imitation of the situation is essential for understanding language. He regards that these experiments could be analyzed by disembodied theories also.

As argued above, the author says that mental simulation can be used for language comprehension but not necessary for the same. He cites one popular approach in the disembodied view of language: truth-conditional theory. According to this theory, knowing whether a sentence is meaningful is to know the truth conditions of the sentence. That is, what conditions make the sentence true. Indexical hypothesis experiments had shown that non-afforded sentences were non-sensical or less sensible because participants could not simulate the meaningful situation. The author argues that even non-afforded sentences were sensible because one could generate truth conditions from that sentence. As that sentence followed a standard arrangement, one could infer many propositions just by looking at the arrangement or syntax of the sentence. If X is Y, one can deduce Y is X also without imagining something. This could be followed in the non-afforded sentence also. Finding truth conditions does not require indexing or mentally simulating any fact. If one knows logical rules, one can find truth conditions and hence can understand the sentence.

Consider the following non-afforded sentence:

[168] For the author one defender of strong embodiment thesis is Zwaan who says that language is 'set of cues' to construct an enactive simulation. The other defender is Glenberg and Robertson who propose in indexical hypothesis that language comprehension is action plan based on affordances that indexed objects make available. Wieskopf D.A., "Embodied Cognition and Linguistic Comprehension", p. 298.

[169] Wieskopf names embodied thesis as ELC meaning Embodied Language Comprehension. He thinks there are three versions of it, strong, medium, and weak.

1) Adam pulled out of his golf bag a ham sandwich and used that to chisel an inch ice off his windshield.

According to the indexical hypothesis experiment, this sentence was termed less sensible because participants could not imagine how could one use a ham sandwich to chisel one-inch ice off his windshield. The author argues that this sentence is not less sensible because its truth conditions can be easily detected and thus it can be wholly understood. He says that what is problematic is this assertion according to the indexical hypothesis:

2) Adam used a ham sandwich to chisel one-inch ice off his windshield.

On reading this, one can easily infer that

3) Adam used something to remove the ice from his windshield.

According to truth-conditional semantics, one has to just know what makes a sentence true. One would infer from 3) and 1) the following sentence,

4) The sandwich was the thing that could chisel ice.

Thus, if one reads that ‘A used X to Y’ then he can easily infer that X was an instrument for A to Y. In the given sentence one needs to just logically infer what truths-conditions could lead one to its understanding and hence need not imagine any background knowledge e.g. whether a sandwich could remove ice or not. They could at least know from the logical inference that something was used to Y and could understand the meaning of the sentence. In this way, the author argues that for understanding, mental imagination is not necessary.

On the question of why sensorimotor activations should not be termed as constitutive of language processing, the author argues that because those activations are linked to just language processing and not necessarily connected; and since the symbolic approaches can explain language processing; therefore, one need not claim that embodied activations are the reason for language understanding. In this way, the author supports that from the empirical investigations only weak embodiment thesis of meaning could be sustained. And since there

are already good theories available to account for meaning, one need not stick to the embodied thesis of meaning.

Addressing the Criticisms

In the above section, we looked at some influential criticisms of the simulation hypothesis of the embodied approach. Some advocated that language understanding involves the use of abstract representations and some argued that language understanding can happen without mental simulation and even if embodied thesis supporters talk about simulation evidence, the opponents argue that simulation happens because that is an epiphenomenon and hence do not play any functional role.

We find that these criticisms are ill-intent because many of them are the result of misreading of embodied hypothesis. Some criticisms also make unsupportable claims like Mahon and Caramazza's proposal that abstract representations are involved in language processing. In the present section, we will try and defend the embodied view of meaning.

a. Mahon and Caramazaa propose that language processing involves abstract representations. They do not present any evidence in support of such a supposition. They think that because abstract concepts' meaning cannot be captured in terms of sensorimotor simulations, it is right to suppose that there exists a separate abstract layer in which all abstract concepts are processed and hence disembodied theories of meaning can be defended.[170] But this does not seem to be a sound argument. Because sensorimotor simulations cannot capture certain words' understanding, that is no reason to suppose a separate abstract layer unless the convincing ground for supposing the same is presented. Thus, Mahon and Caramazza's proposal seems implausible. Kaschak writes the same:

> […] given the deep and well-noted problems with abstract symbolic representational schemes, it is not clear to us that Mahon and Caramazza's

[170] Mahon B. & Caramazza "A Critical Look at the Embodied Cognition Hypothesis and a New Proposal for Grounding Conceptual Content", p. 68.

