

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

A

THE NATURE OF VISUAL MENTAL IMAGES

by

ANTHONY BIRCH

A dissertation submitted to the Graduate Faculty in
Philosophy in partial fulfillment of the requirements for
the degree of Doctor of Philosophy, The City University of
New York.

1999

UMI Number: 9917631

**Copyright 1999 by
Birch, Anthony David**

All rights reserved.

**UMI Microform 9917631
Copyright 1999, by UMI Company. All rights reserved.**

**This microform edition is protected against unauthorized
copying under Title 17, United States Code.**

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

(c) 1999

ANTHONY DAVID BIRCH

All Rights Reserved

This manuscript has been read and accepted for the Graduate Faculty in Philosophy in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

January 25, 1999
Date

David Rosenthal
Chair of Examining Committee

January 20, 1999
Date

Charles Landesman
Executive Officer

Professor Charles Landesman

Professor John Greenwood

Professor David Rosenthal

Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

THE NATURE OF VISUAL MENTAL IMAGES

by

Anthony Birch

Adviser: Professor Charles Landesman

Two fundamental views about the nature of visual mental images have played significant roles in both the history of philosophy and the history of psychology. The traditional, or imagist view, is that mental images are like inner pictures. Experiencing these inner pictures is understood to be something occurring in the absence of a physical stimulus, but is also acknowledged as something significantly like seeing actual objects. This often leads to attributing to mental images the actual properties of physical objects and to postulating an inner homunculus that can observe these properties. Recognition of these difficulties led to the descriptivist view, which holds that mental images are actually inner verbal descriptions. Descriptivists argue that mental images, like physical images or pictures, carry no meanings in and of themselves. They are therefore incapable of performing any of the functions in the mind traditionally assigned to them by

imagists, such as bearing memory information or serving as abstract general ideas (e.g., as in Locke's philosophy).

I argue for a compromise position between the two views. After reviewing the history of mental imagery, I argue that having mental images is a complex family of states, each of which involves varying degrees of visual and intentional (or conceptual) content. At one end of the scale (after-images), mental images may have virtually no conceptual content; at the other end of the scale (thought images), images may serve as symbolic quasi-instantiative particulars in and through which we think. Although they obviously do not have the properties of physical objects, I maintain that phenomenological and linguistic analyses identify mental images as objects, and that there are no metaphysical bars to admitting mental objects as real entities. By means of contrast, I also investigate how two contemporary theories in cognitive science understand mental imagery. I suggest that the hypothesized computational states and procedures meant to reveal the nature of mental imagery lead to untenable views about the mind, and tell us very little about mental images.

PREFACE

This is a defense of philosophical imagism.

Philosophical imagism attempts to hold the middle ground between traditional imagism and descriptivism. Traditional imagism stems from Aristotle and the British empiricists. Its general features are relatively well known. It accepts the common sense intuition that mental images are easily-identified elements in certain quasi-perceptual conscious experiences that we normally have. It appeals to the observation that mental images of many types appear to us, are generated by us, and are used by us as meaningful tools in our mental lives. Traditional imagism also tends to treat or speak of images according to the somewhat less obvious understanding that they are species of mental objects that are inwardly "seen" or apprehended.

Descriptivism is a relatively recent general philosophic movement, stemming from Ryle, Wittgenstein, Dennett and others who have been concerned to replace our ordinary intuitions about what is meaningful and how meanings are generated. Descriptivism has brought to the fore some of the following concerns: (1) Since there are no

images for concepts essential to logic such as "exists" or "and," images can have only a limited role in the generation of logical thought. (2) Images, as a rule, have no apparent intrinsic meaning; what they mean must be provided by a linguistic context, which designates that the image is of some particular thing. (3) If we refer to mental objects as things that are inwardly seen, we invoke not only the concept that there is an inner homunculus that is doing the inner seeing, but that the inner objects themselves have the properties of ordinary visible objects, such as size shape and color.

Philosophical imagism seeks to avoid the errors traditional imagism is prone to. Primarily, it seeks to avoid the implications (1) that because images are inwardly "seen" there must exist an inner homunculus to see them; (2) that because we refer to mental images as objects, we must also mean they have the properties of ordinary objects, such as size, color, or shape. At the same time, philosophical imagism does not give up the common sense and traditionalist notion that mental images are mental objects. They have being and play a role in mental life in a way that is unique to mental, as opposed to physical, objects.

The positive defense of philosophical imagism takes up the first three chapters. In chapter 1, I lay out a common sense account of mental images and the problems it faces.

In chapter 2, I describe the history of the imagist and descriptivist approaches in both philosophy and psychology. Chapter 3 is a discussion of the issues involved in developing a theory intermediate between descriptivism and imagism. It relies heavily on the insights of traditional psychology, Aristotle, and Brentano. It provides a metaphysical discussion of how mental images may be understood as mental objects. The metaphysical treatment is inconclusive on several points. It attempts primarily to map out the alternatives.

A negative, or contrasting, defense of philosophical imagism takes up the final two chapters. No new positive ideas are introduced to support philosophical imagism in these chapters. Their purpose is to show what some other views about mental imagery might involve if philosophical imagism is deemed inadequate. I examine two contemporary theories about the nature of mental images, one proposed by Pylyshyn and the other proposed by Kosslyn. These theories derive primarily from an attempt within psychology to develop new paradigms for understanding imagery. Pylyshyn has proposed a descriptivist-inspired theory and Kosslyn an imagist-inspired theory. Both are concerned to show how principles of computational systems using structures and processes can be applied to imagery phenomena in psychology. To some extent, they repeat, within the context of

contemporary psychology, the concerns of the imagist/descriptivist opposition within philosophy. The vociferous opposition between these two psychological theories has become known in contemporary literature as the imagery debate.

In chapter 4 I seek to clarify, analyze, and discuss the difficulties with the theoretical side of the imagery debate in psychology. I present Pylyshyn's theoretical case for the epiphenomenalism of imagery in computational systems, discuss the difficulties with it, and show that Kosslyn's theory also results in epiphenomenalism for imagery, despite his claims to the contrary. In chapter 5, I discuss the experimental evidence and the dispute involved in its interpretation. In terms of resolving the imagery debate, the result is inconclusive. I argue that neither side has a clear advantage. I argue this is due to two factors. First, the strictures the disputants have themselves adopted regarding the rules of computational systems and the rules of empirical data gathering have made the debate very difficult to resolve. Second, their evidence reflects part of the ambiguous and elusive nature of images themselves. Like the philosophic descriptivists and imagists before them, these psychologists were each inspired by part of the truth about images but failed to see a middle ground.

I close the discussion with some reflections, based on the two example theories studied, about the nature of computational systems that appeal to or result in epiphenomenalism. I conclude that in theories of this sort, one is more likely than not to lose sight of the fact that images proper occur in conscious states and that both the visual and intentional contents of images can largely be apprehended by us directly without reverting to theories about unconscious computational processes.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION TO MENTAL IMAGERY

I. A Common Sense Approach	1
II. Philosophic Questions about Mental Imagery	8
III. Overview of the Thesis Defended	12

CHAPTER 2

A HISTORY OF THEORIES OF MENTAL IMAGERY

I. Introduction	17
II. Imagism	18
Memory Imagery	18
Aristotle	19
Descartes and the British Empiricists	24
Summary Remarks	31
Imagination Imagery	33
Low-Level Imagination: The Storehouse Analogy	33
High-Level Imagination	35
The Moderns	39
Summary Remarks	40
Thought Imagery	42
Historical Perspectives on Thought Imagery	43
A Contemporary Theory of Thought Imagery: Price	49
Summary Remarks	55
The Legacy of Imagism	57
III. Descriptivism	61
Argument 1: No Images for Essential Concepts	63
Argument 2: No Content	65
Argument 3: The Language Trap	66
Argument 4: Wrong Properties	68
The Legacy of Descriptivist Arguments	73
IV. Psychology and Mental Images	77
The Questions for Psychology	77

Foundational Period: 1860-1901	79
First Imagery Debate: 1901-1913	84
Behaviorism: 1913 - 1964	86
Reemergence of the Image: 1964-Present	89
Revised Traditional Imagism	90
The Contemporary Imagery Debate	92
V. Summary: Remaining Problems for Mental Imagery	94
CHAPTER 3	
THE NATURE OF MENTAL IMAGES	
I. Introduction	97
II. Preliminaries to the Study of Mental Imagery	98
The Visible Realm: Things, Images, and Symbols	98
Mental Images	106
A Definition of Mental Imagery	110
Four-Way Causation	112
Subject and Object	119
Conscious Mental Images	122
Descriptive Metaphysics and Objectives of the Study	131
III. The Range of Mental Imagery	136
After-Images	138
Eidetic Images	141
Hallucinogenic Images	143
Memory Images	146
What is a Percept?	146
What is Memory?	148
The Modes of Memory	151
Inspecting Memory Images	153
The Law Of Decay	159
Imagination Images	162
Imagery and the Will	162
The Internal Space of the Imagination	164
Mental Images as Causes	168
Thought Imagery	169
Summary: The Nature of Mental Images	175
IV. Explaining Mental Imagery	177
Images and the Mind/Body Problem	177
Mental Images as Mental Objects	191
Review of the Problem	191
Ducasse's Adverbial Theory	193
Chisolm's Support for the Adverbial Theory	196
Moore's Objection and the After-Image	198
Jackson's Object Theory	201

The Need for a Metaphysical Account	203
Desiderata for an Object Theory	204
Self Awareness and Object Awareness	206
The Mode of Being of the Inner Object	210
The Search for an Alternate Resolution	216

CHAPTER 4

THEORETICAL FOUNDATIONS OF THE CONTEMPORARY DEBATE

I. Introduction	218
II. Background: Epiphenomenal and Computational Systems	221
III. Fundamentals of the Contemporary Debate	234
IV. Descriptivism: Pylyshyn's Theory	238
Internal Descriptions and Visual Information	238
A View of Memory	242
Models, Recall and Problem Solving	246
Critique of Pylyshyn's Theory	252
Knowledge, Abstract Objects, and Explanation	252
The Structure of Memory	254
Problems for the Procedural Model Theory	257
V. Pictorialism: Kosslyn's Theory	263
Kosslyn's Anti-Epiphenomenalism	263
The Theory of Depictive Functional Images	266
Basics of the Theory	266
Critique of Functional Depiction	270
Kosslyn's Computational Model for Inspection	273
Basics of the Inspection Model	273
Critique of the Inspection Model	277
VI. Summary and Conclusions	281
Inner Space: Merging the Theories	281
Epiphenomenalism	283

CHAPTER 5

EXPERIMENTAL EVIDENCE

I. Introduction	284
II. What Kind of Phenomena are to be Explained?	288
III. Influential Studies	291
Mental Rotation	291
Shepard and Metzler	291

	xiv
Learning and Mental Rotation	293
Mental Scanning	299
Kosslyn	299
Pylyshyn's Objections to Scanning Experiments	301
Finke	303
Conclusion	308
IV. Problems for Empirical Cognitive Psychology	309
Individual Variation	309
Underdetermination and Lack of Predictive Power	311
The Will and Conscious Judgment	319
Conclusion	321
V. An Alternate Experimental Model: Chambers and Reisberg	322
Experiments	322
Qualifications of Results	324
Conclusion	327
VI. Concluding Remarks	331
Theory and Experiment	332
Epiphenomenalism	334
Computer User Dualism	341
Bibliography.....	351

FIGURES AND TABLES

Figure 2-1		54
Table 3-1		141
Figure 5-1		346
Figure 5-2		347
Figure 5-3		348
Figure 5-4		349
Figure 5-5		350
Figure 5-6		350

CHAPTER I

INTRODUCTION TO MENTAL IMAGERY

I. A Common Sense Approach

We normally understand mental images to be integral parts of our lives. Mental images are common when we recall past experiences. Recollection of unusually pleasant or unpleasant events may bring to mind mental images that have nearly the potency of the original perception. We can also experience vivid images of events that never happened, using our imagination to conjure up images of possible circumstances. Still another aspect of normal mental activity involves the use of mental images to solve problems. For example, a mechanic might mentally visualize how a part fits in a machine before attempting to install the part, or an architect might visualize the facade of a building before making a detailed rendering. From the naive point of view then, mental images unquestionably exist and are functional, integral parts of mental life.

Other evidence, not too far removed from ordinary experience, demonstrates the many benefits and uses of mental images. It has been demonstrated that athletes can

improve their performance by using mental imagery. Clinical evidence shows that exercising the imagination through constructive daydreams can have important therapeutic effects for the mentally ill. Imaginary objects or imaginary scenarios also serve extraordinarily useful purposes in abstract thinking and theory formation. Einstein reported that at least one factor in his realization that the velocity of light must be the same in all reference frames came by forming a mental image of what he would see if he observed a beam of light while he pursued it at the speed of light (Shepard 1982, p. 6). Kekule credits his discovery of the structure of benzene to a mental image that occurred to him in a dream in which he imagined atoms joining into chain-like molecules that whirled about until one chain formed a ring (Shepard, 1982, p. 7). Numerous other discoveries in science, such as the structure of DNA, have been associated with moments of insight occasioned by a vivid mental image. These examples indicate that mental images are functionally active constituents of processes that produce real physical and mental effects. It seems obvious that we would be at a loss in explaining many of our intellectual or cognitive accomplishments if we could not appeal to the functional reality of mental images.

To refine the observations of common sense a bit, we can separate mental images into specific categories, already indicated in our examples: memory images, images of the imagination, and images used in problem solving or thinking. These separate categories are to be considered advisedly, however. Although we recognize a distinction between an event remembered, an event imagined, and something thought of, we also accept the fluid interchange of the "materials" -- for want of a better word -- involved in these processes. Images from our memory can become part of our creative imagination, and the images of creative imagination, along with factual knowledge and reasoning skills, can be involved in thinking.

How should we characterize the materials, or mental images, involved in these processes? Again, the common sense point of view, using ordinary vocabulary, generates an answer. We tend to refer to mental images as mental objects, or things having object-like properties. There are several reasons for this. First, mental images, like ordinary objects, often seem relatively stable. We say, for example, that we can recall the same image over and over again. Second, we speak of manipulating mental images in the manner of objects. We can, for example, mentally rotate, move, or restructure mental images. Third, we encounter or respond to mental images in ways that are

parallel to, or analogous with, physical forms of interaction. We say we can "see" mental images with the inner eye of the mind, or "feel" or "smell" them with an inner sensibility that is similar to actual sensory experience. Fourth, all these object-like characteristics involved in our use of and encounter with mental images can be easily explained in ordinary language by referring to inner "objects" of the mind. The blue sky with puffy white clouds above the verdant valley that I see with the inward eye of memory must surely be something. Similarly, the imagination must have something to imagine with, or by means of, if it is to function at all. Likewise, it seems that thought processes must have constituents or parts, some of which might rightfully be called objects or images used in thinking. From these considerations, it seems a small step to conclude that there must be object-like mental entities whose presence in the mind accounts for our experience of them.

The common sense view avoids any skepticism that might be generated by referring to mental as well as physical objects. Although mental images seem to be object-like in many senses, common sense still insists that in most cases we are easily able to differentiate ordinary perception of objects "out there," in the real world, from objects inwardly "seen." The common sense view of visual perception

is that it unambiguously informs us about what is out there in the real world, what is immediately present to us. Mental images, on the other hand, are understood to be things that are not currently present in the real, exterior world. Ordinary talk about mental images, I suggest, shows that we accommodate this understanding by using a secondary meaning of the verb "see" when we speak of "seeing" mental images. Often, one simply places quotes around the word to indicate our understanding that mental images are something inwardly seen, or seen with the mind's eye, rather than outwardly seen.

In addition to obvious ways mental images are used by the mind, we also have experiences of mental images for which there are less obvious explanations. Dreams are also usually classified as mental images, and their purpose or function in mental life is perplexing. The appearance in a dream image of the solution to an intellectual problem, as in Kekule's case, is decidedly rare. For the most part, if dreams are informing us or being used by the mind to perform specific tasks, these purposes are not self-evident. Unlike memory, imagination, and thought imagery, dream imagery seems to be not so much directed by us as directed at us, following its own course, and sometimes even causing us to mistake dreams for reality, at least for a brief time.

Yet, the existence of powerful dreams is not likely to sway the common man's belief that mental images are easily identified, are not likely to be permanently confused with objects of perception, and are relatively easy to sort into the meaningful and the meaningless. After all, we know that realistic dreams are similar to other forms of mental images that can be directly induced by external causes. Vivid waking hallucinations, for example, may be induced by drugs. Strong visual after-images can be induced by a flash of light. Even when we experience such strong images, we often have some awareness that these are caused by temporary changes in the nervous system, not temporary changes in external reality. Many dreams may be like these forms of induced imagery, originating from a combination of subliminal sensations and automatic interpretive mechanisms that supply a context to sensations. The subliminal sensation of a hand trapped in a blanket, for example, becomes a dream of entrapment. Speculation about their causes, however, is not the only means we have of differentiating dreams or hallucinations from reality. In many cases, the content of such images gives away their type, if not their purpose. Dreams and hallucinations frequently show us things that could not happen in reality, and this prevents us from mistaking such images for representations of actual circumstances. Like other forms

of mental imagery, I suggest that the common man's view recognizes dreams, hallucinations, and after-images as part of the same general class of mental "objects" or visual experiences that are generally known to represent things not actually present in the external world.

There are, then, from the common sense point of view, a number of points to be made about mental images. First, there are several kinds, including memory images, imagination images, dreams, hallucinations, after-images, and images used in problem solving or thinking. Second, there is an intuitive and easily-grasped sense of what mental images are and how mental imaging is distinct from perception. Mental images are often thought of as being objects of a sort, but ones that we see inwardly rather than through ordinary perception. We understand that seeing mental images is only analogous to perception, for "seeing" mental images means the inner seeing of something not actually present to the senses. Third, the experience of having mental images is so common that one is easily led to the supposition that mental images are necessary and universal; images appear to be essential elements in mental activities, without which we could not think.

II. Philosophic Questions about Mental Imagery

Philosophical questions inevitably arise when we attempt to improve on the intuitions of common sense. Let us consider some general philosophic considerations that apply to mental images.

Philosophers often object that the vocabulary of ordinary language, when used to describe mental images, is grossly inadequate. One of the most common objections is that speaking of inwardly "seeing" something is completely uninformative. Philosophers want to know precisely what the quotes around "seeing" mean. If it is not the same as ordinary perception, we need to give some specific differentiating features of this form of seeing, otherwise, we will not have said how, or even if, it can be reliably distinguished from perception.

The same objection applies to the quotes around the word "object." Again, philosophers want to know what sense to give the notion of inner mental, as opposed to physical, objects. First of all, philosophers are concerned with the issue of the reduction of mental states to physical states of the brain. Most philosophers, and many ordinary people, believe that contemporary science should be sophisticated enough to provide a means of relating all mental states to physical changes in the brain. If this can be done, then so-called "mental" objects must be physically instantiated

in the brain in some fashion. If mental objects do in fact have some form of spatial or physical existence, then we need to explain this using more precise language, for the common man's language connotes that mental images are objects like pictures, and neither a common sense nor a philosophic view is likely to endorse the supposition that mental images are physical in the same way that photographs or paintings are physical. If they were, they would need a physical location, and no one, presumably, thinks that mental images are literally photographs or pictures located in the heads of those who see mental images. Ultimately, in this scenario, the common sense view degenerates into the absurdity that there are pictures in the head.

Philosophers argue that a second series of objections arise if we take the opposite view, and assume that mental objects are not physically instantiated. This leads to metaphysical problems that again challenge a common sense inventory of objects. If mental images are genuinely non-physical, our ontology must include objects that do not exist in space, but with which we seem to be directly acquainted. This, of course, was one of the considerations that led Descartes to formulate a dualistic metaphysics in which objects could be said to exist either as material or non-material substances. This, in turn, leads to the well-

known philosophical problem of how to explain the interaction between the physical and the mental realms.

More philosophic questions arise when we reflect on the role of mental images in thought, even without considering the impact of possible reductionist scientific explanations. We pointed out that Einstein, for example, used a mental image to help him find an insight into the velocity of light in any reference frame. It is clear, however, that merely conjuring up this image does not fully explain how he arrived at his famous equation. If it did, the solution would be as obvious to us as it was to him. The extensive mathematical reasoning Einstein used is not immediately available to us from considering the image alone. We wonder, then, what the mental image really has to do with the thinking process. Perhaps it was not as useful as it appeared to be. Aside from reductionist considerations, the entire common-sense supposition that images in fact play a role in thought and in fact have meaning, could be mistaken.

Many philosophers have made the same sort of point in another way. Consider any sort of image, for example, a picture of a man sitting on a chair in front of a house. How do we know, philosophers ask, what the picture intended to be a picture of? Is it a picture of the man, the chair, or the house? From the picture alone, we have no way of knowing. We need to have a context in which the meaning or

intent of the picture is known. In any case, philosophers argue, it is obvious that an image by itself cannot have any specific meaning. Since thinking relies on the generation of specific meanings and interconnecting them, some philosophers conclude that images themselves cannot really be involved in the thinking process.

There are no obvious solutions to the problems produced by initial philosophic reflection. It is evident that the common sense approach, if it is to be retained, requires serious reexamination. In order to set a course for further examination of the issues, let us limit the scope of the project before us. First, we can limit the investigation to visual, rather than aural, tactile, or other types of mental images, since visual images are most often the subject of philosophic debate. Second, we can think of questions about mental imagery as falling into two broad categories:

1. What is the nature of visual mental images?
2. How are visual mental images involved in thought?

By questions concerning the nature of mental images, I shall understand such issues as determining the origin, kinds, manner of existence, and general properties of mental images. By issues related to the role of mental images in thought, I shall understand the broad issue of how mental images fit in explanations of the thinking process. This includes such issues as the necessity of images in thought,

the causal effectiveness of mental images, the relationship of images to linguistic forms of expression, and the place of mental images in scientific theories of the mind and brain.

III. Overview of the Thesis Defended

I shall defend, broadly, the common sense approach to mental images. The common sense approach, despite its flaws, can be supplemented with a phenomenological account of intentional states and the formal definitions and distinctions of traditional psychology. This provides the basis for a viable philosophic understanding of the nature and purpose of mental images. An outline of this defense follows, in the form of summaries of subsequent chapters.

In chapter 2, I investigate the history of philosophy and psychology of mental images. This chapter is intended to present, rather than to resolve, some of the received doctrines and problems about mental images. I describe the fundamentals of two camps, the imagists, who understood mental images as central to mental life, and the descriptivists, who claimed images could be eliminated from an ontology of the mental.

In chapter 3, I present a positive account of mental images, based on a compromise between the insights of the imagists and the descriptivists. The positive account of

mental images is based largely on what I call the traditional philosophy and psychology of mental images. I argue that the nature of mental images may be understood using introspective evidence, supplemented by descriptive phenomenology and a metaphysics that includes mental objects. This approach, consistent with both common sense and the formal definition of traditional psychology, results in an inventory of mental imagery types, defined as conscious states in which we are aware of a mental presentation of the absent (a non-present "object"). The range of conscious mental imagery types encompasses a variety of phenomenological states, from quasi-sensory states ("given" or "seen" in a manner approximating actual vision), to intentional states in which the image is not so much "seen" as it is posited as a symbol of an intentional content. The notion that mental images are objects, therefore, must be understood analogically, since they lack the properties of ordinary objects and they are not literally experienced as pure visual presentations, but represent the agent's intentional awareness of both visual and conceptual content, provisionally bound together in a single form we call an image. Because they are meaningful, mental images can be among the symbolic particulars which serve as the vehicles of thought.

I conclude chapter 3 with a study of the metaphysics of mental images. The specific claims of this section are limited, but I do attempt to show (1) that we can have an explanation of mental states in terms of their physical causes even though we are lacking a reductive explanation; (2) there is a general-level resolution to the homunculus problem; and (3) there can be a significant task in psychology and in descriptive metaphysics in the absence of a fully-reduced science of the mind. I suggest that in any event, we still need a descriptive metaphysics of mental images that addresses their mode of being as intentional objects that are "in" a subject. Although I leave some metaphysical questions unanswered, I attempt to outline what considerations need to be addressed in a metaphysical account.

In chapter 4, I begin an examination of how two contemporary, opposing theories in psychology define, describe, and experiment upon mental images. This examination spans two chapters. A critique of these views helps differentiate my view from others.

For expositional purposes, it is fortunate that there is presently a debate in cognitive psychology about mental images. This debate has thrown the experimental and theoretical apparatus of cognitive psychology into a stark and revealing light. In outline, the contemporary debate is

a relatively straightforward set of opposing claims. The descriptivist side has been supported by Pylyshyn, who has argued that mental images are to be explained by the operation of description-like data structures in the brain; the image-like qualities they seem to have are the epiphenomenal result of more primitive operations that have no features of true images. Kosslyn has supported the pictorialist or imagist side. His is a particularly interesting comparison to the view I defend, because he attempts to rescue some of the intuitions of common sense, specifically, the notion that we inwardly "see" mental images. Kosslyn also asserts that mental images are causally-effective elements in cognition; i.e., they are not epiphenomenal. At the same time, however, he attempts to defend a computational view of the mind. I show that this attempt fails, and that his pictorialism is just epiphenomenalism.

Chapter 5 concentrates on the experimental evidence adduced in support of the descriptivist and imagist views of mental imagery. I argue that with a few exceptions, these experiments do not support any one interpretation since (1) the models for these interpretations are underdetermined by the data; (2) the experimental design of several important experiments is flawed; and (3) there is significant experimental evidence that conflicts with the proposed

interpretations. I suggest that the failure of these experiments to yield a cohesive interpretation is due to two factors. First, the ground rules for experimental data gathering adopted by the disputants themselves were extremely restrictive. Second, their evidence reflects part of the nature of mental images themselves, which, under the appropriate experimental conditions, yield an amalgam of descriptive and pictorial qualities, or, more precisely, from the side of the subject, show that subjects employ a variety of strategies to solve problems simultaneously using descriptive designators and imagery symbols in consciousness.

I conclude chapter 5 with a summary view of computationalism and epiphenomenalism based on the example theories I have discussed and the general background assumptions that drive computationalist accounts. I suggest that computationalism leads either to a form of epiphenomenalism that is exceptionally difficult to accommodate to common sense or to a self-contradictory position I call "computer-user dualism."

CHAPTER 2

A HISTORY OF THEORIES OF MENTAL IMAGERY

I. Introduction

This chapter reviews both philosophic and psychological approaches to mental imagery. Its purpose is to survey the intellectual history of imagery and to introduce the background information and distinctions necessary to understand contemporary issues. This chapter does not purport to be an exhaustive or unbiased history of the topic of mental images. It includes topics and issues that were selected with an eye toward generating a positive account of mental images (chapter 3) and providing a basis for criticism of other contemporary views (chapters 4 and 5).

The history of philosophy does not provide much in the way of treating mental images as a separate topic. Discussions of imagery generally appear in the context of theories of memory, imagination, and thought. I first review some of the influential philosophic theories on these topics, focusing on how these specific kinds of mental images have been conceived. This review allows us to understand the historical roots of two schools of thought

that run throughout the history of mental imagery. One school, the imagist, allows a large role for mental images in the operation of the mind; the other school, the descriptivist, understands mental operations primarily in terms of language, allowing mental images a much smaller role in explanations of mental processes. The imagist/descriptivist distinction is crucial to our inquiry and appears repeatedly in subsequent chapters.

In psychology, we find a more direct treatment of the topic of mental images, since the definition of mental images is crucial to understanding the nature and goals of psychology itself. The history of imagery in psychology is part of a century-long debate about how mental images are to be understood as objects of the science of psychology. A knowledge of this history is crucial to understanding the approach of contemporary cognitive psychology examined in chapters 4 and 5.

II. Imagism

A. Memory Imagery

A review of traditional theories of memory reveals three important features about the philosophy of memory images. The first feature is the distinction between conscious memory states and the explanation of them in terms of the underlying states of the body and/or soul. This

distinction has been maintained, at least to some degree, by nearly all philosophers, but has often resulted in confusion between what memory is and how to account for it. The second feature is the wide, nearly universal, acceptance of the principles of association as the paradigm for explaining the structure of memory and the process of recall. Finally, traditional accounts of memory nearly always invoke the picture metaphor, an analogy that has caused endless trouble in philosophy. It resulted, especially after Descartes, in the homunculus problem, perhaps the most infamous of all philosophical problems relating to imagery.

1. Aristotle

Aristotle defines memory as "an affectation of perception or conception conditioned by lapse of time" (On Memory and Reminiscence, 449b24). By this he means that memory involves some alteration (affectation) of an original perception or conception that is not coincident with the original moment: "the moment of the original experience and the moment of memory of it are never identical" (On Memory and Reminiscence, 451a31). Aristotle emphasizes that this definition has the important consequence that memory cannot be said to be "implanted concurrently with the continuous implantation of the [original] sensory experience" (On Memory and Reminiscence, 451a25). Memory itself Aristotle

understands as a conscious state in which the reconstruction of past experience occurs.

For remembering, as we conceived it, essentially implies consciousness of itself. (On Memory and Reminiscence, 452b28)

For whenever one exercises the faculty of remembering, he must say within himself, 'I formerly heard (or otherwise perceived) this,' or 'I formerly had this thought.' (On Memory and Reminiscence, 449b23)

It is clear that Aristotle means to defend his view against those who confuse the process of implanting, or the material conditions that account for memory, with conscious memory itself.

Aristotle holds that the processes occurring during perception as well as those that account for the permanence of memory are physical in nature. In what is undoubtedly the most famous passage from Aristotle regarding the origination of memory images, he compares the process of original implantation to pressing an image into wax:

The process of movement [sensory stimulation] stamps in, as it were, a sort of impression of the percept, just as persons do who make a wax seal. (On Memory and Reminiscence, 450a30)

Aristotle observes that the permanence of memory appears to be a function of the quality of the matter in the body that is to receive the impression. Various organic states of this matter, such as growth, decay, becoming too soft or too hard, will directly affect its ability to receive and retain an impression (On Memory and Reminiscence, 450b1-12).

Aristotle does not counterpose the physical and the mental in the contemporary (post-Cartesian) sense. Actualized memory, a conscious activity of the soul, does not, in Aristotle's view, involve some different (non-physical) part of the soul. Aristotle assumes that the soul and the body are unified. The relation between the physical basis for memory and its conscious manifestation is to be understood not in terms of separate physical and mental substances, but in terms of the potential and actual states of a single part or "organ" of the soul. All the conscious faculties of the mind are due to a power or potential that resides within some physical organ of the soul.¹ When this potential becomes actualized, the soul achieves a different

¹ There is room for alternate interpretations of Aristotle's text on this point. See Modrak, 1987, for a comparison of Aristotle to contemporary functionalism. There is also an immaterial intellect in Aristotle's system, but it alone does not, apparently, have the power of conscious thought. The role of the immaterial (agent) intellect and its images is discussed in the section on thought imagery, below.

state, activity, or mode of being, which we call a conscious state.

The question naturally arises which material organ or part of the soul is activated when memory occurs. Aristotle answers it is the same part as is activated in perception, because memory, just as perception and conception, involves a presentation in consciousness (On Memory and Reminiscence, 450a22). This is an important observation, for it shows that from the earliest times there has been some speculation that mental images involve the reactivation of a faculty or organ involved with perception.

