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A Critique of Pure Cognition:
Imagery and The Sensuous

by

Murray Mann

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Critique of Pure Cognition: Imagery and The Sensuous" submitted by Murray Mann in partial fulfillment of the requirements for the degree of Master of Arts.

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9 September, 1994

Date

Abstract

This thesis looks at arguments against the classical computational theory of mind in order to see if they may lead to an alternative account of the uses of mental images. I consider the work of Zenon Pylyshyn in his 1984 *Computation and Cognition.* I offer three arguments against his account of mind and attempt to show how they have serious implications for his explanation of mental images. I then go on to consider a different account of mind to see if it offers an account of the uses of mental images.

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Let us not forget the Grad lounge, the Werewolves of Logic, the full moon-midnight rambles on Nose Hill, the Rortabender, the road trips to the Banff Deli, Montana, the climbing of Mount Rundle, and the trip to New Orleans.

Dedication

This thesis is dedicated to my parents.

Table of Contents

Introduction

The subject of this thesis concerns mental images. Since I discuss images in chapter one, let me just briefly mention here what I take images to be. Mental images are perceptual-like experiences that are generated within the mind. For example, one can have an auditory image of the *sound* of a trumpet; or one can visualize a bright red apple. The subject of this thesis also concerns the view that the mind is a computing machine and that mental images are involved as the material used in what is the manipulation of symbolic representations.

The structure of this thesis consists of three parts. The first part sets out the issues and explains the main ideas. The second part presents my objections to Pylyshyn's computational account. And the third part presents an alternative account.

Let me briefly state what I take my job to be. As far as I can see, there is no criticism of the classical computational account of mind that also considers how the objections apply to the computational explanation of mental images.[1] By the classical computational theory of mind I mean an account developed along the lines of Jerry Fodor's (1975) *Language of Thought.* There are a number of criticisms directed at the computational theory of mind but none of these consider how such objections apply to the explanation offered by the computational theory of mind of mental images.

Thus what I intend to do is to consider how objections to a classical computational theory of mind may lead us on to an account of the usages of mental images. One example of a computational theory is Zenon Pylyshyn's (1984) *Computation and Cognition.* In

[1]Except for some of the work by Mark Rollins (1989) *Mental Imagery: On the Limits of Cognitive Science*

Pylyshyn's work we find a clear explanation of imaging in terms of a computational account of mind. The objections I raise are based upon Pylyshyn's account and some intuitive ideas about what is required for an adequate account of mind. I suggest an alternative account based on some of the work of C. B. Martin in "What is Imagistic About Verbal Imagery and Why Does It Matter?".

Let me very briefly say why I think Pylyshyn's account of mental images fails. It fails because 1) the way in which it comes to acquire intentionality (i. e. how images can be about something or have meaning), which is a necessary part of Pylyshyn's account, either simply begs the question or is not in itself enough 2) his account is unable to explain how imaging and perceiving have sensory or sensory-like experience because it denies any relevance to the actual material used for imaging and perceiving and 3) his account cannot make use of the ordinary and nonpropositional cases of perceiving and imaging. For these reasons I argue that we consider an alternative account.

A couple of footnotes are needed. I intend to use the term *imaging* differently from *imagining*. For the term *imagine* may mean simply to "think of" or "about" in an abstract way without having any distinct image occuring. That is, one might be able to "think of" the sound of a trumpet without any distinct auditory *image*.[2] In other words, one can *imagine* something without *imaging* it. I am primarily interested in *imaging*. Though this "abstract thinking," if it is a conscious and consecutive activity, would involve, probably, verbal imaging. Verbal imaging breaks down into perceptual-like images similar to

[2]The mind has various shorthand or abstractive ways of representing things, not all of which appear imagistic; but I think it is still an interesting question what this so called "abstract" thinking consists of. It is of course well known that thinking without any imaging goes on, for example, C. B. Martin notes the cases of awaking in the morning with a new solution to an old problem, or when pausing to speak, one's mind goes blank just before one begins to articulate a new idea. He refers to this as the "silent psychic hum". It needs to be recognized that this is different from the abstract thinking out of some problem where one may be working with partial images.

perceivings (in one or more various modalites) of utterings or inscriptions as performed by oneself or someone else. When I require a noun cognate to *imaging* I shall use "image", and if I need a noun cognate to *imagine* I shall use *imagining*. I shall not use the term "imagery" because it may be misleading; for it has a number of uses in literary settings that I shall not be considering. I will be using these terms in the way they are habitually used, that is, I shall be assuming some "intuitive account" of their meaning.[3]

The account I am using assumes some form of token identity i.e. the brain just *is* the mind (in some yet to be worked out sense). As there is no inner homunculus (little person) that gets to be the agent or subject acting or being acted upon, the appropriate way to think of the agent of mental activity is as some form of *virtual* subject; however, the problems associated with this view need not be worked out here.

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[3]As Quine very usefully says in the footnote to page 36 of *Word and Object*, "By an intuitive account I mean one in which terms are used in habitual ways, without reflecting on how they might be defined or what presuppositions they might conceal."

Part I: Setting The Stage

Introduction:

In this first part I set out some of the background needed in order to understand the critique I offer of Pylyshyn's account of imaging in part II.

In the first chapter I have used the case of musical imaging to focus our thinking about what imaging consists of. Musical imaging, like "having a tune stuck in the head", is common enough to be useful; and when considered with our capacity for "inner speech", or verbal imaging, we can look at the debate with some degree of freshness.

The second chapter introduces the theory of mind as a computing or symbol manipulating machine. Pylyshyn holds that the mind is essentially a symbol manipulating machine. This means he will try to explain imaging as the processing of sets of symbols.

The third chapter explains how Pylyshyn goes about using this theory of mind to show how imaging must be or at least is just as likely to be the processing of sets of symbols.

The fourth chapter shows how his account of mind cannot make use of what he calls tacit knowledge. Pylyshyn has argued that images have access to tacit knowledge. I do not deny this but argue that his account cannot make use of such knowledge.

The fifth chapter sets out some of the research that has come out since Pylyshyn has argued his case.

This done, I move on in Part II to set out my objections to Pylyshyn's account.

Chapter 1: An Introduction To The Phenomena

A Case of Musical Imaging

A friend tells me that he has composed a new piece of music. I ask to hear it. He says, "Well, I haven't actually written it down yet; its still all in my head." He says he's been working on it now for over a year. He spends hours going over and over each section in his head until it sounds just right. I'm a bit sceptical and at the same time curious. *I* can't hear this piece of music until he performs it, but it does seem possible that *he* hears it, or at least "hears" it as we say "in his head".

What can we say about such a case? Is there really music inside the head? Well, of course, in one sense, "music" only exists inside *someone's* head, even when all the *sound waves* originate from some instrument. What is interesting here is that this "music" originates *inside* the head where, presumably, there are no musical instruments. I consider this a clear case of musical imaging.

Imaging occurs when perceptual-like experiences occur without the immediate stimulus, i.e. they are internally caused.[4] Imaging is a perceptual-like experience. Many people are familiar with the experience of having a tune stuck in the head; but not many have developed the capacity for the richness and fullness of "sounds" in the head to create new "sounds" and arrangements. But if we were to think this capacity is mere pretence consider these words:

> From where do I take my ideas? That I cannot say with certainty. They come uncalled, directly and indirectly. I could grasp them by my hands in the freedom of nature, on walks in the silence of the night or in the early morning through moods which turn into tones which sound, blow, storm,

[4]Percepts we could say are signals used within the system that originate at the receptors; images, are signals used within the system that are qualitatively *like* those signals that originate externally, but originate *within* the system.

> until the notes are standing before me....I carry my thoughts a long time, often very long before I write them down. Therein my memory remains loyal to me, since I am sure not to forget a theme even after years, once I have conceived it. Some things I change, reject, try all over again until I am satisfied.[5]

These words were written by Beethoven a few years before his death. As Deutsch and Pierce remind us, many of the compositions of Beethoven were written years after he became deaf; these creations are a stunning example of the power of the auditory modality not only to *recreate* sounds in the head, but also to invent new combinations and patterns of sounds. This is an extreme case of auditory imaging. Not many can acquire, or are born with, the capacity to generate this sort of musical imaging. But for the musician auditory images are a rich and exciting capacity.

Recent research indicates that musical images contain information on pitch, tempo, loudness, and timbre.[6] Musical imaging is only one example of auditory imaging. Another very important case is verbal imaging. Verbal imaging combines both the imaging of voice sounds with the imaging of the feel of making voice sounds.[7] This verbal imaging is for many people the capacity for both expressing and working with one's thoughts. Auditory imaging, then, can be of any sound that can be heard: voices, music, a bird's singing, waves crashing upon the rocks, the wind in the trees, etc.

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[5]p. 237 D. Deutsche and J. R. Pierce (1992) "The Climate of Auditory Imagery and Music" in D. Reisberg (1992) *Auditory Imagery.*

[6]Musical images contain information on pitch (Hubbard and Stoeckig, 1992; Halpern, 1992; Itons-Peterson, 1992), tempo (Halpern, 1992), loudness (Itons-Peterson, 1992), timbre (Itons-Peterson, 1992). Hubbard and Stoekig consider and reject three different models for the representation of pitch because those models cannot accommodate the musical qualia. (p. 231 Hubbard and Stoekig) They argue for a model "in which musical images are generated in a temporal analog medium by a modular system based upon input from either sense organs (perception) or memory (imagery)." (p. 231 Hubbard and Stoekig)

[7]See C. B. Martin "What is Imagistic About Verbal Imagery And Why Does It Matter?"

The auditory is an important but relatively unexplored modality for imaging.[8] For too long research has considered only the visual modality to the exclusion of all other modalities. It is now time to think more closely about the auditory modality for imaging and perceiving. Auditory imaging is a particularly good case to examine for imaging because it keeps us from thinking of images as pictures in the head. The traditional dichotomy between images as "pictorial or descriptional" no longer sounds appropriate.

Yet imaging is not just of the auditory and visual. Visual imaging has been used for most research on imaging, but imaging occurs in all sensory modalities. For example, imaging could be of the visceral, that is, the conditions of the upper chest, bladder, genitals, stomach, skin temperature, as in flushing.[9] The tactile, our sense of touch and pressure, the motor and kinesthetic senses, used to sense body position, muscle tension, and one's sense of balance and motion, are all capable of being imaged.[10] The olfactory and gustatory, our sense of smell and taste, are also capable of being imaged.[11] Imaging may also be of pain states, or moods as well.[12]

All of these can be very brief, partial, non-propositional; or, they can be exceedingly vivid and sensuous, under the voluntary control of the agent. Together they mix with other aspects such as beliefs and desires and worries and hopes etc, to produce what we might call the life of the mind. After all, the life of the mind *is* the life of the body. Not only do

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[8]See D. Reisberg (1992) *Auditory Imagery*

[9]All these are a part of emotional responses and I think that the capacity for what we might call emotional imaging will be crucial for developing a capacity for empathy.

[10]See M. Jeannerod (1994) "The representing brain: Neural correlates of motor intention and imagery", Behavioral And Brain Sciences

[11]But see M. Carrasco and J. B. Ridout 1993 "Olfactory Perception and Olfactory Imagery: A multidimensional Analysis" *Journal of Experimental Psychology: Human Perception and Performance.*

[12]Because, it could be argued, these are to some degree perceptual states; but at any rate these are cases to consider for future work, they do not present clear cases of imaging as the auditory modality does.

we have these perceptual-like experiences such as "the making up of sounds in the head", but also we can *use* these experiences such as "sounds in the head" for many different purposes and in many different ways.

All of this so far should be uncontroversial. For many people have the capacity for musical and verbal imaging. Although it may be difficult to capture the characteristics of the mind, it is crucial that we recognize these cases of imaging are *a part* of what we generally call the mental. The trick will be to show how it all works.

One common reaction was to think of mental images as strange forms of representations floating about in the brain. This is misleading. Mental images are no stranger than percepts or dreams or hallucinations. It needs to be emphasized then, that *whatever* the material instantiation of images, it is much the same form that allows us to have perceptual, dreaming, and hallucinogenic experiences.[13] Thus what we need to explain is how anything could have these forms of sensory and sensory-like experiences; and, we need to explain how some system could come to have representative uses of such sensorial experience. And, as well, we need to consider how a representative system could have the capacity for non-propositional and partial images and percepts that we find is characteristic of perceiving and imaging. In part II I will argue that the manner in which Pylyshyn establishes his account, and the assumptions he makes about mental representations, cannot meet any of these conditions. In the end I will suggest that there is an alternative account that may allow us to think more productively about imaging and perceiving, and dreaming and hallucinating as well.

Someone might think that the approach I take is a form of 9th planet Hegelianism, because, so the thought goes, it is only something that could be resolved in the laboratory,

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[13]On the functional equivalence of waking states with dream states see for instance R. R. Llinas and D. Pare (1991) "Of Dreaming and Wakefulness" *Neuroscience* where they argue that wakefulness and dreaming states are functionally equivalent brain states.

or by looking at the world.[14] This I deny. Just looking at the world doesn't always tell us *how* it works. I have tried to make use of any relevant empirical work. Yet the work of science proceeds in many different ways. Some of the ways of science are in the lab, others are at a more speculative or conceptual level. What's philosophic about this speculative science is the offering of reasons for certain positions or objections. This is something I maintain I have upheld. The process involved here should rather be thought of as a dialogue between people interested in a certain piece of the world and how it works. Whether I'm labeled as doing science or philosophy makes little difference to me. My concern is with figuring out how a piece of the world works.

I now turn to Pylyshyn's theory of the mind. I sketch what I take to be the central ideas of this theory and then in the following chapter show how he use these ideas to explain images.

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[14]John Baker pointed out to me the following interesting case of a philosopher whose "philosophical" objections prevented him from believing the possibility of a ninth planet. "In his dissertation *De Orbitis Planetarum* (1801) Hegel criticised Newton, gave an *a priori* defence of Kepler, and offered an argument to the effect that if certain sections of Plato's *Timaeus* were right, then there could be no planet between Mars and Jupiter. Indeed even after the discovery of various asteroids between the two planets he still hoped for philosophical accounts of the positioning of the heavenly bodies." Footnote 5, J. A. Baker "Philosophy and Artificial Intelligence in Canada" forthcoming in *Eidos*.

Chapter 2: A Theory Of The Mind As A Computing Machine

Introduction:

Pylyshyn thinks that the mind is a symbol computing machine (read "virtual machine") running "on" the brain.[15] Thus, he argues that imaging consists in the processing of sets of symbols. This view, developed largely since the 1940's, underlies what we can call the cognitive science program. It began with a number of developments in the study of logic, computing science, and neurophysiology that shifted the emphasis in psychology from the study of behavior to a more interesting field of study about activities in the brain responsible for such behavior.[16] One result of this change was the suggestion that the neurons of the brain operated like the switches in a digital computer (i.e. they are either on or off) and so it was thought the brain could instantiate any computable function.[17] A number of people have developed or used an account of mind along these

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[15]See for instance p. 39 Pylyshyn *Computation and Cognition* where he states that "...what the brain is doing is exactly what computers do when they compute numerical functions; namely, their behavior is caused by the physically instantiated properties of classes of substrates that correspond to *symbolic codes*. These codes reflect all the semantic distinctions necessary to make the behavior correspond to the regularities that are statable in semantic terms. In other words, the codes or symbols are equivalent classes of physical properties which, on the one hand, cause the behavior to unfold as it does, and on the other, are the bearers of semantic interpretations that provide the needed higher-level principle for their individuation and for stating the generalizations...we conclude that the codes are "psychologically real," that the brain is the kind of system that processes such codes and that the codes do in fact have a semantic content." See also pp. 87-106 ibid.

[16]For a good history of this period see Howard Gardner's *The Mind's New Science*, another good introduction to this theory is outlined in John Haugeland's *Artificial Intelligence: The Very Idea.* Also see chapter one of Andy Clark's *Microcognition* .

[17]See for example McCollough and Pitts, "A logical Calculus of the Ideas Immanent in Nervous Activity" in W. S. McCulloch *Embodiments of Mind*, M.I.T. Press, 1965. This is reprinted in Margaret A. Boden, ed. The Philosophy of Artificial Intelligence, Oxford University Press, 1990. See also for criticism W. Calvin (1991) *The throwing Madonna* p. 55 on the "physicist's fallacy".

lines. See, for instance, the work of Allen Newell, Herbert Simon, Marvin Minsky, Daniel Dennett, Jerry Fodor to name a few. Pylyshyn takes this suggestion and argues that there is a natural domain of "cognizers" or "knowing things".[18] The central idea is that all members of the domain of "cognizers" can act on the basis of representations because:

> they instantiate such representations physically as cognitive codes and that their behavior is a causal consequence of operations carried out on these codes. Since this is precisely what computers do my proposal amounts to a claim that cognition is a type of computation.[19]

I will go on to argue in Part II that the means by which Pylyshyn comes to establish original meaning (or intentionality) for such a form of representation postulated here, that is, discrete atomic symbols, either simply begs the question or is not nearly sufficient to do the job. Also given the assumptions he makes concerning the form of representation, he is not capable of explaining such fundamental problems as sensory experience, and his account appears to be incapable of catching the ordinary cases of perceiving and imaging, namely, nonpropositional perceiving.