> proposal represents a promising route forward. For example, they assert that there is no set of particular sensorimotor simulations that can capture all the meanings and uses of the word beautiful. This may be, but stipulating an ill-defined "abstract" layer of representation does not strike us as moving toward a workable solution.[171]

Caramazza's view thus, seems to be unsupportable.

In the same manner, Louverse also considers the involvement of abstract representations in language processing. However, his view is different from that of Caramazza et al. as it proposes that sensorimotor information is processed later and abstract representations are processed earlier. Both suppositions are false. First, experiments have shown that motor activity is rapidly seen during language processing.[172] Hence it contradicts that sensorimotor activations happen after abstract representations. Second, the view regards that statistical information processed earlier is abstract or symbolic. This is incorrect because statistical information is co-occurrences of motoric events.[173] From this evidence, we can claim that language processing is necessarily embodied.

b. The criticism that sensorimotor activations are epiphenomena is also based on incorrect reasoning. First of all, no proper evidence is available to suppose the existence of an abstract layer in the brain in Caramazza's paper. Therefore, the only system for language processing remains the sensorimotor system, and then from the neuropsychological evidence, it can be inferred that only the sensorimotor system activates and not the abstract layer and hence sensorimotor system is necessarily related to language use. Second, Mahon and Caramazza admit in their paper that the sensorimotor system is involved in influencing concepts that form in the abstract layer. They say that 'sensorimotor system dress and colour the concepts' but do not accept that they constitute the concepts. Their statement is seen to be confusing. If the sensorimotor system colour and dress the concepts, why not also assume that the

[171] Kaschak Michael et al., "Embodiment and Language Comprehension", p. 123.
[172] Pulvermüller F. "Words in the Brain's Language", p. 253-79, Mason M. et al. "Kicking Calculators: Contribution of Embodied Representations to Sentence Comprehension", p. 59-70.
[173] Kaschak et al., "Embodiment and Language Comprehension", p. 123.

sensorimotor system constitutes concepts. About Caramazza's confusion, Friedmann Pulvermuller writes,

> […] Mahon and Caramazza propose ''an 'abstract' and 'symbolic' level of conceptual content (. . .) not constituted by sensory and motor information''. In Caramazza et al.'s hands, sensorimotor systems are allowed to functionally contribute to conceptual or semantic processing, although this contribution is described, rather metaphorically, as ''colouring'' or ''dressing'' the concept. However, there is some lack of clarity as to what the terms ''colouring'' and ''dressing'' meaning this context. In line with the observation that colours and dresses can be put on an object but are not part of the object, Bedny and Caramazza further stress the idea of abstract concepts in ''modality-independent'' areas, now arguing against a role of sensorimotor systems in conceptual processing. It therefore appears that, in this perspective, action and perception systems are seen as capable of changing the appearance (colour, dress) of concepts, but not of changing their essence, which is contained in the ''amodal'' symbolic system.[174]

Thus, the sensorimotor system can change the appearance of the concepts in the abstract layer but cannot change the essence, if that is implied by 'dressing' and 'colouring' of the concepts. Pulvermüller is not satisfied with this account. If concepts are not constituted by sensorimotor activations, it should also be possible that without them concepts do not get affected. But that is not so, Caramazza and Mahon accepts that this system affects concepts. At one place, they write "removing the sensory and motor systems (as in brain damage) would result in impoverished or isolated concepts."[175] If he accepts this, he cannot argue that sensorimotor activations during language processing are ancillary or epiphenomenal and not necessary.[176]

c. The third criticism proposed that simulation or sensorimotor activation is a contingent factor and not a constitutive factor in language processing. It also argued that linguistic

[174] Pulvermüller Friedmann, "Semantic Embodiment, Disembodiement or Misembodiment? In Search of Meaning in Modules and Neurons Circuits", p. 87.
[175] Mahon and Caramazza, p. 68.
[176] Pulvermüller Friedmann, p. 87.

meaning can be determined from the disembodied perspective and that so without simulation. Both claims are challenged.

Now we address the first question. What makes something constitutive of a phenomenon? That is, what makes C2 constitutive of C1? The answer is that not only one should find instances in which C1 happens with C2 happening but also one must not find instances in which C1 happens without C2 happening. Merely finding C2 together with C1 makes the former a contingent factor and not a constitutive one. Weiskopf cites only those embodied thesis supporters who mention studies in which simulation takes place along with language processing but not researchers who advance studies in which language processing does not happen without simulation. And thus, argues that simulation is a contingent factor. In this way, his argument is incomplete.