Memory, according to Aristotle, is a low-level function of a living soul. All animals with sense perception and awareness of the lapse of time are capable of memory. In man, the capacity of memory is augmented by a higher power, which Aristotle calls recollection. Recollection involves an act of the will which initiates a search for what one wants to remember. Aristotle describes the act a number of ways: a kind of inference, a deliberative act, or an act following a series of previous memories linked by certain relations. The latter description has had profound historical impact, both because it describes the process in physical terms (as "movements" of the soul) and because it defines the fundamental relations among the components of memory as similarity, dissimilarity, and contiguity:

Whenever, therefore, we are recollecting, we are experiencing certain of the antecedent movements, until finally we experience the one after which customarily comes that which we seek. This explains why we hunt up the series [of movements], having started in thought either from a present intuition or some other, and from something either similar, or contrary, to what we seek, or else from that which is contiguous with it. (On Memory and Reminiscence, 451b17)

The discovery of the associative principles mentioned in this passage deserve some additional comment. The associative principles used in recollection have often been cited as one of the first and most important contributions to the science of psychology. Aristotle's actual observation was not, however, as historically important as the uses found for it. We shall see how the British empiricists reinterpreted this observation to support a new philosophic vision of the basic character of mental operations.

There is one other feature of Aristotle's philosophy that has proven to be extremely influential. Although, as we have shown, Aristotle distinguished between the conscious state of memory, or the consciously directed techniques for retrieving memory, and the physical impressions underlying these capacities, he also referred to these physical

impressions as "pictures." Just prior to his introduction of the analogy of the wax seal Aristotle says,

[I]t is clear that we must conceive that which is generated through sense-perception in the sentient soul, and in the part of the body which is its seat -- viz. that affection the state whereof we call memory -- to be some such thing as a picture. (On Memory and Reminiscence, 450a27)

The same occurs when he describes the physical aspect of the process of recollection. He describes recollection as "a searching for an 'image' in a corporeal substrate" (On Memory and Reminiscence, 453a5). These references to mental images or pictures as if they were separate entities in the mind that could be literally seen have had many unfortunate consequences in the history of philosophy, especially after Descartes. As a result, Aristotle is usually blamed for being the originator of the "picture in the head" view of mental images.

2. Descartes and the British Empiricists

Most philosophers and psychologists through the beginning of this century generally accepted Aristotle's view that memory proper is consciousness of prior events and memory storage is due to physical impressions or changes within the body, as well as his views that the principles of

association apparently structure memory. The differences among subsequent philosophers' descriptions of memory result not so much from disagreements about what it is, but how to account for it in a way consistent with alternate metaphysical views about the relation of the mind and body.

Descartes broke with the scholastic view that soul or psyche is a principle distributed in levels of perfection throughout living organisms. Descartes regards animals other than man as mere mechanisms, devoid of soul. Further, he does not accept (in the Meditations) the scholastic distinction between the active (immortal) and the passive (bodily and mortal) intellects. He regards the human mind as a unitary, immortal substance whose function includes not only abstract thinking, but also the functions previously assigned to parts of the soul that were thought clearly to be seated in physical organs, such as memory and sensing.

Descartes faced a problem in explaining memory. On the one hand, he could not abandon the tradition of Aristotle (and common sense as well) that memory is due to physical alterations of matter in the body. On the other hand, his metaphysics of the soul required that consciousness could only exist through an immaterial agency. A connection therefore had to be established between the material site of the original physical impression responsible for memory and the immaterial consciousness. Descartes's solution was to

describe the interaction of the mind and body as occurring at a specific site within the brain, namely, at the pineal gland located in the center of the brain. Memory retrieval is described as follows:

Thus when the soul desires to recollect something, this desire causes the [pineal] gland, by inclining successively to different sides, to thrust the spirits towards different parts of the brain until they come across that part where the traces left there by the object we wish to recollect are found. (Passions of the Soul, Bk. I, Art. XLII).

Descartes explains that traces of memory are pores in the brain enlarged by the animal spirits² when the object was originally perceived. Once the memory traces were found, there had to be some means of restoring the memory to consciousness. It could not be, as in Aristotle's system, that the reactivation of the material substrate was itself a reactivation of the soul resulting in a conscious state, for that would be to embed consciousness in matter. Descartes's solution was to propose that the pores "excite a special movement in the [pineal] gland which represents the same object to the soul, and causes it to know that it is this which it desired to remember" (Passions of the Soul, Bk. I,

² The animal spirits were also material particles, fine enough to travel through the nerves.

Art. XLII). Thus, there is a backward movement from the traces to the seat of consciousness, but the movements themselves do not result in anything until the mind becomes conscious.

There is a similarity to Aristotle, in that the account distinguishes between physical changes and the conscious awareness of memory. But for Descartes, the "seeing" of the image occurs not in the body but in the immaterial soul. Descartes's description, unless it is to be understood entirely as a vague analogy having no explanatory value at all, invokes two suppositions. First, it assumes there is literally some sort of internal image generated at the pineal gland. Second, it invokes the notion of some sort of inner, immaterial "eye" that sees the image present in the pineal gland. Unfortunately, there is little room for a metaphoric or analogical interpretation of this inward seeing, and Descartes's explanations of related phenomena do nothing to help. The literal nature of this inward "seeing" applies, for instance, not just to memory, but to ordinary vision as well. Descartes suggested the spirits had to combine the separate images from each eye in the pineal gland (Passions of the Soul, Arts. XXXII, XXXV) and then invert the image so that the soul could "see" it right-side-up.

The British empiricists sought a different explanation of memory images, one that would avoid Descartes's mind/body interaction problem and would appeal to mechanical principles whenever possible. These philosophers sought a greater continuity between explanations of sensory states and higher, or conscious, states. As a result, they often tended to equate memory with the physical changes responsible for it.

Hobbes, for example, accepted the metaphysical principle that motion "produceth nothing but motion" (Hobbes 1651/1968, p. 86). Since no other principle is available to us empirically, Hobbes reasoned motion must be capable of providing a complete account of the mind. Sensation was evidently caused by physical processes alone, and since no new, non-material results could be introduced into the causal chain following sensation, memory and other apparently non-material conscious states must be nothing more than motion. As an after-image leaves an impression on the senses that is retained after the object has disappeared, so these same motions continue in the body, becoming memory. Hume had a similar theory. He assumed that sensory input in the form of an impression was automatically copied by the mind at the time of the original sensation. Since they were analogous to physical motions,

they decayed in force over time, and these less-forceful copies, subsequently revived by the mind, became memory.

Although this approach tended to equate our ideas with physical motions or impressions, the empiricists also betrayed a knowledge that this form of explanation was not entirely adequate to the phenomenological facts. Hobbes recognized that although what he called the "reall effect" of sensory motion was "nothing but Motion," we did not experience these effects as motion but as conscious states such as "Delight, or Trouble of Mind" (Hobbes, 1651/1985, p. 121). Hume found that there were states of mind that he could not trace back to an original impression, such as an imagined shade of blue. In his first edition of the Essay, Locke defined memory as

the power to revive again in our minds those ideas which, after imprinting, have disappeared, or have been as it were laid out of sight. (Book II, Chapter X, para. 1)

In the second edition Locke modified this because he realized it could be understood to imply that conscious states (having an idea) retained their character as ideas even when the mind was not conscious of them. Locke added the following explanation:

But our ideas being nothing but actual perceptions in the mind, which cease to be anything when there is no

perception of them, this laying up of our ideas in the repository of memory, signifies no more but this,-- that the mind has a power, in many cases, to revive perceptions which it once had, with this additional perception annexed to them,-- that it has had them before. And in this sense it is that our ideas are said to be in our memories, when indeed they are actually nowhere; -- but only there is an ability in the mind, when it will, to revive them again, and, as it were, paint them anew on itself... (Book II, Chapter X, para. 2)

Locke's account, then, reverts to Aristotle's in both the definition of memory and its explanation in terms of potentials of the mind. Locke, like the other empiricists, realized, even if they did not address, the gap in their explanation of how conscious states of memory relate to prior physical inputs and the physically-based storage of impressions.

I mentioned that the empiricists reinterpreted Aristotle's principles of association. If memory could be explained by associative principles and as analogous to a mechanical system, perhaps the other, so-called higher powers of the mind could be explained in similar fashion. The reduction of the number of principles involved would greatly simplify explanations of mental activity. The

empiricists therefore adopted the principles of association, invoking them as explanations not only of memory but of the flow of connected ideas in thought itself. This, of course, was a radical departure from the received wisdom of the scholastics, who attributed thought processes to rational or spiritual powers such as "abstraction" or "formation of the phantasm," rather than mechanical or proto-mechanical principles such as association.

3. *Summary Remarks*

Descartes's ontology coupled with the language of the inner picture derived from Aristotle, results in the homunculus problem. This problem is quintessential to the topic of mental imagery, and appears over and over in historical philosophic accounts.

The problem begins in Aristotle's analogy of imprinting a picture in a wax seal. If images are impressed into a material substratum, as a shape is impressed in a mold, or as a picture is printed on a page, how can this picture be recalled unless it can literally be seen? Aristotle's own theory of inward seeing (unlike Descartes's) does not imply any literal inner eye, only the reactivation of the organs involved in vision. To say or imply, then, that what is impressed in the matter of the body responsible for memory is in any sense a picture, must be wrong. It cannot be a

true description of the means by which this information was stored in matter.

Descartes's suggestion that there are memory "traces" in the brain (a term still in use today) is perhaps somewhat better in that it does not directly connote that these traces are pictures. But Descartes then reinserts the image into the story of memory recall by having the image reconstituted on an inner viewing area in the center of the brain. The empiricists did not escape the suggestive "picture" metaphor laid down by Aristotle or the inner spectator model of Descartes. If anything, they made the problem worse. Locke's emendation notwithstanding, the overall effect of empiricists' philosophy of memory images was to solidify the spectator model of the mind. It results in the notion that images in the mind are thing-like entities that are retained "as-is" in the mind whether or not we are conscious of them. The conscious mind is then conceived of as a spectator that can inwardly rummage around, searching for the mental images already residing in the mind, as if walking through a picture gallery. If carried to its logical extreme, this spectator in the picture gallery scenario leads to total skepticism. Inner and outer perception become entirely equivalent because the subject stands in the same relation to internal objects as to external objects -- that is, in a condition that allows

for the subject to doubt whether appearances are indicative of anything at all. In this case, there would be no reason to believe that any appearances were privileged indicators of an independent reality; the subject would be in a permanent state of doubt.

Because of the homunculus problem, traditional philosophy is frequently understood to have been a total failure in treating mental images. It does not advance much upon the common man's vocabulary of images and how we seem to experience them and store them as objects, and the attempt to explain how physical inputs could have psychic results simply results in skepticism and more confusion.

B. Imagination Imagery

In traditional philosophy, there have been two principal interpretations of the faculty of imagination. The first interpretation describes imagination as a low-level function that explains the behavior of animals in terms of stored images. The second interpretation describes imagination as a high-level function, akin to thought, that explains certain mental powers unique to human beings.

1. Low-Level Imagination: The Storehouse Analogy

Aristotle sought to explain purposeful behavior in low-level life forms by means of inner causes. This was

consistent with his definition of psyche as a principle of self-movement within a living body and with the empirical evidence that many animals continued to perform activities consistent with a desire or goal even in the absence of any obvious stimuli that could cause this behavior. Aristotle proposed that internal images retained by the animal were the inner causes of such purposeful actions. This view suggests that the mere capability to sense pleasure and pain could not result in any purposeful action. Aquinas made use of this point when he described why a bird must possess an image:

So, too, a bird gathers together straws, not because they are pleasant to the sense, but because they are useful for building a nest. Animals, therefore need to perceive such intentions, which the exterior sense does not perceive. (Summa I, Q. 78, Art. 4, sed contra.)

In order to represent these non-perceived forms, Aquinas, like Aristotle, believed some faculty or principle was necessary:

...for the retention and preservation of these forms the phantasy or imagination is appointed, being as it were a storehouse of [sensible] forms received through the senses. (Summa I, Q. 78, Art. 4, sed contra.)

According to Aquinas, an animal perceives an image of the imagination by means of a natural instinct and the behavior

follows as a matter of course. This form of imagination is understood to be an extremely low-level biological function, lower, even, than memory. Memory requires knowledge of lapse of time in addition to a presented image; imagination only requires the image. In this elementary sense, imagination is entirely non-creative. It simply stores images from perception and uses them automatically to guide action.

This, in rough overview, is the storehouse analogy or low-level interpretation of imagination. It is characterized by two fundamental features of importance for the history of mental images: 1) the analogy is intended to apply primarily to animals; and 2) it introduces the concept of mental images as designating internal causes of behavior.

2. High-Level Imagination

High-level, or human, imagination is traditionally understood as a power with two principal functions or features over and above those already present in low-level imagination. The first is the creative or combinatorial power, consisting simply of the ability to make images of things never perceived through the recombination of previously stored memory images. From the imaginary form of gold and the imaginary form of a mountain we can compose the

form of a golden mountain we have never seen (Summa I, Q. 78, Art. 4, sed contra).

The second power or function is less easy to specify, but it is reflected in understanding the imagination as an intermediate psychic power, between the sensory and the rational. While animals may be thought to "read" their inner images automatically or "blindly," humans may be said to be aware of their imaginative creations with an inner vision that makes imagination images "ready for," or perhaps part of, thought. Part of this understanding, that imagination is "almost" thinking, is reflected in contemporary usage. We often use "to think of" and "to imagine" interchangeably in ordinary discourse. Philosophic opinions differ as to how, precisely, to further characterize this feature of the imagination.

Aristotle identified imagination images as presentations that were sensory derivatives and were not yet made part of a judgment. He seems to have thought of the human imagination as a kind of way station, intermediate between thought and perception. He states:

For imagination is different from either perceiving or discursive thinking, though it is not found without sensation, or judgement without it. That this activity is not the same kind of thinking as judgement is obvious. For imagining lies within our own power

whenever we wish (e.g., we can call up a picture, as in the practice of mnemonics by the use of mental images), but in forming opinions we are not free: we cannot escape the alternative of falsehood or truth. (On the Soul, 427b15-21)

Thinking is different from perceiving and is held to be in part imagination, in part judgement... (On the Soul, 427b25)

Aristotle is not only careful to distinguish having imagination images from actually thinking, but he is also keen on reminding us that the faculty of imagination, though definitely reflecting a "higher" power, is nonetheless still entirely a product of a bodily organ: "...[I]magination must be a movement resulting from an actual exercise of a power of sense" (On the Soul, 429a1). That is, imagination images, like memory images, inhere in the material soul.

In defense of his view that the individual soul was created by God, Aquinas embellished Aristotle's view of high-level imagination, describing it more as an aspect of the active (immortal and rational) intellect than an aspect of the sensory powers. Aquinas speaks of reason "overflowing" into the imagination, of the imagination being "spiritual," and of the imagination "knowing" many things:

The cogitative and memorative powers in man owe their excellence not to that which is proper to the sensitive part [i.e., sensible particulars], but to a certain affinity and proximity to the universal reason, which, so to speak, overflows into them. Therefore they are not distinct powers, but the same, yet more perfect than in other animals. (Summa I, Q. 78, Art. 4, Rep. Obj. 5.)

Augustine calls that vision spiritual which is effected by the images of bodies in the absence of bodies. Whence it is clear that it is common to all interior apprehensions. (Summa I, Q. 78, Art. 4, Rep. Obj. 6.)

...the estimative power [of the imagination] is like the intellect in that it knows many things which the senses can not perceive only less perfectly than the intellect. (Summa I, Q. 78, Art. 4, Rep. Obj. 4.)

Historically, Aquinas's concept of the imagination, though less well-known is equally as important as Aristotle's. Not only is it closer (because of its Christian overtones) to a contemporary, common sense view than Aristotle's, but it also recognizes human imagination images as causes within

the mind -- images that affect us "in the absence of bodies."³

3. *The Moderns*

Descartes and other moderns adopted various powers assigned to high-level and low-level imagination to suit the requirements of their own metaphysical views. Descartes recognized the combinatorial power of the imagination, but like Aristotle he associated powers of the imagination more strongly with the body than the mind. In describing the act of imagining, for example, Descartes fell back to his explanation of memory, again appealing to the action of pores in the brain. The pineal gland sends the spirits to the pores "by the opening of which pores this particular thing [to be imagined] may be represented" (Passions of the Soul, Bk. I, Art. XLIII). Descartes rejected, however, that having imagination images should be understood as a proto-rational stage in thinking.

After Descartes, empiricist philosophers attempted to adopt mechanical explanations of the imagination. Hobbes argued, invoking the storehouse analogy, that imagination and memory were nothing more than more dissipated forms of

³ Aristotle seems to deny that human imagination images can actually affect us at 427b22. Tye (1991) and other contemporaries who defend parts of imagism accept human imagination images as causes.

the very same kind of motions. Both imagination and memory were equally just stored images, and so just two different names for the same things. Hume's view was similar, and both focused on the combinatorial power of the imagination as an explanation of mental contents in general, without a sharp distinction between imagining and thinking.

4. *Summary Remarks*

Our brief survey of imagination imagery reveals some general points within the tradition of imagism that are surely amenable to the common sense view. First, imagination images are understood to be derivative of bodily, specifically sensory, operations and organs. This has some plausibility even from casual introspective evidence, since having imagination images is in some respects like seeing. Second, imagination images can be causally effective. Again, this corresponds to ordinary experience. Tye's (1991) example is of an imagined tarantula crawling up one's leg. The result is a case of cold shivers up the spine. In explaining human action, we frequently refer to actions based on or expressive of inner mental pictures. Explaining the behavior of birds and other lower animals on the basis of inner mental images is perhaps less immediately persuasive, but we do not need to accept this part of the theory.

A feature of traditional imagism that deserves considerably less credibility is the way in which it describes the creativity of the imagination in terms of combining images. Imagism gives us no conceptual framework whatsoever to explain how images, qua pictorial presentations, can be combined. The problem is the picture metaphor. A picture is a visual whole, and the only way to combine visual wholes is by literally combining the visually-distinguishable parts. Are we to conceive that mental images are superimposed, butted next to each other, torn asunder and then reattached? Clearly, when we say that the image we have in mind is half-man, half-horse, this does not specify which visual specifics from man and horse are combined, nor how they are arranged. Again, imagism stumbles into incoherence over the picture metaphor. This is a topic we need to address in chapter 3.

Finally, we note that the topic of imagination images is treated by the philosophers according to the needs of their metaphysics. Aristotle's images are half-way between sense and thought, but inclining toward sense. Aquinas's images are proto-rational, indicating the spiritual nature of the human soul. Hobbes's images combine like so many atoms. Which view, if any, is correct? And can we extract the nature of imagination images from a presumed metaphysics

of how the mind operates? Again, these are questions that will be addressed in the next chapter.

C. Thought Imagery

If the philosophers of the imagist school and the common man agree, despite the fine points, that memory and imagination images are functional elements of mental life, their views begin to diverge when it comes to the topic of thought imagery. The common man is apt to claim that one thinks in images -- that mental images constitute the very fabric of thought itself. The philosopher, even the ardent imagist, is not as quick to accede.

This is evident if one considers three issues of central historical importance regarding the role of images in thought. These are

1. Are images necessary to thought? Are they sufficient for thought?
2. Do the mental images involved in thought differ in nature from those in memory or imagination?
3. Do the features of thought images limit or constrain thought itself?

It turns out that even within imagism, philosophers are diametrically opposed; there is no consensus view on these questions. There is a convenient way to map out some possibilities, however. If all of these questions were

answered affirmatively, this would be called Strong Imagism, or the view that ideas are mental images and that thinking consists entirely of operations using them.⁴ The common man, at least prior to reflection, is likely to believe in Strong Imagism. This is not, as Price pointed out, a view any philosopher actually seems to have held, though many philosophers have held some portion of it and some moderns (e.g., Berkeley and Hume) have been accused of endorsing it completely.

I shall divide the discussion of thought imagery into three parts. The first reviews the historical answers to the three questions above. The second reviews the essentials of Price's theory. The third is a summary evaluation of the problems faced by an imagist perspective on thought imagery.

1. *Historical Perspectives on Thought Imagery*

Aristotle has the most unequivocal answer to the question of the necessity of images in thought. He states

To the thinking soul images serve as if they were contents of perception... That is why the soul never thinks without an image. (On the Soul, 430b14-17)

⁴ I owe the distinctions between Strong Imagism and Moderate Imagism and some of the associated points to Price, whose insightful book (1953) is probably the best contemporary attempt to understand traditional philosophic imagism.

The rationale for this view derives from Aristotle's need to explain our knowledge of universals, and universals, in Aristotle's view, are precisely what cannot be represented directly. As we know, Aristotle described the subordinate powers of the soul (sense, memory, and imagination) as primarily passive in operation. These powers are limited to what has been provided by the senses, namely, images of sensible particulars. In order to account for knowledge of non-particulars, Aristotle needed a new power, so he posits the existence of the active intellect, an immaterial agency that would be capable of knowing non-material, abstract objects and producing appropriate images of them. This agency is able to strip away the inessential elements of the images of prior sensible particulars in order to produce an intelligible image, or representation of a universal.

Although the text is somewhat unclear, and this interpretation might be debated, it appears that we have no actual consciousness of the intelligible image. Consciousness of universals occurs because the active mind impresses upon the passive (embodied) mind a token particular that represents the intelligible species.

Aristotle uses mathematical examples to illustrate his meaning. When we imagine a triangle, we imagine it as something specific or determinate in shape, yet we understand that this image is not the object of our thought,

which is something abstract, but merely a token. Similar considerations apply to eternity, God, etc., which are thought of by means of images that remain finite (On Memory and Reminiscence, 450a1-15).

What Aristotle actually means, I believe, in the above passage is that the mode of our thinking is due to our material constitution. The organs of presentation, which are the same as, or part of, the organs of sense, enable us only to represent determinate particulars. What distinguishes thought images is not any of their presentational qualities, but simply their causal history. Those which are due to the agent intellect allow us to think, rather than simply remember or imagine. The presence of the image does not complete the thought, since judgment or truth assessment is also necessary (see passage quoted above on imagination). Since we have knowledge of universals, it is this knowledge that it ultimately operative in thought and the image is merely "incidental" (On Memory and Reminiscence, 450a1-15).

Descartes held precisely the opposite view about the necessity of thought images. He argued that imagery is not necessary for understanding. Not surprisingly, this follows from his supposition that the body is not necessary for conscious thought. We already know that Descartes believed memory and imagination images result from bodily influences,

and as Descartes wanted to purify thought from the body he claimed that knowledge and thinking could exist without these influences. A piece of wax may appear to us in various shapes, sizes, and even as a solid or a liquid, yet still remain the same substance. No specific image of the wax can correctly represent our understanding of it as a substance that remains the same through multiple physical incarnations. Descartes concluded that it is quite possible to understand what something is without being able to form an image of it.⁵

If one rejects the notion that either immediate rational insight or images planted in consciousness by immaterial powers somehow result in knowledge of universals, one needs a new form of explanation for this kind of knowledge. One possibility is that particular images come to have universal application by lacking certain features -- in being general, vague, or indeterminate in a way that makes them suitable as stand-ins for universals. This,

⁵ This conclusion is true, but it is sometimes thought that Descartes also demonstrated the general uselessness of images in thinking. His famous example is comparing thinking of a triangle to thinking of a chilliagon. He noticed that we cannot form a detailed image of a chilliagon, but we understand it nonetheless. His example demonstrates the distinction between thought and imagination, but not that images must be utterly useless in every case. Less complex figures are more easily imagined, as Descartes pointed out. These might well be used to think about the properties of the figure, even though we still distinguish between just imagining a figure and thinking about it.

after all, is what is implied by Aristotle's notion that abstraction strips away particular features and creates a set of universal features true of any object of that type. If this feature of vagueness or universality were to be maintained in conscious appearances, the properties of images used in thought would be better matched to their function. Moreover, one would not need to propose that such images were generated by any unknown agency; they could be readily explained as results of automatic mechanical processes such as the superposition and recombination of images already stored in the imagination.

This is the thesis of "general ideas," usually attributed to Locke. The locus classicus of Locke's reputed invention of the indeterminate image is the following:

For example, does it not require some pains and skill to form the general idea of a triangle (which is yet none of the most abstract, comprehensive, and difficult); for it must be neither oblique nor rectangle, neither equilateral, equicrural, nor scalenon; but all and none of these at once. (Locke, 1690, Bk. IV, Ch. 7, para. 9)

There is some doubt that Locke actually believed there were general ideas of the kind that incorporated mutually incompatible features, but the passage is famous because Berkeley launched an attack on it. Locke's name has been

associated with the thesis of general ideas ever since. In any event, the thesis of general ideas has proven resilient, in both philosophy and psychology, because of its intuitive simplicity: thought images are different from other images and they need to be different because form follows function. Thought images need to represent general terms, therefore they are general in form.

The thesis of general ideas does not place particular restrictions on the manner of our thinking. It contrasts sharply with another tradition within imagism that does. Suppose we accept it as a principle that since all images originate in perception as particulars, the mind has only these to work with, and no new natures can be introduced. Both Hobbes and Hume attempted to follow the implications of this thesis. Both identified thought with a sequence of "ideas" (both sounds and images) in the mind. All these were determinate particulars, differing only from the original perception in degree of intensity and the combinatorial possibilities supplied by the laws of association.

Hume argues, for example, that we have no original perceptual image of causality, only the regular succession of one kind of events followed by another kind of events. Therefore we have no authentic conception of causality. We have no direct experience of an image of the soul or of God,

therefore the existence of these as independent substances is a dubious proposition at best. Another example: consider a mathematical point. Hume asks, what image can we form of it? Hume's introspective evidence is that a point may be imagined as a small dot. He argues such an image has no proper size at all. A small point can be imagined as easily as a large point, and no matter what size the image of a point is understood to be, the image does not admit of division and still remain as an image of a point. Since our image of a point does not admit of division, Hume reasons, there is no such thing as an infinitely divisible magnitude. The properties of the image of the smallest imaginable magnitude do not allow this conception. Mathematicians and philosophers are therefore wrong when they appeal to our understanding of our innate conceptions of mathematical realities, for this is sheer contrivance.

2. *A Contemporary Theory of Thought Imagery: Price*

The primary mistake of the Strong View and the mistake made by many traditional imagist accounts, Price argued, was to imply that mental images are concepts or that they resemble concepts. On the other hand, Price defended the fundamental insight of the imagists that thought requires a symbol. The result was a theory that is an amalgam of

insights from Aristotle, Locke, and Hume with a revised analysis of the relation between concepts and images.

Like Aristotle, Price rejects the notion that universals exist as extra-mental entities independent of the mind. Since universals do not exist, it is not possible for the mind to "see" or come into direct contact with them. The theory that intellection consists of coming into contact with abstract objects and their relations directly is rationalism in the tradition of Plato and Descartes. Price calls this the Classical Theory of Thinking.

Price defends the Symbolist Theory of Thinking against the Classical. The Symbolist Theory asserts that there must be something that embodies thought, serving as its vehicle. Like Aristotle, Price holds that the only candidates for thought-vehicles are occurrent particulars in consciousness. We observe that there are no occurrent concepts; we find no introspectible mental entities that we can identify as concepts. What, then, are concepts? Price says having a concept is best described as having a set of mental and/or physical dispositions. Having the concept "dog" means that I am disposed to recognize dogs when they are present. It also means that I can employ the concept when they are not present. But in neither case, is my capacity to employ the concept the result of my mental inspection of an occurrent particular that literally is identical with the concept of

"dog." This is not to say there cannot be occurrent images that are present when we employ a concept, just that the mere presence of an image is not to be confused with the concept itself. Price describes this nicely in the following passage:

It is dogs, and not the concept Dog, that we recognize; and it is dogs, not the concept Dog, that we think of in absence. The concept is that which enables us to recognize them or to think of them, but neither in recognizing nor in thinking does it present itself to the mind as an inspectable or an introspectible entity. If we say, as I have myself, that it is 'brought to mind' on such occasions, this must not be taken to mean that we have a look at it, so to speak, but rather that it is operative in our minds (indeed psycho-physically also), being aroused from the state of latency in which it is at other times. What does present itself to the mind, and is inspectable, is in recognition a perceived particular. In thinking, even the particulars which we think of do not present themselves to the mind, still less does the concept itself. What do present themselves to the mind are the non-instantiative particulars which we think with (or 'in'), the particulars which we have been calling Symbols: either completely non-instantiative particulars such as words,

or quasi-instantiative particulars, whether mental images or other replicas. (Price, 1953, p. 277)

We can therefore understand concepts, Price suggests, as an "image-producing disposition" (Price, 1953, p. 280). Or, stating the relation between concepts and images in terms of what images are, we can say that images are occurrent mental particulars that manifest a concept. It is these mental particulars in and with which we think.

Price's use of the term "non-instantiative particulars" in the above passage needs further explanation. Price understands "instances" of a concept to be the actual objects denoted by the concept. Thus, the concept "dog" is instantiated by the millions of actual dogs in the world. The word "dog" is obviously not an instance of the concept Dog. A word, as a printed item, an utterance, or as inner speech is nothing like an actual dog. It is, however, something we can use in thinking about dogs. It is therefore a non-instantiative symbolic particular. But a mental image of a dog, according to Price, does bear a resemblance to an actual dog. For this reason, Price categorizes images as quasi-instances of concepts. Mental images, or quasi-instances, can be treated as if they were the actual things they are images of.

The reason mental images can be treated as instances is that mental images resemble not concepts, but the actual

instances of concepts, as illustrated in Figure 2-1 below. Quasi-instances, or mental images, are symbols by virtue of natural resemblance to natural objects. Both have a similar effect on the mind. "[A] dog-like image or model or picture will bring the concept to mind 'straight off' without the need of any further process of learning or habituation" (Price, p. 265).

Now, in Price's theory, although we do not inspect the mental image, the image is not just an inert appearance having nothing at all to do with the concept. As an instrument of thought, a symbol, it is also an expression of the concept, a tool not just used incidentally, but through which we think. Following the thesis of general ideas, Price believed that the expression or symbol required an appropriate form in order to be able to perform its function. In his view, the question of general ideas is a metaphysical demand. An entity of the right kind is necessary to perform this task if the Symbolist ontology is correct, and the right kind of symbolic particular for concepts is a particular whose features are general or vague enough to serve as a quasi-instance of a set of closely-related items.

In order to further support his position, Price insists that we do have introspective evidence that general ideas

exist. Mental images, he notes, can be fleeting or vague as we speak or think. Such vague or indeterminate images take

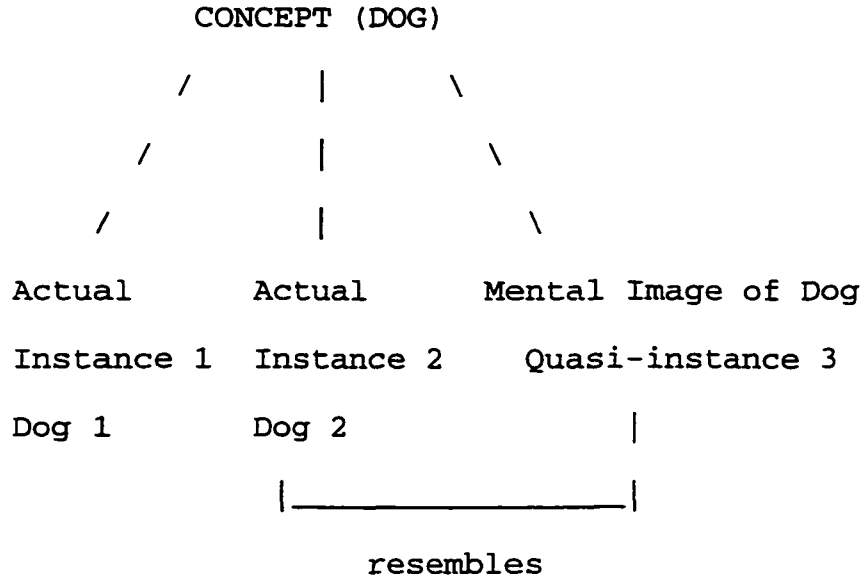


Figure 2-1. Concepts and Instances. An Actual Instance of Dog can resemble a Quasi-instance (mental image) of Dog.

place or form in the background of thought, occurring simultaneously with other mental activities in the foreground. As long as we do not focus on them, they remain inchoate instances. If we stop to "examine" them, we stop thought.