I will go on to argue in part III for an alternative account of how we might be able to have representative use (i. e. meaning or intentionality) in imaging and perceiving, and I will argue that any notion of sensory experience needs to look at the particular material used in processing, and not just simply the processing.

First, in this chapter, I outline the key features of Pylyshyn's theory of mind, for it is a powerful thesis that underlies much of the work in current psychology.

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[18] p. xi Pylyshyn, ibid.
[19] p. xiii ibid.

Computation and Cognition

The basic idea of this theory is that cognition or thinking is a form of computing that makes use of symbols.[20] I begin by explaining what computation means and some of the technical terms used in talking about computers, and the different forms of computation possible. I then briefly say what is meant by cognition; this leads to a statement of Pylyshyn's claim that cognition is a form of computation that is unique in using symbols. After that, I explain some of the main ideas of his account of mind. These ideas include: the notion of strong equivalence, functional architecture, cognitive penetrability, and the levels of explanation hypothesis which postulates an independent level of representation.

Computation is a *process* that can be specified for determining an output given some input.[21] It is synonymous with calculation. A computation occurs by means of some physical device called a computer.

A *computer* is a physical device in which some computational process occurs. For example an abacus is a primitive computing machine that allows for certain computational processes. Because there is not one unique way of processing, there can be many different forms of computation. Each different form of computation requires some computer implementation. There are a number of different ways that one form of computing can be implemented.

One form of computation uses a central processing unit or CPU that manipulates or transforms sets of symbols. The CPU operates according to a fixed set of rules, or procedures, doing one operation at a time, (i. e . such processing is described as serial). The CPU works with discrete states or codes or bits, (i. e . discrete codes are usually thought of as circuits either on or off but not both, in this sense they are described as digital). These

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[20] p. 57 ibid.
[21] From the Latin "*com*" = with + "*putare*" = to consider.

discrete states or codes are used as *symbols* to represent some part of the world. This particular form of computation is referred to as GOFAI or classical computation.[22] According to GOFAI, then, all computational processes and states consist in, or are the result of, transformations of symbols.

Symbols are discrete atomic states or codes or tokens or events used to represent states of affairs external to the system.[23].For example in natural languages we use words, either spoken, signed, or written, to represent or symbolize things or ideas. That is, symbols are *about* something else, and their meaning comes from their interpretation or use. And, like a language, simple atomic or discrete symbols are capable of combining into complex molecular symbol states. Such complex symbol states allow for more complex interpretations or meaning. And, like a language, there are well formed symbol expressions or sentences and ill formed expressions.

Not all symbols need to be about something, but they still have a use or meaning. Consider for instance the expressions "all", "some", "not", "or", etc., "very" etc., brackets and scope indicators, etc. Locke called these *syncategorematicals* and thought of them as symbols used to help in making a statement. In addition to a set of symbol tokens, or code, the system needs a set of rules for forming and transforming well formed or grammatically correct expressions with such codes.

Fixed rules or *algorithms* are needed for the transformations of code. Such rules or algorithms are procedures that set out a certain specific operation allowed for certain symbolic input. Pylyshyn uses the term algorithm "in approximately its standard computer-science sense, as any completely-specified procedure, regardless of whether it is

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[22]GOFAI = **G**ood **O**ld **F**ashioned **A**rtificial **I**ntelligence: See John Haugeland (1987) *Artificial Intelligence: The very Idea* p. 112

[23]See in particular the discussion on pp. xiii, 26, 51, 62, 70-71, 158, 195 Pylyshyn ibid.

guaranteed to produce some particular desired result."[24] For instance, "If input x is a squiggle, write a squoggle as output, otherwise do nothing." That could be an example of a rule or algorithm in some system. The squiggles and squoggles are codes that function as discrete symbols.

In addition to the above terms we must also have some idea of a *program*, a programing *language*, and a *machine*, whether virtual or not. Pylyshyn defines programs as follows:

> A program is a piece of text; it is the encoding of a particular algorithm in some programming language. Thus we can have different programs for the same algorithm (one might be in FORTRAN, another in PASCAL, and still another in LISP). Because *algorithm* is a more abstract notion than *program*, in a variety of ways, it is possible as well to have different programs in the same language for a particular algorithm. In that case , programs are viewed as differing in in inessential respects; for example, they may differ in the order they do certain minor operations..."[25]

"An algorithm," Pylyshyn notes, "is related to a program approximately as a proposition is related to a sentence. The two are in a type-token relation."[26]

Programs are always written in some language.[27] There are a number of languages running in a computer, all at independent levels. Each language interprets the language above it. The bottom language is where concerns about implementation occur. And the processes of the basic operations of this language leads to the idea of the machine or virtual machine. The language provides basic operations for the program. And it appears

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[24] p. 88 ibid.
[25] p. 89 ibid
[26] p. 89 ibid.
[27] p. 94 ibid.

that the "machine" allows for or provides the basic operations or resources for the language.

> In altering the program by varying the sequence of instructions, we are using resources (or basic operations) provided by the language itself. Conceptually, this is quite different from the kind of alterations we can make by going outside the resources of the language, say, by altering the operations the language itself provides by making changes to the command interpreter. In the latter case we are altering what I have called the virtual machine.[28]

A virtual machine and a real machine are the same thing:

> It does not matter here whether by the machine one means the device described in the manufacturer's manual or what is sometimes called the "virtual machine," consisting of the raw machine plus an interpreter for some higher-level programming language.This is merely a conceptual distinction, since the virtual machine is no less a real physical machine than the one delivered from the manufacturer; it just has a different initial state.[29]

The following brief quotation helps to sum up these ideas and contrast the computer vs brain situation. Pylyshyn argues that:

> ---while the computer's operation may be viewed as consisting of various levels, each implying the existence of a program in some language, and a functional architecture that interprets the program---the situation is somewhat different in the case of cognition. There, rather than a series of levels, we have a *distinguished* level, [my italics] the level at which interpretation of the symbols is in the intentional, or cognitive, domain or in the domain of the objects of thought.[30]

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[28]p. 95 ibid.
[29]p. 70 ibid.
[30]p. 95 ibid.

GOFAI or classical computation is not, however, the only form of computation. GOFAI is most commonly contrasted with another form of computing called Parallel Distributed Processing or PDP; it is sometimes also called Connectionism. PDP is a form of computing that is the *simultaneous* (i.e. parallel) manipulation of *numbers* by *distributed* processors (hence Parallel Distributed Processing) where sentence processing supervenes on the number processing.[31] Connectionist or PDP accounts of computation do not posit a simple atomic symbol as the basis of computation.[32] Another earlier form of computation holds that while the processing can be serial and digital, what are processed are sets of sentences.[33] The above gives us some idea of what is involved in computation.

Pylyshyn wants us to think of cognition as a form of classical computation. Cognition is a term used to describe *knowing* in a very broad sense.[34] To cognize something is to be in a state of knowing or to come to know or understand something; hence, cognition is the act or process or state of knowing or coming to know; in this sense it should be thought synonymous with thought or thinking. It is not important for Pylyshyn's account which word we use here, what is important for Pylyshyn is that there is

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[31]See J. Fodor and Z. Pylyshyn (1988) "Connectionism and Cognitive Architecture" *Cognition* where they argue that the classical form of computation is instantiated within a PDP network but the kind of computing done at the PDP level is not cognitive computation, because it does not make use of rules and representations. See also J. A. Baker, "Philosophy and Artificial Intelligence in Canada".

[32]Connectionists do not hold that computation is symbol processing: they (or some of them at least) would say that computation can consist of processing numbers. That is, numbers not numerals are what are being manipulated, for if they were manipulating numerals they would still be processing symbols. Processing numbers is not the same as processing numerals. See Smolenski's BBS (1988) article "On the Proper Treatment of Connectionism" and J. A. Baker (1994) "Philosophy and Artificial Intelligence in Canada" forthcoming in *Eidos*.

[33]See for example McCulloch and Pitts, "A Logical Calculus of the Ideas Immanent in Nervous Activity" As Boden points out, this "visionary" paper held the seeds of both GOFAI and PDP, for though it portrayed the processing as distributed and parallel, what was processed were sentences.

[34]It is derived from the Greek "*gnosis*" or "*gnosein*" = to know.

a level of computational activity that is associated with the following: thinking, believing, desiring, remembering, guessing, problem solving, etc, and these sorts of processes will be explained as cognitive processes. Cognitve activity then, for Pylyshyn, consists largely in classical computational activity.

Computationalism, then, is the thesis that mental activities are best thought of as consisting in or perhaps depending on a certain kind of activity in the brain, namely, computational activity.[35] And this computational activity may be either GOFAI or PDP or some other combination of the two.

According to Pylyshyn, it is essential that cognition involve the computing of symbols.[36] Given this, and because there is no single physical central processing unit in the brain it follows that the serial processing postulated by Pylyshyn has to be virtual processing on a virtual central processing unit, or it seems tempting to ascribe this view to him.[37] This means that he is stuck with the postulation of levels of explanation/ description above the neurological.[38] It is in this sense that Pylyshyn holds that the mind is a computing machine running on the brain. And it is the computing machine itself, not the brain, that is ultimately responsible for our mental life.

Imaging, Pylyshyn will argue, is just the processing of symbols on such a machine. It is an interesting but I think implausible hypothesis, that the brain is running a computing machine and that mental imaging, which does not *appear* to be symbol

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[35]While we can treat connectionist as computationalists it is important to note that Pylyshyn and Fodor argue in their 1988 paper Connectionism and Cognitive architecture that PDP levels of processing are not cognitive processing, although they are computational.

[36]p. 51 Pylyshyn, *Computation and Cognition:* "The notion of a discrete atomic symbol is the basis of all formal understanding. Indeed, it is the basis of all systems of thought, expression, or calculation for which a notation is available."

[37]p. 91 ibid.

[38]See my discussion p. 24 re. functional architecture and levels of explanation.

manipulation, is, nonetheless, explained by reference to procedures which are essentially the processing of symbols on such a computing machine. Next I consider some of the key elements involved in this thesis.

Strong Equivalence

Pylyshyn is making a very strong claim here. He is not arguing that computers can *simulate* or mimic human thinking. He is arguing that human thinking occurs in a digital computing machine that is instantiated in the brain. He's not using the computing machine as a *metaphor*. He really believes that computers and brains are both essentially symbol manipulating machines.

He argues that human thinking and computer processes are equivalent in a *strong* sense. So when he says that the computing machine instantiated in the brain is processing symbols, and the computing machine instantiated in electronic circuits is also processing symbols, what he means is that, at the right "level of comparison," they are both computing machines processing in the very same way. The notion of strong equivalence then has to do with the same or equivalent processes. To define strong equivalence one must decide what counts as the basic operations in a computing machine whatever physical architecture it happens to be instantiated within, and this involves choosing the right level of comparison.[39] Pylyshyn identifies two processes as strongly equivalent when there is what he calls the "complexity-equivalence of computational processes" or "they are indistinguishable in respect to the way their use of computational resources (such as time and memory) varies with properties of their input."[40] So to compare two computing machine processes one must have an idea of how they make use of their "computational

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[39] p. xvi ibid.
[40] p. xvi ibid.

resources." Pylyshyn mentions time and memory as forms of computational resources. For this to be a useful claim we need to know how it would be possible to compare the use of time and memory on two computing machines that run on different functional architectures. Yet it is not at all clear how the use of time can be determined accurately in the brain other than by means of response times, and, as well, it is difficult to determine how memory is measured. Pylyshyn says that the appropriate level of comparison corresponds to "the intuitive notion of the algorithm."[41] Thus:

> ...two programs can be thought of as strongly equivalent or as different realizations of the same algorithm or the same cognitive process if they can be represented by the same program in some theoretically specified virtual machine. A simply way of stating this is to say that we individuate cognitive processes in terms of their expression in the canonical language of this virtual machine.[42]

At any rate Pylyshyn is making the strong claim that the very same kind of algorithm is being run on the radically different functional architectures of the human brain and the silicon computer.

Of course, Pylyshyn is not arguing that present day computers are minds, but rather that, in theory, what computers and brains do is equivalent, namely, manipulating symbols according to rules of transformation.

Functional Architecture

Pylyshyn claims that activities such as imaging or thinking or reasoning are processes instantiated in a classical or GOFAI computing machine, thus he needs to suppose that such activities cannot be explained merely by reference to material properties

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[41]p. 89 ibid.
[42]pp. 91-2 ibid.

of the brain. Thinking and reasoning are *only* explained, according to Pylyshyn, by the properties of a classical but virtual computing machine in the brain. Yet in order for him to describe something as a computing machine in the first place he needs to assume a certain level of abstraction in describing such a machine. He needs to have a characterization of the basic operations or functions needed for such a computer. And he needs to describe how the basic operations of a classical form of computation differ from other kinds of computing such as parallel distributed processing. Although not very helpful, we could say initially that the functional architecture is the "architecture" or "formal organization" of the basic functions that allow for certain computing processes. Certain processes or states must function as representations and rules. There must be something that can function as a "workspace," there must be something that can function as a "memory" etc. In this way, speaking at a certain level of abstraction, he can postulate the processes needed that would allow for a symbol manipulating computer.

While it is not entirely clear how we can characterize the functional architecture, Pylyshyn does think that there is a role for such an architecture that is different from the level of the program. The following is a selection of comments on the functional architecture that Pylyshyn gives:

> The concept of functional architecture has considerable utility in computing science, since it marks the distinction between what corresponds to the program of interest and the various incidental properties grouped under the rubric "implementation concerns".[43]

> By "functional architecture" I mean those basic information processing mechanisms of the system for which a nonrepresentational or nonsemantic account is sufficient. The operation of the functional architecture might be explained in physical or biological terms, or it might simply be

[43]p. 93 ibid.

characterized in functional terms when the relevant biological mechanisms are not known.[44]

Pylyshyn notes that any computing machine, virtual or not, has some functional architecture, and he supposes that the job of cognitive science is to discover the functional architecture of the "cognitive virtual machine."[45] More importantly, as it relates to our concern with mental images, is the claim:

> ...that certain properties of mental imagery are not due to reasoning or other knowledge-dependent processes...[which] can be interpreted as the claim that some cognitive function is actually part of the functional architecture." 46

Pylyshyn notes that there are different notions of what functional architecture means:

> It is unfortunate that the term functional architecture also has an established usage in neurophysiology (for example, Hubel and Weisel, 1968) that differs in important respects from my use of the term here. Although in both cases architecture refers to certain structures, the structures of interest in neurophysiology are anatomical or topographical ones---specifically, according to Hubel and Weisel, the columnar arrangement of related detector cells. In my usage the structures are functional, corresponding to, for instance, primitive symbol-manipulation operations, various buffers, and storage and retrieval mechanisms. I shall continue to use functional architecture despite its potential ambiguity, because the term's meaning in computer science so closely captures the idea I wish to convey.[47]

The idea of a functional architecture, then, as I understand Pylyshyn, is the idea that certain processes or operations need to be postulated (and instantiated in the physical

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[44] p. xvi ibid.
[45] p. 95 ibid.
[46] p. 101 ibid.
[47] p. 92 ibid.

architecture) that can *only* be described as operations or functions needed for computing. The functional architecture is a postulation, at a certain level of description, of the basic operations needed for the *computing* system (as opposed to the physical system). For example, Pylyshyn supposes that in perception there is a "transducer function" needed to provide symbolic input. It is an operation that is postulated to explain how the system can have states that will function as symbols. I examine and criticise this particular function in chapter six.

Pylyshyn will go on to argue that analogue forms of representation cannot explain images because they are a part of what he calls the functional architecture of a system.[48]

Cognitive penetrability

The way to test for the basic operations and regularities of the functional architecture (as opposed to the semantic regularities) is to see if those regularities are affected by any changes in representational content, that is, what one believes. When one pattern of regularities can be altered systematically by means of the information conveyed by stimulus events:

> ...we say that the input-output function in question is cognitively penetrable, concluding that at least some part of this function cannot be explained directly in terms of properties of the functional architecture; that is, it is not "wired in" but requires a cognitive, or computational, or representation-governed, explanation.[49]

So if certain behavioral regularities of the system can be affected, in a rationally explainable manner, by other beliefs or desires then that regularity is cognitively penetrable.

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[48]See my discussion of analogue forms of representation on p. 31
[49]p. xvii ibid.

Thus Pylyshyn does not hold that digestion is affected in the right ways to be cognitively penetrable. Pylyshyn does hold that images are affected by beliefs in the appropriate ways and that means that they are explained as representations governed by rules.