There are impairment studies (neuropsychological dissociation, magnetically impairments, behavioural adaptation, etc.) which show that language processing is linked with sensorimotor activations. They show that language comprehension is weakened when the sensorimotor system is damaged. For example, frontal cortical regions of the brain are commonly associated with the planning, execution, and control of motor responses. In one study, it was seen that patients with impairments in these areas felt difficulty in a lexical decision task. They could not accurately recognize and process action related verbs and nouns.[177] This study at least pointed out that sensorimotor activation is crucial for language processing. Similar to this, there exists many other pieces of evidence on impairment effect on language processing in embodied cognitive science literature.[178]

Now we address the second question. Weiskopf had argued that embodied thesis is not defensible. First, because its fundamental claim i.e. simulation hypothesis, is problematic and second because disembodied theories can account for what embodied approaches propose. That

[177] Galetkza Cedric, "The Story So Far: How Embodied Cognition Advances Our Understanding of Meaning-Making", p. 2.
[178] Bak T.H. et al., "Selective Impairment of Verb Processing Associated with Pathological Changes in Brodmann Areas 44 and 45 in the Motor Neurone Disease-Dementia-Aphasia Syndrome", pp. 103-120, Kemmerer D. et al., "Behavioral Patterns and Lesion Studies Associated with Impaired Processing of Lexical and Conceptual Knowledge of Actions", pp. pp. 826-848, Boulenger V. et al., "Word Processing in Parkinson's Disease is Impaired for Action Verbs but not for Concrete Nouns", pp. 743-756.

is, people could determine the meaning of sentences without reactivating sensorimotor experiences. Weiskopf presented truth-conditional theory of the disembodied approach and tried to prove that meaning can be determined without simulation. Nevertheless, the truth-conditional theory could be easily contradicted. Consider the following two sentences (which I am borrowing from Pulvermuller's article 'Words in the Brain's Language':

S1: A bear had fur.
S2: This bear had fur.

According to truth-conditional theory, for knowing the meaning of a sentence one needs to know conditions that make the sentence true. To do so, one needs to look at the syntax or the logical structure of the sentence. Here, S1 is a general statement. In this sentence, one has to find whether fur is related to bear or not. Since a bear is a mammal and all mammals have fur and since this sentence asserts this, therefore this sentence is true. If one knows the definition of 'bear' he can easily judge this sentence to be true. He need not imagine or simulate something to understand its meaning. He can do so with only logical correlations.

If a theory considers that the human brain consists of amodal symbol system, then truth-conditional semantics is suitable for such a theory because such a system evaluates meaning based on semantic relatedness. And this is what Wieskopf is suggesting that disembodied approach can explain meaning. But this can be argued. Now we look at S2.

Concerning the second statement, to understand its meaning, mere knowing the truth condition is not sufficient. The second statement refers to a specific bear. This could also be a bear whose fur is shaved off. Whether the second statement is true or not cannot be determined unless one refers to the experience of this bear, because the phrase 'this bear' implies a specific bear and since it is not a part of a general statement. Hence, it requires experience of that particular bear in the world. Therefore, S2's meaning cannot be determined by logical and syntactical analysis alone. One must imagine or simulate experiences for this sentence to understand its meaning.[179]

[179] Which requires that person's conceptual system ground words of that sentence to his experiences with the world.

Here embodied thesis helps, for it says that people simulate experiences when understanding language. If people understand S2, then they must be imagining experience involved in the S2.

Thus, we see that truth-conditional semantics fails concerning this type of sentences and not able to falsify the embodied approach of meaning. The discussion so far has evaluated the embodied view of meaning and found that it is a plausible theory.

Implications of Embodied Meaning

Although this view has limitations nonetheless it provides a new avenue to the problem of meaning. Traditionally, the role of cognition in language processing has been neglected which has posed many difficulties in explaining the meaning. The embodied approach not only cares for cognition but also shows how the entire body affects language processing. In this way, this approach seems more realistic. Although problems persist in its way, those problems are due to the lack of formalization of this theory and lack of research. The future thinkers could frame a realistic theory given they find more substantial research.

Applications of Embodied Meaning

Our discussions so far show that simulation through sensorimotor activation is a crucial mechanism in meaning-making. The indexical hypothesis has supported the simulation view suggesting that meaning-making is the construal of situation built on coherent set of actions. Overall, the idea is that people understand linguistic expressions by grounding the expressions to their experiences with the world. This is the embodied idea of language. Experiences are developed through engaging the body's perceptual and motor system with the world and then these experiences are simulated for communication through language use.