Following Hume, Price also holds that any single image, general or not, is not adequate to a concept, and this, he feels is yet another indication of the correctness of the Symbolist position. There are many cases where individual

images, whether determinate or not, would be inadequate as symbols of a class. We must be able to use other, related images as symbols or our concept would be limited to a particular quasi-instance. We know or feel that at any moment other images of the same type as the one presently serving as a symbol, examples falling under the same concept, are "present in power," as Hume said. A single, occurrent image could not have the meaning adequate to a concept; only the mind's readiness to produce others of the same type indicates that one is in full possession of a concept.

3. *Summary Remarks*

In discussing the role of mental images in thought, the philosophers we have reviewed have generally placed images at the service of metaphysical theories, rather than letting image experiences speak for themselves. Aristotle believes the body is necessary, but not sufficient, for thought, so images are necessary but not sufficient for thought. Aristotle concedes that there are many thoughts for which there are no images, but instead of explaining this through some other factor, he employs "images" again – this time, as rarefied intelligible essences – that are the result of mysterious processes. Descartes assumes the body is not necessary for thought. Therefore, images are not necessary.

These accounts have the advantage of liberating thought from the restraints of the image, but then make the presence of images in consciousness merely a consequence -- and a mysterious one at that -- of a metaphysical theory about the mind/body relation. When the Moderns attempted to bring an earthy realism to images and explain thought in terms of them, they often substituted the properties of images for what were presumed to be the properties of concepts. Since concepts must have had their origin in perception, they made mental images occurring during conception fit the requirements of their theory.

Price's theory attempts to avoid these errors, but he ends by accepting too many of the very problems and equivocations he sought to avoid. According to the Symbolist Theory, thought must be instantiated through occurrent symbolic particulars. Let this be granted. It is an additional assumption, however, that these symbols need to be in a specific form. Price's argument does not show the necessity of images, but just of expressions in general. Perhaps linguistic expressions can do all the work. Price admits (anticipating the descriptivist view) that many of the most important symbols necessary for thought (e.g., logical expressions) are entirely non-imagistic in character. Thus, Price also places the role of mental

images in the service of a presupposition about how they must function.

Price is also equivocal about the inspectability of images and their independence from concepts. He claims images are not inspected, but says a mental image will "bring the concept to mind" (see above, and Price, p. 265), as if the image itself operated as perceptual stimulus. This, of course, is the homunculus error, and it implies a visual inspection or sudden recognition of a mental image. Price, like the other imagists, is unable to avoid phrases that evoke the notion of inner inspection. There is also an equivocation in holding that the nature of mental images is that they are occurrent particulars that express or embody concepts and holding that more images are present in power. If an occurrent particular does express or embody a concept, why are others necessary? Why is there an insufficiency in a single image if the Symbolic Theory is correct? Hume noted this problem himself when he stated that particulars serving as stand-ins for general concepts served in a capacity "beyond their nature" (Hume, 1978/1740, para. 61).

D. The Legacy of Imagism

A basic presupposition of traditional imagism is that percepts are integrated visual wholes that can be stored in the mind. Although it is clear that philosophers have

distinguished between what is stored and our conscious internal images, the overall impact of this tradition leaves a rather simple story of how images work in the mind. Original visual impressions are taken in, modified as necessary, and are brought back again as mental images. These forms of internal modification range in degree according to the necessities of each metaphysical account. The modifications range from near zero (memory), to minimal modification through recombination with other images (imagination), to gross modification, such as stripping away of the inessential features (thought). Yet, in each case, the restored image maintains the property of being an image, retaining its resemblance to an original and fulfilling some function similar to the original. Since the images are like the originals our thoughts about them are similar to our thoughts about the originals.

There are fundamental problems with this basic scenario, the foremost of which is that it lends itself to a literal interpretation of inner pictures, and consequently the homunculus objection. The homunculus problem admits of only a few solutions. Among them, hopefully, is the strategy I shall use: 1) identify inner seeing as strictly a metaphor; 2) propose no ontological separation between mind and body, so that, following Aristotle, inner and outer seeing are actualizations of the same thing; and 3) do not

identify what is stored as a picture. This view will be supported in chapter 3. An alternate attack on the homunculus problem, proposed by the descriptivists, is discussed in this chapter, below.

A second problem for imagism is that it fails to correctly sort out phenomenological and conceptual distinctions. Hume and Hobbes suggested that the only difference between memory and imagination images is their intensity. They add, almost as an afterthought, that imagination also recombines images, yet as we observed, they provide no plausible explanation of how visual wholes can be combined. This kind of description simply does not address the facts of the matter. It is both a phenomenological and conceptual truth that we distinguish sharply between memory images and imagination images. Intensity has nothing to do with the phenomenological differentiation. To presume so is to rewrite the description of mental phenomena in terms of a forced analogy to physical momentum. Both memory and imagination images can be vague or sharp, intense or faint. Neither are they conceptually alike, as Aristotle wisely observed. Memory comes with the recognition that this is of some prior experience. Imagination images do not. Imagination images come with the awareness that they are only possible representations of reality or that they are decidedly false. Imagination images are active, consciously

constructed creations of the will, while memory images are for the most part automatically retrieved with no hint of creative origin. The simple ontology of the British empiricists is inadequate. Some other description of the differences among these types of imagery is required.

Finally, imagism falters when it attempts to explain thought in terms of images. It is obvious that a stream of images alone cannot constitute thought. If that were the case, then thinking would be equivalent to watching a movie that did not suggest thought about anything else, but rather formed the entire substance of thought itself. While imagist philosophers have not embraced this gross error in every particular, neither have they entirely avoided the implication that they thought something like this to be the case. Aristotle's dictum that images are necessary (though not sufficient), Locke's idea that conceptual information is conveyed by means of vague images, and Hume's idea that thought contains primarily the resurrected images of prior sensory experience all imply that mental images are the principal means through which thought is accomplished. The Strong View, then, gives over to the Moderate View, as it must. Once this happens, either we need a more complex symbol account incorporating words or another, non-symbolic (rationalist or conceptualist) view of thought. In either case, some reassessment of images is necessary.

These failings are enough to motivate the search for another account of our cognitive capacities that eliminates the problems caused by the initial assumption that images are the primary elements in perception and cognition. We shall explore how this possibility is expressed through contemporary descriptivism in the next section.

III. Descriptivism

"Descriptivism" is a broad term I shall use to designate a family of views in contemporary philosophy of mind. These views derive from linguistic/analytic philosophy since the turn of the century and have been articulated by such thinkers as Ryle, Dennett, and, to a certain extent, Wittgenstein. Historically, there was a close association between the development of descriptivism and the development of behaviorism in psychology. Currently, versions of philosophic descriptivism have been adopted by cognitive psychologists (see chapter 4). The descriptivist view discussed in this section is an amalgam of descriptivist arguments drawn from many sources. Consequently, with the possible exception of Dennett, it does not represent the view of any single philosopher. Despite being drawn from many sources, I believe it is a faithful representation of an important contemporary

perspective that has developed as a response to traditional imagism.

Descriptivism seeks to replace images as explanatory tools in the philosophy of mind with linguistic elements, linguistic structures, and linguistic practices. The goal is to show how these, rather than mental images, can be used to explain our cognitive capacities. At the minimum, descriptivism asserts that the primary work of the mind is carried out through linguistic elements; images, though they may be involved in mental functions, are entirely secondary. At the extreme, descriptivism asserts that all the capacities of the mind, from perception through abstract thought, can be explained through the work of linguistic, or proto-linguistic, elements and their interrelations.

Descriptivism relies on a set of more or less standard objections to mental imagery. Among the claims common in descriptivist accounts:

1. Visual mental imagery experiences (i.e., as the traditionalist conceives of them, as mere pictorial presentations) are epiphenomena. They are the causally-ineffective results of other cognitive processes.
2. All (or nearly all) the causally-effective cognitive processes involve descriptions. Conscious imagery processes may "feel" visual and may seem to be involved

in our cognitive processes, but that is just an illusion sustained by the imprecise way we have of talking about our experiences. Descriptive processes, some of them automatic, actually underlie imagery experiences.

3. Mental images, conceived of as the traditionalist's "pictures" in the mind, cannot exist. There is nothing that has the properties of real pictures in the mind.

What I call strong descriptivism argues for all these claims. Taken together, these claims amount to the view that in a perspicuous explanatory language of causally-effective cognitive processes, references to mental images could be eliminated. We shall examine this extreme descriptivist view, since it provides the most interesting contrast with the views we have already been exposed to. We begin our account with a review of four often-used descriptivist arguments.

A. Argument 1: No Images for Essential Concepts

A fundamental descriptivist objection is that there are many important classes of ideas for which there are evidently no images at all. This applies, first of all, to the logical connectives and quantifiers (and, or, not, some, all). Clearly, these concepts are essential to thought. Since there are no images of them, images are inessential to

formulation of sentence meanings that rely on the meaning of connectives and quantifiers. By extension, if such individual logical sentence meanings cannot be accounted for, no series of meaningful logical steps can be accounted for in terms of meanings. The result is that images will be irrelevant in logically connected reasoning processes.

Secondly, there are many perfectly meaningful words and sentences that do not seem to have mental images associated with them. Words such as "epiphany," "betrayal," or "obfuscate," although they may evoke images, certainly could not be expected to evoke even remotely similar images among different individuals. Clearly, any images they may evoke are irrelevant to understanding the meaning of the terms. A similar analysis applies to a sentence like, "the average tax rate has changed disproportionately to consumer spending." Since such sentences form a considerable part of all discourses in abstract reasoning, true thought images are evidently very much in the background, rather than the foreground of thought.

The assumption that images are necessary, or ought to be present in consciousness, descriptivists argue, is just an ad hoc assumption made in order to bolster the idea that something, derived with a minimum of alteration from raw sensory input, is responsible for our ability to reason using universal terms. If we simply dispense with the

assumption that the form of our thinking must follow a picture-like derivative of sensation, we can view the matter another way. We can look for clues to the substance of thought in linguistic practices and logic rather than visual perception.

B. Argument 2: No Content

What is the meaning or content of an image? Is it obvious or "given," something we may know without learning or the necessity of language? The assumption that images have intrinsic or pre-linguistic meaning seems to lie behind the uses to which images have been put in imagist ontologies of the mental. Price and Hume, for example, seem to assume that if we have a mental image of a chair, we know the image means "chair," rather than "example of furniture."

Descriptivists argue against the notion that images have any intrinsic or "obvious" content. Consider the mental image I would have of Tim or Tom, the identical twins. My images of the two are identical, but when I think of one rather than the other, I surely intend that my image, if it has any function at all for me, be understood as representing only one of them. If the images qua visual or imaginary presentations do not differ, what makes the difference in meaning possible? We must conclude that something other than visual properties of an image

determines whatever meaning it has. At root, descriptivists point out, we are forced to admit every sort of image is fundamentally ambiguous, for in and of itself an image depicts or designates nothing specific at all.

Only some context can bring meaning to an image. Descriptivists argue that this context is supplied by linguistic elements and the patterns of use that grow up around them. At a minimum, an image needs to be verbally labeled, as it were, in order to signify anything at all. Without such a designation, images are meaningless. As Wittgenstein remarked, not even God could tell the meaning of a mental image.

C. Argument 3: The Language Trap

This objection holds that we do not in fact refer to any mental object when we speak of mental images. Instead, we refer to concrete, observable patterns of human speech and action. Descriptivists of this school claim that an analysis of language will show that we refer to mental images as a way of indicating that we can pretend, suppose, hypothesize or imagine that something is the case. All of these occur in ways that are publicly manifested in actions and habits of speech.

What we are really doing when we use terms that imply the literal existence of mental images is to employ certain

modes of intersubjective communication that indicate our knowledge of human capacities. Although we seem to refer to mental images, this is in fact a replacement or metaphor for more complicated sentences that would explain our expectations and interpretations of the current state of affairs in other terms. For example, to say the artist has a mental image of David in the stone, is a replacement or metaphor for our belief that the artist is capable of carving the stone in the shape of David. These capabilities can ultimately be made directly observable. Such references do not actually refer to inwardly seen and completely private mental objects. To actually refer to private mental entities would be pointless in a world where the meanings of words are established by observable human practices.

The reason that we have lost sight of the metaphorical aspects of talk about mental imagery is that we have been fooled by our habits of language. We become victims of the casual use of language when we begin to believe that the words we use to communicate actually pick out incorrigibly private items that exist in some mental space. Since linguistic forms of communication ultimately rely on common agreement of objective reality, there can be no place for any meanings that are attached to distinctively private mental objects. If we actually assumed that all such mental states were intrinsically private, with no possible

manifestation of public behavior, language would be impossible. The fact that we have a public language about the mental realm, then, does not prove its existence as a separate and inaccessible place filled with special sorts of objects such as mental images. It actually proves the opposite, that all suppositions of a private mental world and its content can ultimately be dispensed with.

D. Argument 4: Wrong Properties

This argument asserts that mental images lack the proper characteristics to be accepted into the class of true, proper, or actual images. Actual images are located in space and time, have specifiable parts, specific relations among those parts, and determinate sensible features such as size, color, and shape. This applies to all actual images, whether schematic line drawings or minutely detailed full-color photographs. Since mental images have none of these properties, they do not count as images at all.

Dennett has made extensive use of this form of objection, often combining it with related objections. It will be useful to review some of his arguments here, since together they result in a comprehensive, strong eliminativist view.

Dennett (1969) makes a distinction between the sub-personal or scientific account of images and the personal (conscious or phenomenological) account of images. In neither of these accounts, Dennett claims, do proper images intractably appear.

From the sub-personal perspective, Dennett argues, mental images are obviously not what he calls "proper," or actual, images at all. There are images on the retina of the eye, but this is the last point in the neurophysiological process which transforms light impulses into vision at which there can be said to be an image. The subsequent neural firings along the optic nerve, continuing to other portions of the brain which are responsible for seeing or imagining, have nothing in common with proper images.

A variation of this objection is Dennett's version of the homunculus argument. Dennett argues that in order for something to function as an image, it must be perceived. Images cannot, therefore, be the product of the process of perception; they can only be things that exist independently of us -- things we can literally see. If the perceptual process literally produced images, these would be images of things in the mind, and it would be those images that we would inwardly see and not the external things themselves. And, so the argument goes, since the internal images need to

be literally seen in order to be recognized, there would have to be an internal agent, a man-analogue or homunculus, that could look at the images in order for recognition to occur. But this man-analogue could not perceive any images unless it too had an internal homunculus that could perceive internal images. We have the beginning of an infinite regress. The point of the argument is that we cannot introduce a new, intermediary entity into perception and call it (the intermediary) the object of perception without losing the essential idea of what it means to perceive: for the subject to see, directly, the object of perception.

The defender of images will reply that if proper images cannot be said to exist in the mind from the sub-personal, or scientific standpoint, there is surely an intractable sense in which they must be granted to exist at the personal, or phenomenological, level. So much of our personal experience is structured by images, it seems ludicrous not to grant them existence. Dennett dispatches images from this arena by arguing for what he calls the "descriptive view of awareness." He argues that seeing and imaging actually involve descriptive rather than imagery-based processes. This, he claims, can be demonstrated by examples. If we imagine a man, we have no need to imagine any specific details about the man. A mental image may specify particular features, such as hair

color, but it need not. Mental images are not like actual pictures that must, in virtue of their being pictures, show such details. Mental images are more like descriptions in that we can specify as many details as we want, but the failure to do so does not change their basic character. Imagining, then, is actually the process of providing ourselves with descriptions, rather than images.

The illusion that there are mental images to be inwardly seen or inspected occurs because the process of creating these descriptions is often automatic. As quickly as we imagine something, we provide an inward description, automatically, that provides that actual content to our imagining. The so-called "image" does nothing at all, because it is actually a form of inner description. The same account of automatic descriptions extends to perception. Dennett says, "seeing is rather like reading a novel at breakneck speed" (Dennett, 1969, p. 57). There is an illusion of visual content, but the actual content of perception is conceptually ordered in the manner of language. Dennett concludes that mental images we experience have none of the properties of actual pictures or images. The actual modes of our thinking and perceiving at the personal level can be accounted for through descriptions.

As a final argument against the existence of images in the mind, Dennett gives his own view on the issue of whether mental images must consist of determinate parts in specific relations or can also be vague or indeterminate. (We have already seen that the same issue has been at stake at least since the time of Locke). Dennett argues that we know from direct experience that a mental image is vague and lacking in distinct, numerable parts. Dennett's example is the mental image of a tiger. How many stripes does it have? Dennett claims there is no answer to this question because a mental image of this type is inherently indefinite. No specific number of stripes is represented. Since this "mental image" fails to meet one of the criteria for being an image, it is not a proper image at all.

Dennett concludes that since mental images have none of the required properties, they are not images in the proper sense at all. Mental images, by this criterion, cannot be said to exist. Dennett leaves open only one remote possibility for the "existence" of mental images. If there are mental objects that behave as if they had the properties of proper images, then there may be said to be functional images in the mind. This is the contemporary imagist view defended by Kosslyn, the subject of another chapter.

E. The Legacy of Descriptivist Arguments

Objections 1 and 2 make valid points. As some imagists (e.g., Price) have themselves observed, there are indeed no images for the logical connectives necessary for deductive thought and the synthesis of concepts. It is also true that images, considered as mere visual presentations, have no intentional content.⁶ Traditional imagists did, in fact, seem to assume that mental images could derive intentional content by means of visual similarity to perceptual objects that already have a self-evident meaning. Descriptivists are right to point out that there is no such thing as an image with a self-evident meaning, much less any string of images that could itself carry a meaningful thought.

Arguments 3 and 4 are far less convincing. Accounts based on these arguments place one at odds with the form of our conscious experiences. No one, I submit, experiences seeing as high-speed reading. If some analog to high-speed reading is what is actually occurring as an unconscious process, and this is invoked as an explanation of seeing, it places our whole relation to the external world on another footing, because language, not the operation of the senses,

⁶ This is not to admit that descriptivists are correct in implying, as they often do, that mental images have no content. Mental images do present qualitative content, a point taken up in the following chapter.

will ultimately structure our access to the world. In any event, the descriptivist account does not capture the nature of the conscious awareness of seeing, and, as a result, it does not address the nature of either visual memory or visual imagination. Seeing is ineffable; the experiential quality of it cannot be explained or described to a blind person. Seeing means being conscious of a unified, non-verbal, presentational whole with visually inspectable features. If, as seems self evident, visual memory and imagination are similar forms of conscious awareness that involve an ineffable visual component, some further development of the characteristics of the images involved is necessary.

Besides its objection to images, descriptivism is apparently also aimed at eliminating the notion that there is private, or exclusively mental, access to the elements of thought. Descriptivists argue we cannot make up, as it were, what the elements of thought will be. As Wittgenstein argued, one cannot inwardly say one word and inwardly mean another. I find that this argument also fails to do justice to the imagist perspective. There is, undoubtedly, a confusion in the imagist perspective between the elements of thought and the means of thought. These sometimes appear to be equated. The descriptivist argument applies against construing images as the elements of thought, but it does

not address the sense in which images serve as a means. As a means to thought, images can be suggestive, rather than definitive. We can hold in mind one image that serves as a symbol of a meaning that itself has no definitive symbol. The image of a lion can be used in thinking of the class of lions, but also for the class of animals, for which there is no image.

The descriptivist argument even fails to do justice to the indefinite nature of linguistic symbols. Sentences like "I am going to the bank" have an indefinite meaning (river bank vs. financial institution). The mere occurrence of the symbol element "bank" does not define the meaning of the sentence, whether it is uttered in public or is an "inner utterance." In fact, according to the common man's view, failure in communication between interlocutors is often due to them not having the same mental image in mind when a given word is spoken. It would be the corresponding mental image of the intended kind of bank that would remove the ambiguity of such a sentence.

The descriptivist arguments provide some correctives to the imagist theory, but they hardly provide the basis for a convincing alternative theory based on common sense. The privacy of mental images is not a reason to suppose they do not exist, only that they cannot become the entire basis for shared conventions of meaningful communication. This is

already a point conceded in the Moderate Imagist View. The descriptivist arguments assume that having descriptive information and having visual information amount to the same thing. This is surely false. Any list of facts about Fred and Sam is no substitute for seeing Fred and Sam.

Descriptivists who equate seeing with high-speed description formation try to make experience conform to a theory.

Finally, while imagism falters in explaining thought, descriptivism falters in explaining the presence of images in the lower powers of memory and imagination. If all the information taken in during perception were really descriptional, there would be no reason for it to "reappear" as an image in memory or imagination. Even if the need for the reappearance of the image could be established, the generative process of image construction would require still further explanation. The descriptivist would be forced to provide an elaborate set of rules by which descriptions can be transformed into images (a problem for Pylyshyn and Kosslyn, as discussed in chapters 4 and 5). Either, then, the descriptional view of perception is wrong, or descriptions become transformed into images in memory and imagination for no apparent reason.

IV. Psychology and Mental Images

A. The Questions for Psychology

In the nineteenth century, new developments in neurology, medicine, and physics laid the foundations for understanding psychology as a science separate from philosophy. Part of this new science was speculative, but it was also bound by a new paradigm of science that demanded the use of experimental data even in those matters that had traditionally been thought to be strictly metaphysical or religious in nature. The rapid development of the physical sciences during this period led many philosophers and psychologists to hope that the nature of mental processes could be illuminated by empirical, rather than speculative or metaphysical, methods. It is therefore reasonable to understand our guiding question about the nature of mental images for psychology to be a variation on the original. We want to know if psychology can answer this question:

Is there an empirical means for studying the nature and role of mental images?

This question cannot be answered by a simple "yes" or "no," for it spawns innumerable other questions. Does the empirical method include introspection or only the gross behavior of subjects? Does the gross behavior of subjects include verbal reports of their imagery experiences or only other sorts of bodily movements? Finally, what is the

scientific archetype for psychology and how do mental images fit into this archetype? Is psychology an offshoot of philosophy, a "soft" science incorporating irretrievably metaphysical assumptions, or is it a separate, "hard" empirical science like physics? How do these scientific paradigms affect the way in which psychic phenomena such as mental images are understood to be a part of empirical psychology?

The history of psychology has been marked by many sudden turns, often due to the new answers given to these questions. Each set of answers has, in turn, spawned whole new experimental and theoretical perspectives. In each case, the conception of mental imagery has been of crucial importance to defining these various strains of psychology. As several writers have observed, (Holt, 1964, Yuille, 1983) one can almost identify the history of psychology as a history of perspectives on mental images.

I have divided the history of psychology into eras that roughly parallel a series of dominating positions on the study of mental imagery. These are:

1. Foundational Period: 1860-1901
2. First Imagery Debate: 1901-1913
3. Behaviorism: 1913-1964
4. Reemergence of the Image: 1964-Present

Let us briefly review how these questions have been addressed during the periods I have identified.

B. Foundational Period: 1860-1901

During this period introspection and the study of mental images as conscious, psychical states were accepted as integral parts of psychology. Wundt's Human and Animal Psychology, first published in Germany in 1862, is considered to be one of the foundational works of this period. While Wundt's work does not completely define this period, it is indicative of a perspective that finds psychology to be a self-consciously new science, aware of its philosophical heritage and unsure, even skeptical, of its destiny as an empirical science. Wundt's philosophy of psychology is exceptionally interesting in light of the contemporary issues we shall discuss in the following chapters, so it will be useful to clarify some central themes of his position.

Wundt is sometimes caricatured in the history of psychology as a staunch defender of the infallibility of the introspective method. This has the implication that Wundt was little more than an arm-chair philosopher who accepted the Cartesian supposition that the contents of the mind are infallibly given by introspection. In fact, Wundt held that introspection systematically fails to capture the complete

contents of consciousness. This is because introspection relies on memory. Introspection is not instantaneous; the moment of conscious awareness passes before introspection can be completed. When attempting to introspect, one asks, "what was the content of consciousness?" -- but the answer to this is already contaminated by the contents of the present moment. We do not know how much of the prior content may have been filled in, extrapolated, or deleted during the course of subsequent moments (see Wundt, 1862/1912, p. 240).

Since introspection is not inherently reliable, Wundt concluded that experiment would be a necessary adjunct to psychology. Wundt illustrated this with an example. Suppose we ask the general question, how many ideas are present in consciousness at one time? Introspection or the collection of data in the form of subject reports might suggest any number of answers, from "one," to "several, perhaps, two or three," to "an unspecified number, perhaps, dozens, or hundreds." Wundt resolved to use an empirical test to assist in answering this question. Wundt describes an experiment in which subjects are exposed to random letters for a fraction of a second. Subjects can recall 4 or 5 letters presented in this fashion. If the letters are made into disyllabic words, two words of 6 letters each may be recognized in the same amount of time (p. 243). If more

letters than can be retained are presented, Wundt found his subjects were aware that these additional letters were present even if the subjects could not recall what they were. The experiment does not give a definitive answer to the number of ideas that may be the momentary contents of consciousness; it simply provides an indication of an answer that is more definitive than idle speculation based solely on introspection.

On the other hand, Wundt did not hold introspection to be permanently and unretrievably in error. He thought that experimental conditions would, in many cases, allow the subjects to focus their awareness, so that their introspective reports would be a fair, if not 100 percent accurate, approximation of mental events.

Here, as everywhere, psychological experiment does not dispense with introspection, but, on the contrary, renders introspection possible by furnishing the conditions which it requires for exact observation. (p. 241)

This conviction derives (in part) from Wundt's philosophic view that ideas are ever-changing processes, rather than permanent objects stored in the mind. Wundt does not conclude that because we have set up an experiment to measure experimental "things" we call "ideas" that we have actually measured the properties of these things or that

these postulated entities actually exist in precisely the manner that allows their precise experimental measurement. On the contrary, Wundt concludes only that we can measure something about conscious experience, but this measurement is not definitive. To complete the account we also have to rely on introspection. Thus, Wundt's philosophy of psychology advocates a synthesis of experimental and introspective evidence, in which neither is given absolute preference.

This integrated view of the subject matter of psychology places a limit on the precision of psychology, because it does not allow for an absolute division between the psychic and the physical events which constitute the entirety of the behavior induced by an experimental situation. The context of the experimental task always influences the subject. This holds for even the simplest of all measurements of psycho-physical phenomena: reaction times to sensory stimuli. In such experiments, a visual, auditory, or other stimulus is presented to the subject, and the subject responds by pressing a button. Wundt claims that even here the mental realm, specifically the impulse of the will and effect of subjective anticipation, intrude into the explanation of what occurs within the subject. Wundt describes the process of reacting to a stimulus as follows:

In the first place, physiological processes occupying a certain period of time enter into the total movement-process under consideration. The impression of the star upon the meridian thread [the sense impression referred to in the experiment under discussion] must be conducted to the brain, must arouse an excitation there; and then, before the hand-movement can take place, the impulse of will must be conveyed to the muscles, and these stimulated to contract. To these two purely physiological processes must be added the psychological or psychophysical process of apperception of the impression and impulse of the will. (p. 274)

Wundt discovered that the subject's anticipation of a stimulus could be either concentrated on the muscular movement or on the stimulus itself. As a result, the objective measurements may vary significantly, even within the same subject. In Wundt's view, there is no primitive, absolutely mechanical account for reaction time that can be reflected in an external measurement.

It [reaction-time] is made up, as we have seen, of purely physiological and of psychological processes; and we cannot separate the two, or ascertain with even conjectural probability the time-value of the mental component. (p. 275)

And the association of these constituents

[physiological and psychological] is so difficult of analysis that no conclusion can be drawn regarding the duration of the mental terms of the series. (p. 278)

This traditional view allows only a limited empirical means for studying psychic phenomena. As we shall see, this view about the nature of empirical measurements stands in sharp contrast to that adopted by contemporary imagists.

C. First Imagery Debate: 1901-1913

The first imagery debate started in Germany and involved Wundt at Leipzig and various experimentalists at Wurtzburg. The experimentalists wanted to confirm or disconfirm the presence of imagery in thought. This experimental attempt can be understood as the empirical psychologist's approach to solving the philosophic question of the necessity of imagery in thought. The debate became known as the "imageless thought controversy."

The Wurtzburg experiments involved specific tasks given to subjects in a laboratory environment. The first series of tasks tested by Wurtzburg psychologists between 1901 and 1907 were rather simple. These tasks included several word association tasks (one in which subjects were asked to name a subordinate or superordinate category to a presented word) and a kinesthetic task in which subjects were asked to judge

which of two weights was heavier. Subjects were asked to report the nature of their conscious experiences. It was found that in many cases, though not all, subjects were able to perform the tasks without being able to report any awareness of conscious elements such as imagery.

A second series of experiments involved more complicated tasks, including problems in logic. These tasks required knowledge of a rule of inference. Again, subjects reported some imagery, but the imagery seemed unnecessary to performing the task. The experiments showed it was possible to be aware of a rule or be conscious of a relation without there being any concrete conscious content (visual image, aural image, or other sensory-derived presentation) that embodied or signified the rule or relation. This is not to say that subjects were utterly unconscious of their mental states, but that these mental states could only be indefinitely described as a kind of general awareness. One could, for example, be aware that a problem could be solved by a rule involving logical steps, without consciously being aware of the steps. It appeared that thinking, or at least some tasks that may be presumed to involve mental processes, could be done without any concrete conscious elements that were available to introspection. Thus, the Wurtzburg school concluded that imageless thought does occur.

Wundt responded to these experiments by arguing that they did not allow proper introspection. The subjects were asked to be aware of their conscious contents (introspect) at the same time that they were asked to perform the task. This was impossible, Wundt claimed, because the attempt to maintain attention on conscious content interfered with the performance of the task. Introspection only reveals the contents of consciousness after the fact, not simultaneously with attention. Thus, the experiments actually measured the effects of attention demands, rather than the actual contents of consciousness.

The first imagery debate assumed that images or at least mental contents were, at least partially, subject to empirical investigation. The only question was how this was to be accomplished. As the debate continued, neither side of the debate was able to gain a decisive victory. This led to a sense of dissatisfaction with the methods of empirical psychology and the limits of its claims. Eventually, it led to the adoption of a new scientific paradigm -- behaviorism.

D. Behaviorism: 1913 - 1964

The essentials of strict behaviorism are given in J. B. Watson's 1913 article, "Psychology as the Behaviorist Views it." In this article, Watson proclaimed that the introspective method, however it was to be understood, was

worthless as a scientific endeavor. He objected that introspective methods either produced no results that could be duplicated or, as in the case of the Wurtzburg controversy, had simply resulted in a disagreement about whether subjects did, or even could, introspect properly. In effect, psychologists blamed the subjects in their experiments when the results failed to conform to their theories. Watson concluded that the failure to produce unequivocal results through introspection was due not to a failure to sufficiently refine the technique of introspection, but due to the fact that the entire approach to psychology had to be changed if it was to succeed as a science.

Watson argued that a properly controlled scientific investigation should be like physics, having no place for subjective terms. Psychology, he claimed, must "never use the terms consciousness, mental states, mind, content, introspectively verifiable, imagery and the like" (Watson (1913), in Shipley, p. 808). Watson argued that terms like "sensation" or "mental image" had no definition in the scientific sense. In place of these terms, only stimulus, response, habit formation, and similar terms relating to the gross physical movements of subjects were to be integrated into psychology. Human psychology and animal psychology should be done in precisely the same way; neither should

allow non-observable states of consciousness to enter into the explanatory and descriptive framework of the science.