Representations and a Language of Thought

When explaining certain regularities of behaviour (interpreted broadly) Pylyshyn supposes that the brain is capable of representing features of the world.[50] Certain regularities of behavior cannot be explained without postulating representations or internal states, like beliefs and desires, that are somehow capable of being about or representing the external world. Pylyshyn supposes that in order to have meaning these representations must function as symbols. Such symbols will be given some meaning and complex meaning will come from the combinations of these simple meanings. Thus each possible meaning will have a unique instantiation. In other words the representations will work like a Language Of Thought.[51]

A crude example is as follows: if I want a drink of water, and I believe that in order to get a drink of water it is necessary to get a cup from the cupboard, then all else being equal, I will tend to go get a cup from the cupboard. Getting a cup from the cupboard is explained as a semantic regularity, or logical outcome, of the result of my desire (i.e. to get a drink of water), being combined with my belief (i.e. there are cups in the cupboard). And so certain beliefs are best described as logical inferences. What makes the belief-desire structure useful in explaining behavior is that it exploits the predictive power of logic, and hence is governed by a principle of rationality.[52] The regular and rationally explainable

[50] See Pylyshyn Chpt. 2 *Computation and Cognition*

[51] Fodor 1975 originally coined the term and it is this notion that Pylyshyn refers to and uses when he speaks of a Language Of Thought.

[52] p. 34 Pylyshyn ibid.

transitions between beliefs and desires and actions, he argues, supports the claim that what is used to represent have, as a whole, a grammar and syntax like a language.

> Thus the mind is depicted as continually engaged in rapid, largely unconscious searching, remembering and reasoning and generally in manipulating knowledge---that is, "cognizing"....Because so much of this activity is at least semantically coherent, if not actually logical, representations typically are viewed as truth bearing expressions. For that reason, I referred to them some years ago as propositional (Pylyshyn, 1973). Since, however, propositions are abstractions, whereas representations are concrete entities, such representations should, strictly speaking, be referred to as "sentence analogues" or some similar term. They are, of course, not sentences in any natural or external (utterable) language. According to the view espoused here, they are symbolic expressions in an internal, physically instantiated symbol system sometimes called "*mentalese*" or the "*language of thought*."[53]

Pylyshyn will argue that, because images are affected by beliefs, and so need a semantic explanation, images will be, at the processing level, discrete atomic symbols that are transformed according to some set of rules.

A computational account posits different levels of explanation

In order to postulate any functional architecture, or functional explanation, Pylyshyn must speak of another "level", at least a level of functional explanation. The main argument for speaking of levels of explanation Pylyshyn holds is that there are "valid generalizations at one level that are not expressible at a lower level."[54] So for example, because, *literally* there are no central processing units in the brain he needs a way of speaking about certain

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[53] pp. 193-194 ibid.
[54] p. 35 ibid.

regularities in the brain *as if* there were actually central processing units. That is, he needs a level of description or explanation that allows him to speak of the computing machine.[55]

More generally, he needs to postulate a level of description for psychological regularities in the first place.[56] In attempting to offer a constrained explanation of this domain Pylyshyn postulates three levels of explanation or description.

> Explaining cognitive behavior requires that we advert to three distinct levels of this system: the nature of the mechanism or functional architecture; the nature of the codes (that is, the symbol structures); and their semantic content. This trilevel nature of explanation in cognitive science is a basic feature of the computational view of mind.[57]

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[55]See my discussion p. 17, re. virtual CPU and processing.

[56]More generally Pylyshyn sets out in chapter one the area or domain of regularities that he argues cannot be explained at the level of physics. "It is an empirical fact about some behavior of humans and other animals that the regularities we are primarily interested in cannot be expressed listing certain biological and physical descriptions." (p.17 *Computation and Cognition*); and "Thus we intuitively count as psychological, regularities which, for example, relate "perceived" properties (such as the identity of objects in a scene) to meaningful or intentional actions (for example, "reaching for the salt"), whereas we count as at least partly non-psychological the relation between tripping over a stone and hitting one's knee....Among the considerations that suggest at least the first-order view of an autonomous psychological domain of inquiry, and thus argue for the importance of considering events "under a psychological description," are some of our strongest intuitions concerning the reasons for our own actions....Some of them are: (a) The intuitive presuppositions of our naive questions (e.g. How do we solve problems? What happens when we read, speak, or think?) presuppositions that determine to some extent the sort of account that will be viewed as addressing the questions on their terms....(b) The compelling view each one of us possesses regarding why or how we do certain things (because we are paid to, because we were taught a way to do it)....(c) The fact that a certain rough taxonomy of the world and of other people's actions results in a reasonably successful and predictive folk psychology....(d) The rationality of much (though not all) of our behaviour, which can be exhibited only if we have a taxonomy that allows us to relate beliefs and goals to intended actions....These considerations provide us with a first-draft specification of a domain of inquiry ...they specify what it is to view phenomena *under a cognitive description.*" (pp. 19-21 *Computation and Cognition*)

[57]p. xviii ibid.

This is *not*, of course, a thesis that there are three thing or levels of *being*; it *is* a thesis that for some events or phenomena it becomes necessary *for the sake of explanation* to postulate levels that are not found in a purely physical or functional explanation. The reader is invited to compare this postulation of levels with that of David Marr.[58]

To be clear, the first level is *not* the level using the language of physics, chemistry, biology.[59] The first level is a level of functional explanation. The level of physics etc. is of no use in understanding a computing machine, except as it is implemented. The first level

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[58]I quote from A. Clark: Marr (1982) distinguishes three levels at which a machine carrying out an information-processing task needs to be understood. *Level 1*, Computational theory. This level describes the goal of the computation, the general strategies for achieving it, and the constraints on such strategies. *Level 2*, representational and algorithm. This describes an algorithm, i. e., a series of computational steps that does the job. It also includes details of the way the inputs and outputs are to be represented to enable the algorithm to perform the transformation. *Level 3*, implementation. This shows how the computation may be given flesh (or silicon) in a real machine. Discussions with John Baker have led me to consider that these levels do not simply map onto one another primarily because the account Marr offers need not talk about any representational content.

[59]A commitment to physicalism maintains that all being is physical being. The primary mode of explanation uses the vocabulary of physics. This vocabulary would use terms referring to inorganic materials and their properties, it could mention shape, weight, temperature, motion, etc; it may include reference to functions or uses, or it may not. This primary mode of explanation, however, does not explain biology or organic phenomena. For example, an explanation of the brain using only the language of physics would not recognize that this is "living tissue" or "thinking tissue". It can only give an explanation using those concepts included in a physics vocabulary. Yet, since our descriptions seem to commit us to *more* than what is posited by the language of physics we might make the mistake of assuming that this more is thought of as more "being". What is important to understand is that our explanation of what exists, even in the language of physics, will always be incomplete, but it is not incomplete in "being". It might be easier to describe by saying that everything that exists, exists in some physical instantiation. Functional explanations explain things by means of what it does or what its use is, or why it exists. It is difficult to explain things that are described as biological without using a vocabulary of functions or uses. While some might argue that this is actually three levels itself i. e. the level of physics, the level of chemistry, the level of biology, etc,what is important for Pylyshyn is that within all of these physical vocabularies there is no way of talking about computing machines. So allowing that there is at least the physical level he needs to postulate a further level of explanation or description.

is postulated as a level above the level of physics, unless one's vocabulary of physics already makes reference to functions.Thus:.

1) The first level of explanation or description, then is a level postulated that allows us to make sense of functions conceived generally, but in particular, the functional architecture needed to make sense of the computing machine. Pylyshyn believes that this is the appropriate level of explanation needed to capture the basic computational operations of the computational system.

> The formal structure of the virtual machine---or what I call its functional architecture---thus represents the theoretical definition of, for example, the right level of specificity (or level of aggregation) at which to view the mental processes, the sort of functional resources the brain makes available...[60]

At this first level, Pylyshyn mentions the transducer functions that he uses in his account of perception. The transducer function is a basic function postulated to provide something that can be used in a computation, namely, symbols.

2) The second level concerns the nature of the codes or symbol structures. For example, Pylyshyn supposes that the form of what is used in representing is that discrete atomic symbol, as opposed to the processing of numbers or the processing of analogue representations. It is also called the level of representation, the level of syntax, the symbol level, or the Language of Thought Level. This level is postulated to makes sense of the way inputs and outputs are to be represented to enable the algorithms to perform the transformations.[61]

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[60]p. 92 ibid.
[61]p. 18 Clark ibid.

3) The third level of explanation or description is now necessary to describe what it is that is being computed. Pylyshyn claims that we are aware *at this level.* Hence this is called the knowledge level or the level of meaning or content. Because representational states are determined by their content, no description or further detail of the computing machine can ever provide an account of what the representations represent.[62] For this we need to suppose that the representations are about something other than themselves. These symbols or representations are about something in the world, external to the system itself.

How these representations come to have any meaning or content is simple in the case of computers: we simply fix the interpretation or meaning of the symbols. It is not at all clear, if the mind were a computing machine, how such a machine could have meaning. I consider this case in Part II.

These levels of explanation are autonomous

Pylyshyn holds that it is of fundamental importance that the same computing machine can be alternatively realized in different physical architectures.

Pylyshyn argues that each level of explanation or description will be independent of the level below. For to explain one level one need not say anything about the level below, except that there is some level below capable of instantiating it. Thus, just as the same function can be instantiated in different physical instances, so too a level of representation can be explained without making reference to the functional architecture and, likewise, semantic level regularity can be instantiated in different forms of representation.

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[62]p. 32 Pylyshyn ibid. "The principle that leads us to postulate representational states (individuated by their content) that are distinct from functional states is exactly the same as the principle that leads us to postulate functional states that are distinct from physical states. In both cases we want to capture certain generalizations. We discover that in order to do this, we must adopt a new, autonomous level of description."

A good example of alternative realizations is seen in the case of natural languages. Using one form of representation e.g. the English language there are rules concerning the way in which expressions can be formed yet this does not concern us with *what* is represented *or* the actual manner in which what is represented will be *implemented.* For example the sentence:"The grass is green."counts as a well formed sentence in English. The expression "Green. grass the is;" is not a well formed English sentence.

What is represented; the meaning, is independent of any of the actual physical instantiations it takes. The sentence can be engraved in stone, carved in wood or it may be written on paper, encoded in a computer's circuits. Each different instantiation will still *mean* the same proposition. The proposition is the abstracted meaning of the sentences.

Choosing a different language means that we need to use a different set of rules and a different form of representing, but again this says nothing about how we actually go about instantiating that sentence.

The meaning or what is represented is also independent of the form of representation. For example "It is raining" and "es regnet" both express the same proposition and have the same meaning. One may be written in one form of representation, i.e the English language. The second may be written in a different form of representation i.e. German. Yet the two sentences could have *the same meaning*.

Conclusion

The above is only a very schematic view of some of the main characteristics of the view Pylyshyn holds in the account of the mind as a computing machine. It should not be thought of as a complete account of his theory and it leaves out many details. It should, however, give the reader some idea of the background theory needed to understand the claims Pylyshyn is making about mental imaging. I now turn to his explanation of imaging as the processing of sets of symbols.

Chapter 3: The Computational Explanation Of Mental Images

Introduction:

The theory of mind as a computing machine entails that imaging will be *explained* (although perhaps not always *described*) as a cognitive function computed serially and digitally from some (often *tacit*) knowledge base. Imaging is, to use Pylyshyn's expression, "a semantic structure computed from tacit knowledge."[63] We can say then, that under this account, imaging just is the processing of some set of symbols.

Some background: The debate about the mental rotation and scanning experiments

First let me set the context for Pylyshyn's work. Work on mental images began again in the late 1960's and early 1970's.[64] Experiments in mental rotation of line drawings were originally used by Shepard and Metzler in 1971. These experiments showed that when subjects were asked to judge whether two figures were the same shape or different they took longer to respond if the figures were not in the same position but rather, as it were, had to be rotated into the same position before one could judge if they were the same shape. Subjects, in fact, reported rotating the figures in their head, and then judging if they were the same shape or not. What was interesting was that the time taken to answer increased linearly as the distance increased that the subjects would have to rotate these figures in their head. To explain these rotation experiments Shepard argued that some form of internal representation of the figure was actually being rotated in the head.

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[63]p. 226 Pylyshyn, ibid.

[64]While the history of *debate* about images goes back to Aristotle the history of *research* begins in the late 19th C and early 20thC, a particularly fertile period for the development of psychology. See M. Tye *The Imagery Debate* (1991).

Stephen Kosslyn conducted similar experiments in the early 70's. He had subjects mentally "scanning" across a map they had previously memorized to answer questions about the location of objects on the map. A similar result was produced. The further the distance across the map, the longer it took subjects to respond in answering the questions. Kosslyn argued that the subjects were using an analogue form of representation to answer the questions.

The question about analogue versus digital needs some comment. It is not an entirely clear or helpful distinction, and I do not think it worthwhile here to go into all the details. For the criticisms I make of Pylyshyn concerning the origin of intentionality or meaning, work against both analogue and digital forms of representations. That is, meaning does not lie in either form but comes from the combination of alternative uses plus sensory experience. I go into this in Part III. In brief, however, an analogue form of representation is thought to possess some properties which are like the properties it is meant to represent. Some examples of analogue representations include the following. A map, the most clear example, uses greater distance on paper to represent greater distance on land. But other examples are not so direct. A watch with a face and hands uses spatial properties to represent temporal properties; a thermometer filled with mercury in a tube uses spatial extent to represent temperature. Digital forms, it is thought, do not have such properties. [65]

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[65]These are very crude examples but they are used in the literature; I think that they should largely be avoided when thinking about how the brain will represent anything. They only serve to introduce the ideas of analogue vs digital or propositional. In fact as Pylyshyn notes on p. 200 of *Computation and Cognition* the whole discussion of analogue vs digital accounts of representation is not entirely clear.

Analogue theorists, like Kosslyn, argue that the subject has to be able to exploit the analogue properties, which he argue images and percepts have.[66] They recognize that if the subject cannot use images they cannot make use percepts either.

Pylyshyn's explanation of mental rotation and scanning

Pylyshyn first set out in his position in his 1973 article "What the mind's eye tells the mind's brain".[67] Yet his main argument is to be found in *Computation and Cognition.* (1984) There he argues that what accounts for the increase in time taken to respond is the subjects (tacit) knowledge of how long it would take for one to actually rotate such figures in reality (i.e. with one's hands or by a machine, while one watches). So really the increase in time is not because of the properties of the analogue form of representation which take longer to turn over, but is determined by the knowledge of the subject represented in a symbolic code; and since such knowledge is thought of as something that can be computed; the subject computes from tacit knowledge how long it would take to rotate and then that knowledge governs the time taken to respond. Subjects just *know* what it *would* be like to see this happening. Imaging just is coming to *know* what it would be like in a real perceptual case.

Pylyshyn's approach to this research can be described as trying to explain away the need for postulating a non-inferential (noncomputational) mechanism or analogue form of representation in order to deal with "the imagistic mode of reasoning".[68] He can also be described as trying to explain how the unfolding and transformations of images occurs in a way that preserves semantic distinctions or even logical relations, thus showing how this makes it likely that images are the result of an underlying form of representation that has a

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[66] S. Kosslyn: (1980) *Image and mind*
[67] See *Images, Perception, and Knowledge* (1974) ed. John. M. Nicholas
[68] p. 236 Pylyshyn, ibid.

language-like or even logical structure. In other words, imaging is the processing of a set of symbols.

Pylyshyn's argument:

To argue for this explanation of images Pylyshyn offers the following set of claims:

(1) First, that despite its appearing autonomous of cognitive processes imaging could still be a cognitive operation, i.e. imaging only *appears* to have a certain autonomy;

(2) Second, to argue for this, that certain imaging tasks are also governed by knowledge level processes, he presents a number of cases showing that images are cognitively penetrable, i.e. affected by other beliefs, and thus in need of a semantic level of explanation;

(3) then, he argues that analogue accounts do not provide a semantic level of explanation because they use natural laws, thus imaging could not make use of an analogue form of representation.

I explain these claims in the following sections. In addition to these, and not necessarily a part of the computational theory of mind, is a claim, which I examine in the next chapter, that:

(4) the imaging process involves knowledge that may be known only *tacitly*.

1. Imaging only "appears" autonomous

Pylyshyn states at the beginning of his chapter on mental images that:

> It seems to me that the single most intriguing property of imagery---and the property that appears, at least at first glance, to distinguish it from other forms of deliberate rational thought--- is that it has a certain intrinsic autonomy, in terms of both requiring that certain properties of stimuli (for

> example, shape and size) always be represented in an image, and with respect to the way in which dynamic imagery unfolds over time.[69]

And Pylyshyn points out that this characteristic of images has led some to suppose that:

> various intrinsic properties of imaginal representations are fixed by the underlying medium, and that we exploit these fixed, functional capacities when we reason imagistically. I believe this intuition is the primary motivation for the movement toward "analogue" processes. Now, in general these views are not implausible. We should be cautious, however, in what we assume is an intrinsic function instantiated by the underlying biological structure, as opposed to, say, a structure computed from tacit knowledge by the application of rules to symbolically represented beliefs or goals.[70]

Pylyshyn never says more than this about what he means by saying that imaging seems to have "a certain intrinsic autonomy." Pylyshyn contends that the experimental literature contains anecdotes that "to imagine a certain property one must first imagine something else. For example, to imagine the colour of someone's hair we must first imagine their head or face."[71] I take it that this is what he means by the intrinsic autonomy of images, and that from this, or despite this, appearing autonomous of knowledge governed processes, Pylyshyn hopes to show that such images are nonetheless another form of cognitive processes. That is, imaging is still going to be construed in the form of beliefs. As evidence for this claim, he argues that the scanning experiments can be either constructed in a way that allows one to answer questions using images without involving a lot of detail in one's imaging, in a way that makes the time response disappear; or, when performing the task set out the subject is clearly relying on the use of knowledge.