The embodied view opens a new approach to language analysis. It says that language understanding is mediated by grounded representations than by abstract representations. Traditional approaches supposed that language understanding can be explained through the analysis of written or spoken language just (i.e. by knowing grammar, syntax etc.). The

embodied approach includes the role of cognition and body as well on language, and thus sheds a new light. The findings from this approach can be applied in many domains. For example, in natural language processing (which has importance in computer science and artificial intelligence), in education, in learning a foreign language, etc. Following are some of the applications of embodied view of language comprehension:

1. Reading Comprehension

Embodied approach of language is helpful in the education field too. Teaching should include a method that helps learners to relate their subject matter to their experiences. The embodied approach is significant for early school goers. Reading comprehension can be enhanced if students are taught using methods that helps them ground symbols to their experience. We know from the embodied language hypothesis that people understand when they succeed in grounding words to their experiences. If school-going children have to learn pure text that includes just symbols, they must be instructed through methods that provoke imagination. Early school-going children feel difficulty in normal teaching because they are not able to relate the subject matter to their experience.

In one study, it was found that children who use imagination retain better than children who just read and reread any text. Glenberg applied the indexical hypothesis of embodied approach in this study.[180] In this experiment, a group of children had to read a sentence. After which they are given manipulatives[181] to manipulate according to what they read and then asked to describe the situation implied by the sentence. The other group is asked to read a sentence multiple times and tell the information they found. The result of this study showed that children of the first condition were better able to recall and describe the situation than children of the second condition. The study implied that this happened because manipulatives corresponded to the situation implied by the sentence. The experiment hypothesized that retention is strong when children learn words connecting them to their immediate experience than just mugging up the words.

[180] Glenberg Art, "Embodiment in Education" in *Handbook of Cognitive Science: An Embodied Approach*, p. 360.
[181] Toys were manipulatives in this case. The sentence was about activities on a farm. The toys represented cows, buffalos, a farmer, etc.

The embodied way of teaching can be applied for the teaching of subjects that are more complex and abstract, like mathematics and science. Glenberg has elaborately mentioned some experiments, which show the effectiveness of the embodied approach in the teaching of science and mathematics.[182]

2. Second language learning

Embodied approach of language comprehension has an application in learning foreign language as well. The traditional classroom method of learning a foreign language is sometimes not effective because it involves boring lectures and thus learners find it difficult to attentively listen to the instructor and hence, not able to index spoken or written words to their experience, which embodied hypothesis says is important. Therefore, they do not become proficient second-language speakers.

Instead, the embodied idea suggests that new learners should learn the way they have learned to speak the first language. For this, they can use an environment in which their discussions involving new words range within that environment. In such a situation they will be able to ground words to the immediate environment and thus will have deeper activations of the sensorimotor system. Apart from this, instructors can use gestures along with speaking when teaching. This helps learners to memorize foreign words more effectively. Group discussions should be emphasized. In the group discussion, learners engage in a meaningful exchange of ideas. Because in such a situation they have an objective.[183] In a group discussion people are more likely to engage in discussions and use information revolving around their immediate environment because they have objective in those discussions. This is not likely to happen in classroom teaching. Suppose a group discuss on 'Trump's nomination for Noble peace prize' in second language, in that case group members are more likely to utilize their current knowledge and use them for speaking and discussions become more meaningful for them. The support to these methods comes from experiments. In one experiment, it is observed that recalling performance is smoother after learners perform a gesture related to a word than after

[182] Ibid, p. 366.
[183] Adams Ashley, "How Language is Embodied in Bilinguals and Children with Speech Language Impairments", p. 6.

they trace a picture related to each word or after simply learn the words verbally. In another experiment, it is observed that body engagement is maximum among second language learners when they converse in their second language.

One important question is how, in principle, such methods facilitate foreign learning language. According to Adams, the idea is that people do not learn a second language as effectively as they learn their first language.[184] The reason behind this is that second language learning takes place differently than first language learning. In first language learning, vocabulary acquisition happens alongside actual sensorimotor activations. But in second language learning, vocabulary acquisition happens in a different pattern.[185] Consider people whose first language is Hindi and who learn English later in their life. How do they learn English?