As to the causes of behavior, Watson held it was pointless to specify unobserved sensations or mental images as causes of behavior. This would amount to admitting unnecessary metaphysical postulates into a science that should be based only on what is observable. Although Wundt and others had already called for the elimination of metaphysical hypotheses from psychology (and presumed that they had already done so), Watson felt there was simply no way to introduce terms derived from the concept of consciousness without falling back into the muddy waters of dualist forms of explanation. The parallelism that was popular at the time was no escape. When it came to explaining behavior, the parallelists had no choice but to propose some mental cause of the physical behavior. They would then have to explain the mechanism of the mind/body interaction -- which inevitably, Watson argued, simply reverted to dualism again.

Watson concluded that the way to purify psychology of metaphysics was to completely eliminate the idea of unseen, or mental, causes altogether. He argued that the salient variables for psychology are only the environment and the organism's responses, and the predictions of future behavior must be made taking only these variables into account,

without reference to unobserved mental processes or states. The task of psychology was just to develop a set of functions that interrelate environmental stimuli with physical responses. Ultimately, Watson suggested, these functional relations would be correlated not to mysterious mental correlates, but to explanations in terms of a physiochemical causal change originating in the environment and terminating in some bodily behavior (Watson, 1913, in Shipley, p. 820).

E. Reemergence of the Image: 1964-Present

As behaviorism developed, the strict version was gradually abandoned. More attention was paid to subject reports and experimental standards began to allow a wider range of phenomena as data. In addition, experiments with psychotropic drugs, sensory deprivation, imagery therapy and related areas all gave impetus to including imagery within psychology once again. Equally important, physiological studies began to corroborate psychological theories with findings that indicate shared structures in the brain for perception, visual imagination, and memory. In a famous experiment, Penfield was able to induce detailed recall of aural and visual memory images by stimulating parts of the brain (Penfield, 1955).

Holt's 1964 article "Imagery: the Return of the Ostracized" is a convenient historical marker for the beginning of psychology's self-realization that once again the role of the image was about to mark a turning point in the history of psychology. Holt thought the next pro-image reaction to behaviorism would be to make images part of computational psychology, which was just emerging at the time. After Holt's article, there were, in fact, two significant counter movements to behaviorism. The philosophic fallout from both of these movements form a substantial part of the subject matter of the next three chapters, so we shall simply review their essentials here.

1. *Revised Traditional Imagism*

The first school to reject behaviorism reasserted the traditional notions that psychology is the study of conscious contents. Although there were a number of clinical studies before this, I mark the beginning of this era with the publication of Richardson's Mental Imagery in 1969. This work reasserts the traditional understanding of mental images as distinctively conscious experiences, rather than forms of response to the environment, linguistic artifacts, or unconscious computations. Richardson's work accepts experiences rather than the descriptive phrases or overt behavior of subjects as the most important aspect of

mental imagery. Overt behavior is not excluded from study as an effect of mental imagery, but is not to be confused with mental imagery itself.

Like the traditionalists, Richardson did not think psychology could be made into a precise science on the order of physics or computer science. Subjective reports could be correlated with the objective conditions surrounding them, but a set of precisely quantified, universally applicable attributes for imagery experiences was an unlikely prospect. Thus, in the manner of Wundt, the "measurement" of imagery amounted to suggesting to subjects how to introspect and in recording their responses to these instructions.

Richardson also revived another aspect of imagery studies that had been lost. Fechner (1860) had listed many types of mental images and the characteristics of each. Richardson suggested that these types can be, to a certain extent, quantified and cataloged, determined by a combination of subjective and objective conditions associated with each type. Richardson suggested a division of imagery into four basic types: after-images, eidetic images, memory images, and imagination images. Subjectively, the types differ in degree of vividness and degree of autonomy, or independence from control by the subject. Objectively, they differ in the preceding and antecedent conditions of their occurrence. One of the

principal tasks of psychology, in Richardson's view, is to find correlations between measurements for various types of imagery and other psychological variables. The degree of vividness of various imagery types, for instance, could be correlated with efficiency in memory tasks, sports performance, efficaciousness of psychotherapeutic exercises, problem-solving abilities, and numerous other variables of interest. This empirically-based division of psychological imagery types is the basis for the intentional types of imagery I explore in chapter 3.

2. The Contemporary Imagery Debate

Richardson's work was quickly overshadowed by the rapid development of the second reaction to behaviorism: cognitive psychology. Holt saw tremendous promise for this new, computational model of psychology. He thought that previous psychology, although it might serve to establish the presence of images or the lack of them, did not provide a meaningful explanation of how the mind was able to perform certain tasks. Under the new model, unconscious computational processes can become explanations where conscious contents failed.

The important point about this new approach to the psychology of thinking is that it is no longer necessary to assume that thought processes are

identical with what can be reported by the thinker as his conscious contents, whether imageless or not.

(Holt, 1964, p. 260)

Holt thought that the "subjective world of images and the like" could now be found to be "a legitimate output of a theoretically constructed psychic apparatus," allowing psychology to give us "something of a look inside the famous black box" (Holt, 1964, p. 263).

The hope that computational models would prove to be far more explanatory than any possible traditional approach received a major impetus in 1971, when one of the most influential experiments in contemporary psychology was published by Shepard and Metzler. This experiment purported to show that some combination of computational "hardware" and "software" in the brain handled image rotation problems and was constrained to a certain innate speed.

This experiment spawned a whole new industry of experiments in cognitive psychology. The result was a new debate about the validity of the experiments and the necessary constraints for the new paradigm in psychology. The debate continued at an intense pitch throughout the 1970's and 80's. Although Kosslyn pronounced the principal aspects of the debate "over" in 1994, the basic issues have not been resolved within contemporary psychology.

The debate concerns two views about how the new paradigm in cognitive psychology applies to imagery. Since these are the subject of chapters 4 and 5, I provide only a brief indication of them here. The views are:

1. Pylyshyn's view: Mental images are epiphenomena.

They are caused by cognitive operations that cannot involve, as a matter principle, images.

2. Kosslyn's view: Mental images are not epiphenomenal.

They are functional parts of the mind caused by cognitive operations that bear image-like qualities.

Pylyshyn's view is a defense of hard-nosed cognitive science, which adheres strictly to the principles of computationalism and the strong AI hypothesis. It is the psychologic parallel of philosophic descriptivism.

Kosslyn's view is an attempt at a compromise position between a traditionalist view that images are part of psychology and the computationalist view that all cognitive operations must be compatible with principles of computer science.

V. Summary: Remaining Problems for Mental Imagery

We have examined proposed explanations to the puzzles encountered in historical accounts of mental imagery from both the imagist and the descriptivist perspectives.

Imagist accounts of memory images as stored pictures can

result in the homunculus problem. The imagist tradition of imagination and thought imagery does not explain the creative power of the imagination and creates a confusing picture of the relevance of mental images in thought. The Strong Imagist View, that thought is identical with having mental images, must be abandoned in favor of a Moderate Imagist View, which includes images among verbal symbols as vehicles of thought. The unsettled state of affairs with traditional imagism prompted us to examine the descriptivist school. Descriptivist arguments demonstrate that the images, as pure pictorial data, cannot be the carriers of meaning nor is it correct to speak of them as if they had the physical properties of actual images. Descriptivism solves the homunculus problem by insisting that "visual" mental images are not actually visual. There is no inner visual scrutiny of mental images as there would be if mental images were like actual external stimuli. While we agreed that meaning cannot be intrinsic to a picture, we found that descriptivism gives us a distorted picture of the world we experience. It solves the homunculus problem at the expense of understanding what it is like to see. Like imagism, descriptivism builds a story of mental contents from the ground up, starting in perception and ending in thought using a single metaphysical archetype.

The question of the place of images in the science of psychology at first appeared to be a different and ancillary question. Our review of the history of psychology from the standpoint of the fate of mental images revealed that psychology suffers from a similar problem in finding a definition for mental images -- swinging back and forth between common sense and eliminativist views with no resolution. Any contemporary philosophy of mental images, however, should not dismiss psychology for its failure to resolve the issue any more than it should dismiss its own history. It remains to be seen if psychology can offer meaningful perspectives and meaningful empirical data for philosophers.

The arguments we have examined so far suggest that mental images are neither just pictures nor just descriptions. Perhaps a compromise view in which mental images are understood to incorporate features of both images and descriptions is possible. I examine this possibility in the next chapter.

CHAPTER 3

THE NATURE OF MENTAL IMAGES

I. Introduction

I suggest that many of the difficulties in mental imagery accounts come from overlooking or misconceiving some fundamental features of mental images. One overlooked feature is that mental images have important similarities to public, visible images. One misconception is that mental images are pure visual data or unidentified "pictures." In fact, an analysis of imagery experiences shows that images are "objects" that have intentional depth. Many images are more like topics, exemplars, or designated symbols than pictures. Another overlooked feature of mental images is that, according to traditional psychology, they fall into a set of fairly well-defined types. These types may be categorized according to a variety of established psychological parameters, including apparent location in space, degree of conscious control, and type of conceptual content. The most important feature of mental images is that they involve conscious states. As a consequence, their description depends upon how we understand consciousness and

its objects. In this chapter I attempt to see how these and other features may be brought together in order to form a descriptive account of the nature of mental images.

I argue that the common sense view, that mental images are indeed real and have meaning, turns out to be substantially correct once it is amended by philosophic distinctions. I follow many insights brought to bear on the nature of mental images by traditional psychology and philosophers such as Aristotle, Brentano, Moore, Ducasse and Jackson. Some metaphysical issues are left unresolved, but I attempt to find what is involved in formulating the various alternatives at hand.

II. Preliminaries to the Study of Mental Imagery

A. The Visible Realm: Things, Images, and Symbols

Much of the confusion in the history of mental images is due to failure to make clear the similarities and differences between the contents of, and the human activities appropriate to, two realms: the visible realm and the mental realm. Imagists have made a close comparison between these two realms. They find images, objects, and percepts in both. Descriptivists find no images or image-like objects in common to the two realms. They reserve the concepts of perception and its derivatives for use in the visible realm.

Visible things are obviously among the things we encounter and interact with in the real world. If we want to understand how mental life is manifested in publicly-observable ways, we need to examine the kinds of visible things there are, their properties, how they may affect us, and how we may use them.

Visible, that is, publicly observable, things include a wide class of phenomena. First, this class includes solid physical objects, such as cars and stones. These are unified physical objects with determinate properties such as size, apparent color, shape, texture, and location in space. They are also visually inspectable objects, for although we see them as unified objects, we can also identify visually separate parts, or features, of these objects. Second, the class of visible things includes physical objects that do not have a determinate color, shape, size, or texture, and may only have an approximate or inexact location in space (e.g., transparent objects, mirrors, clouds). Such objects are also visually inspectable, if less precisely so. A cloud, for example, may have an area of greater translucency on the left part, a deep shadow on the bottom, and so on. Finally, the class of visible things also includes items that have no actual location in space, but only appear to have a location in space, such as rainbows or holographic projections. Visible things, then, are most broadly

identified as things of which we can form unified percepts and that have at least an apparent location in space. They may be either determinate or indeterminate with regard to other visibly-inspectable properties, such as color, shape, size, number of parts, or visibly distinguishable regions.

Publicly observable, visible images are a sub-class of visible things, and share some of the properties of visible things. Virtually any visible thing may be deemed to be an image, or visual likeness, of something. We need not limit images to photographs or drawings. A paper cutout, a cloud, or even the random discolorations of an old bit of cloth are equally capable of being interpreted as a visible image, or likeness of something. A visible image need not be any more or any less determinate in its physical properties than a visible thing. Like visible things, public images can also be inspected. They may have distinct visible parts or features to the same degree that any visible thing has these. Finally, like other visible things, images can obviously affect us. Our reaction to seeing the image of a person, place, or thing, can be as powerful as actually encountering the person, place, or thing.

Visible images differ from mere visible things not by any specific physical characteristic, but entirely by the fact that some things are deemed to have enough visible similarity to other things to be accepted as images of other

things. Although we sometimes speak of seeing an image as a way of implying that what we see is either vague or not really a physical object, but only an illusion, this is not the primary dictionary meaning of "image." To be an image in the primary sense, and, so far as we shall be concerned in this discussion, the proper philosophic sense, is to be an image of something. Hence, rainbows are not images; they are not likenesses of anything else.

Visual similarity cannot be defined by any strict set of requirements. The reason for this is that it is in part driven by context. Both a life-size photograph of Clinton and a quick sketch of his profile on a slip of paper may be counted as images of Clinton. The photograph is likely to be universally recognized as an image. The quick sketch, while it might not be recognized as an image of Clinton if it is mixed with the trash in an alley, will almost surely be accepted as an image of Clinton if it is hanging on a wall in the White House. While some degree of visual similarity remains a requirement for something to be called a proper image of something else, verisimilitude becomes secondary to the requirement that there is some context in which an observable thing is understood as a visual reference to some other thing.

The human ability to shift from seeing something as merely a visible thing to seeing it as an image, is a

circumstance woven into the fabric of the visible realm. It is due to the existence of intelligent, conscious agents capable of intentional shifts. When a slip of paper is moved from an alley to the White House, and in the process becomes an image, the physical properties of the image do not change. Rather, we have changed; we have shifted our inner perspective on the identical physical item. Another example: consider a visible vertical line.

|

This might be considered just a dark mark on a white background, a visible object only -- an image of nothing at all. But it might, if one were to creatively reflect on it, be considered a reasonable likeness of something: say, a fence post in the snow, seen at a great distance.

Apparently, the only thing changed when a visible thing becomes an image is the subject's intentional state -- how the subject understands or creates a meaning for something it considers. Such changes occur within individual minds, but images need not remain private. Public images exist as part of our real world -- part of the visible realm -- not just as part of private mental worlds. The world of the shared conventions of human agents, whether linguistic or visual, is both a public reality and part of individual mental realms. Public images and the intentional shifts that create them are just as much a part of shared reality

as language elements and linguistic conventions. We communicate through public images, we react to them, we use them, understand them, and interpret them, just as we do linguistic signs. The conventions that apply to our interactions with and communication through images evidently differ from those of language -- arguing how and why this is true is a philosophic difficulty -- but this should not block us from accepting the fact that public images play a significant part in our mental life.

Intentional shifts also enter the account we must give for a related phenomenon that is part of the visible realm: the existence of symbols. Suppose now that the vertical mark above is to be understood as a symbol of a fencepost. Again, nothing changes in the thing; only our attitude toward it -- what the visual appearance is understood as -- changes. This is an entirely new intentional attitude because now visual similarity is irrelevant. I might as well have designated this mark as a symbol of a man, a car, or even something that has no visible appearance, such as the number one. Our apprehension of what a symbol means does not require any visual resemblance.

I understand the possibility of the shifts from visible thing to image and from image to symbol, as well as the reverse of these same shifts, as a datum of the human world.

thing <-----> image <-----> symbol

That these shifts exist within the context of the visible realm, that their existence and use is accepted as part of the common-sense view of the world, I see as unquestionable. Why and how they exist, the philosophic problems, come after this starting point.

We need to consider one such philosophic problem before closing this review of things in the visible realm. This is the problem of how to describe the manner of the existence of public images. I shall adopt the position that images are best described as relative beings. The reason for this is straightforward. Public images are real, but are relative beings because they owe their existence qua images to the existence of other things. This is true of anything (e.g., also symbols) that are representations of other things. Existing as a representation can be signified formulaically.¹ When we say

X represents Y to Z,

and X is an image, Y the object it represents, and Z a conscious agent, we express the fact that representation is a triadic relation, and X is in relation to both Y and Z. If one of the terms is removed from the relation we are no longer speaking of the same thing. This itself is not an

¹I owe this formula to Professor Charles Landesman.

insignificant metaphysical point, for some philosophers apparently believe that representation is only dyadic. They assert

X represents Y

can be an unadorned fact about the world -- a fact not requiring the existence of conscious agents (Z). Dretske's philosophy of the flow of information in the natural world hinges on this interpretation of what it means for one thing to represent another. Other views about what it means to be a representation are sometimes implied or stated in philosophic accounts. Among them:

X causes Y,

X is correlated with Y, or

X functions as if it were Y.

It is often argued that one of these relations is sufficient to characterize how physical states in the brain are "representations." This is a point we shall review when we discuss contemporary models of human psychology. In the meantime, I shall assume the only correct way, and, not coincidentally, the way most compatible with common sense, to understand representation is to insist that it is inextricably bound up with human intentionality.

In summary, the visible realm includes images that serve as representations of other things by way of visual resemblance. These images, like visible other things, are

visually inspectable and may figure in causal explanations of human behavior. Public images are relative beings that can be transformed to symbols, and when this is done visual similarity ceases to be a factor in our relation to it.

B. Mental Images

Let anyone who doubts the existence of private, non-visible, mental images attempt to explain the existence and function of images in the visible realm without assuming that individual minds make for themselves representations of objects that are absent from perception. Even strict descriptivists do not deny there are such private representations. What they do deny is that these representations are distinctively visual, or that they are visual in any important sense that would make them much like public images. This false transference from the visible to the invisible realm (mental) realm can be characterized by two related faults which descriptivists justly level against the imagists.

The first fault is to speak of the mind as if it were entirely passive when mental images are present. We do not come upon mental images in surprise fashion, as we come upon images in the visible realm. Imagists speak as if mental images were objects planted in the dark recesses of the mind, suddenly and accidentally illuminated by the light of

consciousness. Such passivity, descriptivists point out, does not reflect what actually happens. The contents of the mind are brought about by the intent to recall or to be engaged in constructive thought about something.

The second fault is to describe mental images as if they were items that can be visually inspected in the manner of an external stimulus. Imagists sometimes speak as if, when images appear on the inner stage of consciousness, we take some time to reflect on their properties -- how they "look," how "vivacious" they are, whether there is a "feeling" of belief associated with them, and so on, and then decide what kind of images they are.

Descriptivists are right in arguing this simply cannot be the case. Something more must be active in the mind if such presentations are to have any meaning or any effect, for raw images can neither have meaning nor be causally effective until they are interpreted. By saying, for example, that I have a memory image, I do not ordinarily mean to imply that I inwardly see an unprocessed visual presentation which, upon scrutiny, I have decided must be a memory. No such inner visual scrutiny occurs. The imagery of active, waking life seldom has the ambiguity of dreams or hallucinations. We do not, except rarely, wonder "what kind of image is this?" The image and a consciousness of its type forms a unified experience. In the vast majority of

cases we automatically accept images as being of a certain type. Otherwise, we would be continuously lost in speculation about the contents of our own consciousness.

Despite these problems for imagism, imagists surely are correct in identifying visual experiences as a unique form of experience. Suppose someone were to make the following proposal:

Let us replace all the portraits and sketches of Clinton in this gallery with descriptions. In place of each image, we will place a descriptive paragraph, containing the information that was in the image. People can still visit here and read the descriptions. Since the information is the same, everything will be just as it was, and nothing will be lost.

The absurdity of such a proposal is evident when we speak of visible images. Surely, the "information" in the replacement descriptions is not the same. "Information" is not even the correct word to describe what was replaced, since visible images do not have a definitive informational content in and of themselves. The imagist perspective leaves open the notion of "visual presence," in all its ambiguity and possibility, as a factor in mental life, both public and private. One wonders why, when descriptivists offer essentially the same replacement proposal described

above with respect to mental images, it is even given a moment's credibility.²

Imagism is also correct in insisting that no matter how "conceptual" or "verbal" cognition is thought to be, it does not change the fact that we have object-like presentations that, while lacking physical properties, induce in us sensations similar to those we experience in seeing. If imagists described the mind as too passive, passivity cannot be eliminated altogether. Mental images do resemble visible images in that they can stimulate the mind -- not, perhaps, precisely in the manner of a pure stimulus -- but in a way that produces similar effects. The mind is not entirely active; it is also passive in the sense that internal representations are presented to it.

A compromise position is called for. The similarity/dissimilarity between visible and mental images is not an all or nothing proposition. The mind is both active and passive with regard to internal representations, and neither linguistic nor visual artifacts alone constitute its contents.

² The descriptivist proposal for descriptive replacement could be credible, however, if it could be shown that all mental images do and must have a definitive informational content, fully translatable into linguistic form. This possibility is explored in the next chapter.

1. *A Definition of Mental Imagery*

Richardson's revitalized traditional psychology provides a useful starting point for a philosophic definition of mental imagery. In his book, Richardson defined mental images as follows:

Mental imagery refers to (1) all those quasi-sensory or quasi-perceptual experiences of which (2) we are self-consciously aware, and which (3) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (4) may be expected to have different consequences from their sensory or perceptual counterparts. (Alan Richardson, 1969, pp. 2-3).

Writing again on the topic of the definition of mental imagery in 1983, Richardson defended this definition against the advances of cognitive science. The only concession that Richardson made was that the fourth criterion for mental imagery – different consequences than an original stimulation – should be slightly more hedged. Although we might generally expect different consequences in the case of mental imagery, it is not always the case. Directed imagination, for example, has been shown to produce effects that are identical to those experienced in the case of external stimulation. This minor point aside, Richardson has consistently maintained his view that this constitutes

the definition of mental imagery that is appropriate to psychology.

Clearly, the definition encapsulates some important features of traditional and common sense imagism we have already touched on. Under this definition, mental images are distinctively conscious experiences, can have causal efficacy, and have a distinctive phenomenological quality understood by analogy to vision.

The definition entails methodological prescriptions for the study of mental images in empirical psychology. It implies that since experiences are the subject matter, subject reports of these experiences are the primary data. One of the principal tasks of psychology, in Richardson's view, is to find correlations between various types of imagery and other psychological variables. Imagery could be correlated, for instance, with memory tasks, sports performance, psychotherapeutic exercises, mathematical problem-solving abilities, and numerous other variables of interest. In such studies, overt behavior is not excluded from study as an effect of mental imagery, but is not to be confused with mental imagery itself. Obviously, then, behaviorist or behaviorist-inspired approaches to mental imagery will simply have little or nothing to say about mental imagery under the rubric of Richardson's definition. Another methodological prescription is implied in that

normal sensory stimuli should be absent when we are studying mental images. This corresponds to the imagist intuition (e.g., Aquinas's) that images explain behavior in the absence of certain stimuli.

Richardson's definition is only a starting place for attempting to unify the imagist and descriptivist views under a new philosophic paradigm, and in the following sections I attempt to expand upon it.

2. Four-Way Causation

There is a common-sense view of causation that is entirely unencumbered by the conundrum of metaphysical dualism. This view is woven deeply into our ordinary language of causal explanations. Ordinarily, it goes without saying that physical events cause other physical events. Equally, we unhesitatingly accept that mental events can cause other mental events. Mentally entertaining premises can lead to forming conclusions; anticipation of a coming event can lead to a reverie on previous events, and so on. Common sense also recognizes that physical events can have mental effects. Drugs, disease, bodily injury, and brain injury all have mental effects. These physical causes may result in temporary hallucinations, depression, loss of memory, and any other of a number of mental effects. Finally, the common man is quick to acknowledge that mental

acts have direct physical results. The most obvious case is the production of physical movements of the body by the impulse of the will, but more subtle cases are also commonly-recognized, such as the influence of mental attitudes, sometimes manifested in the production of mental images, on healing the body. The pre-theoretical, common-sense view of causation, then, recognizes all four forms of possible interaction between the mental and the physical.

A contemporary common sense view may also suppose that four-way causation is possible because mental and physical events are somehow related or correlated (albeit in some unspecified way) in the brain. When the common man is pressed for a deeper explanation of this correlation, dualism may begin to creep into the explanation. But I assume that in contemporary times many people will seek to avoid dualism by holding that mental events always have corresponding physical events in the brain, even if they are not sure about the details of the relation (e.g., whether the reverse, that physical events always produce mental events, is true, and so on). Given this, it seems rather easy to explain the presence of mental images in terms of brain functions. One need only assume mental images and their effects are possible because the brain is capable of recording the visual appearances of objects or events, and then of playing them back via physical changes in the brain

that restimulate the mind in a manner similar to the original experience.

This physical/mental correlational explanation of mental imagery, however meager and insufficient it may appear to be in light of the demands of a reductive science, is a substantial part of traditional psychology and its contemporary offshoots. In 1890, James suggested that since sensory (peripheral) neurons sent signals in toward the center of the brain for additional processing, it must also be possible that centrally produced stimulation could be transmitted back out to the sensory organs (James in Beakley, p. 188). He also noted that some subjects had reported "negative after-images of objects they had been imagining with the mind's eye," thereby establishing a possible link between his suggestion and subject reports (1892/1961, p. 178). It turns out that James's reverse flow explanation is now supported by many studies in psychology that correlate mental events with measurable physiological changes.

Finke (1984) designed a well-controlled experiment to prove that imagined colors produce optical illusions, previously thought only capable of production under exposure to actual stimuli. Finke also showed that imagined, rather than actual, physical movements could create measurable "training" effects in hand/eye coordination. Physical

training by means of imagined performances is now used by athletes all over the world and has been proven to be effective. In a series of experiments in which subjects were asked to think of one color while looking at another, Kunzendorf (1990) demonstrated that some subjects were able to induce, at will, a measurable pattern of electrochemical responses on their retinas, corresponding to what was normally induced only by a colored stimulus. Some subjects were even able to produce the "red" response at will, while simultaneously observing a green stimulus, thus completely overriding the natural, physically-induced, response pattern. Kunzendorf's studies demonstrated continuity in the so-called "higher" senses with other previously studied, and very well-known, reverse-flow phenomena, such as conscious control of the heart and other autonomic functions.

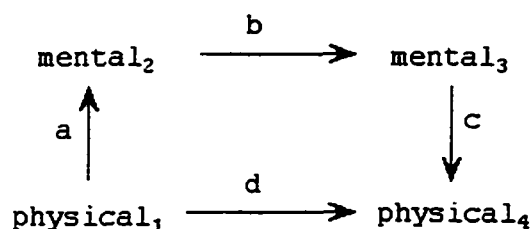
Brain studies also show a close association between the physical visual centers and the mental process of using visual imagination. When mental images are reported, radioisotope studies show that the visual centers of the brain are activated. Kosslyn has shown that the same area of the brain is activated when the capital letter "A" is imagined as is activated when the letter is actually seen. Even the size of the brain area activated varies directly

with the size of the letter imagined, just as it does when the letter is seen (Kosslyn, 1994, pp. 17-19).

Additional evidence of the association of visual centers with memory comes from brain damage studies. If the visual centers are destroyed, the ability to form descriptions based on visual memories is impaired. One famous case reports of a man who lost vision on the left side of the visual field (Kosslyn, 1983, p. 70). When asked to describe the village square that he knew very well since childhood, he could only describe the shops and objects on the right-hand side of the square. The descriptive knowledge was not lost, however, because the man could recall the other side of the square by imagining himself standing in a different location. This case argues that the physical generation of images in the appropriate hemisphere is prior to and necessary for description of certain memories.

There is, then, a common-sense view, supported by empirical psychology, that explains mental imagery by allowing physical and mental states to be causally connected in both directions (as depicted below). Mental states of

conscious visual contents can be the result of physical inputs to the organs of visual presentation or they can be the result of mental inputs to these same organs, as Aristotle's view suggests. A physical state (physical_1 in



the diagram) can produce some mental state (mental_2), this mental state can produce another mental state (mental_3), and this mental state can produce still another physical state (physical_4).

Brentano (1973/1874, p. 6) thought this way of describing causation was to be accepted as part of the normal circumstances for doing psychology. Like chemists and physicists working together by explaining different parts of the same process, psychologists and neurologists need not come into conflict. Any series of mental events, traced back in time, can be found to have a physiological correlate, and vice versa for physiological events. The neurophysiologist will have the job of explaining immediate physical causes of sensation, and the psychologist will have the job of finding "the first mental phenomena which are aroused by a physical stimulus" (Brentano, 1973/1874, p.7).

The philosophical upshot of the correlational view is that it leaves open the issue of the priority of causes. Neither physical nor mental causes need to be given absolute priority in describing and explaining the phenomena of interest. This, again, corresponds with our direct experience, our ordinary means of explanation, and the common-sense knowledge we have that we are not fully in control of all our conscious mental experiences. When physical causes are thought to predominate (e.g., in experiencing an after-image), we appeal to neurophysiological states as the predominating influences; when we are thinking, we feel that mental causes predominate.

It is, of course, precisely this ad hoc scheme of assigning influences and causes that reductionists object to. But the correlational view has some advantages. The correlational view has metaphysical plausibility because it implicitly adopts metaphysical neutral monism. It implies that the states studied in psychology are not ultimately either just mental or just physical. Again, this is (roughly) like a traditional Aristotelian view in that the changes studied are of a single substance, the psyche, that incorporates both material and non-material (formal and final) causes. We need not assume that one type of change is always prior in time to another. It is possible that

mental states and their physical correlates spring into existence simultaneously without being determined by any prior states in any sense that we might presently be familiar with according to physical laws. Wittgenstein (Zettel, 1967) suggested this as a possibility: we can think of the brain as moving from a beginning state to a final state as a natural process, without the intervening states being determined by causal law (para. 613). Wittgenstein realized that thinking of brain processes in this way has little precedent. But he replies, "If this upsets our concept of causality then it is high time it was upset" (para. 610).

I believe the correlational view has some plausibility, and it will be useful in describing mental images. Initially, then, I shall adopt it.

3. *Subject and Object*

In a famous passage, Brentano attempts to define mental phenomena in terms of intentionality:

Every mental phenomenon is characterized by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call, though not wholly unambiguously, reference to a content, direction toward an object (which is not to be

understood here as meaning a thing), or immanent objectivity. (Brentano, 1874/1978, p. 88)

This passage has often been misinterpreted. The word "inexistence" in this context does not refer to the ability of the mind to conceive of objects that do not exist. That is a capacity of the mind, but not the definition of the mental, and not the topic Brentano is addressing here. The capacity in question is, as Brentano states, reference to a content or direction toward an object. The "in" of "inexistence" means that the presentation is in the mind; presentations capable of reference to non-present objects only exist in the mind.

In what sense mental images may be said to be objects, and in what sense they may be said to exist "in" the mind are topics we take up latter in this chapter. As we observed in chapter 2, some philosophers regard images as non-intentional because they (or, more precisely, their raw appearances) have no intrinsic content. It is now clear, however, that this describes mental images as if they existed apart from the lived-through experiences of the subject -- as if they were public, rather than mental images. Public images have "content" (when a subject interprets them) in two senses: (1) the visual content, or the visible features that one may notice, inspect, or be aware of, and (2) the intentional content, or the content

derived from what the image is understood to be an image of. To attend to (1) misses the point of what it is to be an image. We do not inspect the properties of the ink to determine what the sketch of Clinton is to connote.

"Clinton," not "this sketch," is the intentional content of the image. The same is true of mental images; they have both visual and intentional content. It is, of course, possible to conceptually or theoretically strip away the consciousness of the raw appearances of mental images but (with a few exceptions) that is not the way we experience them. They have an intentional depth or content they are directed toward that is not actually separable from their being.

The meaning of introspecting mental objects needs to be clarified, since imagists have been accused of holding the characteristics of mental images to be given infallibly through introspection. Brentano, while he insisted on the general validity of inner consciousness as a form of understanding, did not even think introspection was possible. Introspection in the sense of inner observation (beobachtung) is not possible, because there are no separate inner objects that retain their properties independent of the acts of the subject. Brentano, like Wundt, insisted that we could not directly observe inner "objects" because the act of having an object was inseparable from the

subject's attitude toward it. The only valid sense of introspection was "inner perception" (from wahrnehmung, containing the roots for "true" and "to take"). I understand introspection to be absolutely certain only in the tautologous sense implied by Brentano's distinction: when we have a presentation, the only thing certain is that we have it. Everything else about it -- its causal history, and sometimes even its type³ - is subject to occasional error. The "properties" one does claim for images, then, belong not to objects per se, but are ways of characterizing our experiences and their general presumed causes and purposes.