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[69] p. 225 ibid.
[70] pp. 226-7 ibid.
[71] p. 225 ibid.

Pylyshyn argues that when performing a mental scanning task, a subject might suppose that they were to interpret the task as either:

> 2a. Using a mental image, and focussing your attention on a certain object in the image, decide as quickly as possible whether a second named object is present elsewhere in that image; or
>
> 2b. Imagine yourself in a certain real situation in which you are viewing a certain scene and are focussing directly on a particular object in that scene. Now imagine that you are looking for (scanning toward, glancing up at, seeing a speck moving across the scene toward) a second named object in the scene. When you succeed in imaging yourself finding (and seeing) the object (or when you see the speck arrive at the object), press the button.[72]

He argues that tasks 2a and 2b have different task demands.[73] That is, they have a different criterion for success. This means that one need not go into a lot of details in the first case, 2a, in order to answer the question, and yet still have successfully completed the task. In the second case, 2b, one needs to fill in all the details to have successfully completed the task. He says that if subjects interpret their task as a 2a then the reaction time disappears and so there is no need to postulate an analogue form of representation. But if they interpret their task as 2b, then such tasks can also be explained as/by what they know, the result of knowledge governed processes (even if what they know is known only tacitly). He argues that the experiments set up by Kosslyn and others used 2b tasks and so should be explained by appeal to the subjects tacit knowledge. Thus in neither case does one need to postulate an analogue or a non-inferential, non-computational mechanism in order to deal with the imagistic mode of reasoning.[74]

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[72]p. 235 ibid.
[73]p. 235 ibid.
[74]p. 236 ibid.

While the main thrust of Pylyshyn's work is to show that subjects have been led to carry out 2b tasks and that 2b tasks are explained by tacit knowledge, Pylyshyn seems to ignore that 2a tasks involve imaging. He, of course, will argue that they are both tasks which involve accessing what one knows, and so are explained as semantic regularities. But if 2a tasks do involve imaging, and it is, he thinks, a form of imaging that is not concerned with "incidental features of the visual task considered." Then what kind of imaging is this? I suggest that this is a partial imaging. And that it is to some degree capable of abstractive purposes. Imaging can be partial or even fragmentary, and in being partial can still be used. The case of imaging the colour of someone's hair is misleading at best. To image the colour of someone's hair one must image a bit of their hair --- period. This in fact may be an abstractive use from images.

Partial and abstractive use of images may be the most common form of imaging. Pylyshyn mentions that Mozart could hear a symphony "all at once." It would be interesting to know what this means. Pylyshyn says that what it does not mean is that he imaged something that took 22 minutes (i.e. the time it would take to perform a symphony). I suggest that --- probably--- his knowledge of the symphony allowed him to image some partial and/or abstract piece of imaging which could be used by Mozart himself to stand for the whole symphony.

2. Imaging is cognitively penetrable

Despite appearing autonomous Pylyshyn argues that images are cognitively penetrable. For something to be cognitively penetrable is for that event or regularity to be influenced by other beliefs and desires, at least to some degree. Thus despite appearing autonomous of cognitive processes, images are cognitively penetrable and so they:

> must be explained in terms of a cognitive rule governed process involving such activity as logical inferences, problem solving, guessing, or associative recall, rather than in terms of the *natural laws* that explain the behavior of analogue process....The tremendous flexibility of human cognition, especially with respect to the more "central" processes involved in thinking and in common sense reasoning, may well not admit of many highly constrained, nonprogrammable functions.[75]

As images are affected by other beliefs in regular ways, he believes *that images are explained as beliefs*. Pylyshyn describes statements about images in terms of counter-factual statements. In such a manner he, in effect, structures images as beliefs. Images are thus described in terms of *beliefs* and then explained as beliefs and other semantic phenomena.[76] Thus wanting to know how the sound of a trumpet would go in a real perceptual case, and, according to Pylyshyn, having the tacit belief of what a trumpet sounds like in a real perceptual case, then the result, that is, the image of the sound of a trumpet, is also an inference computed from my tacit knowledge base.

3. Imaging does not use an analogue medium

Pylyshyn argues that images cannot be explained by analogue forms of representation. His argument is as follows:

1) Images appear to be autonomous of cognitive processes,

2) Yet images are affected by other beliefs,

3) So images are a cognitive phenomena,

4) Thus images require an explanation that makes sense of semantic regularities

[75]p. 227 ibid.
[76]p. 211 Pylyshyn, ibid.

5) But semantic phenomena cannot be explained by analogue representation, because an analogue form of representation, Pylyshyn argues, is explained according to "natural laws" and natural laws do not give any semantic level of explanation.

6) The only form of representation, Pylyshyn argues, that can make sense of semantic regularities, is one that makes use of discrete symbolic representations manipulated according to certain rules of transformations.

7) Thus imaging is explained as a result of symbolic representations, and in that respect parallels that of beliefs and desires. In other words, imaging is the processing of sets of symbols and this account is dependent upon his assumption that the mind is a computing or symbol manipulating machine. It is not going to be necessary to refer to the functional or biological properties of the system which is what an analogue account is usually thought to do.[77]

Conclusion:

In this chapter I have tried to show how Pylyshyn tries to explain mental imaging. He has tried to argue that 1) given that analogue accounts don't seem to be good explanations for representations, and 2) given that images are affected by beliefs, and 3) given that the mind can be thought of as a computing machine, then as a result, it makes sense to argue that imaging just is the processing of sets of nonanalogue discrete atomic symbols. I disagree. The reasons for my disagreement are set out in part II.

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[77] Pylyshyn does allow that there will be biological *constraints* on our capacity for imaging. For example performing some computations may take longer for the brain than a computer. But they are both doing the same computation. Biological properties may manifest themselves at the knowledge level but not as knowledge. And the claim that Pylyshyn is making is that such knowledge is enough

Before I go onto the reasons for disputing Pylyshyn's claim, I want to set out in the next two chapters some considerations that make it easier to argue against the account that Pylyshyn gives. The first is that his claim that images have access to tacit knowledge will not work with his account. And the second is that the enormous amount of research in the last 20 years shows that imaging shares some of the same functional/ structural properties as perceiving.

Chapter 4: The Tacit Knowledge Thesis

Introduction:

Pylyshyn appeals to a notion of tacit knowledge when he tries to explain mental images. It is crucial to recognize that accepting the idea of tacit knowledge does not commit one to accepting the account of mind that Pylyshyn offers.

When Pylyshyn set out to provide an alternative explanation for the regular and smooth transformation of one image to another other than supposing that the medium manifests itself directly in our knowledge level, he posited the following explanation: that I already *know* (tacitly) *what it would be like* in the perceptual case.[78] I will argue that his account of mind requires explicit encoding of all knowledge and so he cannot even make use of a thesis concerning tacit knowledge. This would result in the agent being unable to learn or invent anything new. Something like tacit knowledge is probably an important part of the story of how we learn and invent new ideas; mental imaging, I think, will also play an important role in this process; but Pylyshyn, at any rate, cannot make use of tacit knowledge as he sets it up.

Pylyshyn's comments on tacit knowledge:

We must know what he means by such knowledge if we are to evaluate his argument. Unfortunately he does not say much about it. The following is his most detailed articulation of tacit knowledge:

> tacit knowledge cannot be freely accessed or updated by every cognitive process within the organism, nor can it enter freely into any logically valid

[78] p. 226 ibid.

inference. For example, much of it is not introspectable or verbally articulable (relevant examples of the latter would include our tacit knowledge of grammatical or logical rules, or even of most social conventions)....the existence of such constraints is no doubt what makes it possible for people to hold contradictory beliefs or to have beliefs that are only effective within certain relatively narrow classes of tasks. For example, it might be that many people only have access to their tacit knowledge of physics when they are acting upon the world (e. g. playing baseball) *or perhaps when they are engaged in something we call visualizing some physical process, but not when they have to reason verbally or answer questions in the abstract.*" [79]

What is tacit knowledge?

I think there are three possible conceptions of tacit knowledge.[80] Tacit knowledge may consist of all three; or, in fact, it may reduce to one or two of these.

All three conceptions make use of a form of memory for, or of experience. This experience is of unarticulated (or unarticulable) or unexpressed material. They differ in the ways these memories are manifested. They are as follows:

(i) Memory of, and for, performance, i.e. knowing *how to do* something. This is the kind of tacit knowledge that Polanyi refers to, and it includes things like knowing how to ride a bike or swimming etc. It is the memory we have for performing everyday tasks like speaking according to the rules of grammar, tying one's shoe, riding a bike, driving a car, walking, and all those learned skills where one does not need to explicitly represent the

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[79]pp. 161-162 Pylyshyn, ibid.

[80]The notion of tacit knowledge was originally articulated by M. Polanyi (1958) *Personal Knowledge.* M. Davies in his (1989) paper "Connectionism, modularity, and tacit knowledge" in the *British Journal for the Philosophy of Science* offers an account in terms of a causal explanatory construct in which tacit knowledge need not be explicitly represented; he also points to some of the work that has been done on the subject; he associates tacit knowledge with N. Chomsky's (1965) *Aspects of the Theory of Syntax*; he also mentions an account of G. Evans (1981) "Semantic theory and tacit knowledge" where Evans gives an account of tacit knowledge in terms of dispositions. Others have written on the subject and include J. Fodor (1968) "The Appeal to Tacit Knowledge in Psychological explanation" *Journal of Philosophy* and A. Reber (1989) "Implicit Learning and Tacit Knowledge" *Journal of Experimental Psychology: General*

rule after having learning it; this form of knowledge has often been referred to as procedural memory. This form of tacit knowledge is generally compared with propositional or verbal memory, which is often referred to as declarative memory. An example of declarative memory is remembering *that* Ottawa is the capital of Canada.

(ii) Memory of unexpressed regularities in experience, i.e. knowing unarticulated rules or generalizations that affect either what is done or what is imaged. These, I think, sound like unexpressed or unarticulated beliefs. I'm not sure what the difference is between tacit knowledge of regularities and an unexpressed belief about how the world regularly goes. I think that the problem for Pylyshyn will turn upon how these beliefs, which we would assent to and use everyday, but have not yet articulated, are to be construed.

Pylyshyn offers, as an example of tacit knowledge, concepts such as transitivity and other examples that could be taken from elementary logic or physics. In such cases people are familiar with the regularity that such rules describe, e. g.. "if some *a* is inside *b*" and "*b* is inside *c*" then "*a* is also inside *c*," etc. From the examples that Pylyshyn offers it appears that he is thinking of tacit knowledge primarily as these unarticulated rules. In fact he states that:

> to imagine the the episode of "seeing" certain physical events, one must have access to tacit knowledge of physical regularities. In some cases, it even seems reasonable that one needs an implicit theory, since a variety of related generalizations must be brought to bear to predict correctly what some imagined process will do...[81]

Pylyshyn also relies heavily upon the subjects knowledge (tacit) of how long something takes to occur. The knowledge of the time it takes for something to occur is another example he uses of what is known tacitly. It is a difficult question how such knowledge is encoded or represented as tacitly.

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[81]p. 238 Pylyshyn ibid.

(iii) Memory of perceptual-like experience, i.e. knowing *how it would go* or *how it is*. Tacit knowledge in this sense is long term non-propositional memory of perceptual experience for each modality. How something would go is more like projecting the present perceptual experience into the near future. I think this is different from an unexpressed memory of regularities in experience. For consider one's experience with the world: even without formalized rules of physics or logic one will generate many informal rules or generalizations that capture more or less the regularities found in nature. That knowledge, which exists unexpressed or unarticulated, (but could be articulated), is supposed to exist in the form of rules or regularities. It would be expressed as generalizations, if it were so expressed; but it is not or need not ever be expressed. It can be affected by beliefs about the situation, or objects and their properties involved. Just as one can forget about "thinking" how to throw a stone, one can also forget about "wondering" how it will go after it is released. One expects or anticipates it to go within a certain range, and not to suddenly veer off track.

2. Two problems in using tacit knowledge in a computational account:

i) The problem of accessing and representing tacit knowledge:

The main problem in using a thesis about tacit knowledge with a computational account of mind is as follows: all explicit knowledge is represented using some set of symbol tokens or code, but if some knowledge is only tacit, then for that knowledge, is it still represented by some set of symbols, in which case it is not any longer tacit, or if it is not yet represented then in what form does it exist, and how can it enter into a computational account? Let me explain.

Mental images, according to Pylyshyn, require an explanation that refers to semantic regularities so images are going to be represented and stored in some symbolic format or code. Mental imaging also has access to tacit knowledge. Now there are two possibilities for tacit knowledge:

1) either the format for storing such knowledge is not in terms of codes, (which is what makes it tacit) and if not, this makes the problem one of how knowledge can be stored without a code and yet be computational;

2) or, if it is stored in codes, then it does not appear to be different from other forms of knowledge that are stored in codes but are not present to one's conscious mind at this moment.

For according to Pylyshyn, when I am thinking about the tree in the back yard and not thinking about 2+2 = 4, it is still true that I know that 2+2 = 4, even though I'm thinking about something else. Or when I'm sleeping, I still know 2+2 = 4; so all explicit knowledge is represented in some code, but knowing something tacitly suggests that this tacit belief cannot be encoded in a similar manner. The tacit knowledge code cannot be of the same form as explicit knowledge, (i.e. a set of sentences tokens) because otherwise, it would no longer be *tacit* knowledge. The reason why it is *tacit* is, presumably, because it is not explicit, and is used in a different fashion; its very use demands that the form is different.

As I have already suggested, tacit knowledge is likely to consist in a number of different possible alternatives. Tacit knowledge may involve programs for acting or performing, or it may involve unexpressed or unexpressable generalizations, or finally it may involve a memory for perceptual experiences that are not conceptualized in any clear sense.[82] In this final sense we find that tacit knowledge is more like what we are talking

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[82]This is, of course, to borrow some of the language of the computationalists, and I think is misleading; the "program" for performing may be described mathematically but it can hardly be said to consist of a set of beliefs; rather it would be better to think of this structure as a set of largely learned responses that have become internalized.

about when we speak of imaging. It is not at all clear why it should be called *knowledge* instead of a form of *knowing*, for it is misleading to think of it as knowledge (if we think such knowledge is some set of sentences). Knowing something tacitly, is primarily, I have argued, a nonpropositional or non-linguistic form of memory-experience often perceptual-like. To say that a subject knows tacitly a certain regularity, that for example, if some object *a* is inside *b,* and *b* is inside *c,* then *a* is inside *c* also, is actually a high level of knowledge that needs to be learnt.

Tacit knowledge is not just potential knowledge, for it is used. But if it is not in *some* code, then for Pylyshyn it cannot be used. So Pylyshyn would need different codes; codes that can be easily accessed by language and other codes that manifest themselves through other routes. And only after being so manifest can they then be made explicit. But according to Pylyshyn's own account, there is *only one code*, i. e. only one form of representation or language of thought, and if some regularity needs a semantic explanation, then it will either be explained according to those representations, or not at all. So how could there be any knowledge or beliefs that are known tacitly and play a role in a computational account? This is the main problem in using tacit knowledge in what is basically a proposition manipulating machine, everything must already be in some code.

ii) The creation or newness problem:

The second problem is a result of the first problem combined with a need for creating and learning. First the reason why images need access to something tacit is because an existing store of beliefs places constraints on the forming of new beliefs or insights. The reason why Pylyshyn wants mental images to access to a store of *unarticulated beliefs or regularities*, is that mental images appear to be rich sources of creative insights.

> Such responsiveness of the imagination to involuntary processes and unconscious control is a major reason why imagery is associated with the creative process: It appears to have access to tacit knowledge and beliefs through routes other than deliberate intellectual ones.[83]

The new version of Meno's paradox in Pylyshyn's AI.

Any theory of images that does not explain how they can manage to bring out or create new insights or inventions will not be worth looking at. In fact, that is what happens to Pylyshyn's account. For if all images are going to be construed in the form of beliefs then they must be already known. In other words in order to go from the unknown or to invent something new, Pylyshyn's account must already have things in the form of beliefs, that is, they will already be known. This assumes that the subject is drawing on some knowledge. And we already have seen that, for Pylyshyn, all knowledge, to be knowledge, must be explicitly represented. Then this excludes the subject from ever imaging anything which he does not *already* know.

On his account, then, there could *not* be any creative writers musicians scientists; in fact, one could never learn anything new. For if one already knows (tacitly) how something will go, and it is *that* knowledge that guides one's image formation, and *that* knowledge must be explicitly encoded, then we get the following odd result. In order to have any knowledge, one must already have such knowledge encoded in the system, so any new knowledge must also have to be encoded, but it is not clear that any new knowledge could ever exist without being in some code (i. e. it could never exist unrepresented) so it must have always been there in some form and then, perhaps, remembered anew; suddenly we hears echoes of Plato's account of knowledge as recollection as presented in the *Meno.*

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[83]p. 226 ibid.