Typically, they first find Hindi correlates of English words, then they use grounded representations of Hindi correlates to understand English words. When they have learned sufficient English words in this way, then they try to reduce dependency on Hindi words and afterward directly relate new English words with already conceptualized English words. From this stage, they activate sensorimotor representations that they do not do in the earlier one. However, it is normally observed that this way of learning takes much time in being a proficient English speaker. Thus, in reaching to the second stage a lot of time is spent. Embodied approach suggests that instead of correlating second language words with first language words, cues which engage perceptual and motor systems directly with new words can be used. These cues could be gestures, visual representations, group discussions, etc.

The classroom teaching adopts the traditional method. It translates foreign-language words with learners' first language words and does not care that new words have to be attached to learners' experiences. Thus, it remains ineffective. Proficient bilinguals process the second

[184] Because first language learning happens by engaging bodily experiences with the world. Children learn language by seeing others speaking, or by getting instructions through pointing etc. in this way, along with words listening, children keep adding experiences to their word use. For second language learning, learners do not become as active as children could.

[185] In this connection, Kroll and Stewart's hierarchical model can be referred. Kroll J.F. et al. "Category Interference in Translation and Picture Naming: Evidence for Asymmetric Connections between Bilingual Memory Representations", p.1008

language like their first language. It has been observed that the sensorimotor system gets activated even in the case when bilinguals converse in their second language.[186] This suggests that new learners should adopt the same manoeuvres that proficient speakers adopt.

3. Natural Language Processing

Embodied approach of language comprehension can be used to build models for NLP and hence be implicated in the field of artificial intelligence, linguistics, and computer science. The problem is that embodied language algorithmic formalization is still in infancy. Currently, only one formalism is operational in the field of Artificial Intelligence, Embodied Construction Grammar. This is used for language acquisition experiments for artificial agents.[187] Some researchers are developing new generation language processing tools that use simulation principle.

Thus, we see that the embodied approach can be widely used. However, given its novelty, more research and formalization are hoped for future direction.

Areas of Extended Research and Improvements in Embodied Theory of Meaning

Although the embodied view is an effective approach to explain the meaning of linguistic expressions, nonetheless it has also some limitations. In this section, we will see some of the problems that this view faces.

a. Syncategorematic words

The simulation mechanism is hard to apply to syncategorematic[188] words. The word ‘big’ gets its meaning when it occurs with other words. Sensorimotor features of other concrete words like lemon, watermelon, can be determined because they evoke specific regions. But since this word is syncategorematic, it is likely to evoke different activations when associated with different words. Hence this word’s meaning cannot be developed in terms of sensorimotor activations. For instance, the word ‘big’ attached with an event word produce different

[186] Adams Ashley, “How Language Is Embodied in Bilinguals and Children with Specific Language Impairment”, pp. 1-13.
[187] Pastra K. et al., “Embodied Language Processing: A New Generation of Language Teachnology”, p. 26.
[188] These words get their meaning after co-occurring with other words e.g. big, safe, etc.

activations than when attached with a noun i.e. the activation for *big dog* does not overlap with activation for *big run*.[189]

The word 'big' might seem a bit obscure but the problem persists even with familiar simple words e.g. *safe* or *jump*. These words seem more concrete or empirical but they pose the same difficulty. For example, 'safe beach' might be interpreted as either a beach in which people are free from threats (i.e. from stealing or defects in the beach itself, shore break) or a beach which itself is not under threat (absence of soil erosion). Thus, it is hard to decide the sensorimotor features of the usage of 'safe'. In addition, people themselves are likely to be in confusion when understanding this word. Benjamin Bergen, an influential linguist, suggests that there are more examples like these in which meaning cannot be decided through simulation alone.[190]

b. Experimental Defects

Simulation studies check activity in the brain while participants read. But people read texts in multiple way. Sometimes they pay attention to what they read closely but sometimes they do not. Sometimes they read for understanding something. Sometimes they read to find something. In each case different patterns are likely to be found. Most simulation studies do not mention these ways of comprehension. Researchers should study these factors for a broader perspective on embodied simulation theory.

c. Ununified thesis

A major problem for the embodied view of meaning is that it suffers from a lack of a well-specified theory. Based on certain findings, supporters of this view make big claims but do not specify a coherent theory. Now, when sufficient evidence are available, cognitive scientists and psychologists should draw a viable theory that looks more formalized.[191]

d. Abstract Words

[189] The syncategorematic words cannot be tested alone. Therefore, they are tested with other words.
[190] Bergen Benjamin, "Embodiment, Simulation and Meaning", ch. in *Routledge Handbook of Semantics*, p. 150
[191] Gibbs Raymond, "Embodied Experience and Linguistic Meaning", p. 13