4. *Conscious Mental Images*

If having mental images implies that we are conscious of them, we need to consider two other problems. First, what of the common-sense intuition that we have mental images even when we are not conscious of them? We do, of course, as both the accounts of Aristotle and Locke show, tend to refer to mental images in unconscious memory as if

³ Perkey's 1910 experiment is probably the most famous one demonstrating how subjects can be mistaken about the source of visual presentations. In the experiment, the subjects were fooled into thinking that an actual visual stimulus was the product of their own imagination. This is additional proof that the source of stimulation is not invariably the determining factor in our interpretation of visual presentations.

they were stored away in some physical space. If a visible image is removed from its hanging place on the wall of a museum and placed in storage where no one sees it, it remains an image. Is there a meaningful analog to this when a mental image disappears from consciousness?

An image disappearing from consciousness is occasioned by the deactivation of visual centers (among others) in the brain. What is left is the ability of that subject to (possibly) regenerate some similar state of activation of the visual centers. This ability is, presumably, underwritten by some physical state of affairs in the brain. These physical states, whatever they are, have the ability to serve as intermediating instruments in the recreation of a conscious presentation, but while they are in this state of latency they themselves neither bear a likeness to anything nor serve as a symbol for anything to an agent. Hence, they are not images. If mental images were like actual pictures, it would be as if pictures disintegrated into a collection of molecules once they disappeared from consciousness. Only some additional cause could reorganize the molecules to make them into an image again. In the case of mental images, this additional cause is fortunately at

hand, in the form of the intentions and purposes of the subject.⁴

As Locke said, unconscious images are nowhere; they have only potential being when not in consciousness. Mental images require that we acknowledge the being of potential being. Only by accepting being in this sense can we say we have unconscious mental images. Had Aristotle been more scrupulous in applying his own principles, he would have made this point more clearly and not referred to them as "images."

A second problem for the view that having mental images implies we are conscious of them is the opposing view or intuition that mental images exist as subconscious or near conscious concomitants of ordinary conscious perception. In this way, subconscious mental images could be operating causes in mental life.

Three possibilities in defense of subconscious mental images emerge. First, there is a meaning of the term "mental image" by which we understand a complex of ideas about some subject matter, as in "he has a mental image of the French people." There may be many actions attributable to having an image of something in this sense, but this use

⁴ Again, pictorialist computationalists dispute all this. The original information in the image, they would say, is just stored in a different place or different form. Since it has not utterly disappeared, it can still be called either "an image" or "image information."

does not imply any particular visual presentation that uniquely defines such an image. It implies, rather, a set of prejudices or concepts as motivations for behavior. We shall not be concerned with an analysis of mental images consistent with this meaning.

A second temptation, very much a live possibility both within the scope of common-sense and contemporary psychology, is to assume that unconscious mental images are causally operative in perception. One such way is the so-called "template matching" view of perception. It holds that what we see generates an image that is then compared to other stored images of previous perceptions. The input image is then identified according to its similarity to one or more of the stored, unconscious images. Thus, stored (unconscious) mental images account for all visual recognition. Some imagists appear to hold this view, and it is often held to be quite consistent with nominalism and an empiricist epistemology. It has also been revived in the form of visual recognition programs for computers.

There are numerous difficulties with the template matching theory, and I will just briefly indicate them here. First, let us consider what simple template matching would involve. One problem is the number of templates needed to accomplish even simple recognition tasks. There are a large class of items that are almost infinitely variable in

appearance, such as the human hand. If there were inner pictures for each possible appearance of a hand (as a fist, with one finger pointing, fingers together, fingers curved, etc., and from each possible point of view) the resulting picture file would contain hundreds or perhaps even thousands of stored images. Supplying adequate visual templates for other visual concepts is even more difficult to imagine. How many images are needed to encompass the possible visual appearances of "dog" for example? While there may be some visual types, such as "box," that do not have significant appearance variability, the idea that each and every case of visual recognition could be supported by matching (or even approximately matching) visual templates, ultimately implies a nearly infinite supply of separate images that must be sorted and then scanned each time they are to be used. While this might be done by a huge computational system, the theory lacks plausibility on this point.

One can significantly improve the viability of the theory by proposing that it is not the sheer appearances that are used, but some model of the inner structure of an object plus its possible outer appearance. Thus, a hand or a dog would be modeled by means of a presumed inner structure of bones and joints that can move in certain permissible ways. This would reduce the number of

templates, or "prototypes" as they are sometimes called in this version of the theory, to as few as one in the case of "hand" and perhaps only a dozen or so in the case of "dog."

The problem with the improved proposal is that it is no longer the visual qualities alone that are instrumental in making the comparisons. The possible configurations of visual appearances must be constrained by rules governing the possible configurations of the inner structure. This is no longer a pictorial theory per se. Rather, it is a combination theory. If computationally instantiated, it would require both "analog" or "visual" data and propositional rules about their relationships.

Either a pure picture or a picture/propositional theory must also face the following objections. Matching proposals, as H. H. Price has pointed out, are rather like strong imagism. In taking the matching of two templates to be sufficient for causing our judgments, it is rather like saying that visual images are our concepts. It inverts the relationship (in Price's view) between concept and exemplar: it is the concept that enables us to recognize an image, not vice versa. As to what concepts are, Price argues, we have no direct access. It may be that there are locked away in the human soul some image-like "schemata," as Kant termed them, that are instrumental in elementary processes of

recognition. Presently, however, we can only speculate about their nature.

As unconscious operations, it is difficult to see by what criterion can say templates, prototypes, or schemata must be "images," if the way in which they could "resemble" or "look like" anything we perceive is unspecified. To insist that the inner representations are literally images also invites the homunculus objection. What intelligent agent, operating unconsciously, visually (rather than by other means) compares the incoming image with the store of templates or prototypes? I take up a question directly related to this in chapter 4, in the discussion of Kosslyn's theory. His theory seems to claim that there are unconscious images that are "inspected" in the visual sense. I attempt to show that his computational theory alone cannot encompass any form of visual inspection. The question of existence of biological recognitional modules in the brain, however, is another matter. These might exist, but how inner, unconscious "inspection" actually occurs here (if it can be said to occur at all), is still a mystery.

More might be said about this issue. For the purposes of my study, which concentrates on the concept of the conscious image, I believe the initial difficulties of such theories outweigh advantages of pursuing these issues

further. Consequently, I shall not be concerned with the notion of causally-operative unconscious mental images.

The final case that philosophers and psychologists have sometimes used to argue for the causal effectiveness of unconscious mental images is the case of the ambiguous figure. The duck/rabbit figure, the face/vase, the old woman/young woman figure and many others have been cited as examples of mental imagery determining what is perceived. In looking at the duck/rabbit figure, for example, one is tempted to say that the reason I now see it as a duck, and a second later see it as a rabbit, is that I store unconscious mental images of these that temporarily determine what I actually see. Finding what I see with my eyes to correspond equally well to either of these inner representations, I shift back and forth between recognizing the figure as one then the other. These unconscious operations involving mental images so profoundly influence my perception that it literally changes, seemingly of its own accord.

There is, in my view, a convincing counter argument that retains the definition of mental images as conscious affairs, distinct from perception (I am indebted to Richardson, 1969, pp. 131-135 for this argument). First, the appeal to unconscious mental imagery really adds nothing to our understanding of how we interpret an ambiguous figure. It is simply an ad hoc theory that gives a

suggestive name to processes of which we are not directly aware.

Second, closer examination reveals that interpretation of ambiguous figures actually involves some conscious mental work. Ambiguous figures involve a time-delay between seeing and perception. Perceiving the ambiguity in such figures is not a case of ordinary, automatic perception, but a case of conceptual and visual problem solving. If we immediately see, without effort, an ambiguous figure as one thing, it is just a perception, and we give it no more thought. If we fail to have an interpretation of an ambiguous figure or are told "this is an ambiguous figure," conscious work begins. We ask ourselves, "what is this?" and then consciously explore interpretive strategies to find an answer. These conscious strategies involve visual and conceptual posits. We consciously posit that some visible feature represents, say, an ear, and we then attempt to see the figure in a new way, given this posit. If the strategy is successful, a percept is formed. The percept may present itself so powerfully that we cannot "see" the figure as being anything other than, say, a rabbit. The temporary overcoming of the raw visual information by the mental image is consistent with the reverse-flow phenomenon discussed above.

The entire interpretive process involves two distinct stages, one in which conscious mental imagery is involved in resolving a pre-perceptual problem, and one in which a percept appears automatically as being a representation of something specific. When the percept stage is reached, the mental imagery stage is over and is no longer involved.

To conclude, then, we shall not be concerned with unconscious or near-conscious causally-effective images. In describing mental images, we shall be concerned with consciousness and its contents.

C. Descriptive Metaphysics and Objectives of the Study

Prior accounts have often described the nature of mental images in a way that makes them conform to the needs of a pre-supposed metaphysical system. This need takes a general form in that it starts from a definition of the unit of perception and ends in a description of the units of thought in terminology directly derived from perception. To coin a phrase: the perceptron (unit of perception) is transformed into the mentron (unit of cognition). For the imagist camp, the perceptron had to be intuitively obvious, directly derived from conscious experience, and never lose its fundamental characteristic of being an image through its various incarnations as memory, imagination, and thought. Berkeley, for example, claims that in order to attain

clarity and truth, he will direct his mind to objects, "divested of words," so that he will understand the contents of the mind through "attentive perception of what passes in my own understanding" (Berkeley, 1710/1965, p. 59).

Descriptivists also wanted to reveal the nature of the mentron, and believed they found it not in images, but in language or linguistic analogues. Still, from a general standpoint, the descriptivist theory is identical to the imagist theory because it also retains the continuity of transformation from perceptron to mentron. In the descriptivist case, the continuity is kept intact by construing perception as descriptive.

I shall attempt a bottom up, rather than a top down, approach to the topic of mental imagery. This attempt is aimed primarily at a description of what mental images are, a definition and a list of characteristics that circumscribe mental imagery, rather than finding a convenient place for them once a metaphysics is already established. The lessons of history and many recent critiques of the very idea of a neutral or purely "descriptive" metaphysics may make such an attempt seem absurd on the face of it. I do not claim any description to be neutral, only that I try to avoid presuppositions that drive other accounts. I allow the possibilities, for example that there is no perceptron, at least as others have apparently understood it, and that

percepts are indefinite in form. I also allow there may be (as a consequence of percept variability) no universal psychology, and that no physical causal chain (in the conventional sense of 17th century physics) can be invoked as an ultimate explanation of mental imagery events.

The strategy I shall follow is simple and consists of four objectives:

1. Recovery of lost information;
2. Creation of a philosophic inventory of imagery types;
3. Establishment of an alternate understanding of what the explanatory problems are for mental images;
4. Indication of ways to avoid technical mistakes in empirical psychology.

The first objective, to restore lost information and lost perspectives to the topic of mental imagery, consists in recovering the insights of Wundt, Fechner, Galton, James, Brentano, and Richardson and incorporating them with contemporary discoveries in the neurophysiology of imagery.

Traditional accounts of mental imagery include a good deal of reasoning, speculation, and experiments with imagery types (see Holt, 1964). The reason for this is that, as these psychologists correctly understood, there is no way to isolate the vast complex of all the possible psychic and physical changes associated with the general term "mental

image" and make this an object of study. Because there is always some varying mix of psychic and neurophysiological components in mental imagery, the field must be broken up somehow, even if arbitrarily, in order to design empirical investigations that are directed to a fairly isolated range of phenomena. Thus, the second objective in my study is to redirect attention to imagery types, and improve upon the insights of traditional psychology. In this way, we can distinguish stimulus-like properties from conceptual properties, and, instead of giving a univocal answer to the question of the source of image content, we can separate the cases, using imagery types, and give a nuanced description of how visual content may be induced, generated, and provisionally bound to conceptual content.

The third, or metaphysical, objective is to clarify the description of mental images to such an extent that the problem of explaining them is clearer, even if it remains indecisive how to proceed. While a complete reductive explanation of consciousness, and therefore of mental imagery, is presently lacking, we do have causal explanations of mental imagery in terms of the neurophysiological states correlated with imagery. This metaphysical approach places the primary burden on description. It is a topic neutral approach in that it does not seek to specify precisely which components of imagery

experiences are due more to "mental" or more to "physical" factors. This is, I believe, also consistent with some aspects of current folk psychology. We cannot always readily separate the physical versus the mental components or causes in our discussions of why people enjoy smoking, or running, or contemplating. The same is true of mental imagery, but there are fairly distinct variations according to types, in the so-called mental/physical mix. I have called this a "correlational view," but this an epistemic rather than a metaphysical separation and is not to be understood to imply there are separate metaphysical substances causing changes in each other. The "explanation" I give of mental images is quite limited, but by comparison to the other presently popular accounts discussed in chapters 4 and 5, is actually less speculative and stays to the topic (intentionality and conscious forms of awareness) instead of reverting to explanations in terms of mechanisms driven by principles of 17th century physics.

The definition of the problem of explanation has implications for the fourth objective, avoiding mistakes in empirical psychology. These implications come to light in chapter 5. Several important contemporary investigations measure phenomena that simultaneously involve perceptual problem solving and short term memory images. The ambiguity in these experiments might have been avoided, given a better

understanding of the nature of mental imagery and its various types. Experiments in a more traditional mold, I show, are more fruitful and true to the phenomenon to be investigated.

III. The Range of Mental Imagery

Just as it is possible to have a range of attitudes toward visible objects, it is possible for there to be a range of intentional possibilities associated with internal visual presentations. We know from experience that mental images range on a scale from induced reactions, with no or minimal content, to free creations of the will in which the content is posited by the subject. These experiences can probably be correlated with neurological changes that correspond, roughly, with each type of experience. Mental images are not only visually presentational, due to varying degrees of reverse information flow in the brain causing a restimulation of the sensory system, but also conceptual, again to varying degrees in each case, due to the concurrent or accompanying awareness of what mental images represent.

The solution to finding an adequate characterization for mental images lies in treating various types separately. I propose to clarify both the phenomenology and conceptual content of imagery by identifying, among other variables, (1) the degree to which they are controlled by the will, (2)

the relative degree to which visual and conceptual aspects are present in the image, and (3) the kinds of intentional content or objects toward which such states are directed. Such an effort is not to be understood as an attempt to make mental experiences conform to an essentialist ontology of pre-defined mental objects.⁵ Rather, it is an attempt to organize what would otherwise be an insolvable problem in the metaphysics of mind. Our historical survey showed that other treatments have described memory, imagination, or thought imagery, but always with the intent of making them conform to a pre-established metaphysics of mind. These accounts (except for Aristotle's) generally failed to match the significant differences among mental imagery experiences with even probable neurophysiological circumstances that would account for the mix of visual and conceptual components that exist with the range of phenomena we call mental imagery. Since they did not discuss the range of these phenomena, these accounts have failed to establish what mental images are. Without establishing what,

⁵Richardson argues, it is dubious that any classification scheme can be found that is not ultimately arbitrary (Richardson, 1969, p 127). He recognizes variables more amenable to empirical psychology, such as location in space and control by the will. Along these axes, there is indeed no firm differentiation. Everything from thought images to after-images can to some degree or another be controlled by the will. The inclusion of conceptual and intentional differences among types allows for a firmer basis of differentiation, but not an absolute one.

metaphysics is in no position to establish how mental images are possible.

We shall proceed by using the categories of mental imagery already alluded to in previous chapters. Table 3-1 lists types and assigns suggestive entries to the variable qualities associated with each type. Again, it must be emphasized that not only the categories but each entry under the various qualities are to be understood as generalizations.

A. After-Images

Normal after-images are induced by external stimuli. Of all forms of mental images, these are the only ones that can be said to be visually inspectable in any obvious sense. Normal after-images are true sensations having duration, apparent position in space, color, size, and shape. Yet the form of this in experience is that it is not a perception of an external object. We are given visual clues that there is no ordinary object present because after-images appear to float in space, move when the eyes move, and fade rapidly.

It might be argued that after-images should not be categorized as mental images. One could argue that after-images do not immediately represent anything to the subject. That is, one might claim that in seeing an after-image, the subject merely sees an uninterpreted visual presentation,

and that the after-image is merely a visual sensation occurring as in ordinary perception. In this case, there would be only visual content and no intentional content. It would be possible, under this scenario, for the subject to be mistaken, and interpret an after-image as a visual impression due to an external object.

Such a state of consciousness about an after-image, however, would be an extremely rare case. In an authentic after-image, the "object" of visual awareness is surmised not to be an object "out there," but due to changes in us. Because after-images are rapidly produced, the time-consciousness of the after-image surrounds the occurrence of both the stimulus event that caused the after-image and the occurrence of the after-image itself.

Ordinarily, then, there is no ambiguity or question about what we are experiencing when we experience an after-image. We ordinarily cognize the after-image as "an after-image of the previous visual stimulus." There are means by which this cognition is (usually automatically) accomplished: (1) after-images nearly always take the shape of the original stimulus object that caused them; (2) after-images have an indefinite location in space, moving continuously as the eyes move. As a result, after-images are cognized as visual likenesses to a previous impression and as sensations that have no correspondence to any fixed

location in exterior space. Since, as we have argued, being a visual likeness and not being categorized as a visual feature of a present stimulus are essential characteristics of mental images, after-images deserve to be categorized as such. Additionally, as mentioned earlier in this chapter, after-images may be produced by conscious will power, and these unquestionably should be categorized as belonging to the mental realm.

Confusion about the status of an after-image (i.e., whether it is "mental" or not), is normally short-lived. Extended forms of confusion about visual impressions belong to the category of hallucination. The philosophic points, often made, that visual impressions can be distinguished from our consciousness of them, that we have the ability to adopt various (non-automatic) interpretations of them, that skeptical doubts introduce the possibility of "mistakes" in conscious awareness, and so on, do not belong to the initial psychological/ phenomenological description of the phenomenon. I take up these philosophic points in a subsequent section ("Mental Images as Mental Objects").

Table 3-1. Types of Mental Imagery

Table 3-1a. Conscious and Intentional Properties

TYPE	CONSCIOUS CONTROL	PHENOMENOLOGICAL QUALITY	DIRECTED TOWARD
After-Images	NO	sensation	itself
Eidetic	NO	stimulus-like	object
Hallucinogenic	NO	stimulus-like	unknown
Memory	YES	pre-interpreted	experience
Imagination	YES	posits	possibilities
Thought	YES	posits	reality

Table 3-1b. Modal Properties

TYPE	SPATIAL LOCATION	MODE
After-Images	YES	single
Eidetic	YES	single
Hallucinogenic	?	multi-modal
Memory	NO	multi-modal
Imagination	NO	multi-modal
Thought	NO	multi-modal

B. Eidetic Images

An eidetic image is one that, for the subject, reputedly bears remarkable stimulus-like properties. The subject claims to literally see the mental image in physical space. Apparently, an eidetic image is a cross between an after-image and a pure memory image. They are distinct from ordinary memory images in that they can, according to the reports of subjects, be inspected in the manner of a stimulus. They differ from after-images in that they can be triggered by simple visual inspection of a physical object.

No overloading of the retinal tissues appears to occur, since the visual study of the object usually lasts several minutes and eye movements are continuous during the process. When the object is removed, a person capable of forming an eidetic image will retain a detailed memory image that (according to the subject) appears to be in the same space as the now absent object (unlike an after-image). If, for example, a figure or painting is shown on a wall or desk top and then removed, the eidetic subject will point to the appropriate surface area location when describing the details of the eidetic image "seen" in the vacated space.⁶

Eidetic images are part automatic and part willed. They are usually generated spontaneously in children and by choice in adults. Maintaining an eidetic image, in either case, requires both interest and effort on the part of the subject. Despite this, eidetic images appear to fade in most cases at rates that are not fully controllable by the subject. It is therefore a judgment call as to whether to list eidetic images as under conscious control. I have

⁶ See Stromeyer and Psotka, 1970, p. 346 and Richardson, 1969, pp. 29-44 for more on the distinction between eidetic images and after-images. Eidetic imagery is generally reputed to exist in a significant percentage of children between the ages of seven and fourteen. Haber and Haber (1964) found that 8% of children between the ages of 7 and 12 appeared to have eidetic imagery (Haber and Haber in A. Richardson, 1969, p. 37). Eidetic imagery tends to disappear with age and is very rare among adults.

indicated that they are not, because the greatest incidence of eidetic imagery is among children.

Again, as in the case of the after-image -- and particularly when children are being interviewed -- it may be debated whether the subject understands that apparent properties of an eidetic image represent the properties of the absent stimulus, or if the subject is content to regard the eidetic image as a mere presentation. In most cases, I presume that eidetic images are understood as representations of an absent stimulus and that, in any case, some admixture of ordinary non-visual (conceptual) memory is also present. In this case the subject understands the image as aimed at representing the features of the absent object.

C. Hallucinogenic Images

Hallucinogenic imagery is a broad category that includes drug-induced imagery, hypnopompic imagery (prior to waking up), hynogogic imagery (prior to sleep), imagery induced by psychosis or hypnotism, and dreams. Richardson has suggested that Perky (1910) grasped the essential quality of hallucinogenic images when she described a class of images that involve "concentrated and quasi-hypnotic attention with inhibition of associations" (Perky in Richardson, 1969, p. 94). This means that hallucinogenic

imagery is only loosely controlled by conscious intentions to have imagery conform to expectations of reality. Normal hallucinogenic states are generally partly passive and partly active. When we dream and we know that we are dreaming, for example, we can sometimes change or influence the course of the dream. Abnormal hallucinogenic states include states where the subject's mental images permanently supplant reality and the subject loses contact with reality. This is severe psychosis. Normal hallucinations, in dreams or temporary drug-induced states, last only seconds, minutes, or at the most hours, and do not cause the subject to permanently mistake hallucinogenic images for reality. Nevertheless, philosophers since Descartes have fastened on the possibility of permanent deception through deceptive mental images.

The investigation of these skeptical arguments is really orthogonal to our topic. The concern here is to develop a view compatible with common sense and traditional psychology, neither of which seriously entertains radical skepticism or suffers from any difficulty in differentiating severe psychosis from ordinary dreaming. The skeptical arguments arising from examples like dreams do not tell us much about the nature of dream imagery. Many dreams are clearly just random shapes and colors, the result of the passive processing of minute sensations on the back of the

eyelids, combined with a degree of active conscious control that lacks the normal inhibitions of waking life (see Richardson's discussion of dreams, hypnopompic, and hypnogogic imagery, p. 168 ff.). Whether or not dreams have any deeper meaning or are simply the remnants of sensory activity has been debated for thousands of years. We shall not address this here.

What dreams and hallucinations actually show is not that we are in danger of being permanently deceived by mental images, or that admitting the existence of mental images is a threat to sound epistemology, but that normal minds are capable of generating their own internal visual stimuli. These stimuli are associated with many levels of conscious awareness, up to and including conscious states that seem like perception when the critical faculties are absent. The conscious mind needs sensory stimulation. When external stimulation is unavailable, it creates its own. Sensory deprivation studies show that visual stimuli are created spontaneously when external stimuli are unavailable. Apparently, the Platonic notion that if the distractions of the senses could be removed, states of pure, imageless thought would be more open to us, to not only sustain but purify the mind, is itself a dream.

D. Memory Images

Descriptivism and imagism are at definite odds on the topic of memory images. The primary issue is inspectability. Imagists describe memory as if the entire percept were resurrected "as is," in the manner of an eidetic image, except internally displayed. They appear to believe the conscious agent retrieves the memory information by inspecting this image, "reading off" the image in order to get the desired information. Descriptivists argue this simply cannot be the case for many reasons, not the least of which is that literal visual inspection requires a homunculus. In this section I want to develop a positive account of memory images, showing how imagist and descriptivist perspectives can be combined in describing the conscious form of memory.

1. *What is a Percept?*

Both the imagist and descriptivist perspectives on memory hinge on a theory about what percepts actually are. Both sides argue in terms of a unit of perception (either a picture or a concept/word) and corresponding unit of subsequent memory. Is there then, as both sides assume, a specific unit of perception, existing in a specific cognitive mode which then is reactivated in memory? I suggest that the questions in these analyses, "what is the

nature of the unit stored in memory -- is it visual or descriptive?" is really the wrong question. Both perception and memory involve not one or the other aspect exclusively. Nor is there any predetermined unit of perception. What is taken in during perception and what is subsequently recalled depends on the interests and background knowledge of the subject.

Suppose there is an apple on a table in a busy store. Some who pass by merely glance at it and see a red blob on the table. They are only vaguely conscious that the shape might be an apple. Others see the shape, perhaps in more detail, and are immediately aware of it as an apple. Still others (say, apple experts) see the apple and are aware of it not only as an apple but as a particular kind, say, a partially ripe grade "B" Macintosh. Each of these, I submit, constitutes a perception. There is no predetermined "unit" of perception that is prior to and common to these experiences. The unit of perception is not a universal constant, but constantly changes according to the interest and background knowledge of the agent at each moment.⁷

⁷ There is a stage of conscious awareness in which we may be aware that visual stimuli are present, but in which we cognize no particular objects at all. This may be called merely "seeing" as opposed to "seeing something as." This stage, however, does not define what is controversial among the various schools: the unit through which or on which cognitive processes operate.

2. *What is Memory?*

When each of the agents who saw the apple in the store retrieves what they saw from memory, there will be a corresponding variation in the kind of memory experience. For some agents the visual appearance will predominate, for others the conceptual content will dominate. The subjective qualia present in memory vary as much as the original percepts. Both can be either indistinct or precise in their visual aspect and both can be coupled with a vague descriptive awareness, such as "something red on the table," or an elaborate description of size, color, and quality. Those who remember an apple, might inwardly see a detailed red image or they might see only a vague red blob, coupled with the memory that the apple was a grade "B" Macintosh.

Psychologists might hope there to be invariable rules or structures in perception, memory, or imagination. To discover any such rules would be a suitable, and possibly attainable, goal for a science of the mind. Both imagism in the materialist/empiricist tradition and, as we shall see, contemporary descriptivism in the form of cognitive psychology, tend to view perception and memory as a matter determined by invariable physiology coupled with the demands of their preferred theory. For imagists, it is obvious that images are perceived and that images are recalled. Descriptivists cannot claim it is obvious that we perceive

"descriptions," but they do claim perception and memory conform to the descriptive modes required by their theory.

There is no sense, however, on insisting on the existence of rules and structures for the convenience of a science. Human variability might outrun all possibility of finding such universal forms of cognition. James thought that this latter possibility was indeed true and had to be accepted as a principle of psychology. He wrote:

Until very recent years it was supposed by philosophers that there was a typical human mind which all individual minds were alike, and that propositions of universal validity could be laid down about such faculties as 'the Imagination.' Lately, however, a mass of revelations have poured in which make us see how false a view this is. There are imaginations, not 'the Imagination,' and they must be studied in detail. (James, 1892, p. 170).

In support of his view of variability James cites Galton's famous "Breakfast Table Experiment." Galton sent out questionnaires to people, many of them famous scientists of the time, and asked them to describe what image they had of their breakfast table. Many scientists responded they had absolutely no image of their breakfast table, but could only recall what they had eaten. Others were able to recall the appearance of their breakfast table in great detail. One

form of memory was not necessarily better than another, but they were decidedly different, and since everyone had, presumably, been subject to similar environmental input the only account of the variation in form of recall is variation in natural disposition to create a selective memory according to the values and interests of the subject. We saw another experimental indication of this in Wundt's experiments with scanning words and letters. This demonstrated that subjects' memory awareness can include a scale of cognitive types and a scale of cognitive wholes, from vague impressions, to individual letters, to whole words. The interest of the subjects in retaining as much as possible, in conforming to the demands of the experiment, is reflected in the kinds and levels of the information they recalled.

This evidence from traditional psychology just tells us what we already know from common sense. Outside of experiments, subjects who are interested in maintaining awareness of objects and their spatial relations, tend to retain this kind of information. Those interested in conceptual relations, facts, and propositional knowledge tend to retain this sort of information. Having a memory does not entail having it in one kind of cognitive mode; memory exists in a variety of modes.

3. *The Modes of Memory*

Visual and verbal memory can exist independently. When I forget where my keys are and then inwardly see them on top of the dresser, this is a form of visual memory, and no inner description or proposition need be formed. We can also have conscious verbal memory alone, without any trace of an image. Forgetting a face, but remembering a name is a common example.

For the most part, however, memory involves visual and verbal forms inextricably bound together. It is for this reason, I suspect, that the imagist/descriptivist dispute over memory has been so contentious. They are both right, but they understand different aspects of the same thing and take it as the whole, as in the tale of the blind men arguing about the definitive features of an elephant.

A simple experiment in short-term memory demonstrates the multi-modal nature of the revived percept. I survey the items on my desk, taking a mental inventory of the items. I consciously record that there is a book, a stapler, a pencil, and so on. Then I close my eyes. I discover that I have a form of awareness that enables me to reach out and instantly locate, with minimal effort and a high degree of accuracy, many of the objects on the table. I do not need to grope for the objects as if searching blindly. My form of awareness is not just that a certain object is there. My

awareness is, in part, in the form of a visual representation of my immediate surroundings. I can inwardly visualize the objects and their spatial locations relative to me. This representation allows me to draw a fairly accurate picture of the desktop from memory. I can also describe, sometimes in surprising detail, many of these objects. I can specify, with a fair degree of accuracy, the actual physical size of many of these objects in inches or some other unit of measure. This experiment applies only to me at one particular time and place, but it is, hopefully, indicative of average abilities.

One way to describe what has transpired in this example is to say that visual information has been transformed to a diversified set of motor/linguistic/cognitive capabilities. This is true, and it would be possible to test these abilities in order to refine the sense of just what they are. Focusing on the external manifestations of these capabilities might lead, however, to missing the nature of the mental image itself. The mental image mediates all these capabilities; it is the means through which I accomplish various tasks I set for myself. I reach into the space defined by awareness of the image (of what I do not see or touch) toward the object of my inner attention and touch, not it, but the actual object. I might have actually

touched the object without such an awareness, but that would not be the same thing.

I suggest the way to capture the fact of inner awareness and the function of the image in such examples is to use evolutionary and environmental terms. Such a visual presentation allows the subject to interact with the environment as if it were still present to the senses. When I am in this state, I retain an awareness of the space around me. Distant objects and surfaces are defined vaguely, less by distance than relative direction; closer objects, particularly those within reach, are more precisely located. This is a state of spatial awareness, a non-verbal, unmediated awareness of a space, and the objects in it, that was formerly present to the senses. This state makes possible an indefinite set of potential interactions with the environment. The evolutionary advantages of this ability are obvious, for it allows the organism to continue to interact with the environment, and even to imagine possible interactions with the environment, even in the temporary absence of sensory input.

4. Inspecting Memory Images

In what manner may memory images be inspected? To continue our example from above, it seems I have the ability to "inspect" or "attend to" certain parts of this image.

For example, the impression that the pencil is "over there" can come to me independently of my recollection of the color of the book, or the size of the stapler, or my descriptive assessment that the desk was messy. I can, as it were, inwardly "look" at individual features of this general image I have of the desk top. So, one might conclude, we have direct evidence that memory images can be inspected. This conclusion has the additional advantage that inspection is easily explained in terms of the continued activation of the visual centers after closing the eyes. The original activations signifying distances and objects simply remain "lit up" in the brain after outside stimulation has ceased, in the manner of an after- or eidetic image.