Plato used a story of souls existing before birth to explain how children could learn new ideas...maybe Pylyshyn could use that story too.

Conclusion:

In this chapter I have argued that the tacit knowledge thesis is not available to Pylyshyn. The problem comes back to the claims 1) that knowledge must be in the form of explicit representations, because the mind is thought of as a computing machine, and 2) that imaging is both a form of knowledge and a source of creative and new insights, and 3) that creative and new insights cannot already be explicitly represented (or they would not be new). The answer lies in allowing the agent to make use of sensory and sensory like experience without requiring that such forms have any explicit interpretation or meaning yet. Pylyshyn cannot do that.

Chapter 5: Current Research On Perceiving And Imaging

Introduction:

The last twenty years have seen an enormous amount of research showing that imaging is, in fact, a lot like perceiving. This work on imaging now clearly indicates a strong connection between imaging and perceiving.[84] For instance, we now know that there is interference within the same modality.[85] So for example, if one is trying to image some piece of music, then one should avoid listening to other music or other sounds, at the same time, because the perceiving of sounds interferes with the imaging of sounds.

The rehabilitation of Perky's work

The claim that imaging and perceiving are similar has been around since C. W. Perky's work in 1910. The original experimental research was largely ignored for fifty years. The experiment involved subjects instructed to look at a screen and form an image of, for example, an orange, while an experimenter projected a picture of an orange onto a screen.

> We find that, under suitable experimental conditions, a distinctly supraliminal visual perception may be mistaken for and incorporated into an image of the imagination, without the least suspicion on the observers part that any external stimulus is present to the eye....Thus we reach the general conclusion that the materials of imagination are closely akin to those of perception.[86]

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[84]For a good account of this work see R. A. Finke (1989) Principles of Mental Imagery

[85]See C. Craver-Lemley and A. Reeves, (1992) "How Visual Imagery Interferes With Vision" *Psychological Review*

[86]pp. 450-451 C. W. Perky "An Experimental Study Of Imagination" 1910

Yet it was not until the early 1970's, when a number of experiments using mental rotation were conducted by Roger Shepard and others, that closer work began on the connections between imaging and perceiving. In 1980, Ned Block noted in the introduction to his book *Imagery*, that, in effect, we have reduced the problem of imagining to one of explaining how there could be anything like perceiving, but we do not have any explanation for this problem.[87]

The original experiments conducted by Shepard and Kosslyn, it must be noted, were not cases of pure imaging. These cases involved *perceptual* tasks in the same modality and at the same time as the *imaging* tasks so that according to Perky's hypothesis there was bound to be interference within the same modality. And in fact this has been borne out in recent work. Catherine Craver-Lemley and Adam Reeves (1992) reexamined some of the experiments concerning interference between imaging and perceiving originally discovered by C. W. Perky. The Perky effect is the reduction in performance in a visual task as the subject first performs visual tasks, without imaging, then at the same time as imaging. Craver-Lemley and Reeves (1992) conclude that "Imagery acts in a fashion that is equivalent to reducing target energy in the region of the visual field in which the image is located."[88] These results suggest that any experiment that attempts to have the subject doing imaging and perceiving in the same modality at the same time will not get a satisfactory picture of the imagistic capacity.[89]

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[87]p. 10 N. Block (1980) Imagery

[88]p. 648 Craver-Lemley and Reeves

[89]Modern noninvasive technological advances in brain scanning and blood flow experiments provide research that does not involve interference. These will be of utmost importance for future imaging research.

Perceiving and imaging as similar

Based on the rotation and scanning experiments, Shepard and Kosslyn argued that imaging behaved like perceiving. Much evidence for a shared form of representation has since been demonstrated, both in visual and auditory modalities. I set out some of the evidence for the claim that imaging and perceiving are similar in relevant ways. Margaret J. Intons-Peterson and Mark A. McDaniel explain three general approaches that have been used in thinking of images and percepts as similar. They are the functional, the structural, and the interactive frameworks.

Functional theories argue that mental images function as a representation of the external sound or object by preserving relations among external objects.[90] Roger Shepard (1975) argued that there existed a second order isomorphism between internal representations as images and what they are meant to represent in this case percepts. For example an image of the sound of the phone ringing is some functional state that maintains the first order characteristics of the percept. Images *function* as percepts. Shepard claimed that images have "something in common with what went on in the brain when a square was previously experienced, enough in common to produce relations among images that parallel the relations among the perceived objects."

The structural approach holds that there exists some first order isomorphism between images and percepts.[91] On this account images give "direct access to adjacency, distance, and other geometric properties." Kosslyn refers to this as "abstract surface property isomorphism."[92] Because response times and scanning experiments show a regularity that corresponds to the distance scanned, it has been argued that the imaging is

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[90] p. 48 M. J. Itons-Peterson and M. A. McDaniel, (1990) "Symmetries and Asymmetries Between Imagery and Perception"

[91] p. 53 ibid.

[92] p. 54 ibid.

taking place in a structural feature that is like a percept of the same object. Thus the longer it takes to scan from point *a* to point *b* in a percept a similar distance must be scanned in images.[93]

The functional and structural accounts are convincing. Yet it is still possible that imaging is a knowledge construct and so needs appeal to explanations at the semantic level. If only because there may be ways that *what* one knows could explain the similarity between perceiving and imaging. These objections, and the evidence from interference studies are good reasons to suppose that imaging and perceiving are similar at some level. If there are any doubts about the similarity of imaging and perceiving the latest claims should put them to rest.

The interactive approach to the similarity between imaging and perceiving makes the strongest claim.[94] The claim is that imaging and perceiving activate the same neural tissue. Farah et al. claims that *images and percepts make use of a shared representation*

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[93]Two standard objections to Pylyshyn's explanation that these increases in time are the results of the subject's usually tacit knowledge are as follows. The tacit knowledge of the amount of time something actually takes in a perceptual case does not explain the following cases of imaging: 1) the amount of time taken to estimate in those cases where subjects were instructed not to use images. For example, in one case subjects had to first estimate, (presumably using tacit knowledge) *but not image*, the amount of time it would take to mentally adjust the loudness of one sound to the same loudness of another. Then subjects were to image the sounds and adjust them in their head. If this was explained by tacit knowledge then it should have taken roughly the same time in both cases for them to reach the same level of loudness. Yet it took subjects much longer to estimate the amount of time it would take to adjust their images than it took for them to actually image them. This suggests that the increased time was not explained by the subject's *knowledge* of how long it would take in the perceptual case. 2) Cases where the subject had no knowledge of the perceptual case. Because there was no familiarity with the objects then the amount of time taken to scan an image should have been greater than scanning a percept. Yet the response times for *imaging* unfamiliar objects was the same as the times for *perceiving* unfamiliar objects.This suggested that the subject was scanning an image that was something like a percept. p. 55 ibid.

[94]p. 57 ibid.

medium.[95] Farah points out that, although previous results show that imaging interferes with visual tasks, it is not clear at what level that interaction occurs. She suggests there are two possibilities. One, "imagery affects stimulus processing at earlier, modality-specific stages of stimulus representation," or "imagery affects stimulus processing only at later, amodal stages of stimulus representation." The first implies that "the shared stimulus representations are visual." The second implies that "imagery involves more abstract, post visual stimulus representations."[96] She argues that:

> To distinguish between these two possibilities, we repeated the earlier imagery-perception interaction experiment while recording event-related potentials (ERPs) to stimuli from 16 scalp electrodes. By observing the time course and scalp distribution of the effect of imagery on the ERP to stimuli, we can put constraints on the locus of the shared representations for imagery and perception. An effect of imagery was seen within 200 ms following stimulus presentation, at the latency of the first negative component of the visual ERP, localized at the occipital and posterior temporal regions of the scalp, that is, directly over visual cortex. This finding provides support for the claim that mental images interact with percepts in the visual system proper and hence that mental images are themselves visual representations.[97]

Although subjects could know about certain visual conditions that would then influence their imaging, it would be difficult to suppose that the subjects could know that their occipital and temporal regions of the cortex are invoked in visual perception and so modify their ERPs.[98] *Thus, because this level of processing is cognitively impenetrable it would be difficult to explain the activation at that level as the result of tacit knowledge.*

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[95]See Farah et al. (1988) "Electrophysiological Evidence for a shared Representational Medium for Visual Images and Visual Percepts" *Journal of Experimental Psychology: General*

[96]p. 248 ibid.

[97]p. 248 ibid.

[98]p. 254 ibid.

Further evidence for the role of perceptual processes in imaging comes from computerized tomography studies by Goldenberg, Podreka, and Steiner.[99] They begin by asking the following question:

> Does the architecture of mind contain any structures and processes that are specific to imagery, or does imagery simply consist of the application of general cognitive structures to data structures whose content happens to be about the world?"[100]

The different answers to these questions give rise to different hypotheses regarding the neurological substrate of imaging. First, if imaging is subserved by specific structures, and, one then supposes that these are specialized for visual information processing, then one would expect to find the anatomical substrate for imaging in those areas of the brain which receive their main input from visual perception. Second, if imaging involves the use of general cognitive structures and knowledge about the visual world, then the neurological substrate should be located in brain ares which receive information from different sources and are not restricted to processing visual information. They suggest that the supramodal association cortex would be the place to look for the neurological substrate of visual imaging. They answer that:

> visual imagery activates a whole functional system, the exact boundaries of which change from task to task. Indeed, no single region was activated consistently across all imagery conditions. Although the left inferior occipital region appears to have an outstanding role within the system, its correlation with the vividness of the image in the third experiment was less strong than those of inferior temporal regions....as to whether visual imagery is subserved by the visual cortex. The inferior occipital lobe

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[99]See Goldenberg, Podreka, and Steiner (1989) "The cerebral localization of visual imagery: evidence from emission computerized tomography of cerebral blood flow" in P. J. Hampson, D. F. Marks, and J. T. E. Richardson *Imagery: Current Developments*

[100]p. 307 ibid.

> contains primary and secondary visual cortex. In the superior occipital regions there is secondary visual cortex. The medial (hippocampus) inferior temporal region contains secondary visual cortex in its posterior portion, but its anterior part consists of supramodal association cortex which is known to play a crucial role in memory. The hippocampus itself acts as a link between neocortex and the limbic system and on its anterior pole the region covers the amygdala which is part of the limbic system. The lateral inferior temporal region is mainly composed of supramodal association cortex (Creutzfeld 1983). *Hence, visual cortex is involved in the system* [my italics] but it seems to work only in conjunction with the supramodal association cortex and possibly also with the limbic system....[101]

They conclude that "...visual imagery corresponds to a distinct mode of cognitive processing and hence to a distinct pattern of cerebral activation...."[102] Their experiments give evidence for the claim that imaging activates the left hemisphere. (Marks et al. 1985; Farah 1986)

The most recent work in this area comes from Kosslyn et al.

> Emerging from this work is the view that mental imagery involves the efferent activation of visual areas in prestriate occipital cortex, parietal and temporal cortex, and that these areas represent the same kinds of specialized visual information in imagery as they do in perception. In addition, different components of imagery processing appear to be differentially lateralized, with the generation of mental images from memory depending primarily upon structures in the posterior left hemisphere, and the rotation of mental images depending primarily upon structures in the posterior right hemisphere.[103]

Kosslyn et al. in a recent paper report:

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[101]p. 328 ibid
[102]p. 328 ibid.
[103]p. 395 M. J. Farah, (1989) "The neural basis of mental imagery"

> It has long been known that area 17 (also called primary visual cortex) is topographically organized in humans....All the relatively "low-level" (i.e. early in the processing sequence) areas of cortex are topographically organized. Furthermore, virtually every area involved in vision (not solely the low level areas) that has an afferent connection to another area also receives an efferent connection from that area, and the forward and backward projections are of comparable size....These features of the anatomy imply that a great deal of information flows backward in the system, from the "higher-level" to the "lower-level," topographically organized areas. Indeed, Douglas and Rockland (1992) have found direct connections from area TE (in the anterior inferior temporal lobe) all the way back to area 17...such direct cortico-cortico connections from the higher-level to the lower-level areas are consistent with the hypothesis that visual mental images are formed by using stored information to reconstruct spatial patterns in topographically organized cortical areas. Similar ideas have been popular at least since the late nineteenth century. (e.g. see James 1890)[104]

This latest work presents a strong case for taking imaging and perceiving to be capacities that represent in a similar form.

Conclusion:

In this chapter I have tried to set out some of the evidence showing how imaging shares important structural features with perceiving. The importance of this is that it now appears unlikely that we can simply think of images as like or as forms of beliefs as Pylyshyn holds.

Pylyshyn cannot deny this research. He should either accept that imaging is like perceiving, and hence requires an explanation of images in terms of percepts, or else, show how he can acknowledge this research and maintain his account of imaging. He chooses to do the latter. Instead of this research being an obstacle to his account of imaging, Pylyshyn

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[104]pp. 263-4 Kosslyn et al. (1993) "Visual Mental Imagery Activates Topographically Organized Visual Cortex: PET Investigations."

instead argues that it makes little difference because on his account perception is also going to need a semantic explanation, just as imaging or believing.

Thus for Pylyshyn perceiving and imaging as well as believing, and desiring, and other cognitive processes all share a similar form of representation, i.e. they all consist in the processing of sets of symbols. They all share in the Language of Thought, and this involves a set of interpreted symbol representations. .

What this means is that we can now proceed to look at both his account of perceiving and imaging and to see if they make sense as the computing of symbols.

Part II: Three Arguments Against Pylyshyn

Introduction:

In this part I present my arguments against Pylyshyn. I offer three objections to his account that imaging is the processing of sets of symbols derived from his assumption that the mind is essentially a symbol manipulating machine. The first objection holds that the account of perception he offers does not account for original meaning. The second objection argues that even if we allow that he could explain such meaning, his account cannot explain the sensory and sensory like experience of images. The third objection maintains that Pylyshyn's account of perception requires that all perceiving be propositional perceiving. The suggestion I consider is that in fact most perceiving is both partial and nonpropositional. His account of perception cannot handle such perceiving.

Chapter 6: The Argument From Original Meaning

Introduction

Something within the brain allows us to represent the external world. Pylyshyn supposes that the symbol is the basis for representing the world. But how do we suppose that a simple symbol all by itself (or an analogue representation for that matter) acquires original meaning in the first place? Yet this is exactly what Pylyshyn leaves unexplained when he supposes that the symbol is the basis for all understanding.

> The notion of a discrete atomic symbol is the basis of all formal understanding. Indeed, it is the basis of all systems of thought, expression, or calculation for which a notation is available. It is important to stress that such an idea not only has deep roots in what is sometimes called the intellectualist tradition but that no one has succeeded in defining any other type of atom from which formal understanding can be derived. Small wonder, then, that many of us are reluctant to dispense with this foundation in cognitive psychology under frequent exhortations to accept symbols with such varied intrinsic properties as continuous or analogue properties. Unless these notions can be reduced to either atomic symbol foundations or to physical foundations, they remain intellectual orphans, hence are a poor foundation for explanation. The problem is, such notions lack systematic foundations; we do not know what can be done with them. To state the matter more precisely, when we refer to such symbolic (or mental) entities, there is a sense in which we do not understand what we are talking about![105]

Perception

The account of perception that Pylyshyn uses is designed to introduce discrete atomic symbols into the system. Perceiving, on Pylyshyn's account, turns out to be the

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[105] p. 51 Pylyshyn, *Computation and Cognition*

formal relations amongst these symbol states; thus, a percept and image represent in much the same way words do. In this chapter I argue that such an account could not get off the ground. I argue that we cannot get original meaning using the account of perception that Pylyshyn uses. The account of perception Pylyshyn uses does not allow him to establish any notion of "original meaning" because either these symbols already have meaning, and thus he simply begs the question, or they themselves cannot be all there is; a symbol does not use itself, it must come from a system that has the right capacities to make use of such a symbol. We will eventually need to postulate a system that can make use of something that does not already have meaning. But first let me present his account of perception as a transducer function.

Perception is a transducer function for fixing semantic interpretation

Pylyshyn presents perception as the boundary between the cognitive and noncognitive. That is, perception is the transition between semantic and nonsemantic regularities. In going from a nonsemantic to semantic explanation Pylyshyn holds that certain functional states can be interpreted as representations.

Pylyshyn's account of perception is influenced by his assumption about the nature of the representations. He argues that the process of perception establishes a set of symbols, or a symbolic code, that is capable of capturing all the possible semantic distinctions needed. In order to generate a symbol system or code that represents things, Pylyshyn maintains that there must exist a primitive function in the brain that produces such simple symbols. He postulates a primitive function that serves to convert all non-computational physical patterns of incoming energy into energy that is computationally relevant.[106] He calls this function the transducer function. The transducer is the noncognitive/ cognitive boundary.

> as Fodor and I have argued (Fodor and Pylyshyn, 1981), a clearly noninferential component is required as well, one that is part of the functional architecture. This component, called a transducer, may well be extremely complex by biological criteria, yet it counts as a cognitive primitive. Furthermore, the transducer component is cognitively impenetrable.[107]

The transducer function itself is nonsymbolic or noncognitive. Pylyshyn does not identify it with any particular organ, such as motion detector cells or even further down, at the level of the retina. Yet he thinks of it as a primitive function that converts one form of energy (input) into another form that, as input, is at the same time computationally relevant. All perception is above the level of the transducer function because the output of such a transducer is now capable of taking part in a computation. But just what is a transducer and how does that so clearly fix the boundaries between the cognitive and non-cognitive?