Concrete words and concepts activate sensorimotor representations but whether this happens with abstract words is a tough question. It had been proposed in the second chapter that sensorimotor activations are observed for abstract words also. As determining meaning of abstract words in terms of sensorimotor activations is difficult, the metaphor theory had been proposed. For instance, if a specific sensorimotor activation for word 'justice' is observed and that pattern is associated with the word's meaning, that would not make sense. But metaphor theory eases this difficulty. According to the metaphor theory, people understand complex and abstract words such as *justice, virtue,* etc. in terms that is nearer to their experience. When comprehending abstract words, people use experiential metaphors and understand abstract words in terms of these metaphors. The activations observed in studies during comprehension of abstract words happens for these metaphors and not for the original words as subjects use metaphors when thinking about abstract words. In this way, abstract words' meaning is analysed with help of metaphors and sensorimotor patterns are attached to metaphors. Simulation hypothesis, thus is claimed, applies to abstract words also.

But many researchers doubt this speculation. For example, Aziz-Zadeh et al. in one study found that metaphors based on motor movements did not provoke any comparable brain activation patterns.[192] He reasoned that activations are found for newly discovered metaphors but not for familiar metaphors. Dalla Volta et al. found in their study done on both concrete and abstract words that concrete words evoke sensorimotor regions but abstract words evoke no pattern.[193]

Galatkza says that the simulation hypothesis works for concrete action-related words but not completely for abstract words. He also holds that the metaphor approach is limited to account abstract words meaning. So, he proposes a weak embodiment approach for abstract words, according to which sensorimotor activation helps with abstract words comprehension but is not essentially involved.[194]

[192] Aziz-Zadeh et al., "Congruent Embodied Representations for Visually Presented Actions and Linguistic Phrases Describing Actions", p. 1818-23
[193] Dalla Volta, R. et al., "Spatiotemporal Dynamics during Processing of Abstract and Concrete Words", p. 172-78
[194] Galatkza, "The Story So Far: How Far Embodied Cognition Advances Our Understanding of Meaning-Making ", p. 4

Conclusion

Mental Simulation is crucial for meaning-making This is the central idea of the embodied view of meaning. Some critiques oppose this view point. They hold that simulation is epiphenomena and does not have a role in meaning-making. However, these criticisms can be shown to be incomplete. The conclusion is that simulation is necessary for understanding. Nevertheless, the theory is not without limitations. It cannot determine some words meaning i.e. syncategorematic words and some abstract words. Furthermore, simulation experiments do not capture the entire aspect of language comprehension due to limitations in research methods.

Conclusion

In this dissertation, the objective was to assess whether the embodied approach was adequate for the analysis of meaning. We addressed one particular question related to meaning, that is, how do linguistic expressions get the meaning that they have. This is answered if one knows how people understand linguistic expressions. What words and expressions mean is not discoverable by the analysis of only their forms. The semantic content can be determined by knowing how language is processed in the mind. To discuss so, we talked about the popular view on meaning in the philosophy of cognitive science, the representational approach. However, this approach can be shown to be inadequate for explaining the linguistic meaning. The embodied approach of language comprehension was discussed as a new alternative. In the second chapter, we discussed this approach. In our last chapter, we analyzed this theory to check whether this approach was viable for language understanding or linguistic meaning.

The traditional/representational approach regards that language is processed in the mind by syntactic manipulation of mental representations. The linguistic expressions are translated into abstract and amodal symbols; and manipulation over these symbols leads to meaning or understanding of those expressions. The semantic content of linguistic expressions is determined by the referents of these inner symbols. The traditional or the representational idea of meaning is influenced by representationalism. Representationalism is a doctrine about the mind and mental processes. It explains mental processes in terms of computations applied over mental representations. In the first chapter of the dissertation, we discussed the doctrine of representationalism elaborately. Under representationalism, we discussed three theories – Representational Theory of Mind, Computational Theory of Mind, and Physical Symbol System Hypothesis. All of these theories mentioned that the mind is an information processing system and that the mental processes are caused by the manipulation of *mentalese* symbols.