At this point we must apply several correctives to our account. First of all, the willful and deliberate storing of information about items on a desk top does not replicate the automatic storage of information of interest in a non-experimental, lived-through environment. Secondly, this state is not, strictly speaking, a memory state according to traditional psychology. James follows Aristotle on this point (see James 1892/1961, pp. 154-155). Memory necessarily involves the consciousness that one formerly thought or perceived something, not only implying that a time-delay is necessary between perception and its revival, but that during that time, something else be present in

consciousness prior to the revival of the perception. Only in this way can we ensure that we are speaking of memory proper and not some phenomenon that amounts to a continuation of the original perception. Our experiment, then, may be misleading, for it deals with only a part of memory-related phenomena, what contemporary psychology identifies as short-term memory. It has also made our explanation too easy, for we do not need to explain the death, disappearance and subsequent resurrection of the original perceptual stimulation. So short a time has expired since shutting the eyes, that the percept may hardly be said to have "died" at all. It is perfectly possible that the original pattern of stimulation of the nerves in the visual cortex has remained in a very close approximation of their original state during the shift from original perception to inward inspection. Small wonder, then, that inner visual "inspection," supported by this residual activity of the cortex, is possible. Even so, we should use the term "inspect" advisedly, for introspection alone does not demonstrate that we inspect or attend to inner presentations, even ones in short term memory, precisely in the manner of an external stimulus.⁸

⁸ This is the issue of whether or not true discovery is possible during the inspection of a memory image. See section on Chambers and Reisberg, chapter 5.

How does memory differ for the images revived from long-term memory? I hold that images revived from long-term memory are visually "inspectable" only in a special sense. This is an attempted compromise position between imagist and descriptivist perspectives on this issue. From the imagist side, I accept the long-term memory image as a spatial awareness in the same way that the short-term memory image is. Recalling from memory the rooms of a house from childhood is a familiar example. Such an ability matches evolutionary demands: one needs to recall the spatial information about former environments. Such images can be inspected in the sense that one can inwardly "focus on" or bring to mind some particulars from a former environment.

There is also a second sense in which revived images can be inspected that conforms partly to imagist and partly to descriptivist accounts. This is a decidedly derivative sense, but it is significant because it demonstrates that image recall is not entirely visual or spatial. Let us consider an example of constructive recollection via descriptions. I awaken one morning thinking of da Vinci's Mona Lisa. I review what I inwardly see, and at first it is only the face and the famous smile. I wonder then about the rest of the painting, which at the time seems clouded in darkness. I realize then that part of the background around the face is a horizon, including some vague indications of

buildings or a bridge. Still, the image does not seem complete to me. I reason that da Vinci would not have painted only the face and background in a light color. The painting would be unbalanced. I wonder then about the hands of Mona Lisa. If they were present, they would balance the painting. At first, I cannot "see" them. As I attempt to remember, I suddenly "see" the hands, somehow placed together, in the painting. I attempt to reason about them, again using presuppositions about da Vinci's style. Certainly, the hands would not be clenched, nor would the fingers be interwoven. This would be the wrong mood. The terms "languid" or "limp" come to mind. Suddenly, an image of a whole hand comes to mind, all the fingers visible, placed in a relaxed position, held horizontally. I am still uncertain about other details, but at this point my memory takes on a new security. I feel certain that the painting does in fact show at least one beautifully rendered, relaxed hand of Mona Lisa.

I suspect this example corresponds to many other familiar, and far less complicated, experiences, such as remembering the location of misplaced objects. The experience is both conceptual and visual, involving both memory and what Aristotle called reminiscence, or following one clue to another to reconstruct memory. The process is unlike a purely visual inspection of a visible image, but it

is analogous in that it involves a progression from one detail to another and separate details of the visual presentation occur during the process.

This account is far from being unambiguous or satisfactory as it stands. The feeling of certainty accompanying the reconstruction of the details of an image is no guarantee that we are still dealing with memory. In fact, some of the visual components of the image may be nothing more than a confabulation brought on by the power of the descriptive phrases that occur to me. Also, in what sense does this conscious process amount to having "an image" of the Mona Lisa? In some respects it is more like a compilation than a single entity. Nevertheless, the single focus of effort is to create a unified presentation of retrieved visual information about a single thing. In this sense, and one that I believe matches common usage, there is a single image.

Without constructing any theory as to the unconscious structure of memory we observe, then, that surface structure of conscious memory can involve a process of searching for and reasoning about the details of a mental image, considered as a unified presentation for inner awareness. We also observe that memory images seem to have a spatial character, creating an awareness as if one were "in" an environment. The possibilities for mental or physical acts

based on that awareness are limited only by the imagination. Memory images always involve both vision-like states and object-specific information. I believe that the wavering between the conceptual and descriptive constraints that have characterized the philosophic debate on this issue is due not to the legitimacy of one side of the argument over the other, but due to the elusive and partially ineffable nature of the experience itself. One should not think of images as inner objects to be literally seen, but one cannot avoid the sense that mental images are passively presented to us as well as actively generated by us as we recollect. Whatever character they may have as conceptual constructs due to our own efforts, there remains a visual component that seems to inhere in the presentation itself.

5. *The Law Of Decay*

Memory images, no matter how vivid, can never supplant perception. If they did, this would be hallucination, not memory. Relative to perception, memory images have nowhere to go but downhill in intensity, and, over time, memory images generally lose intensity. Imagists identified this as a law of decay, and we noted in chapter 2 that the imagism of the British empiricists makes the law of decay follow the law of momentum. As momentum is but a single quantity, and the empiricists understood the image as a

cognitive unit varying on a single axis, they described the law of decay solely in terms of loss of intensity.

Descriptivists point out decay is not a matter of decrease in intensity alone since bits and pieces of memory disappear too. Names, places, and objects disappear from memory even if the image is vivid. This is thought to conform to memory being stored in a conceptual, rather than visual, mode.

Obviously, both forms of decay occur. The memory of the blue clock on the mantle, becomes the memory of the blue clock somewhere in the room, and then becomes just the memory of a clock. But, I suggest, common experience does not reveal a law to this disintegration. No discernable pattern is evident in the pernicious cancellation of names, places, faces, times, colors, or the specific visible features of objects. There appears to be no universal hierarchy of what will be forgotten first or what will be retained last, either in conceptual or visual modes. Although time, repetition, and associative patterns clearly have some impact, there does not appear to be any complete, systematic, predictive theory of what will be forgotten, or what will visually fade, based on these variables.

Why, then, have imagists and descriptivists insisted on there being a law of decay, in self-evident contradiction to common experience? Again, the answer lies in the defense of a presumed theory. First, philosophers and psychologists

tended to believe they could discern it because this would allow them to infer particular features of the unconscious storage mechanism of memory. Second, the empiricists in particular seemed driven to presume that memory images must be qualitatively different, not only from perception, but from imagination or thought images. Otherwise, they would not be properly "recognized" by the spectator consciousness. The descriptivist corrects this by showing the fallacy of this implicit dualism.

If the process of decay cannot be codified and introspection does not reveal any distinctive features of memory images, except at the risk of invoking the spectator consciousness, what can we say about the distinctive attributes of memory images? If they could be considered as pure pictorial presentations, I submit, there would be no distinctive notes to memory images. The differentiation of memory from other states of consciousness normally occurs automatically (but not, of course, infallibly). Memory images, to put it metaphorically, carry with them a mental emblem corresponding to "this is a memory image," a fact that has been observed by philosophers and psychologists since Aristotle. Ordinarily, awareness of inner content is not just of raw content; there must be some awareness of the source or purpose of that content. Otherwise, as I pointed out near the beginning of this chapter, we would be

continuously lost in speculation about the contents of our own consciousness.

E. Imagination Images

1. *Imagery and the Will*

Wittgenstein noticed that we say the bodily motions are under the control of the will, but we also say that these motions can be imperfectly controlled. The hand sometimes seems to refuse to "obey" the mind. But, Wittgenstein asks, have we ever experienced an image not following the will? Has an image ever not come out right? Wittgenstein presents this question as a kind of puzzle with no answer, but his implication seems to be that images invariably conform to the will (Zettel, para. 643). Wittgenstein's generalization would certainly not apply to after-images or eidetic images. Even memory might be said to not come out right, in the sense that they may not be as vivid as hoped. Imagination may also fail to be as vivid or detailed as might be wanted. Wittgenstein's dictum is therefore of little help in showing us how we might use the connection of the will with mental imagery to differentiate various kinds of mental imagery. In this section I shall introduce other criteria, relating to intentional acts and their purposes, by which mental images are differentiated.

Memory images are meant to indicate something about an actual state of former affairs; therefore they can be more or less adequate. The intentional content is this former state of affairs, and this is partly given by the visual features of that internally presented "object." There is no way, internally, to check memory object against memory content, so the memory image takes on its own integrity, and I accept it "as is."

Imagination images are relieved of the constraint of being checked against reality; therefore there is no absolute measure against which they can be said to succeed or fail. Imagination images are therefore intentional posits. It is just the intentional state, not the specific visual features, that define the content of the image. As a visual posit, unrelated to the requirements of reality, appearance properties are secondary. What is imagined, i.e., conceptually, takes precedence over how it is (visually) imagined.

Memory images may become imagination images, not by way of decay, but by intentional act. This accomplishes the transference of mental "materials" from one use to another (part of the common man's view, chapter 1). The command to imagine a tiger may evoke a memory image, but this becomes not a presentation whose visual content is confined to a single instance relative to a previous experience, but a

possible image among countless others. Hume's world of infinite substitution is immediately opened up. This transformation from memory to imagination was a source of great confusion in the British empiricists' account. Indeed, a memory image will do if one is asked to imagine a tiger, but this is not because, as Hobbes said, memory and imagination are the same. There need be no difference in terms of the pictorial qualities of a memory and an imagination image. The mental act, not the image, is what needs to change. When I imagine a tiger, I accept the posit as a) outside of my personal history and b) as a visual representation that may be a likeness to a particular, but for which any such likeness may be irrelevant to the topic of consideration. A memory image gives us a visual presentation that reveals its own entire contents. An imagination image is, we might say, an incomplete or unfilled intention, because there is always a consciousness that "this" (the current presentation) may not be adequate to the task of the imagination.

2. The Internal Space of the Imagination

There are spatial constraints, undoubtedly varying among individuals, that apply to imagination images. This internal "space," for want of a better word, constrains our mode of imagining in fairly clearly defined ways. Some of

these ways are evident to introspection. It is easy, for example, to imagine a tiger at a distance in front of you. It is quite a different thing to imagine a tiger behind you. The "space" of the imagination normally presumes a first-person point of view in an imagined environment. Similarly, this space has a limited ability for detailed representations. Imagining three coins is easy; it appears all at once as a visual "given" with little or no accompanying conscious conceptual posit. Imagining 30 coins (for most people) is no longer all visual, or at least lacks the visual clarity of the simpler task. It requires a posit of the form "let this (what I visually present) stand for 30 coins".

Using the visual imagination is as if one said: "consider these as possible sensory input and form an image of these things in so far as possible." To the extent that forming an image is not possible, one falls back on conceptual posits of these possible states of affairs. The existence of spatial constraints for the eye of the mind, when combined with what we already know about the actuality of reverse information flow in the visual system, suggests a simple explanation in physiological terms. Evidently, imagination uses (as Aristotle suggested) some portion of the same presentational faculty as is used in vision. We imagine things in front of us rather than behind us; we

imagine things in terms of a number of elements we could easily comprehend in normal vision, we imagine things from a point of view in a posited environment, and so on. The limitations of visual presentations are therefore more tightly bound to non-conceptual physiological changes in the visual cortex than the other (conceptual) concomitants of imagination. (This is the physiological basis for Kosslyn's theory.)

The spatial restraints and sensory-like features of the imagination must, if what is presented is not grasped, as it were, all at once, be combined with rational or conceptual restraints to set limits on what is appropriate to the imagined state of affairs. Aristotle is surely right in implying that we cannot imagine literally anything as an example of what we want to think about. One could not, for example, imagine a point and use it to derive the properties of a circle. Another example: suppose one were to imagine a bridge across the Atlantic. First, there must be some visual representation, for if we cannot visualize what a bridge across the Atlantic would look like, we have no image of it at all. (This is not to say that we could not imagine that there was a bridge across the Atlantic). Second, the image must have some components appropriate to the concept of bridge. The supports for the Atlantic Bridge might look like the supports for the

Brooklyn Bridge -- only larger. Often, the pictorial features of fantastic creations do compare to the corresponding features of real things as they are recorded in our visual memory.

Inner appearances are limited by the capacity of the mind to represent multiple details simultaneously. This, as I suggested above, is probably a physiological limit varying greatly among individuals. The lack of details, the overall "sketchiness" of imagined images and their similarity to primitive line drawings has been a point seized on by some contemporaries (Tye, Dennett, Kosslyn) in order to find correspondences with computational schemes. Tye and Dennett hold, for example, that sketchiness is a function of the indefiniteness of an underlying description. Thus, the underlying description of "a man" is so vague that the corresponding translation into visual terms leaves nothing but a stick figure. While points of correspondence may exist with a theory that purports to uncover the deep structure of the imagination (and what lack of inventiveness on the part of theory builder could prevent it?), this does not address the experienced quality of imagined environments in their own right. It is not the term "a man" that I imagine, nor are acts of the imagination like the contemplation of such static terms. An image of a man becomes a professor, the professor becomes Kant, Kant

becomes a man walking stiffly down the street -- visual details are freely added and subtracted not according to any necessity in the association of underlying terms, but according to the logic of an act about a series of things realized in and through the "objects" presented in the imagination.

3. *Mental Images as Causes*

As conscious presentations of the absent, mental images are defined in way that makes them ready to be understood as causes of actions. Their presence indicates that current realities may be sought to be brought into conformance with the absent. Michaelangelo observes a piece of fine marble, rendered useless because it is the wrong shape from which to construct a figure in a suitable heroic pose. Suddenly, he forms a mental image of a figure that will fit the shape of the stone. In ordinary language, he "sees" the David in the stone. Shall we then say that having this mental image was the cause of Michaelangelo's carving of the David? Certainly, there are other factors involved. It is not the image alone, however detailed, that Michaelangelo wants to render. He also wants to do justice to the concept of and emotional content of the story of David. In addition, we would probably not say (although this is entirely possible for a true eideticer) that Michaelangelo copies the image

while he carves the stone, checking his carving minutely against a pre-formed mental image. Rather, we would suppose that the carving itself is a creative act in which creation and execution are often simultaneous. Yet, if Michaelangelo had not had an image in mind, he would never have started with the intention of carving the David from this particular piece of stone. The experience of attempting to make reality conform to an image argues in favor of the traditionalist conception of images as causes or as factors in a sequence of causes and effects.

F. Thought Imagery

The memory image of a dog can become evoked when one wills to imagine an image of an arbitrary dog, and again when one thinks about the important features of dogs in general. As in the case of public images, mental images can undergo an assignment by the agent, transforming it from the visual record of a particular object, to a likeness of a possible object, to a symbol for a class.

Historically, the issue of thought imagery has been utterly confounded by the issue of visual likeness. Obviously, an accurate memory image is visually similar (for the subject) to an actual dog. Similarly, when a dog image is brought up to consciousness to serve as an exemplar in thought for the concept "dog," this visual particular may

well be thought to be visually similar to all the other members of this class. In some cases, there may actually be something in consciousness similar to the various options suggested by imagist theories: blurred photos (James), images stripped down to their essences (Aristotle), or articulated stick figures (as in some contemporary computational models). These retain visual similarity. But when the same image is to be thought of as an exemplar of "mammal," the visual similarity evaporates. There is no visual image for "mammal," or any of the thousands of other such concepts. Nor can the problem be repaired by supposing that images can do justice to concepts by supposing additional images are "present in power," that is, that the subject has the ability to substitute additional images of the same class for the current particular present in consciousness. Such a power presumes what it purports to explain. One must already have a grasp of a concept to use another image as a symbol for it.

At this point, the entire theory of visual similarity is threatened. Since the instrumental value of the image disappears at the final stage of its transformation to thought, perhaps it was wrong to think of it as part of the mental landscape in the first place. Perhaps some other, less obvious, factor accounts for thought. Perhaps it was wrong to think of "visual" concepts in the first place.

Being a dog, for example, is not defined as being visually similar to a dog. If that were the case, we might not distinguish them from wolves.

Worse yet, the entire Symbolist Theory of Thinking (see discussion of Price, chapter 2), is threatened. For if there are no visual symbols for such concepts, what symbols may be employed for the purpose of being the particulars instantiated in consciousness in and through which we think?

To retain the symbolist view, one cannot suppose that there is nothing present at all in consciousness. That would make us literally unconscious. Nor can one suppose that the mind is open to, or comes into contact with, rational essences, propositions, forms, intelligibles, or any of the other abstract entities proposed to give meaning to mind. This would be to reassert the Classical Theory of Thinking.

The principal error of these theories is the assumption that visual similarity is constitutive of the being of a symbol. In the case of visible images, we saw that they could be instantaneously transformed to symbols for which there might not be an image and for which any visual similarity to the image was irrelevant. The theory that form follows function and its consequences, the theory of general ideas and Price's theory, are therefore wrong.

The shift to thought imagery involves more than just an intentional shift toward a single presentation. It also involves a shift in the rules of mental engagement. Thought re-imposes the requirements of the actual world. Einstein may imagine riding a light beam, but he is not thinking about it until he attempts to deduce the consequences of imagined actions under these conditions as they would apply to the actual world of physical laws. Descartes can imagine that his mind exists without his body, but when he considers this supposition in the light of what God and nature teach him, he cannot actually think this to be true (Meditation VI). Thought images, then, give rise to non-imaged thought, by means of reasoned consequences of situations symbolically indicated by images. None of these images may be strictly necessary, but they can be extremely helpful.

The issue of the necessity of images has been confused with the helpfulness or suggestiveness of images. Speech is structured by a sequence of discrete parts. It establishes spatial relations by abstract designation rather than by direct symbolic representation. Think how long it would take to specify the positional relations of the players on a stage set. Images allow relations to be presented simultaneously rather than sequentially. This obviously has enormous evolutionary advantages, since any part of an environment becomes equally ready for response.

The usefulness of phenomenally-presented images becomes most evident when the topic of thought is itself space and the relation of actual or hypothetical parts and relations within it. Example: imagine two equilateral triangles superimposed, the first with the base horizontal and the second inverted and directly over it, such that its apex bisects the base of the first. Various questions can then be asked about the figure (number of apexes, alternate interpretations of the combined figure, etc.). In cases like this, the use of the image appears to be necessary.

To address the historical question of the necessity of imagery in thought, we need to distinguish between practical necessity and apodictic, or logical, necessity. In problem-solving cases like the above (two triangles) or in environmental situations calling for visual recall, it may be practically necessary for the subject to generate a phenomenal image in order to solve the problem at hand. Failure to generate the image results in failure to perform the task. This is not to say that logically it is impossible that any subject, under any conditions, might not consciously manipulate equations to solve the same problem. Imagists cannot, then, prove apodictic necessity; they can only point to examples where the natural human proclivity is to form images and failure to form them generally results in failure to perform a certain task. Fortunately for

philosophical imagism, necessity (of either sort) is not the issue. The claim is that some occurrent images are in fact instruments of thought.

The practical necessity of images in thought, then, actually seems to involve a very restricted class of task-oriented or problem-solving cases. The historical idea that an image can do the work of a universal and is therefore necessary is, as we have seen, a powerful one. If meaning is derived only from words, the meaning of each word can only be given in terms of other words. Semantic content can never be injected into the circle of words referring to other words unless some words derive their meaning from something whose meaning is intrinsic to itself. If we enlist propositions to do this job, we need to explain the existence of abstract objects. It seems the task is much easier if we assume that something mental, yet non-propositional in nature and derived directly from experience, is involved. Therefore, it has often been suggested that mental images fit the bill.

The general problem with this line of reasoning, as we have seen from the British empiricists through Price is that mental images do not seem to have the right properties. They say, if mental images are visual particulars, we once again cannot explain content unless we presume that they are presented to us in "surprise fashion" very much like sense

data, from which we might discern what they indicate in the manner of perception -- but this introduces the homunculus problem. There is no resolution to this problem within traditional imagist theory, and the descriptivists have been correct in identifying the problem. This is not to say that any descriptivist-inspired alternative (e.g., some form of nominalism) therefore solves the problem of universals. Essentially, as I see it, the imagist/descriptivist debate leaves the problem much as it was. Pursuing this issue further is beyond the scope of our present concerns.

G. Summary: The Nature of Mental Images

Mental images exist on a continuum from those in which automatic, physiological factors predominate (after-images, perhaps eidetic images), to those in which interests in responses to the environment predominate (memory and perhaps dreams), to those in which self-directed creative impulses are set in the context of the possible and the actual (imagination and thought images). Each of these states represents a deepening of conceptual components in the imagery experience and may be associated with a corresponding decrease in importance of visual content. Having memory, imagination, and thought images is each characterized by intentional shifts with a distinctive character, independent of the purely visual components, and

dependent upon the distinction between object of presentation and symbol. Memory, imagination, and thought images can provide a mediated awareness, replete with multi-modal capabilities, of a non-present environment -- a space that was, or might be, experienced. These forms of mental images are not pure visual presentations, but are provisionally bound to conceptual content. What we mean, in these cases, when we say that we are having mental images is not that we are hallucinating or dreaming aimlessly, but that our mind is taking something under consideration, and part of that process involves a quasi-visual experience in and through which a particular content is present to us. Mental images of memory, imagination, and thought are more like mental topics than they are pictures in the mind. The human mind is (perhaps) unique in being able to release a pictorial presentation from its content, to consider it as something new, or even strange, as just a visual presentation with no history or purpose. This ability is the foundation of radical skepticism (for which we gave reasons to presume false), but also the foundation of thought, which lifts the "given" and pronounces whatever it wishes a symbol for the absent.

IV. Explaining Mental Imagery

We have completed the first two objectives of this study, the restoration of lost (traditionalist) information and the creation of a descriptive, intentional analysis of imagery by types. It remains to complete the third objective, to clarify the options for an explanation of mental images. In this section, I am primarily concerned with laying out the options, but in the process I argue for my own view, that descriptive metaphysics is at present the most viable way we have of examining the nature of mental images.

A. Images and the Mind/Body Problem

As we know (chapter 2), one of the most well-known passages in the history of mental images is Aristotle's comparison of the formation of a memory image to the impression of a seal made in soft wax. Less well-known is Aristotle's introduction, in the immediately following passages, of the problem of presence and absence. Aristotle asks:

[W]hen one remembers, is it this impressed affection that he remembers, or is it the objective thing from which this was derived? (On Memory and Reminiscence, 450b13)

Bear in mind that we have already established that (as Aristotle also argued) memory presentations cannot be recognized as such unless they are known to be representations of something absent. Then Aristotle asks:

how is it possible that, though perceiving directly only the impression, we remember that absent thing which we do not perceive? (On Memory and Reminiscence, 450b15)

In other words, how is consciousness of the absent possible at all? Aristotle attempts to answer this question by using an example. Aristotle points out that when we contemplate a painting we can contemplate it as something absolute, just as it is itself, or as a representation of something else simply by a change in point of view: "one changes his point of view, and regards it [the presentation] as relative to something else" (On Memory and Reminiscence, 451a8). So, he concludes, if a presentation is "actualized in consciousness," and if "the soul perceives it qua related to something else, then...the experience involved in this contemplation of it is different" than if it were just a mere presentation (On Memory and Reminiscence, 450b25-451a3).

This explanation or, more precisely, observation sets out a path we have already explored at the beginning of this chapter. We followed Aristotle's implied suggestion that

the answer lies in understanding how images are used in the public realm. It must now be admitted that this was a bit of misdirection. This does not explain the inner realm, it just moves the problem of inner representation out into the public realm and asks us to accept what goes on there as proof of the non-mysteriousness of the inner realm. We are told that images can represent the objects they do by a change in point of view. No doubt. In the public realm, the agreed-upon meanings of images might be accounted for by some complicated system of verbal and other non-vocal cues sustained by implicit agreements among various observers. In the private realm, no similar hypothesis suggests itself. My mental image of a man holding his hand inside his shirt can suddenly become a representation of Napoleon. My mental presentation of Tim can suddenly become a representation of Tom, his identical twin. But how is this to be accounted for? What, precisely, is a change in a mental point of view?

We said these changes in point of view were intentional changes -- again, as if that were a sufficient explanation, and as if descriptive metaphysics were an unambiguous project. We need to define intentionality more precisely and locate it within a broader system of terms. In defining intentionality Brentano states "no physical phenomenon exhibits anything like it" (1973/1874, p. 89). This

apparently means that intentionality is utterly without possibility of explanation in terms of physical entities and the causal laws presumed to govern them. This understanding of intentional phenomena, when combined with what the history of mental images accepts as the origin and function of mental images, is the foundation for the most intractable philosophic problem about mental images. The other old saws of the history (role of imagery in thought, homunculus problem, etc.) are by comparison far less problematic.

The nature of the problem is indicated in the following set of propositions:

1. Mental images exhibit intentionality because they can represent something absent from present perception. The content of images is defined by what they represent.
2. The origin of mental images is in the physical workings of the perceptual equipment of the body.
3. The mental realm is defined by intentionality, reference to a content, or the ability to understand an (inner) presentation as being of something absent. Nothing in the physical realm appears to exhibit intentionality.

We now have a set of philosophically problematic theses. Each thesis has intuitive appeal, yet finding a harmonious interpretation of them that yields a satisfactory

explanation of human mental powers proves to be enormously difficult.

The main problem, historically, is that theses 2 and 3 are thought to conflict. How can a physiological, materialist-based explanation of the origin of mental images be reconciled with the mental capacity to take a given presentation as representing something absent? Physical things are either present or not. Physical things do not (at least in any obvious way) indicate or intrinsically represent anything which is absent. How can a physical residuum from sensory processes become transformed into or serve as the basis for a mental phenomenon that represents something absent? Mental and physical modes of describing events and processes seem to be utterly different. It is therefore a problem when we are asked to refer to physical processes in order to explain mental processes.

What solutions present themselves to this trilemma? Let us review some options, beginning with the present account.

B. Accepting the Mystery

The solution I find the most persuasive is to accept all three theses as basically true. The apparent conflict between theses 2 and 3 can be ameliorated, if not resolved, if we accept four-way causation. Mental images can be

caused by physical events, but that does not mean that they must somehow also remain physical events. So we do have an explanation -- a causal explanation -- of how they are brought into being. It is the mode of being of mental images that is in question not their causal history. Because mental things are a new order of being, we do not have a reductive explanation, i.e., an explanation that would -- to put it paradoxically -- explain how mental images, despite being mental, are nonetheless physical. What many philosophers and psychologists want to insist on is that we must have not only a causal explanation, but a reductive explanation in order to make headway on the mind/body problem. If we release this restriction, it is possible to further analyze the being of mental images without being distracted by the demands of reductionism.

There are three general reasons in favor of releasing restrictions on the types of explanations and the types of causality that are appropriate to entertain in conjunction with the mind/body problem. These derive from a priori, practical, and scientific considerations. I shall indicate briefly what each of these is.

Hume argues that we lack an a priori reason for supposing that causal connections cannot bridge the gap between the mental and the physical. It is only a prejudicial supposition that mental and physical events are

too dissimilar to be causally connected that prohibits us from accepting the possibility of their causal connection. Hume defended this position eloquently in the following passage:

We need only reflect on what has been prov'd at large, that we are never sensible of any connexion betwixt causes and effects, and that 'tis only by our experience of their constant conjunction, we can arrive at any knowledge of this relation. Now as all objects, which are not contrary, are susceptible of a constant conjunction, and as no real objects are contrary; I have inferr'd from these principles, that to consider the matter a priori, any thing may produce any thing; and that we shall never discover a reason, why any object may or may not be the cause of any other, however great, or however little the resemblance may be betwixt them. (Hume, 1739/1978, p. 247)

And, as far as experience teaches us, Hume continues, we perceive a constant conjunction between thought and motion all the time: "every one may perceive, that the different dispositions of his body change his thoughts and sentiments" (Hume, 1739/1978, p. 248). Therefore, Hume concludes, "matter and motion may be regarded as the causes of thought as far as we have any notion of that relation" (Hume, 1739/1978, p. 250).

One of the long-standing premises of traditional biology and psychology is that these sciences have a different starting place than sciences such as chemistry or physics. The most compelling biological and psychological explanations often take the form of referring to an organism's inner desires, needs, beliefs, and other properties that have no apparent form of practical reduction into terms of equal explanatory value. While biological or psychological terms might, according to some accounts of physical causality, be reduced to an elaborate history of physical micro-events, there is still an enormous practical value of retaining vocabularies that pick out the biological and psychological factors of our direct acquaintance and immediate concern.

One of the assumptions that seems to be accepted along with the notion that reductive explanations are, or will be, "final" is that physics itself is (or will be) the final terminus of our knowledge of forms of causality and the ultimate entities that make up the world. If this supposition rests on a faith that contemporary physics has itself resolved what the ultimate principles of the universe are likely to be, then it is simply mistaken. The contemporary controversies over the nature of wave/particle duality and the meaning of Bell's theorem demonstrate that contemporary physics is in no position to state its own

principles unambiguously, much less stipulate the ultimate principles of any science whatsoever. The supposition, often implied or stated as a "principle of reductive explanations," that in the final analysis the principles of mental causation or the fact of human consciousness will not be included in physics is far from secure. I state this point, without any elaborate defense, merely as a reminder that there are many possible points of view about what scientific reductionism amounts to.

We lack, then, any compelling reason to say that because we cannot (presently) provide a reductive explanation of mental phenomena, we have no explanation at all. Let us now see how we can use the principles of causal history and description of mental phenomena to elucidate mental images, the homunculus problem, and the epistemic claims of psychology.

We find that it is impossible to reduce mental imagery to either a pictorial or a descriptivist phenomenon. We find it impossible to maintain the dichotomies that form the basis of the differences between the imagist and descriptivist perspectives. We find it impossible to completely separate the conceptual and pictorial, the active and the passive, and the being-present-to and being-present-for in having mental images. I suggest that the inability to maintain these dichotomies is due to the nature of mental

images themselves. There are ineffable, vision-like, pictorial features to mental imagery experiences, but these are never without the effects of the subject's intentional awareness toward these experiences, be it the subtle awareness that what is presented is not an external stimulus, or a more intrusive conceptual frame that what is presented is logically possible but false to the actual world.

Because mental images retain these ineffable vision-like features they cannot be reduced to mere description. Since a description never captures the "object" of visual consciousness, one refers to the mental image as an object, in order to identify the state of consciousness we mean to designate. Mental images are not physical objects, but we adopt an object language in speaking of them analogically as objects of inner vision.

The necessity of this analogical language resolves the homunculus problem. When taken literally, the object language requires an inner homunculus to make mental images inwardly seen. Yet we can no more explain in strictly physical terms or strictly descriptive terms inner seeing than outer seeing. Neither kind of experience has any explanation whatsoever in light of a complete description of the physiological processes and the physical laws thought to be governing them. In vision, we can only trace the

progress of the electro-chemical changes inwardly from the eye to the cortex so far, and then at some point announce "and then we see" - more precisely, we see that we see. We see not in the manner of sheer insect-like receptiveness to light stimuli, but in the manner of self-conscious awareness. The physical transforms into the mental. The same is true when we trace the development of mental images from some inner impulse outward toward the visual cortex and even to the retina. The only "reductive" or "physical" explanation we have of the similarity of these experiences is quite general. Apparently, some of the same visual centers of the brain and eye are activated in both seeing and imaging. This general physiological explanation shows the so-called homunculus is just ourselves becoming conscious of visual presentations using the same physiological equipment that we do in seeing. The homunculus, then, disappears when we stay within the realm of general physiological explanation, but the sheer fact of consciousness through seeing and inner awareness remains as mysterious as ever if one attempts to reduce this explanation to more primitive terms.

The epistemic claims possible for a philosophic psychology, under this conception of mental images, are modest. There is no claim to be made as to the ultimate explanation for conscious mental images, unless there were

to be an ultimate explanation of consciousness itself. Other than to say that consciousness and its contents are phenomena we directly encounter, and that these are evidently the result of biological processes in living beings capable of inner representations of the environment, we have no deeper, or more reductive, explanation. Our "explanation" takes the form acknowledging a brute fact -- a description of the world. We agree with Aristotle and simply observe that the mental act of supplying a reference to an image is something we can do. Any further details we can provide represent attempts to understand imagery states as states of which we are self-consciously aware, on their own terms. We use "mental" terms, such as "understand in a new way," "supply a content to," "make a mental reference to," and so on, to explain what it is we do. If this view is correct, as I believe it is, then description of this sort will be all we have. This description uses the irreducible terms drawn from experiences and refers to the "objects" with which we are directly acquainted.