> There must be an interface between semantically interpreted symbols and physical properties; that's what perception is....The interface between physical and semantic principles is a special, functional component (instantiated in the functional architecture) called a transducer. A transducer is not a particular organ; rather it is identified functionally....a transducer is a device that receives patterns of energy and retransmits them, usually in some altered form....The function carried out by a transducer is a primitive and is itself nonsymbolic....A transducer is primarily stimulus bound...A transducer output is an atomic symbol (or n-tuple) and transducer inputs must be stated in the language of physics.[108]

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[106]Pylyshyn never specifies what physical form this energy takes but it would be likely to be some electrical form that would allow it to be computationally relevant.

[107]pp. 135 ibid.

[108]pp. 153-165 ibid.

Objection #1: The transducer function does not fix meaning

The output of the transducer function is a discrete atomic symbol. Pylyshyn supposes there will be a unique code or symbol for each possible meaning so that all semantic distinctions have syntactic parallel.[109] He argues that these symbols are each going to have a single value. And it appears that they get this value by simply being the output of another function.

We can suppose that at least some of the symbols need meaning. And for symbols to have meaning is for them to come from a rich enough system for alternative uses. But if the meaning of a symbol, what it is about, comes about through the alternative *uses* of such a representation, then it would appear these representations do not yet have such meaning. The problem is that the input to the transducer does not have meaning, and so is not symbolic. And so the story of the transducer needs to be one of use. Yet the transducer does not *use* the input to represent anything, instead it converts the input automatically into output that is now supposed to be a symbol. But it should be clear from the above quotation that we do not get any account of use; as it is described the transducer is not designed to make use of its input in a way that makes its output representative or symbolic. So the output of the transducer is not yet symbolic. Thus the transducer function does not fix or establish meaning or intentionality in the system.

Thus we will need to talk about a system that can make use input in a way that does not already have meaning. It is of course easy to fix an interpretation of a symbol if you already have meaning, the trick here is to explain how some system can come to have meaning in the first place. This is a problem for all forms of representations whether they be symbols or analogues.

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[109] p. 40 ibid.

Pylyshyn just assumes original meaning

Pylyshyn takes as a given the meaning of these primitive symbols and then tries to show how thinking is best explained by means of computing using symbols. Pylyshyn never shows how these symbols were used. In fact he denies that it is necessary to worry about that. This is a very serious criticism and I think Pylyshyn is not the only one to gloss over this problem of establishing original meaning. The difficulty is common and often seen in the use of the term "information." It is fairly common for instance to find oneself reading along through some account of perception: Light waves, sound waves etc, traveling through space washing up against sensitive cells which trigger other cells, etc, action potentials etc, then all of a sudden something strange happens; I find that almost immediately the author shifts somehow to speaking now of "this information." As I see it, this change in vocabulary introduces meaning.[110] For, presumably, information has meaning, (if it did not then why call it information?); when you inform someone you give them some meaning; and I, for one, do not see how this input has now acquired this meaning. The conflation of physical energy as input with information (which has meaning already) begs the question of where or how that meaning came from. The temptation I guess is to say that because the energy has been "trans-formed" and reduced, that it is therefore "in-formed."

The assumption on Pylyshyn's part appears to be that if one can introduce the meaning into the system in one step somewhere near the beginning then it can make the whole system work. I think we must suppose that any transducer function is not such a symbol output function but a mere energy conversion function. Such transducers are just

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[110] Although see F. I. Dretske (1981) who argues that information is prior to meaning.

automatic converters of stimulus energy into neural activity; they are of no help in establishing any original meaning.

Pylyshyn's account may be of use in establishing potential meaning

The most his description of transducers shows is that these functions might be *capable* of making input available for use within a system. They clearly don't have any meaning yet. So there could be certain signals that are *potential* symbols, and are *ready* for representative use. And those signals, could be stored as certain patterns, and could be reactivated for representative uses.

Pylyshyn may respond by arguing that he doesn't need any account of original meaning, that by articulating the logical structure of semantic phenomena, and explaining the rules used by such systems, he is giving all the explanation that can be given for semantic phenomena. Yet even with an account of meaning Pylyshyn's explanation of images as semantic phenomena does not fit. This is because in giving sensory experience a cognitive or semantic explanation, (i.e. sensory experience as a cognitive construct that supervenes upon the syntactic structure), I think he ignores the full nature of such sensory experience. I consider this possibility in the next chapter. First I want to consider and set to the side some possible misinterpretations that may occur at this point.

Non-representational states of the brain

Before we move on to the next section, it is important to note that not all functions in the brain require appeal to *semantic* regularities. It is another question whether they should be considered computational. Pylyshyn argues that because they are do not involve the use of symbols they are not cognitive or semantic, hence, for Pylyshyn, they do not involve any notion of meaning or intentionality. This is important because they remain very complex functions making use of certain inputs and yet are not explained as cognitive functions expressing semantic regularities.

Digestion and the regulation of body temperature are examples of apparently noncognitive functions. They are noncognitive because, even though they can be affected by beliefs and desires, they are not affected in rationally explainable ways. In other words, Pylyshyn argues that just because someone can affect their digestion by holding a certain belief, does not make digestion a cognitive function because the effect on the stomach is not a semantic regularity but a physical-biological regularity influenced by the physical instantiation of that belief. Only when the effect is explained as a *logical* outcome of the belief and desire *structure* (as opposed to its instantiation) does he hold that it is a semantic regularity.

The brain is not a digital computer

There is a possible misunderstanding that should be cleared up right away. Although I do not find Pylyshyn explicitly stating that, because neural firings are either *on* or *off,* they provide a machine language for computations, it is a very common assumption among many. In fact it is false because neurons also have graded potentials. To suppose that neural firings are on or off and therefore are either true or false, depending upon what physical state they correspond to is just to make what Calvin calls the Physicist's fallacy.

> Those more familiar with computers than neurons immediately see an analogy (physicist's fallacy #1): The neuron must, so the extrapolation goes, be detecting simultaneous events as does an AND gate. So the brain is a digital computer in disguise![111]

[111]p. 55 W. H. Calvin (1983, 1991 revised edition) *The Throwing Madonna: Essays on the Brain.*

It is well worth briefly taking into account some of what Calvin notes about neural functioning to clear up this possible misconception. A neuron spike occurs when the depolarization of the cell membrane spreads along the length of the cell. When the depolarization reaches the end of the cell, there is a release of neurotransmitters that either begins to depolarize the next cell or prevents that cell from being depolarized. This neural electrical state of the cell then is said to use its voltage to communicate with its neighboring cells.

As for the supposedly on/off nature of most neurons Calvin notes that many neurons are nonspiking. This means they eliminate the spike because they are close enough to do without.[112] These nonspiking cells work in a way that is not best described as either firing or not firing (digital) but they can be slightly in between. Calvin calls it a form of analog computation. He points out that this does not mean that spiking computation is digital as in the "physicists fallacy." Indeed, it too is usually analog with a threshold. Calvin recommends thinking of the way that a cell acts using the following analogy, think of the control of spiking computation more like the pedal of a sewing machine: For gentle presses on the pedal, nothing happens. When its threshold is reached, the machine starts stitching at a certain minimum rate; harder presses, and it speeds up proportionally to pedal pressure.[113]

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[112]To function without spikes, a neuron must be small---and thus not one of the neurobiologist's favorite neurons whose large size makes them an easier target for inserting probes to measure internal voltages. Elongation over several millimeters usually means that the neuron uses impulses. But the brains of humans, as well as of our favored research animals, are filled with cell types that fit the small-size criterion; most have yet to be studied. p. 84 ibid.

[113]p. 87-88 ibid.

"Being like" a computational process and "being" a computational process

The idea of computation may just be an old metaphor. I think it is important here to recognize the difference between, on the one hand, calling something computational because it can be described mathematically and looks like what takes place when someone computes something; and, on the other hand, calling something computational, in the sense Pylyshyn supposes, because it is manipulating symbol tokens of the world according to a certain set of procedures. It seems doubtful that the "machine language" of the brain is computational in the sense Pylyshyn requires because, for one, the cellular level cannot be given a semantic explanation. It is another question whether a mathematical *description* of the process by which a cell comes to fire "summing" all levels of calcium or whatever then "deciding" to fire is also computational in anyway more than a metaphorical sense. I take it that Pylyshyn is not committing himself to anything more than the following claim: that *somehow* the brain is capable of instantiating *symbols* for use in computation.

Conclusion:

Pylyshyn argues that only symbols can represent. My point is that whether one uses symbols or any other form of representation nothing functions as a representation until it is *used* as such. And use comes *before* meaning, and it comes *from* or *out of* a complex system of capacities, (I explain this in Part III). If the outputs of his transducer functions are to be of any use they need more behind them than a simple transducer function to give them meaning. Yet it is not clear, even if we granted Pylyshyn's system meaning, that this is all he needs to explain images and perception. For this would likely be unable to explain the sensory and sensory-like experience involved in perceiving and imaging.

Chapter 7: The Argument From Sensory Experience

Introduction:

In this chapter I argue that there is more to explain than the formal relations amongst of sets of sentences consisting of symbol tokens. In particular, we need an account of how sensory experience is a part of the mental. To explain such sensory experience we could argue, as Pylyshyn and others do, that knowledge or belief, consisting of interpreted symbols, is primitive; and, as a result, any qualitative experience is a cognitive construct that supervenes upon the symbol processing. This is a common, but I think mistaken assumption. The idea is well expressed in the following passage from Clark:

> For either version of the physical-symbol-system hypothesis claims that what is essential to intelligence and thought is a certain capacity to manipulate symbols. This puts the essence of thought at a level independent of the physical stuff out of which the thinking system is constructed. Get the symbol manipulating capacities right and the stuff does not matter. As the well-known blues number has it, "It ain't the meat, it's the motion." The philosophical doctrine of functionalism echoes this sentiment, asserting that (in a variety of forms) that mental states are to be identified not with, say, physiochemical states of a being but with more abstract organizational, structural, or informational properties.[114]

Or we could argue, as I will, that a supervening relation or emergent phenomena will depend upon the *material* that is used in the processing and not the computational activity or processing itself; that is, sensory experience and sensory-like experience is not a formal relation amongst semantic or logical symbols. In other words, contra Clarke, it's not

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[114]See p. 21 A. Clark *Microcognition* (1989)

the action of processing but the material processed that *is* responsible for the existence of experience.

On what there is to explain for imaging and perceiving.

It is a good thing to have some idea of what it is that we are trying to explain. Presumably we start with something unfamiliar and explain it in terms of what is more familiar. Often a theory is used to explain or make sense of a great deal of unfamiliar phenomena. Sometimes however a certain theory does not make sense of all that needs to be explained. When this happens we need to offer alternatives theories or rethink the theory; sometimes, however, it turns out that what it was that we were trying to explain did not really exist in the first place, so the theory survives, and the supposed phenomenon is dropped. The moral of this is that we need to be clear about just what it is that we are trying to explain.

In the case of mental images I do not doubt that a wide range of personal differences and styles of thinking results in a variety of mental lives. I submit that, despite these differences, there exists a wide range of internally generated signals that are qualitatively-like external signals commonly thought of as perceptions. These sensory-like, internally generated signals parallel our externally generated perceptual signals. So they include the visceral, tactile-motor-kinesthetic, olfactory and gustatory, the auditory, and visual. All of these sensory-like experiences can be partial, brief, or exceedingly vivid. They may mix together with other aspects such as beliefs and desires and worries and hopes etc, to produce what we might call the life of the mind. It is crucial we recognize that *these* internally generated signals, that are qualitatively-like perceivings, *are a part* of what we generally call the mental.

The theory that the mind is a computing or symbol manipulating machine requires that all phenomena that we want to include in "the mind" such as imaging and perceiving and dreaming and hallucinating must be explained as a form of manipulating symbols. For Pylyshyn, any symbol-system is independent of the particular instantiation. And because Pylyshyn claims that images are cognitively penetrable, (i. e. affected by beliefs in rationally explainable ways), they require a cognitive or semantic explanation. He thus believes that, because images are semantic phenomena, they are best explained as a symbol-system and in this way are independent of any particular instantiation. This means that, although the material places certain constraints upon the manifestation of the semantic structure, the semantic structure (i. e. the formal relations amongst the symbol tokens), qua semantic structure, is what the images are! But surely this is too strong; for it doesn't follow that, because images may become cognitively penetrable, within limits, images are completely explained as formal semantic or logical relations. Yet this appears to be his position. A weaker claim is that because imaging can become cognitively penetrable, it requires a semantic interpretation in addition to its other physical instantiations. While I agree with Pylyshyn that images are affected by beliefs, I do not agree that this means images are explained as a set of sentences being processed by a symbol manipulating machine.

The cognitivist account of sensory experience

Why do we have anything like sensory experience at all? And why are images, percepts, dreams, and hallucinations so full and rich in this sensory and sensory-like experience? The cognitivist story, or the theory of the mind as a computing machine, even with the addition of the tacit knowledge thesis, has generally ignored this aspect. It has chosen instead to model other cognitive features such as inference making, and speech production to name a couple of examples.

There are a number of positions that one might take with regard to the origin of sensory experience. One hypothesis, the one favoured by Pylyshyn, is that what we take as the raw sensory experience is the output of perceptual processes which are themselves explained according to an information processing model. Sensory experience, according to Pylyshyn, is a cognitive construct and is the output of perceptual processes:

> We now know that such sensations as the conscious experience of redness, of roundness or brightness, are, in fact, *cognitive* constructs [my emphasis] not determined solely by the nature of the stimulating event but by the pattern of stimulation as well, as Gibson (1966b) persuasively argued. Further, the phenomenal properties of perceived objects are affected by what people believe they are looking at (see, for example, Rock, 1983). The colour you see something as possessing depends on what you take the object to be; red looks different on an apple than on an orange (for example, Delk and Fillenbaum, 1978). In other words, sensations are not stimulus bound; they can be affected by context, memory, expectation, and inference. *Sensations are not the basis of perception but, rather, the result of it.* [My emphasis] In the present view, perception begins with the output of transducers, not with sensations.[115]

This approach argues that the knowledge (beliefs, interpreted symbols) structure is a primitive or basic unit from which all cognitive operations (i.e. thinking), or *any mental life whatsoever*, are to be explained. That is, they argue that once we have the underlying processing of a knowledge structure going, then, any experience available to us will follow later, or supervene as a cognitive structure at the same time. In other words, the semantic structure determines the experience. For any change in the semantic structure, there will be a corresponding change in the experience, and this change is a result of the change in the semantic structure.

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[115] p. 174 Pylyshyn, ibid.

Sensory experience itself is the cognitive structure that supervenes on some set of symbols for Pylyshyn. To experience something, on Pylyshyn's account, is *just* is to have a set of sentences in a Language of Thought processed in a certain way and the resulting experience supervenes on the processing of *those* sentences.

> Effects can penetrate upward through levels, since each level is supervenient on levels below; that is, there can be no difference at level *n* unless there is some difference at level *n*-1, even though the converse is not true (because of the multiple-instantiation property of ascending levels; supervenience of psychological states on biological states entails that there cannot be two different thoughts unless there are some biological differences between the two underlying brain events).[116]

What this means, according to Pylyshyn, is that what we experience as imaging just is the computing of some set of sentences. That is, sensory experience is the instantiation of some logical or semantic relation. And thus it is completely explained by rules and representations; the experience of the system results from the appropriate relations among sets of sentences in the system. What this means in effect is that there can be no experience, for the cognitivist, that is not also or actually formed as a belief.

The supervenience thesis tells us is that for every mental state there is a physical state such that if that physical state occurs then (necessarily, for strong supervenience) that mental state occurs; but it does not tell us a great deal about how this occurs. What does the supervening relation amount to as experience? It is argued by Pylyshyn, and others, that it is a logical relation amongst symbols, called a cognitive construct, and this is the kind of relation of the mental to the physical that will explain the sensory experience.

The supervening relation of the cognitive construct, then, includes *both* logical relations and sensory experience. It is used to explain the relation of the mental to the

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[116]p. 38 ibid.

physical, and needs to be used to cover *all* cases of mental phenomena; it would include both semantic regularities that have logical relations and sensory experience. Yet these are surely different enough to wonder how any notion of supervenience on computational activity explains such a range of different types of properties. The account of sensory experience offered by Pylyshyn is ill defined because it assumes that beliefs will serve as the primitive explanatory construct; the notion of the mental however should include such sensory and sensory-like experience as primary cases. Thus we need to look for a better account of these primary cases of the mental that are best seen in imaging, perceiving, dreaming and hallucinating. A better account will recognize that the properties of the specific material used are likely to play a considerable role in what we call the mental.

Pylyshyn, however, is committed to the position that it really doesn't matter what material he uses. He thinks he can produce a cognitive process that will be the same thing as what the brain does---and here he shuts his eyes and waves his hands and says that the really rich experience we have *really* can be done on *any* material at a fine enough grain, and then he says under his breath, logically speaking of course; and, of course, logically speaking he is right. But it is that logical possibility that his account is based on and not any physical possibility.