The researchers in cognitive science believed that apart from cognitive processes, language processing/representation of meaning can also be explicated in terms of manipulation over abstract symbols. With this belief, many semantic models in cognitive science had emerged that adopted this idea. Some prominent among them were HAL, LSA, Kintsch's construction-integration model, and so on. These were discussed in our first chapter. However, the

representational approach faced the symbol grounding problem. It was seen that that mere manipulation based on the syntax of the abstract symbols is not sufficient for understanding. The reason is that symbols in these semantic models and in *mentalese* are arbitrarily connected with their referents and are amodal. This happens because symbols are ungrounded. Symbol grounding problem suggested that for any word to convey meaning it must be grounded in (related to) the user's experiences. However, in representational theory of meaning, it is supposed that symbols and its processing in the mind is independent of the perceptual and motor system of the body. Hence, symbols get detached from user's experiences and thus, no connection is formed between them and what they refer.

To solve this problem, the embodied theory of language comprehension was discussed in the second chapter. In this chapter, the attempt was to highlight how the embodied approach tackles the symbol grounding problem. The embodied approach is influenced by the thesis of embodied cognition that attacks representational-computational theories of mind or cognition. Embodied cognition theory attacks the idea that cognition is independent of the medium in which it is implemented. It says that cognition emerges from the dynamic interaction between body and environment and thus is dependent on the body. Mental concepts and processes are shaped by bodily experiences. Many examples in favour of embodied thesis was explained. For example, visual processing and memory etc. were seen to be embodied. The embodied approach of language comprehension supposed that language processing is also embodied. Embodied approach tackles the symbol grounding problem by supposing that representations in the mind are not abstract and non-modal but perceptual. Perceptual symbols are neural patterns, multimodal and componential and they can be re-used for cognitive processes.

On the question of how meaning comes about, the embodied theory presents the simulation hypothesis. In simulation, we re-activate the experience, which we do at the time of perception and action of objects and events in the world. This is done through the activation of the same perceptual and motor system of the body that is done during the perception of actual objects. During language processing also, simulation happens. The scientific investigation in neuroscience, psychology and cognitive psychology on language processing have shown sufficient evidence of simulation during language use. Based on these investigations, the researchers Zwaan, Barcalow, Lakoff & Gallesse, and Glenberg had come up with the

simulation theory of language comprehension, in which they proposed that simulation through sensorimotor system activation is necessary for language understanding. During language processing, we simulate the same experience that we do during perception or interaction with the object or situations described in the linguistic expressions. This happens through the activation of the sensorimotor system. In this way, meaning comes through simulation.

The embodied approach overcomes the problems faced by the representational approach. It does not have to assume that information received through senses is translated into inner codes. Rather, it says that information is retrieved in the same form in which it was received. For example, the information or experience received through the perception of a lemon is not changed into some abstract codes in the mind, as the representationalism assumes, but is stored in the same form; the visual system stores colour information of the percept, the motor system stores its touch information and so on. When this word is processed, all the information depending upon context is retrieved in the same form by activation of the concerned perceptual or motor system. There need not be any assumption of a separate interface or *language of thought* according to the embodied approach.

Apart from the simulation hypothesis, we also looked at the indexical hypothesis. This hypothesis talked about the importance of bodily abilities in the simulation of a meaningful situation during language processing. This hypothesis proposed that sentences or other linguistic expressions are understood provided that their comprehension leads to the construal of meaningful situations. For instance, ‘climb the pen’ is a non-sensical sentence because for a human this sentence does not lead to a meaningful situation, i.e. a human can't climb a pen.

Simulation theory works for words and sentences that seem experience-based, for example, *kick, pick, watermelon, run,* etc. Sensorimotor activations are obtained for these expressions but many expressions do not seem experience-based or have clear referents like democracy, justice, law, etc. Do these expressions too evoke the sensorimotor system? and even if they activate, how should one determine their semantic content in terms of sensorimotor activations. This seems problematic. To tackle this, we included the metaphor theory of George Lakoff. Here it was shown that people understand abstract words in terms of metaphors. Metaphors are

closer to human experience and people understand things easily when those things relate to their experiences. As already discussed, people understand the abstract word ‘Time’ in terms of ‘Money’. Activations are also obtained for abstract words and in the embodied approach these activations are analyzed with the help of metaphors. Thus, simulation theory is shown to be applicable for abstract words also. Overall, the embodied approach of language comprehension proposed that simulation through sensorimotor activations is essential for language understanding.

However, the question emerged whether sensorimotor system activation is sufficient for language comprehension or whether activations can determine the meaning of the linguistic expressions. These questions were dealt in our final chapter. In this chapter, we dealt with some major criticisms often applied against the embodied approach of language comprehension. These criticisms were:

1. Sensorimotor activations are epiphenomena.
2. Sensorimotor activations are not necessarily related to language comprehension.
3. Language processing requires abstract representations.
4. Simulation is not required for understanding meaning.