If we accept this form of descriptive metaphysics combined with bio-physical causes of mental states, then our work is essentially over. By this I mean that we can, of course, elaborate our description, expanding our inventory of mental acts and mental dispositions, but we have now accepted or established the realm, i.e., the mental realm,

in which our further descriptions will be sought. Whatever we find in this way is unlikely to be either any more or any less mysterious than the already established fact of human consciousness.

Further investigations of mental imagery can also continue in practical psychology and physiology. Richardson's program of discovering the subjective and objective conditions of imagery experiences remains intact, as does the goal, originally envisioned by traditional psychologists like Fechner and Wundt, of finding all the physiological concomitants of mental states.

Finding and interpreting mental/physical correlations defines the prospects and limits for traditional philosophic psychology. Wundt's attitude toward the limits of psychological knowledge is exemplary (see Foundational Period: 1860-1901, chapter 1). Wundt adopted what was essentially explanatory dualism while maintaining metaphysical monism. For Wundt, the separation of mental and physical explanations had to be accepted as a given in psychology. This did not mean there were two separate metaphysical substances in which mental and physical events occurred. Rather, Wundt thought of the series of mental and physical changes as two parallel streams of events. Any series of mental events had physical circumstances that coordinated with it, and vice versa, but each series of

causes retained its own integrity as a viable object of study. In the final analysis, however, the physical accompaniment of psychic changes were of secondary importance, because Wundt considered the subject matter of psychology proper to be the conscious contents of the human mind. The primary aim of this science is solving practical problems for the benefit of human beings; it is not an attempt to empirically investigate how consciousness of the absent is possible in physical terms.

This type of philosophic psychology supposes a metaphysics in which mental images have being because one accepts potential being, relative being, and real relations among subject, object, and signs indicating objects. In this universe, we can account for mental images essentially by describing both the physiological and mental changes that occur when subjects have mental images. In this universe, too, my accepting either a visible thing or a mental presentation as an image or a symbol is a new state of the universe, and it makes no necessary connection with any particular physical states in the body (though, it is presumed, there is some, unspecified, state corresponding).

C. Mental Images as Mental Objects

1. *Review of the Problem*

In chapter 1, I stated that the intuitive, common sense view of mental images is that they are kinds of mental objects. I pointed out that many images seem to exhibit continuity over time. Memory images, for example, seem to be recalled over and over again, and imagination images, even though they may be transitory, one-of-a-kind images, seem to be stable while we are having them. Some mental images, for example, can be mentally "manipulated," in a manner analogous to physical manipulation, by rotating or moving them in an imagined space. Finally, I pointed out that mental images might be regarded as objects in the sense that they are like "materials" or "constituents" in the overall economy of mental life. We seem to use or employ images as fundamental constituents in memory, imagining, and thinking activities, and we are subject or witness to them in the form of dreams, hallucinations, eidetic images, and after-images.

Despite these considerations, I argued in chapter 1 that it was necessary to put quotes around the word "object" because even elementary considerations show that mental images do not fit our concept of ordinary physical objects in the external world. Mental images do not literally have size, shape, or color. Other difficulties for accepting

mental images as objects were indicated in the review of history in chapter 2. This showed that object language results in a tendency to conceive of mental images as if they could be literally seen by an inner eye, and this requires a homunculus. Descriptivists attempted to remove the homunculus by showing how linguistic elements and concepts could fulfil the role attributed to images. The descriptivist correctives, I argued, went too far, resulting in loss of a correct description of the phenomenon to be examined. The review of history was therefore inconclusive, and the proper sense for the "object" designation of images was not found.

In this chapter, I have attempted to consolidate common sense with science and philosophic psychology by accepting a definition of mental imagery as referring to quasi-sensory or quasi-perceptual experiences. This definition also accepts the fact that these experiences may be significantly like perceptual encounters with actual objects and that these mental encounters may have consequences similar to their sensory or perceptual counterparts. The sense of "objects" implied by this definition also stands in need of elaboration.

Finally, I have also referred to Brentano's definition of intentionality. Again, there is mention of objects and their "inexistence" in the subject. The "in" of the

intentional inexistence of the object needs to be clarified since it is not obvious how there can be objects either "in" or "existing" in consciousness.

In short, the philosophic task remains of attempting to sort out what the scare quotes around the term "object" actually amount to. We need to clarify how such objects can be said to be "in" the mind, in what manner, if any, they may be said to exist, and how, or whether, they obtain the properties they seem to have.

I shall begin by briefly describing two competing views about the nature of mental objects. The two views are the adverbial account developed by Ducasse and Chisolm and the act/object account defended by Moore and Jackson.

2. Ducasse's Adverbial Theory

Ducasse states his theory as one to be contrasted with G. E. Moore's "object" or sense data theory of conscious awareness. Moore pointed out that in the case of sensing something blue, it is possible to distinguish the consciousness of sensing from the sensation itself. The sensation is of blue, rather than of, say, green, so there is a distinct, identifiable sensum or object that we are aware of that differs from other objects. At the same time, there is an element that remains the same in both sensations -- consciousness -- so it is the objects, not consciousness,

that differentiates the cases. Normally, we think of "blue" and our awareness of it as being unified or at least concurrently existing, but, as Moore pointed out, there is no logical objection to the possibility that "blue" and our consciousness of it could exist independently. This establishes the logical possibility of an unsensed sensation or sensa that has independent existence. Moore introduced this possibility in order to argue against idealism. By arguing against the idea that consciousness of sensory qualities necessarily implied the existence of something "in the mind," rather than something "objective" and possibly capable of independent existence, Moore hoped to weaken one of the central arguments in support of idealism. This argument is that the being of sensible objects consists entirely in their being perceived; as Berkeley put it, esse est percepi. Moore's argument is that the proposition that the esse of anything consists in its being perceived does not even hold true in those cases where consciousness and its objects seem most firmly united, i.e., in the case of the apprehension of sensory qualities such as blue.

Ducasse argued against Moore not in order to defend idealism, but in order to show that esse est percepi is true for a certain class of conscious processes. In Ducasse's view, this does not result in idealism, because he distinguishes between the content of conscious processes and

the object of conscious processes. In the case of consciousness of blue, blue is the content of consciousness, not the object of consciousness. For this content, it is true that esse est percipi, for the content exists, although it has no independent existence apart from the process of which it is a part, and this is the only mode of existence it can have. The object of consciousness, on the other hand, must be an object external to consciousness, having an independent existence.

How are we to understand the mode of existence of the content of consciousness? Ducasse claims that this is a mode of existence of "things" that we readily accept as part of the real world. Consider a waltz. Waltzes are things that can exist, but a waltz has no existence apart from the act of people dancing it. What we find in case we are looking for instances of waltzes, and what we come to know, if we seek to know waltzes, are not some independently existing things, but some recognizable parts of a particular kind of process. Similarly, in our consciousness of blue, we become aware not of something independently existing but something that is part of the conscious process itself: "what is known by the knowing process is then its own determinate nature on a given occasion" (Ducasse, 1951, p.260). To say we have consciousness of blue, then, is ultimately a way of characterizing a particular mode of a

conscious process. As a waltz is a mode of dancing, consciousness of blue is a particular mode of "being aware of." It is not the case, then, that there is any object that literally is blue when we see blue. "Blue" is not something independently existing in the world but only something brought about by, and inseparable from, conscious activity. This activity takes on the mode of awareness of its own specific form of activity we call sensing blue.

In light of these considerations, Ducasse claims that the essence of the activity of seeing blue would be most perspicuously formulated by eliminating the noun "blue" altogether. The process should be described as "seeing bluely" -- a process verb, adverbially modified to indicate its particular kind. Hence, "blue" is not something objective at all; it is a species of conscious awareness, not an object of awareness.

3. Chisolm's Support for the Adverbial Theory

In support of the adverbial theory Chisolm (1966) argued that the object theory utilizes various forms of invalid inferences and unnecessarily multiplies the entities necessary to explain perception. One error is to conclude from the premise

(1) something appears F

that

(2) something presents an appearance that is F.

This error is easily seen by substitution. From, "this ship appears water-tight," we cannot conclude that "this ship presents an appearance that is water-tight" (Chisolm in Rosenthal, p. 382). This, Chisolm would say, is the kind of error Moore commits when he attributes "blue" to a sense datum or an appearance in consciousness. From the fact that there is an appearance of blue, we cannot conclude that the appearance itself is blue. Reasoning in that vein will end in infinitely multiplying entities. For if any perceived object A with property X generates another entity (an appearance) B, having property X in virtue of which A is said to have X, then B must also generate an appearance entity C, in virtue of which it may be said to have property X, and so on. In order to eliminate these unnecessary entities, Chisolm concludes, following Ducasse, that it is necessary to avoid attributing properties to appearances.

Chisolm's argument is an important one to bear in mind in determining the issue of the qualities of mental objects. For the purposes of the discussion below, I shall accept Chisolm's argument that to attribute properties to appearances themselves is an error. I shall refer to this as "the sense datum error." This error is closely related to another one that we must also consider. To say that from "I see a ghost" it follows that there exists a ghost that I

see, is also an error. All of the mental images we report might be likened to such an example. I shall refer to this as "the existence error." We should note that each of these errors might be corrected by a suitable interpretation placed on terms such as "appearance," "see," or "exists," but that without such embellishments they remain logical errors.

4. Moore's Objection and the After-Image

It is important to note that what we have said so far about the adverbial theory is only indirectly related to our investigation. Ducasse and Chisolm concentrated on an analysis of perception as an adverbially defined mode of consciousness. In one fundamental sense, it may even be said that Moore and Ducasse are bound to agree on the essence of perception as it applies to our investigation. Both accounts endorse versions of common sense realism: independently existing physical objects are the objects that we know. Whether the means by which we know them are designated "contents" or "objects" of consciousness is immaterial as long as it is recognized that some form of conscious mediation is involved in the process. When a physical object is present, the nature of this conscious mediation may be debated; whether it is most accurately designated a mode of consciousness or whether it involves

consciousness and a sense datum is a problem, but it is not precisely the same problem as the one we face in the case of mental images. Ex hypothesi, for the purposes of our investigation, there are no conscious mental images involved in perception.⁹ We are concerned with the relation of consciousness to its "objects" when consciousness is not directed toward an external stimulus.

Now, both Moore and Ducasse did address the problem of one sort of mental image we have mentioned: after-images. Moore thought the ability to see blue in the absence of any physical object supported his position, since the after-image is a form of direct presence of a perceptible quality in consciousness. Since the question of the ultimate relation between consciousness and the physical object was now ancillary, the after-image case supported even better, he thought, the claim that consciousness is necessarily of non-physical objects (Moore in Ducasse, pp. 282-283). Ducasse responded that after-images are not simple objects (of any kind) at all. Rather, they are complexes of qualities. That is, an after-image is not a single intuition of a single color quality but always appears with the additional qualities of size, shape, and location. While Ducasse allowed that there was a sense in which the

⁹ Though, as we stated earlier in this chapter, whether or not there are unconscious mental images in perception is a point that might be debated.

after-image constituted a whole, and might even be designated a "sensa" or "sense datum," he held that (1) it was nevertheless composed of distinguishable elements, and that (2) in order to determine the status of the whole, one need only determine the status of the parts because "the existential status of the sense datum...can be no other than that of its elements" (p. 284). The elements, in turn, were most aptly described in terms of modes of consciousness since they literally were qualities and did not themselves bear qualities (as Moore's sensa were reputed to bear). In order to formulate the experience of having an after-image according to the adverbial format, Ducasse suggested that we should most properly speak of seeing an after-image, not just blueely, but, for example, blueely, squarely, and largely.

We now have two accounts, both of which seem to be partly right. Ducasse's account seems to be right from the standpoint that in the absence of a physical stimulus, certain forms of conscious awareness should be thought of as modes of consciousness itself. Moore's account seems to be accurate in pointing to the phenomenological fact that we encounter after-images as if they were separate objects and not parts of consciousness. At this point we will do well to consider another aspect of the object theory.

5. *Jackson's Object Theory*

Jackson (1976) argues that the adverbial theory is not successful in eliminating mental objects because its proposed linguistic recastings of the nature of our experiences fail to do justice to the nature of these experiences, specifically sensations and after-images. While Ducasse has argued that his own theory correctly represented the common sense view and attributed the failure of our linguistic conventions to conform to this to "linguistic inertia" (p. 278), Jackson thinks our linguistic conventions correctly indicate the true state of affairs. By convention, we do in fact refer to many sensations and mental images as singular terms identifying something existing at a particular time and (sometimes) in a particular place. (This corresponds with the assessment of the common sense view I have maintained since chapter 1.)

Jackson claims that mental objects can be eliminated only if we can find a correct, non-question begging analysis of a statement such as

(1) Bob has a pain.

A non-objective account needs to show that "pain" (or some other named sensation) does not appear in a way that logically implies its objective status. But it is immediately obvious that there is not, for example, such a thing as someone simply having "a pain." Bob's having a

pain implies that he has a pain somewhere, and this gives an objective status to the pain. The adverbial approach, in order to capture this, must resort to awkward constructions such "Bob senses painfully-legily." Similarly, the adverbial approach cannot successfully recast the meaning of what it is to be conscious of an after-image that has more than one property. For example, if (following Ducasse) the suggested formulation for sensing a blue, square after-image is

(2) I sense bluely and squarely,

then this cannot logically differentiate two different cases:

(3) I sense one blue thing and one square thing,
and

(4) I sense one thing that is both blue and
square.

According to Jackson's critique, then, Ducasse's proposed solution to identify the locations in the visual field as modes of consciousness simply cannot work. Ducasse's formulation "I sense bluely, squarely" cannot distinguish between sensing an indefinite patch of blue and a square from sensing a blue square. Nor will separating the visual locations of such color and shape intuitions do the trick. Sensing "leftly bluely" and "rightly squarely" would indeed remove ambiguity, but it also implicitly introduces a new form of object identification into the description of the

phenomenon. The locations in the visual field are themselves species of objects. We have a sensation "here" or "there" in the visual field, thereby logically implying an object-like status to the segments of visual space themselves. These spatial object areas, designated "left" and "right," then remain as static (non-adverbial) givens even if the mental objects "in" them can be designated as "modes" rather than objects.

We see, then, that there are substantial reasons for accepting that a linguistic account also terminates in the need to accept the object status of mental images.

6. *The Need for a Metaphysical Account*

Let us review and assess these accounts. Ducasse's account seems physically correct, even if metaphysically ambiguous. Moore's account seems phenomenologically correct. Jackson's arguments are reminders of the fact that mental images are linguistically identified as objects, even if only minimally as objectively-given aspects of the visual field.

If both Moore's phenomenological and Jackson's linguistic accounts of mental images grant them an object status, is there a metaphysical account that conforms to

this?¹⁰ In what sense, if any, can we grant object status to mental images? Chisolm's arguments are reminders of the fact that in any object account we need to address the sense datum and existence errors. The analysis we have so far, then, does nothing to settle the issue of the metaphysical object status of mental images.

7. Desiderata for an Object Theory

An object theory of mental images based on our investigation should retain, as far as possible, (1) the characteristics of mental images that have been found central to the revised common sense approach advocated in this chapter and (2) the most valuable insights into the nature of mental images introduced by discussion of the act/object and adverbial accounts. I propose that a metaphysical account of mental images should address and, if possible, decide upon the issues related to the following characteristics.

(1) Object Awareness. Mental images are experienced by us as encounters with presented properties. These properties often cohere, if only temporarily, in a way similar to the coherence of properties given with external objects.

¹⁰I owe this way of stating the "object problem" for mental images to Charles Landesman.

(2) Mode Awareness. We are aware of most mental images (mental images used or created in normal waking states) in a mode that identifies them as experiences distinct from ordinary perception. We are aware of them as being like a sensation or perception of an ordinary object. Imagery experiences, in other words, occur with an accompanying awareness of the context, one that identifies our experiences as being of a certain type or in a certain mode of conscious awareness.

(3) Self-Conscious Awareness. When we are conscious of a mental image (in normal waking states) we are not only conscious of the image, we are self aware, or aware that we are aware of the image.

(4) Relative Being. Mental images are, or can be, understood to be representations of visually similar visible objects. Like publicly visible objects, their being qua image is derivative of the existence of conscious agents who understand the appearance properties of mental images as relative rather than absolute.

(5) Causal Relevance. The common sense view is that mental images bear information in memory and act as tools of imagination and thought. In this sense, they act as mediating elements in a series of causally connected events (e.g., the derivation of a theorem, or the shaping of a statue). In other cases, mental images play a more

immediate role and may be identified as either causes or effects themselves. Dreams or after-images, for example, may be either the results or causes of other mental or physical events. Barring strong evidence to the contrary, mental images should be accepted as fitting into the normal causal chain of events in our everyday life.

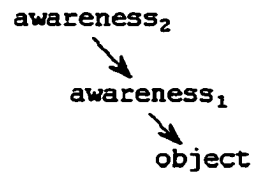
(6) Inexistence. There should be some identifiable sense in which mental images can be said to "in" the subjects that experience them. This would help give some intelligible meaning to the commonly-accepted idea that statements like "she has a mental image" can be a true statement correctly reflecting the implied linguistic analysis that refers to an inner object.

Enough has been said on the way in which we are aware of the various types of imagery (the mode awareness in which mental images occur) and the various properties we may say "inhere" in the mental images belonging to these types. In the sections that follow, I shall be primarily concerned with the last four desiderata.

8. *Self Awareness and Object Awareness*

When we are conscious of a mental image we need not be conscious of it alone. We can also be aware that we are aware of the mental image, and this, as Moore says, is one of the aspects we mean to capture when we say that something

is a mental, as opposed to a physical, fact. Moore says we



are aware of the object of awareness and aware of that awareness in exactly the same way (Moore, 1903, p.449).

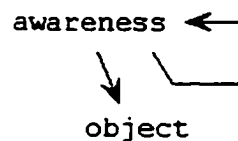
This analysis cannot be entirely right if it is meant as a full explanation of how awareness is related to objects in consciousness. Aristotle's treatment of this issue indicates one of the problems. Aristotle asked by what sense could we be aware that we are aware of a colored object (On the Soul, 425b10-427a15). Aristotle felt there

were only two options. First, we could say that there are two senses aware of the same object. The first sense would be aware of the object alone and the second sense would be aware of the object plus the awareness of that object (as indicated). This appears to be Moore's solution. The problem with this solution is that the second sense does not yet specifically achieve self awareness. It only posits a higher-order awareness that bears a relation to another awareness. This higher-order awareness in turn needs to be aware of itself, but if this is accounted for by a still

higher-order awareness, we have the beginning of an infinite regress.

Aristotle thought the only solution was to accept it as a brute fact that there is a single sense that is aware of itself and aware of its object in the first place. Whether or not Aristotle's pre-Cartesian conception of self-conscious awareness can be likened to our contemporary view is controversial (see Modrak, 1987), but this need not concern us here. Our concern is the general form of the relation between subject and object.

Including self-awareness impacts how we understand the way in which the object is "given" in consciousness. It means, among other things, that we are not aware of mental objects simpliciter, e.g., as a fly might be aware of a moving object. As many imagists have tried to point out, our self-awareness carries with it some nascent knowledge of the individual's own cognitive resources that may be applied



to an image. One is aware that other images are "present in power" (as Hume observed), that a rotated image might have a different interpretation, that an image might be of something impossible in the actual world, and so on.

When we refer to the fact that self-awareness is involved in imagery consciousness, this also introduces a possible way to understand how the object can be in the subject. We may be tempted to say, as in Ducasse's theory, that what we are aware of in consciousness is not an independent object but a mode of consciousness itself. It is not, after all, the subject that is "colored," or "square," so it must be some part or sub-process within the subject that has these properties. But if we attribute to some part or sub-process these properties we shall commit the sense datum error. It would be more appropriate to say, then, not that the parts or sub-processes have properties but that they are properties. Still, this does not seem correct, because the question reasserts itself: properties of what? Not the subject -- that has been excluded -- and to say "of an object" just starts the problem again.

The above considerations lead us to question the nature of the independence of the subject and the object once more. The fundamental intuition that consciousness of mental images is due to internal processes in the subject is a strong one, and it may be that one could still conceive of the inner object as a part or sub-process of consciousness. Aristotle took up a similar consideration when he asked how the subject and the object could be separate and yet "one." Aristotle reasoned that the object and the sensing of it are

"one" in the sense that they come to be simultaneously. That is, the object, qua something perceived, is only potentially perceptible until it becomes actually the percept of a sentient being. Likewise, a sentient being (or a power of sense) is only potentially conscious of something until it senses something. The two potentialities become a single actuality in the moment of perception. Yet, Aristotle claimed, "the distinction between their being remains" (On the Soul, 425b25) and, he added, "they differ in their modes of being" (On the Soul, 426a15-20). We shall follow Aristotle's suggestion, and turn next to examining the mode of being of the inner object in the hope that this will clarify its status as an object.

9. The Mode of Being of the Inner Object

According to our desiderata, we want to capture the sense in which images are relative beings. At the same time, we want to keep, if possible, some intelligible notion of the inexistence of the object. The first question, then, is to consider how a relative being could be in a subject.

Recall that just as in the case of perception of a visible image, we can, when attending to a mental image, attend either to its visual features or to what it represents. To appropriate the terms "content" and "object," we can make the visual content the object of our

attention. And, just as in perception, we have no consciousness proper of a mediating visual content qua representation unless we are aware either (1) that it at least potentially bears a relation to something else or (2) what, specifically, it does in fact refer to. This conforms to the analysis of visible images we gave at the beginning of this chapter, where "X represents Y to Z" was given as a formula indicating what is meant by apprehending an image.

What sort of circumstance can sustain these relations? It seems clear that this is quintessentially a circumstance brought about by the existence of conscious interpreters and that the apprehension of "objects" not physically present is a mental phenomenon without any obvious counterpart in the physical world. If, therefore, fundamental aspects of the mental realm are structured this way, we ought to admit the existence of objects that are part of this structure. Also, there seems to be a logical constraint on our description of the relations. If we assert the reality of the relations among X, Y, and Z, we ought to assert the reality of the relata -- including, therefore, mental objects.

However, such considerations about the relative being of mental images reach a stumbling block when we attempt to address simultaneously other desiderata, such as inexistence. There does not seem to be any clear way to explain this notion. Suppose we say, despite also wishing

to claim that the subject and the object of consciousness are metaphysically distinct, that the object must (since it is "in" the subject) be a part or process within consciousness. Aristotle provides an interesting account of this possibility. He asks, "can a part of a substance, whether a contiguous part or a process within it, have relative being?" To this question Aristotle answered "no" (Categories, 8b15-25). A part of a substance does not conform to the requirement that when we cognize a relative thing we also cognize that to which it is related. A part of anything is not necessarily experienced as a part. For example, an old car part lying in a field is not necessarily apprehended as a part of any whole. Aristotle concluded that objects of knowledge and perception bore what was a singular type of fundamental relation to the substances in which they inhered: they were "in" the substance, but not as a part. Perhaps, then, this is the best that we can do to explain the notion of inexistence.

Let us now describe how these considerations come together in the form of a paradox. We have said that mental objects can be understood to be "in" the subject but not as a part. Yet, this is a strange, and perhaps unintelligible, way of putting it.¹¹ Mental images themselves cannot

¹¹Aristotle equates, at one point, being in a subject but not as a part with "being incapable of existence apart from the said subject" (Categories, 1a22). This is a less

literally be of a certain size, shape, or color. That is the sense datum fallacy. Yet we are conscious of presented shape and color properties that seem to inhere in an object, and the relations among subject, inner object, and what is represented seem to be real. We should not state, however, that simply because this is the form of our experience that the object itself unequivocally exists. That would be the existence error. Shall we then say that there exist no objects that have these properties and that there exist no objects that are literally "in" us, but that we are nevertheless aware of them as objects in consciousness? That would indeed be paradoxical.

To state the problem another way, we have in mental images consciousness of properties that we think of as belonging to an inner object, but we cannot assert that an inner object exists in any physical fashion. When it comes to defining how this is to be understood, it appears that we can state this only in a way that appeals to an intuitive understanding of the very notion we are trying to clarify. To say that the "object" is "in" the subject, but not as a physical part, is just to aver to the way in which mental objects are intuitively understood to be "in" consciousness.

unintelligible way of putting it, but it also locks in a certain metaphysical interpretation of the mode of existence of mental objects. This is point that might be pursued further.

One form of solution to this paradox can be derived from Santayana's philosophy of critical realism. Santayana distinguished between those things which have being or reality and those we should most properly say actually exist. The things that exist are beings in flux, determined by external relations and "jostled" by irrelevant events (Santayana, 1923, p. 42). The term "existence" was to be reserved for "facts and events believed to occur in nature" (Santayana, p. 47). There are, according to Santayana, also entities that have being but not existence. These are what he calls "essences," and they include the immediately given *sensa* of consciousness presented to us in perception and imagination. They include, in other words, what we have described as the appearance properties or pure visual content of mental images. These immediately given data of consciousness are not in nature; rather, they are the evidence by which I come to believe in the existence of exterior things that are in nature.

This account has the advantage that it coheres with a number of the desiderata we have listed. Mental images are real things that we encounter and we can also say that individuals have them. For what the facts and events of nature include, according to Santayana, are such facts as someone intuiting an image. What exists in the physical world is the person having the mental image, but not the

mental image itself (Santayana, 1923, p.45). This allows us to say that it is true that someone has a mental image and that the mental image has objective being, but does not commit us to say that it has physical being.

This way of describing the facts also has the advantage that it defuses the question of how mental objects are "in" subjects. Objective essences are neither in nor out of the subject, and they are not parts of anything at all. They have their own objective being outside of time and space. The base fact of our world is that consciousness is able to know essences without altering the essences themselves.

On the other hand, this view is difficult to maintain in light of the desideratum of causal relevance. In Santayana's Platonic realm of essences, essences themselves are causally inert. How can they be effects or causes of human acts if they belong to an entirely different metaphysical realm?

I leave this final riddle unsolved. To solve it would be to give a more complete analysis of "nature," "physical," "cause," and other terms. In short, it would be to review the entire scope of the mind/body problem. Officially, I shall leave the metaphysical status of mental objects an unsolved problem. On the other hand, I believe that there are no metaphysical bars to exclude such objects.

C. The Search for an Alternate Resolution

If the above approach is rejected, there is another possibility – and this seems to be the most popular one to entertain at present. It might be possible to show that terms in Brentano's thesis, "reference," "content," "inexistence," and so on, could have meaning in a scientific theory of the mind that would reduce to one in which only physical terms would ultimately be implicated. This approach would seek to eliminate, not merely describe, the mystery of the mental realm by showing how the explanatory schemes of the physical and the mental are not really in conflict.

At the close of chapter 2, I indicated the rudiments of this approach and how it grew as a response to behaviorism. It is undoubtedly the single most influential approach in both psychology and philosophy in the latter half of this century. The fundamental philosophical impulse behind this approach was recognized by Wundt more than a century ago. He understood that philosophers would never accept the explanatory dualism he thought was inevitable.

The key to the contemporary effort to unify the sciences is the concept of information flow through the brain. There is an ordinary language description of how we acquire our mental abilities that roughly fits an elemental theory of information processing: we take in information,

store it, process it, and utilize the results to perform actions. Note that if we substitute "images" for "information," we have just repeated the rudiments of the imagist theory of the British empiricists. There is a profound difference in the information processing analogy, however, because in this case we have no conscious access to the "information" that results in our various capabilities.

This ordinary language description of information flow is, as it stands, nothing but a suggestive metaphor. Can empirical science coupled with a new theory about "information" get past this metaphor? If the brain is regarded as an information processor, there should be no reason why we cannot learn the manner of its operation. The next two chapters discuss the theory and practice of this contemporary effort.

CHAPTER 4

THEORETICAL FOUNDATIONS OF THE CONTEMPORARY DEBATE

I. Introduction

Many contemporary philosophers and psychologists would find the traditionally-derived philosophic perspective developed in the previous chapter completely unsatisfactory. They would object that it represents no improvement on the speculative metaphysics of previous centuries and that it is without a contemporary scientific foundation. In this chapter and the following, I examine two contemporary theories about the nature of mental images, one proposed by Pylyshyn and the other proposed by Kosslyn. As indicated in chapter 2, these theories derive primarily from an attempt within psychology to develop new paradigms for understanding imagery. To some extent, they repeat, within the context of contemporary psychology, some of the same issues the have driven the imagist/descriptivist debate within philosophy.

The primary purpose of this and the following chapter is to critically examine these two theories. I shall be primarily concerned with the following issues: (1) the internal consistency of the theories; (2) how well the

theories can explain the nature of our imagery experiences; and (3) the evidence used in support of the theories. All of these issues will be discussed from the viewpoint of the computational strictures and computational models both writers have proposed. I shall be primarily concerned with the published works of both writers, attempting to give a clear and fair exposition of their views. For the most part, I shall refrain from speculation about how other, derivative theories, held by philosophers or psychologists might fare against the same sorts of criticisms. My primary concern is to establish how the two main proponents in the current imagery debate within psychology have made their cases, and what evaluation we can make of them.

There is a secondary purpose to these two chapters. This is to describe and explain the implications of the background conditions, or context, in which the debate occurs. By means of this, I mean to indirectly support the view expressed in chapter 3. There are two significant general problem areas that derive from the background conditions. One is computational epiphenomenalism and its implications. This forms a background condition to both theories, since Pylyshyn adopts full epiphenomenalism with regard to images and Kosslyn a partial or provisional epiphenomenalism. I indicate briefly some of the general problems with computational epiphenomenalism at the

beginning of this chapter. A second general problem area is the strictures imposed by the rules of empirical psychology adopted by the participants in the debate. I indicate the problems with these strictures in a section of chapter 5 ("Problems for Empirical Cognitive Psychology").

To develop a complete critique of computationalism, epiphenomenalism, and methodology in psychology lies beyond the scope of this work. I hope to show, however, that awareness of the background conditions of the debate (particularly when coupled with the specific results claimed by the theories) prompts this question: "do these contemporary theories work from the right sort of general viewpoint from which to understand mental images?" At the close of chapters 4 and 5, I suggest that there is something wrong with this general viewpoint. As long as the endorsement of strict epiphenomenalism (whether actual or de facto) remains part of both theories and the role of subject reports remains ambiguous, neither theory, I suggest, tells us much about imagery. I suggest that the ultimate lesson to be derived from the debate is that we are left with an amalgam view of mental images very much like the one supported in chapter 3.

In this chapter, I discuss the essentials of Pylyshyn's epiphenomenalism. I show that although it is a logical possibility and is quite consistent as a theory, it has

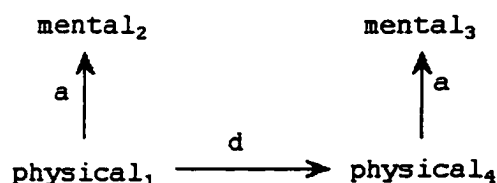
serious problems in systematically explaining how and why our experiences are different from the form of processing thought to underlie them. I then turn to a discussion of Kosslyn's theory. Kosslyn has claimed his theory does not suffer from the problem of disparity between processes and experiences because the processes themselves are imagistic. He claims his theory does not reduce the image to an epiphenomenon. I show that computational considerations mean that his is also an epiphenomenal system.

I reach only preliminary conclusions in this chapter, reserving final comments on the systems and the ultimate implications of computational epiphenomenalism for the close of chapter 5.