For this reason I want to make it clear that when we speak of the manifestation of knowledge structures we can be referring to either logical relations or qualitative states. Thus when we talk of the Pylyshyn's explanation of images we need to know how this will explain the knowledge or semantic structures (tacit or explicit) *as a perceptual like experience*. And it is not clear that Pylyshyn's account can explain this.

Conclusion: Pylyshyn's Reply

At this point Pylyshyn can and should respond by saying that it is true that the account he offers does not do justice to the claim that images are qualitatively like such sensory experience, but, he would reply, that is not important. In other words he would argue that he is only concerned about explaining cognition and if certain aspects do not fit that account then so much the worse for them. His claim is that images should be considered part of cognition *because* they are best explained as cognitive phenomena, i. e. they are affected in regular ways by beliefs. His assumption appears to be that it is possible to proceed with a theory and ignore certain considerations until either the theory is shown to be too constraining or alternatively the phenomena that we thought important to explain are no longer relevant or interesting. I have argued that this theory of the mind as a computing machine has turned out to be empty when it comes to explaining certain phenomena, and that such phenomena, as the sensory-like qualities of mental images, are not to be set aside as unimportant or uninteresting.

Chapter 8: The Argument From Nonpropositional Perceiving

Introduction:

Pylyshyn argues that perceiving and imaging, like believing, are explained as semantic regularities. This means that all perceiving and imaging, like believing, must exist in the form of a proposition. I now consider that the ordinary cases of perceiving are largely nonpropositional, and, that imaging is also nonpropositional. If this is so, then Pylyshyn cannot explain this nonpropositional phenomena. Thus in this chapter I argue that his account of the mind as a computing machine cannot make sense of nonpropositional perceiving or imaging.

The case for nonpropositional perceiving

I now want to make a case for non-propositional perceiving. I begin by giving some idea of what a proposition is and the different ways that perceiving may be thought to be propositional.

Propositions

Propositions are thought to be *what it is* that a particular sentence or expression means or is about. This means that a proposition has what can be called a propositional content or semantic content. For example, the sentence "The grass is green" is about the light wave reflective capacities of certain forms of plant life. Propositions, according to Pylyshyn, are abstractions instantiated in some physical form or representation; while the representations, he says, are the concrete entities.[117] Pylyshyn suggests that

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[117] I don't think this is a terribly controversial position to take.

representations be thought of as "sentence analogues."[118] Because the the meaning of the sentence, "The grass is green" could be expressed in any number of different languages the proposition is thought to be independent of its material instantiation, or form of representation i. e. the language. The sentence may be instantiated in a natural language, e. g. English or French or German; or an artificial language, instantiated in morse code or a computer code or, if Fodor and Pylyshyn are right, in a language of thought. The sentence may be spoken out loud, encoded in a computer chip or spoken to oneself inside one's head, as in the case of verbal imaging.[119]

Perceiving as propositional

Perceiving is propositional if, in general, it is a certain state of mind directed to some particular (or specific general) aspect of the world. It is often thought to be expressed in the form of a "that clause." It helps to consider some examples: One perceives (in the seeing) *that* the grass is green. One perceives (in the feeling of a growling stomach) *that* one is hungry. One perceives (in the feeling of skin temperature) *that* the weather is hot. One perceives (in the hearing) *that* the sound is of a trumpet. One perceives (in the tasting) *that* the honey is sweet. One perceives (in the smelling) *that* the smell is of roses. One perceives (in the feeling of muscle contractions) *that* the weight is heavy. One perceives (by means of, or in the recognition of certain signs) *that* a storm is coming. One perceives (perhaps by means of, or in the recognition of certain signs or perhaps intuitively) *that* the situation is dangerous.

Is all propositional perceiving expressed in an utterance or language token, such as *that* or *as*? It seems unlikely. For while it is true that in each case one *might* say out loud:

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[118]pp. 193-194 Pylyshyn, ibid.

[119]Verbal imaging, as Martin argues, is the most common form of linguistic activity, i. e. the imaging of utterances in one's inner ear/voice.

"I see *that* the grass is green" or even "the grass is green!" or one might utter "green" in one's inner voice to one's inner ear (*but that is a verbal imaging of a perceiving).* Yet it is also true, or so it seems, that one might just say "ahh" or simply act in accord with the meaning of the recognized situation or state of affairs which would be a sign of one's having such a perceiving. It is likely that for much propositional perceiving we are not using any linguistic device to formulate our perceiving but it is nonetheless true that we are still perceiving in ways that should be thought of as *directed to* and clearly *about* something. Isn't it the case that perceiving a situation *as* dangerous is done without articulating it as dangerous. In seeing the saber tooth tiger approaching the infant one simply runs to save the child. Anyone who does articulate it may miss out on precious time needed to act. On the other hand, it is not always clear that a situation is dangerous and only when one says: "this is dangerous," does it move one to action.

Thus I want to suggest for now that propositional perceiving need not be tied to linguistic expressions. For example, the dog perceives the smell of a cat and he "perceives" it *as* a cat and *not as* a rat. This could be a form of propositional perceiving at a language of thought level. Or it may be manifest in something like a protolanguage.[120] It will remain an important consideration. It points out that when we refer to propositional perceiving we are not simply referring to the linguistic presentation of some perceivings; we are, however, thinking of a state of mind that is clearly directed towards some object to the exclusion of others. This is in contrast with the cases of nonpropositional or nondirected perceiving.

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[120] See C. B. Martin "Proto-Language" 1987 *Australian Journal of Philosophy*

Nonpropositional perceiving

What does it mean for a perceiving to be non-propositional? I have argued that propositional perceiving is largely a state of mind directed at some aspect of the world and, not others; in contrast, nonpropositional perceiving should be thought of as the state of mind that deals with the rest of the input to the system in a way that is not directed but is not, at the same time, ignoring it completely. I want to consider the suggestion of Martin's that the truly ordinary cases of perceiving are in fact such nonpropositonal or peripheral perceiving. While very directed states of mind that characterize propositional perceiving are a necessary and sophisticated use of input, they are by nature excluding most of what the system must deal with. Most of what is available to the perceptual system is better characterized as being available for use but not at the center of one's attention. To get an intuitive feel for this idea simply consider how many colours you have been perceiving *as colours* in the last ten minutes.

We can get a better idea of what we mean by nonpropositonal perceiving if we consider that most of what is available as input simply cannot be perceived all at once. We can only be directed to a small portion of the input available to us. This does not mean that one is completely unaware of the majority of input; it is still a part of one's phenomenal field. It can be argued that the uses made of the greater part of input to the perceptual system are not so directed and are better thought of as a nonpropositional or nondirected use of input. I shall continue to use perceiving *that* or *as* to indicate the propositional or directed uses of inputs, knowing that the linguistic expression itself is not necessary.

Some cases

The following cases illustrate that not all perceiving is as the directed perceiving *that* or *as*. First, let's consider the child in the womb and the newborn infant under four months. During the last stages of pregnancy the child's nervous system appears to be capable of perceiving sounds in the environment. The child can be tested for hearing; it is capable of making different responses, although not differentiating responses. It is not easy to construe this as a perceiving "that" or "as". As Martin notes of the newborn infant: "The child *hears* speech long before it understands it or even hears it *as* speech, and even longer before it can execute it."[121] Another case is the autistic child. They have a rich world of inner experience but it is unclear that it is a perceiving "that".

The most common case of nonpropositional perceiving for adults concerns our peripheral perception. One can make use of such peripheral perceivings without having perceived that such and such was the case. Peripheral vision or tactile perceiving come close to being a form of detection without awareness. The case of priming gives some idea of this. In such cases subjects show an increased likelihood of perceiving a word in one sense when they have been exposed, below the level of awareness, to another word that offers an interpretation of the first. Although there is always some object of perception or input to the system, it is not always the case that such objects can or need be conceptualized; one's state of mind need not be directed to such inputs. One example is a version of the stopped clock example. In this example an individual does not realize that one has been hearing the clock until it stops ticking.[122] It is used but it is not the center of attention. It is a part of one's phenomenal field and available for use. For consider all the perceptions you are making use of right now but not attending to fully. For example, if you

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[121] p. 44 C. B. Martin "What Is Imagistic About Verbal Imagery And Why Does It Matter?"

[122] Martin presents in his classes an informal experiment that one can perform on one's own to determine the validity of this case. It goes as follows: First close your eyes. Do you perceive any light? Now cover your eyes with your hands. Do you notice any difference? If you do then you were perceiving light but without really being aware *that* you were perceiving light. This is an example of how we make use of perceiving all the time without making it a propositional perceiving.

suddenly lost all feeling in the seat of your pants you'd notice that.[123] These examples illustrate that there is perceiving or use of input going on that is not the dominant processing and the use of such input may constitute the ordinary uses of perception.

Other sense modalities, like the gustatory and olfactory, make this quite clear. In particular, it is difficult to construe all gustatory experiences as tasting *that.* While it is true that in some olfactory cases, like the smell of a pulp mill, one does perceive *that*; for most cases of olfactory experience there is a definite lack of ones being directed to some particular aspect in any way that could be construed as propositional. Thus for the most part, it can be argued that olfactory perceiving is a good example of how the most common and natural state for humans is largely nonpropositional; in the case of a dog, however, the olfactory is likely the most likely to be directed and selective and hence propositional.

As I have shown in chapter five, there is a great deal of evidence showing that imaging and perceiving share similar structural features. Thus if we can argue that the ordinary cases of perceiving are nonpropositional (that is, that the ordinary and most common form off perceiving has to do with using or making available for use the vast majority of perceptual input that floods one perceptual field; and this use is distinguished from the more careful directed and selective uses of input involved in dominant or selective processing), then we should expect to find that in a similar manner, the ordinary cases of imaging are, likewise, of such a nature.

Objection # 3:The output of a transducer function is not nonpropositional

I argue that the account of perception that Pylyshyn uses cannot accommodate such nonpropositional perceiving. The output of the transducer function is supposed to be an

[123]An example that Martin often mentions; it is useful in recognizing that the peripheral perception, which one "adapts" to is still being used at some level.

interpreted symbol already, so it can hardly make sense as the basis for any notion of nonpropositional imaging and perceiving. And everything that enters the system, according to Pylyshyn, is the output of some transducer function. So there is no basis for understanding peripheral perceiving in Pylyshyn's account.

Pylyshyn notes that the representations used in the language of thought should be considered sentence analogues and not thought of as sentences in some natural or utterable language. This only means that not all perceiving will be articulated or expressed. Yet we have already agreed that such is the case, and that, what is essential to propositional perceiving is the state of mind being directed to some aspect of the world. Thus just claiming that a language of thought does not have to be expressed in a natural language, does not mean that a language of thought is not directed in certain specific ways towards certain aspects of the world. So this claim does not help his case unless we think of the outputs of the transducer functions only as potential representations, as I have already suggested. I have argued that the outputs of such transducer functions, which are used to establish these symbols, are only potential symbols and cannot be about something else until they are used in the right way. In that case the system is perhaps making use of or has available something like peripheral perception.

Conclusion: Pylyshyn cannot explain nonpropositional perceiving

As it stands, Pylyshyn's account cannot make sense of such nonpropositional perceiving. I argue that if we can make sense of nonpropositional perceiving and imaging at all then we have found a serious flaw in the language of thought thesis. My contention is that this is in fact the ordinary nature of imaging and perceiving. I have pointed out some cases that suggest not only that we can make sense of nonpropositional perceiving and imaging but also that it is more common than we acknowledge.

Part III: Some Suggestions For An Alternative Approach

Introduction:

Part II was meant to cast doubt upon the plausibility of Pylyshyn's account of imaging as the processing of sets of symbols. As I argued in part II there are three problems with Pylyshyn's theory of mind. The first problem is that his theory of perception begs the question as to how there could come to be any original meaning at all. The second problem is that his account does not provide any sensory and sensory-like experience. The third problem is that the account offered of nonpropositional perceiving does not fit his account of perception.

Thus what we need is an explanation of 1) how anything like intentionality or meaning could arise in nature 2) how there could be anything like sensory and sensory-like experience and finally we should consider the possibility that 3) imaging and perceiving are nonpropositional and yet available for representative use of sensory experience, and that is not subject to Pylyshyn's claim that the "real underlying process" is the processing of symbols.

I now offer an alternative approach to what are admittedly difficult questions. In this final part I set out briefly some features of an approach that emphasizes the causal capacities of a neural system such as the brain. The approach that I use is one offered by C. B. Martin in "What is Imagistic About Verbal Imagery and Why Does It Matter?" In the first part of this chapter I outline briefly some of the main lines of this account. After this I briefly sketch the answers it offers to these questions.

Chapter 9: An Alternative Account

Introduction:

The approach I take offers answers along the following lines. First, original meaning could arise through a number of factors. Causal dispositionality of properties allows for directedness and selectiveness in nature prior to the mental. This causal dispositionality, combined with different kinds of use at the level of the system, and with the alternative and voluntary uses of sensory like experience found in imaging, allows for a notion of intentionality or original meaning that is compatible with a naturalistic account.[124] Second, this approach assumes that sensory and sensory-like experience arise from the specific neural material and is not a cognitive construct. Third, this approach assumes that nonpropositional imaging and perceiving are the ordinary cases and then seeks to understand how they can come to have projective, anticipatory, selective and representative uses for alternative manifestations of these signals. Thus imaging itself will play a crucial role in the establishment of original meaning. Imaging as a causal neural systemic disposition base can be used without intrinsic meaning but can be used to mean or represent; so imaging, because it shares the same structure as perceiving, *and* in addition is under the *voluntary* control of the agent, may be able to have representative use of sensory experience that is explainable as essentially non discrete.

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[124]By a naturalistic account I simply mean an account that is compatible with the claim that intentionality has to have come from something that is not already itself intentional and that such properties are likely to have evolved from simpler properties common to the world.

An Alternative Model for the Mind

What we need to explain is how directedness and selectiveness exist in nature but are not yet intentional; we need to talk about kinds of uses found in natural systems and show how there can be alternative uses of input; we need to understand how sensory-like signals could have projective and anticipatory and combinatorial uses, so that the system can make alternative uses of similar signals and yet not be explained by appeal to the processing of symbols, for I have already shown how that cannot account for much of what is needed.

1.Some metaphysics: Properties have dispositions

First, how does anything like intentionality or meaning get started in nature? The question has a surprising answer; to some degree nature already has a directedness, and selectiveness, built into the properties of all objects.[125] That is not intentionality but it is the beginning of a story .

The thesis Martin offers is that properties of objects have both a categorical and a dispositional side.[126] The dispositional aspect of some property is like a key without a lock: its ready and fit to unlock that lock even while it is not doing so.[127] The manifestation of reciprocal dispositional aspects of certain properties, like the salt dissolving in water, should be thought of as a kind of mutual partnership.[128] Cause and effect should be thought of as the manifestation of certain dispositional properties.[129] For

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[125]This account takes properties, not objects, as the basic pieces of the world. See *The Debate on Dispositions*. Forthcoming.

[126]See pp. 4-11 for an account of dispositonality C. B. Martin "What Is Imagistic About Verbal Imagery And Why Does It Matter?"

[127]P. 5 ibid.

[128]P. 6 ibid.

[129]P. 6 ibid.

example two playing cards propping each other up can be explained as "reciprocal disposition partners for the mutual manifestation" of their dispositional properties.[130]

The thesis maintains that these dispositions exist, even if unmanifested.[131] What does not exist is the unmanifested manifestation of some disposition. For each property is not now or at any one moment manifesting all that it is capable of. In other words the idea of pure categoricallity is false, except for mathematical entities. Martin calls this the Limit view.[132] This causal dispositionality is an existing part of the world and not just a strong conditional statement. For a conditional statement could be true of something and yet it be that the dispositonality had changed.[133] Everything has some dipositionality even elementary particles, for at any one moment they are not manifesting all they are capable of manifesting.[134] The only things that are in pure act are the properties of mathematical entities.[135]

The thesis is that dispositions are directed to (and selective of) certain manifestations of states (or properties) and not others. "...so they are, whether physical or mental, in their very nature directive, projective, discriminatory readinesses for and to what is external to themselves."[136] Such properties *fit* other properties, like the lock and key, and have a fit for many other properties that would result in further properties or states of the world. These dispositions are directed to or for and selective of certain manifestations and *not* for other manifestations,.in that sense they are *directive* and *selective*. These

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[130]P. 6 ibid.
[131]P. 8 ibid.
[132]P. 8 ibid
[133]See C. B. Martin "Dispositionals and Conditionals"
[134]P. 7 C. B. Martin "What is Imagistic About Verbal Imagery And Why Does It Matter?"
[135]P. 8 ibid.
[136]P. 8 ibid.

dispositions may be for something that does not now or may never exist, e.g. a lock could be made and no keys ever made for the lock.[137] These dispositions are characterized in terms of what they are for, e.g. a disposition for dissolving in water. A disposition may be directive in an indeterminate manner, e.g. a hen has a disposition (or set of dispositions) for laying some egg, but not any particular egg, and a set of dispositions for laying this very egg that is now forming.[138] This directedness and selectedness is for an infinity of manifestations within limits determined by the fit. For example there could be an infinite number of keys that unlock this lock, and only this lock. A different key does not have the dispositional property for unlocking this lock, in fact it has the disposition to prohibit it from unlocking this lock, just as a square peg has the prohibiting disposition to fit a round hole.[139]

Thus we suppose that at the bottom or quantum level nature has dispositions that exist in their fit for some manifestations and not others and this *is* a kind of primitive being about something else, or, being for more than itself. All physical and mental properties are at all times ready to manifest other states and prevent other states from becoming manifest; this is so because these properties have a dispositional aspect in addition to their categorical aspect that is directed to or selective of some properties and not others. And because of these existing dispositions, waiting for other properties, (Martin calls them their reciprocal dispositional partners for the mutual manifestation), we have a notion of the disposition being for *alternative* manifestations for which the existing dispositions are ready to go. The notion of being for *alternative* manifestations or states of affairs exists in the unmanifested causal disposition for that state. So being a disposition for the alternative manifestation of some property is not accidental but is a part of the disposition base array of that property.