It was found that these objections were inadequate. The objections were based on wrong arguments. Apart from this, these objections were based on an incorrect analysis of the embodied theory of language comprehension.

The first and second criticisms were also shown to be incorrect. For there was evidence that established that without perceptual and motor system involvement language processing is impacted. Some impairment studies were discussed in which it was observed that people who had defects in perceptual or motor areas in their brain had difficulties in comprehending words or sentences. For example, patients with defects in the frontal cortical region of the brain felt difficulty in a lexical decision task which involved action-related words. The frontal cortical region is used for the planning and execution of motor tasks. Those who propose that activations are epiphenomena do not give a sound argument for assuming the same.

Some thinkers such as B. Mahon and M. Caramazza, M. Louverse and others assumed that language processing is accompanied by both abstract and grounded representations. This argument was also contradicted. The proponents of this view could not garner strong evidence of abstract representations in the brain during language processing. They argued that for explaining the meaning of abstract words or sentences, one cannot subscribe to all individual experiences, therefore there must exist a layer within the brain where abstraction happens. Without exposition of evidence, such an assumption seems self- contradictory.

The fourth argument was that for understanding linguistic expressions simulation is not required. The meaning of linguistic expressions can be determined without taking recourse of simulation. The proponent of this view had put that truth-conditional theory is sufficient for generating meaning of expressions. In truth-conditional theory, one can get the meaning by the logical analysis of sentences or propositions. We saw that this argument was also found to be weak. Some examples were put forwarded that showed that the meaning of those propositions could not be determined by the truth-conditional approach. In those instances, the simulation was required for generating meaning.

In this way, it seems that the embodied approach is quite a plausible view for the analysis of meaning. For it says that for understanding the meaning of linguistic expressions simulation is necessary. In other words, the words get the meaning that they have because of simulation by the individual of the content which those words express. This was the objective of the dissertation, that is, how do linguistic expressions get the meaning that they have. The embodied theory seems to succeed in answering this.

However, there are some limitations of the embodied approach too. One limitation was that in the literature about simulation emphasis was given to language comprehension. While very little research is motivated on simulation during language production. This is because it is easier to empirically investigate subjects when they are comprehending the language than when

they are speaking. Studies on which this hypothesis is based do not capture the entire aspect of language.[195] Hence, there are some methodological constraints on this approach.

The second limitation is concerning abstract and syncategorematic words. The metaphorical analysis does not work for all abstract words. Some researchers have shown that sensorimotor activations are not obtained for some abstract words even after the metaphorical analysis. Thus, abstract words pose challenges to the embodied approach. The syncategorematic words are those expressions that occur often with other words and whose meaning changes depending upon the words with which they occur. For instance, words like safe, big, etc. The meaning of these words cannot be analyzed in terms of sensorimotor activations alone.

Finally, the embodied approach is a novel research program. It is not a unified thesis. Its proponents do not agree on just one hypothesis. However, empirical studies in neuroscience and psychology on language processing are still developing and it is hoped that with the advancement in researches in this field, this approach might be developed into a unified thesis. We also looked at some applications of embodied theory in various fields. We saw that in education, this approach is quite useful. School-age children can enhance reading comprehension by cues that increase their imagination. The embodied approach of language comprehension is useful for learning foreign languages also. In artificial intelligence, some natural language processing tools have been developed that use embodied theory. Overall, the embodied theory of language comprehension is quite effective for the analysis of meaning. The theory is based on empirical researches and thus seems to be more plausible. However, more research is desired so that a well-specified theory of meaning could be developed.

The dissertation in its limited scope tried to analyse embodied theory of language comprehension. The scope of this dissertation could have been expanded by comparing embodied theory with other prevalent classical semantic theories in philosophy of language such as truth-conditional theories, Fregean semantics, etc. This could have led to a better analysis, But, given the present objective, the dissertation was limited to its comparison with traditional theory of meaning in philosophy of cognitive science. There were certain other

[195] Bergen Benjamin, "Embodiment, simulation and meaning", *Routledge Handbook of Semantics,* p. 150

issues, for example, the role of Image Schemas, Metonomy, etc. in meaning-making that remained untouched. They locate embodiment in language by analysing words and phrases. For example, CONTAINER Image Schemas. Apart from this, researches for simulation during discourse or text-comprehension are still few. The research on these aspects of language could leave more scope for development of embodied semantics.

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