[137]P. 9 ibid.
[138]P. 9 ibid.
[139]P. 11 ibid.

The causal dispositionality of properties exists throughout nature and long before the mental. This causal dispositionality is not intentionality but it is the first part of the story.

2. A discussion of the notion of systems and use

Systems exist at some level of description in nature. Systems, we may suppose, have more unity than a set of parts but not as much unity as a natural kind. A system seems to capture the idea of a whole or complete collection of parts or bodies or substances that maintains a certain equilibrium. Systems may be either open or closed. A thermodynamic system (a range of substances through which a certain equilibrium of temperature is maintained) is likely to be more open than a biological system (for example the substances and processes necessary for maintaining the continued existence of a single cell). This is because heat does not tend to remain within the kinds of boundaries that a biological system would. Often however biological systems have sub-systems for regulating the flow of heat within them.

Use arises within systems. In order to understand a system we need to make reference to the system making use of some input or some part of the system having a certain function within the system. For example a primitive living cell makes use of certain processes or mechanisms for maintaining and reproducing a certain internal environment. A plant uses sunlight, water, and soil to maintain its continued existence as a system. A complex living organism makes use of limbs to move about in the environment. These parts of the system exist for some function or use within the system. This use without agent is not metaphorical use. It is not metaphorical because if we limit use to conscious use by agents then we conflate use with meaning. That is, although we can suppose that *meaning* involves alternative uses of some input, *use* need only refer to use within a system even without assuming meaning. In this sense use is prior to meaning.

> Unlike directedness, use is only almost everywhere. It seems that use is limited to the systemic. It is intrinsic to systems of dispositional states and admits of all kinds of complexity. Such a non-psychological physiological system as the thermoregulatory system in its vegetative totally non-psychological functioning --- as in an individual in a persistent vegetative state is still capable of uses of input through the function of the the brain stem. Indeed, these uses may be far more complex and intelligence-like than are the more favoured machines of artificial intelligence. This use of input is use in a straight-forward and non-metaphorical sense even though it applies to a system that may be non-mental.[140]

The crucial point that needs to be made is that use occurs in different ways; not all use is the same. To say that a system makes use of some input, or that some input has a function within such a system can mean different things.

There exist different kinds of use in nature. Martin distinguishes between 1) the nature of the instrument of use 2) the nature of the mode of operation of use 3) the nature of the material of use.[141] He suggests the following example:

> A better example would be that of a machine that forms material injected into it at one end and heats the material to a certain temperature and ejects it at the other end. The nature of use could be that of baking bread, making ceramics, or producing a fireworks display according to the difference not of the nature of the instrument of use or of the nature of the mode of operation of use, but of the nature of the material (or input) that is used.[142]

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[140]P. 13 ibid.
[141]P. 15 ibid.
[142]P. 15 ibid.

What has largely been ignored in functional accounts of mind, Martin argues, is the nature of the material of use.[143] Material of use, Martin argues, can be of use in the following two ways:

> 1) The material may be in the form of a substance, such as blood, that is used in the cardiovascular system in a manipulative and directive way.
> 2) The material may be in the form of a stimulus whose signals are received within a systemic region that has the capacities for use in the form of integrative, adaptive, projective, (to other systems that are hierarchically ordered within the organism) responses and reactivities that, as in the case of some autonomic as well as cerebral systems, may be individual-specific and not merely species-general in their adaptivities.[144]

What is absolutely essential is to see the importance of the material of use in any account of mind. Thus the brain is a combined set of neural systems each of which, and together, form a holistic complex disposition base array. A neural system is a capacity base for alternative uses of input *signals*, as for example, regulatory, adjustive, combinatorial, and anticipatory uses.[145]

3. Martin's discussion of neural systems: the non-mental and the mental

The use of input signals involved in the nonmental or so called lower systems of the brain, for example the Nucleus Tractatus Solitarius and the Hypothalamus is far more complex than expected.[146] The nonmental systems already have the complexity needed

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[143] Pylyshyn's account of mind is a functional account insofar as the computational states function as the mind.

[144] P. 16 ibid.

[145] P. 14 ibid.

[146] I make no pretense at being a neuroscientist but I can report that the Nucleus of the Solitary Tract and the Hypothalamus play an important role in controlling the output of the autonomic nervous system. See pp. 766-768 *Principles of Neural Science 3 ed.* Kandel, Schwartz, Jessell.

for the mental. Such "primitive" systems needed to run the cerebral cortex are just as complex and have all the uses that we find at the level of the cerebral cortex. Martin points out that such systems employ "integrative, adjustive, projective, anticipatory, negative and positive feedback and feedforward reactivenesses to (use of) input."[147] These uses require some explanation.

Integrative and adjustive uses of inputs are needed by any living organism, simply to maintain a homeostasis, but for creatures on the move, it becomes useful to have projective and anticipatory and representational uses of inputs.

The notion of negative feedback is that of the kind of use necessary to maintain an equilibrium. The best example is that of a thermostat. A thermostat switches off heat when the temperature reaches a certain point and turns on the heat when the temperature drops.

Positive feedback does not merely switch something on or off given a further state, but is used to amplify or strengthen an existing signal.

Feedforward as opposed to feedback is not a monitoring of some state or signal but rather are signals used in anticipatory or projective manner. Feedforward signals can get something going without having to monitor it "...it can apply anticipatory signals....Such feedforward capacities are termed 'anticipatory.'" [148]

Neural signals differ in quality. This will be crucial for discovering the difference between non-mental and mental directedness and use. Thus Martin argues that

> The difference between *mental* and *non*-mental directedness and between *agent* and *non*-agent use is in the special *qualitative* difference between the *kinds* of neuronal sensory and sensory like signals *used* that we may detect, or, given certain identifacatory skills and linguistic skills, we may identify or *characterize* as sensations, percepts, images and feelings.[149]

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[147] p. 203 C. B. Martin *Debate on Dispositions,* circulating copy forthcoming.
[148] p. 206 ibid.
[149] P. 17 ibid.

Signals not only differ in quality but also differ in causal origin.

> 1) External signals are signals, *within* a system, that are caused by signal input at receptor level by stimuli from the immediate environment.
> 2) Internal signals are signals, *within* a system, that are qualitatively similar to signals that are external signals. They are not only *caused* centrally within the system but are for *use* (have their primary functional connectivities) within the system.[150]

The use of internally generated signals is unique to higher centers. The use of externally generated signals is common to all levels of the neural system. What appears unique to higher level centers of the brain appears to be the use of *internally* generated signals. In other words: "...no autonomic functioning system has internal signals. The use of such internal signals is not a normal part of any autonomic functioning, and the use is never kept just within the originating central system."[151]

The use of cue manifestations is unique to higher centers. Another feature that Martin argues for is the relative importance of what he calls a "cue manifestation" and a "typifying manifestation."[152] The importance of these is that a cue manifestation is a capacity for knowing without having to perform some test that one is ready to proceed or not. A typifying manifestation is the actual performing of that capacity. Such cue manifestations are, Martin argues, not found in the vegetative functioning, they appear to be unique to the higher functioning. The point of these is that they are to be thought of as brief feelings or sensations or other possible brief sensory experiences used, although often fallible, to cue us into our readiness to continue or not. "These sometimes fleeting feelings

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[150] P. 18 ibid.
[151] P. 18 ibid.
[152] P. 44 ibid.

concerning some unperformed (on the occasion) cognitive capacity are what William James and Wittgenstein, too verbalistically thought of as the "Got it!" or "I can go on." or the negation of these."[153]

4. Uses of perceptual-like internally generated signals

There are two interesting modes of use of imaging for the agent: 1) The more voluntary and controlled use of imaging; and 2) the less voluntary forms of imaging. These are both subject to a range of vividness and partialness.

Let's consider briefly the second form. The best case to think of here is hallucinations. Then, consider dreaming and the transition between dreaming and waking: hypnopompic imaging (when waking) and hypnogogic imaging (when falling asleep). Yet at least for dreaming there are ways perhaps limited to control dreams as in the case of lucid dreaming.[154] Another interesting case is that of Phantom limbs.[155]

Probably less noticed is the use of tactile motor kinesthetic imaging that accompanies visual or auditory imaging. Because of the primacy of the tactile motor kinesthetic modality for us, and the extent to which imaging can be partial and fleeting we may be using this form of representing perceptual like signals without paying a great deal of attention to it.

More work in this area is starting to be done. A recent target article in B.B.S. by M. Jeannerod draws attention to the use of motor imaging and its connection with motor planning. He argues that a continuum exists between the two, and that motor imaging is

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[153]P. 44 ibid

[154]See S. Blackmore (1990) "Dreams that do what they're told", and S. LaBerge, L. Nagel, W. Dement, and V. Zarcone (1981) "Lucid dreaming verified by volitional communication during REM sleep"

[155]See for instance, R. Melzack "Phantom Limbs" Scientific American, April 1992

involved in the preparation and intending movements.[156] Motor imaging he argues pertains to

> the representation of the self in action, with the subject feeling himself executing a given action, whether this involves the whole body (as in running for example) or is limited to a part of it (as in writing, pointing to a target, or maintaining pressure against an obstacle).... A number of everyday situations (most of them ill-defined) correspond to this definition: imitating somebody's movements, anticipating the effects of an action, feeling kinesthetic or bodily sensations (muscle contractions, heart beats), and so on, can be considered putative motor images. The difficulty of verbalizing such situations, in conformity with the implicit nature of motor preparation, contrasts with the more accessible visual imagery.[157]

Partial imaging is common and may not be readily noticed, it is not of the same vividness or fullness of imaging as the richer and more sensuous voluntary uses of imaging one has when waking in the morning; or when slowly and carefully going over the way her voice sounded, etc. That kind of imaging involves a greater degree of vividness and voluntary control (except for extraordinarily vivid dreams and hallucinations).

The voluntary uses of perceptual-like signals are under control of the agent. "The imagistic signals unlike the perceptual signals, are under *direct* voluntary initiation and use and therefore apt material for intention-driven and semantic use."[158]

Perception is fleeting and partial and often not verbalized. If an organism cannot make greater use of this largely nonpropositional perceiving by carrying it through into a representative use of a perceiving by means of imaging and dreaming, then such an organism is not making very effective use of its environment.

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[156]P. 189 M. Jeannerod (1994) The Representing Brain: Neural correlates of motor intention and imagery" *Behavioral And Brain Sciences*.17, 187-245.

[157]P. 189 ibid.

[158]P. 43 C. B. Martin ibid.

Carrying perceivings through into imaging and dreaming has a number of uses. Three important feature are as follows: *Magnification*, the strengthening of the input signal; *Enhancement*, an increase in the number of the properties associated with the signal so that there is a greater discrimination of the signal and greater memory activation; *Enrichment*, a case where "the signal triggers associated internal and cross-modal signals. This is a kind of cross-modality reverberation that is common. In rare clinical cases this is *synesthesia*."[159] The reinforcement and strengthening of neural connections would be a possible and obvious advantage.

This carrying through and projective use could be very selective, and partial, and abstractive

> This selectivity and abstraction is a natural (acquired without being taught) process. It is a requirement for the development of memory. Reminders and promptings are not total replicas of what is being remembered. It is a requirement for fast response recognition as well. Just a tip of the tail of the leopard should be enough, or the faint suggestion of part of the print of a paw or what are called "secondary cues". For example, a carcass in a tree is a secondary cue to the presence of a leopard, because only a leopard deposits its prey in a tree. Some monkeys just never catch on, but some other non-human primates do. This mastery of secondary cues requires an abstractive cognitive mediation process.[160]

Martin argues then that:

> The *intention-driveness* of imagistic uses comes in the individuals abstractive, partial, fragmentary, schematic and attenuated and fleeting nature of the imagery resulting in its diminishing similarity to the typical perceivings of the kinds of object, situation, etc. that the imagery is used to represent. The use of imagery that must stand above all others is that of

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[159] P. 41 ibid.
[160] P. 34 ibid.

> stimuli *independent* of stimuli from the immediate environment. So the child has *that* long before it has language.[161]

So we can argue that the nature of so called abstract thought may depend upon, to a surprising degree, this capacity of imaging to be "abstractive, partial, fragmentary, schematic and attenuated and fleeting"; and together with its projective uses, we can see that imaging something is never just simply repeating the original perceptual like experience.

5. A causal account of mind

We have now a brief sketch of an alternative model. Can such a model provide answers to the objections set out against the computational account of Pylyshyn and at the same time be used to explain imaging and perceiving? The questions I set out at the beginning of this chapter, now have some possible answers.

The first question, concerning the origin of meaning involves the representative use of partial, nonpropositional perceivings by and through the abstractive and selective uses of various imaging modalities.

No image or symbol in itself has meaning. To look for meaning in the images or words themselves is a mistake. That is, meaning is in the use manifestation coming from a rich dispositional base array for alternative use manifestations.

The second question regarding the sensory and sensory-like experience will rely on an explanation in terms of the kind of material in use.

This is a very brief sketch of an alternative model. I shall now briefly consider how this model applies to the case of musical imaging.

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[161] P. 36 ibid.

An alternative account of imaging

Musical imaging

I now want to return to the case of musical imaging and round off the discussion by considering how this account works when applied to the case introduced in chapter one. How does the account outlined above help us in thinking about the case of musical images?

Let's briefly compare verbal imaging and musical imaging. One of most interesting things about musical imaging is that the "sounds" imaged are not sounds that an individual can produce. For instance one can go over in one's head the sound of a trumpet but one clearly cannot make or produce the sound of the trumpet. This suggests that the ability to reproduce sounds in the head is tied closely to the hearing of such sounds unlike verbal imaging which also introduces the ability to produce such sounds externally.

Yet musical imaging, like verbal imaging, is likely to involve mixed modalities:

> Musical imagery, as well as verbal imagery, perhaps is accompanied by proprioreceptive, pharyngeal, etc. muscular activity, though the musical soundings in the head are not at all as *of* those movements. Musical imagery is of sounding and often not just of one's own voice or any voice at all, but of one or more musical instruments, perhaps a full orchestra.
>
> Glenn Gould would spend hours outdoors without any piano and without any observable movements of fingers, hands and arms, making innovative use of sequential imagery of the motor-kinaesthetic feel of fingers and arms and shoulders, plus the Enrichment of the tactile feel of the tips of his fingers on the keys of his beloved piano, and auditory Enrichment, all of this in his head, for the inventing of new fingering techniques for some composition. Not much hope of giving an account of this in terms of "tacit knowledge".[162]

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[162] p. 42 ibid

Yet tacit knowledge as the rich but unarticulated store of experience, forming a complex dispositional array, is necessary for creative uses. But the kind of uses made of such sound images are not to be thought of as getting at something one already knows, rather the uses that are made will be *new* uses and *new* combinations; and the process will be, as discussed above, one of Magnification, Enhancement and Enrichment and the projective, representational, and partial uses of perceptual-like experience, combined with the different modalities provides a wide range of uses that can be performed inside the head.

Pylyshyn may still try to argue that all this usage is just the processing of symbols. Yet I have tried to argue that this approach undercuts any possibility that such a system could get started; for no symbol in itself could ever have meaning, unless it is from the right kind of dispositional base. I think it is difficult when we take the case of musical imaging as resulting from symbol processing because music relies mostly upon, whether it be perceived or imaged, the sensory and sensory-like aspect and *that* is not found in the account that Pylyshyn provides. The apparent need for sensory experience in music makes it a tough case for the symbol processing view. I think we should look for a different approach for explaining musical imaging.

Conclusion

In conclusion I suggest that nothing in what Pylyshyn says ever suggests that he cannot adopt a dispositional account for his computational theory. Indeed he must see that what is necessary for any computational use of a symbol candidate is that it is such only if it comes from a rich enough dispositional base of capacities for alternative computational uses of alternative symbols.

The question is whether this is enough. I have argued that Pylyshyn's account of imaging does not provide the qualities needed to explain the essential qualitative similarity between the sensory percepts and the sensory-like images.

The computational account that Pylyshyn offers of imaging has been in need of explicit criticism for some time now. I hope to have provided some of that criticism.

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