II. Background: Epiphenomenal and Computational Systems

A difficulty in the common-sense view of four-way causation arises when one is called upon to explain transition "d" (see diagram below). Are physical states 1 and 4 causally related? Since they are changes in the body, it certainly seems they must be, and if so they must be subject to the laws governing the transition from one physical state to another. If this is true, then ultimately, in a completed science, we would need only concern ourselves with such physical transitions. If the scientifically explainable chain of events is strictly

physical, and the mental events that seem to follow one upon the other as causes and effects in their own right are not, then perhaps the mental events are not really connected to each other in a causal chain, but only seem to be. They could be incidental effects of the strictly physical transitions occurring in the brain. This solution has the benefit of making all our conscious thought fully explainable, once we have a completed physical science. It



has the disadvantage of making all of our conscious life a meaningless side-show to an irrevocable chain of physical causes. This is epiphenomenalism in the strictest sense.

What I call general or strict epiphenomenalism has what the common man can only understand as astounding consequences. It must hold it technically incorrect to say such things as "I willed to move my finger, and my willing it caused my finger to move." For the present, we shall be content to observe that the common man, and the traditional psychologist, usually rejects epiphenomenalism.

Epiphenomenal systems, when combined with computational theory and the concept of physical symbols, are reputed to

solve Brentano's problem, and this is probably the greatest reason for interest in them today. This reputed solution is accomplished, in outline, as follows. Recall that being a symbol means that "X represents Y to Z." But, it can be objected, the ontological status of the symbol as an "object" is inherently ambiguous, and this causes a problem in explaining how it could play a causal role in physical changes. Is it an abstract object? In that case it could have no causal connection with physical things. Is it to be considered "in" the subject's consciousness or a "part" of the subject in some special way (among the possibilities suggested in chapter 3)? If so, then this "object" is wrapped up with an explanation of consciousness and consciousness itself has no explanation within physics.

I attempted to remove (or partially remove) the ambiguity by saying X is an intentional object and that X is "in" Z -- in the figurative sense, leaving open the possibility of physical correlates. But now suppose we said X is literally inscribed in the brain in a cognitive code that is used in all our cognitive processes, and these processes are all computational processes that manipulate these codes. These manipulations will all be physical and the transitions between them will all be fully explainable in terms of physics. Under this general senario, it has now become fashionable to say X, a physical symbol, is a

representation. That is, within the computational system said to comprise the mind, this physical brain state (X) represents a belief or other unit of information that the subject possesses, and X functions within that system in ways that make it represent Y. This way, the ontological status of X is unambiguous. It is a physical state in the brain and as such we do not need to worry about it going in and out of existence as it appears and disappears from consciousness or about how it can be a cause of behavior.

This is, again roughly, how Brentano's problem is "solved" by the cognitive science approach (see Pylyshyn, 1984, p. 26). But what of the semantic content of these physical symbols? In a computer, the physical states that are symbols have no semantic content. They are raw physical states, utterly meaningless in themselves, having no content at all except what they derive from users of computers.¹ Moreover, the semantic content given to us in conscious

¹Hence, in my view, the perversity of designating them "symbols" or "representations" in the first place. It is true that the computational scheme fixes the status of the object X, but now it is the meaning of "to Z," i.e., the relation of the object to the agent that is utterly ambiguous. As the convention of referring to physical symbols in computational systems has been so widely adopted, it is almost hopeless to fight it. In describing such systems below, I will accept this convention, but the reader is advised that all of the new language of symbols, representations, and their cognates is not to be confused with the meanings previously proposed as consistent with traditional psychology.

awareness through intentionality, is utterly powerless to cause any change within the system. Pylyshyn observes:

As we have already noted, the semantics of representations cannot literally cause a system to behave the way it does; only the material form of the representation is causally efficacious. (Pylyshyn, 1984, p. 39)

If, then, Brentano's problem has been "solved," we are now faced with a new problem: the causal ineffectiveness of semantic content assigned to physical symbol systems. This problem has proven to be one of the most intractable in the contemporary philosophy of mind. It is particularly important in light of computational considerations, for in this case the question is not just how physical symbol systems in general might acquire semantic content, but how physical symbols that operate entirely within computational restrictions could attain content.

Searle's famous articulation of the problem is the Chinese Room argument (Searle, 1980a). Searle argues it is quite impossible for the human mind to literally operate according to the computations of a physical symbol system. In support of this, he argues that (1) all semantic content of computational systems is derivative of the interpreter's view of the system (or, semantic content is extrinsic to the system) and that (2) the semantic content of human minds is

intrinsic (or, as he sometimes states it, that meanings are "in the head" but not in the form of a computer program). Searle believes that intrinsic semantic content is unique to biological systems. Since the source of semantic content in a computer is utterly different from the source of semantic content in a biological organism, Searle concludes that (3) computationalism cannot be the basis for a true theory of mind.

Needless to say, Searle's notions of what semantic content is and how it is obtained are controversial (Searle, 1980b, 1990). Neither assertion (1) nor (2) above is universally accepted. Theories about how physical symbols might obtain semantic content in computational systems (e.g., functional role semantics) have been proposed. Likewise, it is by no means obvious that meanings are "in the head." If they were, what we mean by "understanding a meaning" could be identified with having certain internal representations in the mind, but it is not obvious that we make such an identification. My internal representations of a beech tree and an elm tree, for example, might be identical, but this does not imply that I mean the same things by thinking of them. By differentiating them, it has been argued, I mean to imply that I rely not on my own internal representations, but on the meaning given to

"beech" and "elm" by a wider community of scientific experts (see Putnam, 1975, pp. 215-271).

The above points might be pursued indefinitely. A complete treatment of the origin of semantic content is not our concern, nor is every possible defense of computationalism. Rather, we shall be concerned with how the problem of semantic content has been addressed in Pylyshyn's theory and implications his approach has for the meaning of "imagery" in his system. Although Kosslyn's conclusions are quite different, his understanding of the basic restraints imposed by functionalism and the restraints imposed by empiricism are similar. This brief treatment of Pylyshyn's assumptions will therefore provide an understanding of the background considerations that apply to both theories.

Pylyshyn appears to accept the first of Searle's propositions (Pylyshyn, 1984, p. 43). He agrees that in a computational model the symbolic codes themselves are devoid of semantic content. In a computational model, all the semantic content given to the symbolic computational states and their results derives from the assignment of meaning by the theorist who either designs or observes the system:

The particular interpretation placed on the states, however, appears to be extrinsic to the model, inasmuch as the model would behave in exactly the same way if

some other interpretation had been placed on them.

(Pylyshyn, 1984, p. 43)

Furthermore, Pylyshyn acknowledges that if Searle's view is correct, then it "undermines" Pylyshyn's claim that "functional models...address the issue of representation-grounded behavior" (Pylyshyn, 1984, p. 43). Yet, this does not force us to accept Searle's second proposition, Pylyshyn suggests, because (among other reasons) concerns about the source of "meanings" may simply not be relevant to empirical psychology. Pylyshyn suggests that for the purposes of empirical psychology we can focus on another sort of question:

In my view, the question of whether the semantic interpretation resides in the head of the theorist or in the model itself is the wrong question to ask. A better question is: What fixes the semantic interpretation of functional states? or, What latitude does the theorist have in assigning a semantic interpretation to the states of the system? (Pylyshyn, 1984, pp. 43-44)

Pylyshyn suggests that if there were robots who behaved like humans, we would be constrained to attribute semantic content to the internal physical states that governed their behavior. Pylyshyn states that "it would be perverse to deny that these states had the semantic content assigned to

them by the theory [that described the robot's behavior]" (Pylyshyn, 1984, p. 44).

Pylyshyn's suggestion that the robot case is appropriate opens up a huge topic for debate on the principles of psychology. We can only consider a few of its implications here. As Pylyshyn himself acknowledges, whether or not it would be "perverse" not to assign semantic content to the functional states presumed to govern a robot's behavior is itself a highly contentious claim. It is a claim about which we are likely to "run into differences of opinion that could prove unresolvable" (Pylyshyn, 1984, p. 44). We need, therefore, some way to limit the appeal to intuitions about what attributions we might make to robots and concentrate on what Pylyshyn's suggestion implies for the study of imagery in psychology.

There is one sense in which Pylyshyn's suggestion is reasonable. If one feels that we must be constrained to obtain knowledge about the subject matter of psychology through an objective, third-person point of view, then the robot case is useful. Recall, however, that according to traditional psychology, we should not have any expectation that the entire nature (or even the essential features) of the phenomenon in question could be investigated in this way. Wundt cautioned against a purely behavioral approach and demonstrated that even at the base level of behavioral

response (reaction time) we cannot expect to eliminate the influence of private mental states (chapter 1). Nor should we, in Wundt's view (or Richardson's, or in the view I developed in chapter 3), claim that psychology would still be the same science if it were concerned only with behavior (or the possible models for behavior) and did not address itself to conscious contents. I suggest that what Pylyshyn's sort of robot theory inclines us toward is something quite different than an investigation of consciousness and its objects: it is an investigation of behavior and its possible explanations given a certain set of assumptions about causality, namely, that all causal interactions occur at the physical level.²

²This is not to be confused with the claim that, as Pylyshyn has often observed, that there should be three autonomous levels of the description of phenomena in cognitive science: the physical, the symbolic, and the semantic. While, ostensibly, Pylyshyn's brand of cognitive science allows the validity of higher level (semantic or symbolic) attributions of causal effectiveness, his descriptions of what actually counts as a cause (as far as I have been able to discover) invariably revert to the physical. Pylyshyn's account of how thought may affect digestion is a case in point. Pylyshyn says that a cognitive state, such as a belief, can be a cause of poor digestion because "every state of a cognitive system is simultaneously a biological state and a cognitive state" (p. 143). But since, in Pylyshyn's view, cause and effect must fall under the same domain of description, a belief cannot be shown to alter digestion unless we "first do something like discover a relevant biological property that happens to be coextensive with a certain class of cognitive descriptions" (p. 144).

Thus, the background consideration we must bear in mind (and allow to surface again from time to time) is this: once any "obscure" or "metaphysical" forms of conscious intentionality have been eliminated from the picture and a new set of criteria proposed, what sort of images do these new criteria leave us with? The answer to this question is quite clear, at least in Pylyshyn's theory. In his view, since all operations in any computational system must be performed using logico-linguistic elements, there is no room at all for the images in the classical or traditional sense to either exist or to be causally-generative items in the system. There may be mechanisms that transform visual input into usable logico-linguistic data, or even those that transform data as if they retained image-like features, but as images themselves are utterly non-computable, they disappear entirely from the system. (The details of this deduction appear in the section on Pylyshyn, below.)

The concern about this background issue in computational psychology can be put another way. It is sometimes asserted that if we were in possession of a fully-reductive physical science we would not be prompted to attribute mental states to human beings as the causally-effective states in their behavior. Suppose there were a robot whose behavior was sufficiently complex when using visual inputs that we attributed to it the property of

"having a mental image." Despite the claims we might make about what is real at the functional level, however, we would know that at the physical level "having an image" was merely an empty attribution. We are already in possession of a fully-reductive science of robots; we would know that at the base level of causation all the micro-events would be of the same "on/off" physical type and would involve no images.

Suppose that we were in possession of a fully-reductive explanation of human behavior. Would we have to say that "having an image" would also be an utterly empty attribution? I submit we would not, because it is not only the behavior of human beings we need to account for but the conscious states they are in. As long as we accept that consciousness is a factor to be accounted for, the addition of reductive science does not allow us to fully equate the explanatory situation with the robot case.³ This can be seen by considering the consequences of the following: suppose that it can be shown that the reductive neural (or other) states are the sole causes of the conscious states in

³Pylyshyn has also recognized the salience of this point. He cites the fact that robots are unconscious as one of the reasons some are unwilling to accept the comparison between robots and humans as adequate tool for empirical psychology. Pylyshyn points out that in developing a cognitive theory concerns of this sort have caused theorists to leave aside "questions about what constitutes qualia" (Pylyshyn, 1984, pp. 44-45).

which images seem to inhere and that the conscious states themselves are utterly without causal effectiveness. In this case, we are still left with the possibility of a metaphysical analysis of the being of consciousness and its contents, since the knowledge of the causes of our conscious mental images alone does not capture their nature. Nor could these reductive states be identified with mental images, since, by hypothesis, they differ from their effects. Note also that except for the fact that we would then know that mental images are true epiphenomena, we would not be in an essentially different explanatory situation than we presently find ourselves: we presume that there are physical causes of our mental states (though these are not the only ones, since we acknowledge mental causes as well), but none of these physical states themselves have the properties of apparent size, color or location in space that mental images have. We would still need an explanation or analysis of these presented properties. Finally, we would also need an explanation of where the apparent intentional content of conscious mental images came from. The question about whether content is intrinsic or extrinsic would reassert itself.

Another point to bear in mind when considering computational models is that there is an incipient dualism in framing the explanation of how physical symbols are

supposed to relate to conscious interpreters, or subjects. All of the semantic content derives from subjects and none from physical symbols themselves. But what is the subject? Is it not, in the final analysis, supposed to be identical with, that is, be composed of and operate according to, some system of physical symbols? How then does the subject reappear in the system, gaining access to the interpretive stance outside the system through which meaning and interpretations are made possible?

III. Fundamentals of the Contemporary Debate

Two fundamental terminological distinctions structure the contemporary imagery debate.

(1) The phenomenal image is what we experience, i.e., what we "see" through the mind's eye.

(2) The internal brain representation is the brain state or process that is understood to be physically instantiated in the brain, and is designated as the cause (or sometimes less precisely, the explanatory factor or correlate) of the phenomenal image and the behavior predicated upon it.

The participants in the debate do not question the existence of the phenomenal image or the existence of internal brain representations. The only questions concern how to characterize, within psychology, the functions of each and

the relation between them. The first, theoretical, issue is how to characterize the quintessential features of the internal brain representations involved in imagery experiences and imagery-related behavior:

- (1) Can these internal brain representations justly be called functional images, in virtue of their distinctive role in cognition?

The second, experimental, issue is:

- (2) Are there any root phenomena in the functional architecture of the brain that are intrinsically pictorial or imagistic in character?

Psychological descriptivists answer "no" as a matter of principle to the first question, and "no" as a matter of empirical fact to the second. Imagists answer "yes" to both questions. While the answers to these questions are the central issues, both views also differ markedly on how we are to understand the role of the phenomenal image in cognition. Pylyshyn holds that the phenomenal image is strictly epiphenomenal, while Kosslyn believes that since there are functional images there is a strong reason to believe that phenomenal images are not epiphenomenal. The issue of epiphenomenalism with respect the phenomenal image is also an aspect of the debate and sometimes assumes prominence in the description of what is at issue.

There are other ways to state what is at issue in the contemporary imagery debate. Block (1981a, p. 7) believes the question of epiphenomenalism is a red herring from a philosophical perspective. Block argues that several of the proposed grounds for the debate involve a confusion in the meaning of the term "mental image." Block considers three possible meanings for the term and how this affects the claim made by pictorialists that images are not epiphenomenal. First, if mental images are understood to denote certain kinds of experiences, Block claims the pictorialists have no grounds for their claim that their experiments prove that our experiences have a certain character. The experimental evidence he states, simply does not address the issue of experiences at all:

...[T]he experiments certainly do not show that what has the causal role is any kind of experience. The experiments cast no light at all on whether the experiences are epiphenomenal accompaniments of representations in the brain that are the real causes.

(Block, 1981a, p. 7)

Second, if "mental image" is thought to refer to either abstract entities or intentional objects, then the issue of epiphenomenalism is moot and the pictorialist's evidence is "irrelevant" (p. 8). Abstract objects, he claims, "have no causal commerce of any kind," and intentional objects also

fall out of consideration because they "could not be the effects of any causes" (p. 8). Third, if images are thought to denote internal brain representations, then again the whole issue of epiphenomenalism disappears because it can't be the case, according to the imagery debate, that brain representations are causally ineffective. Both parties agree that it must be brain representations that are causally effective. Block then suggests that the debate is not about epiphenomenalism per se, but about what the properties of these brain representations really are (p. 9). The pictorialists claim that the brain representations have pictorial properties and that these are causally effective. The descriptivists claim the brain representations do not have pictorial properties.

Block's view is partially correct, but he combines his assessment of the debate with a neutral description of it. I have great sympathy for his view, for reasons that will become apparent in chapter 5, that the empirical evidence settles very little about the nature of our experiences. On the other hand, Block also states that if the debate concerns determining the nature of the brain representations, then "some of the experiments they [the pictorialists] cite are indeed relevant" (p.8). I try to show the problems with the view that the empirical evidence we have reveals precisely what pictorialists claim, but this

general point might also be accepted. It is also quite correct to say that one of the issues, the central one, concerns the properties thought to inhere in the brain representations.

I depart from Block's analysis in his assertion that the nature and causal effectiveness of experiences is not an issue at all. This may be Block's judgment about what the disputants are, or should be, disagreeing about, but does not, in my view, precisely reflect what Kosslyn has claimed. I have tried to state what is at issue from the perspective of the disputants, both from the theoretical and experimental points of view. In this chapter, we shall be concerned with the first question (above) at issue in the opposing views: in what theoretical sense, if any, can there be said to be functional "images" in psychology, given the strictures of computationalism?

IV. Descriptivism: Pylyshyn's Theory

A. Internal Descriptions and Visual Information

Pylyshyn understands the mechanism of cognition to consist of computational procedures that operate on a specific form of representation that is not actually verbal, but proto-verbal, i.e., a base mental language that can only be suggestively characterized as "propositional," "abstract" or "descriptive." Pylyshyn's view is that when

we store the information that something before us, is, say, the Mona Lisa, we store a single type of information that enables us in future contexts both to remember features of the visual image and to verbally identify other images as being similar.

The term "image" is to be avoided in describing this unconscious code. Pylyshyn writes:

Because the representation is so obviously selective and conceptual in nature, referring to it as an image - a term that has pictorial or projective connotations -- is very misleading. Although there are some who have no objections to speaking of "conceptual images," I prefer the term "description" or "structural description" because it carries certain desirable connotations. (Pylyshyn, 1978, p. 173)

Among the desirable connotations Pylyshyn lists are that the representations are constructed on the basis of concepts, not raw appearances, and they are understood to attain their function by referring to objects rather than by resembling.⁴ Pylyshyn adds that the relation between the representations and what they represent is "the primary reason for persisting in calling them 'descriptions'" (Pylyshyn, 1978, p. 177).

⁴ Referring not, obviously, in the sense of a subject's intentional reference to content, but in the sense of an internal symbol corresponding to the represented domain.

The specialized, theory-specific use of the term "proposition" appears in Pylyshyn's analysis of how sentential analogs are used and manipulated in vision. Since knowledge (knowledge in the computational system sense) is propositional and we need to have knowledge of what we see, it is necessary that visual appearances be translated into propositional knowledge. Otherwise, the appearances involved in seeing would remain inert and we would not be able to formulate any knowledge.

When we use the word "see," we refer to a bridge between a pattern of sensory stimulation and knowledge which is propositional. This is not to deny there are such things as appearances, only that if they have a role to play in cognition, the nature of such a role is at present a mystery. We cannot even talk about appearances without, in fact, talking about the propositional content of the appearances. (Pylyshyn, 1973, p. 6, emphasis added)

Why is visually-derived knowledge best understood as ultimately descriptive in nature? If we accept Pylyshyn's account, we agree that "something" stored in the brain must be responsible for our cognitive abilities.

This something is best characterized as a descriptive symbol structure containing perceptual concepts and relations, but having the abstract qualities of

propositions rather than the particular qualities of pictorial images. (Pylyshyn, 1973, p. 7)

We see, then, that Pylyshyn follows the previously trodden path of philosophic descriptivists. Like Dennett, he objects to the very idea that we could store images.

In summary, Pylyshyn says that the special abstract qualities of propositions should be understood as implying three characteristics of the stored symbol structures or representations.

1. Raw sensory data are not stored. The results of sensory processes are already "highly abstracted and interpreted" in the stored representations. (Pylyshyn, 1973, p. 7, emphasis added.)

2. The representations are such that they are "not different in principle from the kind of knowledge asserted by a sentence." (Pylyshyn, 1973, p. 7, emphasis added.)

3. Since sensory events are encoded into a finite number of concepts and relations, the stored representations are "formally equivalent...to a finite...number of logically independent descriptive propositions." (Pylyshyn, 1973, p. 7, emphasis added.)

Again, the underlying reasons for all these characteristics derive from other aspects of his theory. The representations stored as a result of visual sensory

processes must not differ in kind from other representations; there can be only one mental code that forms the knowledge we obtain from all sensory sources. Since whatever knowledge we have can in principle be translated into linguistic descriptions of some sort, this code more nearly approximates descriptions than a picture or other form of preserving and expressing information. Finally, it is assumed that the processing of sensory data happens mechanically, and that this sorting of information results in a finite, pre-processed set of data neatly filed into concepts and relations. If sensory inputs were not processed into a finite set of information packets, it would be impossible to perform computational procedures on them in order to interpret them further. Raw pictorial data are useless for any computational procedure, since they represent a potentially infinite set of concepts and relations. We must view sensory data as pre-processed or, as Pylyshyn would have it, "abstracted" and "interpreted" in order for them to fit into a computational scheme. The abstracted and interpreted data are most conveniently understood as descriptions.

B. A View of Memory

Pylyshyn argues that the imagist view, that memory contains raw visual data, not conceptually processed or

organized, simply does not hold up. The descriptivist view, he maintains, supplies a superior account of the structure and mechanics of memory.

Pylyshyn notes several undisputed facts about memory.

(1) Memories of a given topic are often both global and specific. I may recall some general features of the party last month (many well-dressed guests) as well as very specific details that relate to the same event (Julia wore a gold necklace). (2) If visual data are forgotten, they disappear in discrete conceptual parts rather than pictorial parts. We have no memories in which a pictorial part of a normally complete mental image is missing. We do not have mental images of, say, half a desk in a room, as we would if raw visual data could be forgotten in the same way part of a photograph could be torn away or mutilated. (3) The process of interpretation may not end when simple recollection takes place. It is often possible to discover additional details or make deductions based on what is recalled. The phenomenology of recall is that I may remember Julia at the party, and in the process of this recollection (which may seem to me to involve the inspection of a mental image) I may also recall that she was the one wearing a gold necklace.

Pylyshyn argues that (1) and (2) can be explained most simply if visual memory depends entirely on a network of

conceptual links. This would explain the speed with which we are able to recall various details stored in memory. When asked if someone at the party last month wore a gold necklace, we may be able to respond in an instant. This suggests that something like a hierarchical index of memories exists that can be accessed in the manner of a computer data base. In this case, the indexical hierarchy might correspond to: last month, parties, place, time, hosts, visitors, unusual items, watch, gold necklace. A procedure involving a search through a data base structured in this way would be much faster than one in which entire visual scenes had to be replayed and individual items picked out in order to accomplish the recollection. If unprocessed images were involved in recalling details of this type, the imagist theory would have to hold that inspection of them occurs at an unconscious level, and if the images were searched qua images, this would imply a homunculus. As we have no conscious experience of searching through randomly sorted images for details related to various topics, the homunculus option seems the only one available to the imagist.

In addition to the concerns with the speed of operations based on images, Pylyshyn points out that if uninterpreted images were stored, it would place a huge burden on the storage capacity of the brain. Since images

would have to be both broad enough (the party) and detailed enough (a necklace) to meet the needs of later recall, virtually every aspect of experience would have to be recorded. The more probable mechanism, Pylyshyn thinks, would involve the selective storage of discrete conceptual data.

The same considerations apply to loss of memory. The kinds of things we forget tend to fall into specific categories or features originally derived from visual impressions. We may forget the color or exact location of something, but not its size. This indicates that the features of items are structured in memory by way of discrete conceptual links rather than in holistic images.

An objection can be raised at this point. Suppose that there is a hierarchically arranged conceptual map of the items in memory. That does not rule out the possibility that there are images filed, as it were, in certain spots. This would combine the speed of a conceptually-driven search with the possibility that the search could terminate in an image. This would account for the speed and storage problems and still maintain images that could conform to our experience. Pylyshyn responds that this is a pointless arrangement. The content of an image has to be interpreted in the first place in order for it to be properly placed in the set of conceptual links. Once the content of the image

is established, what is the point of maintaining the image in storage?

C. Models, Recall and Problem Solving

A major objection Pylyshyn has to the imagist view is that it appears to rest on ordinary experience and simple examples rather than a scientific theory:

This "image retrieval before perception" view is phenomenally very powerful and is implicit in the everyday sense of the word "image." It is also present in all the illustrative examples used by psychologists to persuade their colleagues of the reality of images.

(Pylyshyn, 1973, p. 9)

The various improvements to the imagist position during the period since 1973, including a massive amount of experimental data, have not changed Pylyshyn's assessment of the imagist position. In a more recent book, Pylyshyn again charges that the pictorialist theory just reduces to the phenomenological truth that mental imagery is similar to seeing (Pylyshyn, 1984, p. 251).

As a case in point demonstrating how intuition takes the place of theory, Pylyshyn mentions the influential window-counting example (originally used by Shepard): one is asked to count the number of windows in one's house; almost invariably, subjects report having phenomenal images of

interior views of rooms or of exterior views of the house (Pylyshyn, 1973, p. 18). Citing examples of this sort, imagists have claimed that since the phenomenal image appears to be a necessary element in the process of recall, images must be part of the operative cognitive architecture of the mind.

Pylyshyn theorizes that so-called necessary imagery is explained entirely by the operation of unconscious algorithms, or computational procedures, on previously stored and interpreted perceptual information. Consciously, it seems to us that we extract new information from images, but this can be explained by unconscious procedures operating on previously stored information. Strictly speaking, no new information is being generated; we cannot create more information than is already stored. We can only improve upon or transform the levels of access we have to previously stored information. The various procedures applied to the information contained in the model yield information that was not previously made explicit, resulting in the impression that the image is being inspected or interpreted directly.

Why do visual images appear if they are not necessary from a computational standpoint? When we encounter a problem that is too difficult to solve by conceptual memory or simple deduction alone, more cognitive resources are

required. Pylyshyn suggests that the problem parameters are moved to a "workspace" or area where there are sufficient cognitive resources to solve the problem, and in which a "more detailed representation may be generated...than is, in fact, called for by a particular cognitive task" (Pylyshyn, 1973, p.19). In a computer, the use of a workspace can be created by simply allocating more free memory to a problem. In the human brain, Pylyshyn suggests, the workspace may involve the physical locations responsible for producing visual presentations. The generation of a visual presentation is an automatic process that uses the information derived from the application of algorithms to the original descriptive information, but the generated image itself does not play a part in obtaining a solution to the problem being worked on. The solution is arrived at by means of other processes, and the image is simply a left-over manifestation of that fact.

We can understand what Pylyshyn means by analogy to the case of a computer instructed to deduce the consequences of Euclid's postulates. The proofs themselves proceed by means of procedures applied to symbolic encodings that represent relations such as equality, inequality, greater than, as well as items such as lines, points, distances, and so on. If these symbols were then translated into instructions to produce visual images by means of a mechanical writing pen,

it is obvious that the accompanying drawings would have nothing to do with the computing processes themselves. Pylyshyn's suggestion is that human mental imagery is like the computer case: mental figures, mental drawings, the entire subjective feeling of the "use" of mental images, are entirely epiphenomenal.

Pylyshyn identifies this theory of image generation as the procedural model theory. One can recognize that the mind produces models or visual representations of cognitive processes without implying that these models are themselves operative in cognitive processes. Although this point has already been established in theory, it is one that needs further emphasis and clarification. It might be thought that in allowing that images are models, the view Pylyshyn is promoting is not very different from the imagist position after all. Pylyshyn is well aware of this. He writes:

Such considerations might suggest that we are tending towards the view (favored, e.g., by Chase and Clark, 1972) that while picture-like entities are not stored in memory, they can be constructed during processing, used for making new interpretations (i.e., propositional representations) and then discarded. ...There is little harm in using the metaphor in this context so long as one can resist the temptation of assuming that the relation of the model to its

cognitive representation is like the relation of any physical object to its representation. (Pylyshyn, 1973, p. 19)

Pylyshyn means that we must not think there is any use of an inner visual model that corresponds to perceiving a physical stimulus. Chase and Clark take the imagist view on this point. They state, "...the subjects are in fact abstracting new information from the visual image in much the same way they would from a physical stimulus" (Chase and Clark, 1972, p. 229). The problem with such analogies, Pylyshyn points out, is that a physical model of something has properties that are independent of whatever knowledge was used to construct it. A drawing produced on paper or a computer screen is of a certain size, a certain color, and is visible to the eye. The knowledge used to construct it has none of these properties. Furthermore, the physical properties of a model, its size, color, and other visible features, are completely irrelevant in deducing additional properties about what it represents. What it represents is determined by the conceptual information from which it was derived. For these reasons, Pylyshyn argues the model can not enter into the process of the interpretation of knowledge already stored except in performing the ancillary function of "making what was implicit in the [stored] description more

explicit, accessible, and manipulable" (Pylyshyn, 1973. p. 19).

It is clear from these considerations that in Pylyshyn's theory the translation from description to model does not represent any shift in the kind or form of knowledge represented. There can be no creation of new, specifically visual information in the model. This would be creation of information ex nihilo. The model, just as the original data from which it was formed, can be reduced to a list of propositions. The processes that operate on the model are not perceptual processes, but formal, computational processes. Thus, Pylyshyn concludes, "the representation corresponding to the 'image' is more like a description than a picture" and "there is nothing in the representation corresponding to the notion of 'appearance'" (Pylyshyn, 1973, p. 22).

In the procedural model theory of mental images, the use of models in computational theory forms the basis for describing the meaning of our experience of mental images. Like a visual model generated on a computer screen during a computer's computations, the image has no causal role in our own consciousness.

D. Critique of Pylyshyn's Theory

1. *Knowledge, Abstract Objects, and Explanation*

I suggest that much of the plausibility of Pylyshyn's account trades on the philosophic idea of abstract entities. Pylyshyn follows philosophers in pointing out that no specific encoding or expression of a proposition is identical with its content or meaning. Neither Pylyshyn nor philosophers are inclined to doubt that expressions have meaning. But philosophers are circumspect about how specific expressions acquire the meaning. Some kind of theory about meaning is required, whether or not it ultimately ends in including propositions as abstract objects. Pylyshyn, on the other hand, assumes that while meaning and its expression are separate, meaning is just equivalent to what has been derived from sensory inputs and coded into a finite set of descriptive elements in a mental interlingua. If this were true, meaning would be encompassed in a finite set of particulars, regardless of how "abstract," "interpreted," or "propositional" one may choose to understand them. This just reestablishes the problem of meaning on a new level. Instead of explaining how individual verbal expressions acquire meaning, we now have to explain how each expression in the mental interlingua acquires meaning.

The confusion reflects, I believe, a fundamental difficulty in a computational, materialistic theory of the mind. If the theory is true, some arrangement of concrete material parts and the processes involved with them must be responsible for the phenomenon of knowledge. The problem is that it is far from obvious how this can be possible. The suggestion that content is due to the syntactic, rule-governed operations over the representations, in such a way that the function of the representations mirrors the content they would have when viewed from outside the system, results in a number of problems. Consider just two problems. First, there is the problem of establishing the meaning of fundamental real-world relations. Suppose there is a brain representation of a fundamental relation such as "is a part of." How is the meaning of the relation itself generated? One might propose, as some have, there are certain primitives, such as "is a part of," "to the left of," and "is the opposite of," innately coded in the brain. This appears to be an ad hoc assumption made to make the system conform to the demands of the real world. If it assumed that the system "learns" these fundamental relations, this leads to a second problem. All the fundamental spatial relations are inherently ambiguous and context sensitive in application. Is my hand "on" the table when only one finger is touching? If the cat has only its hind legs on the mat

is the cat on the mat? This requires a propitious selection of even more primitive terms – more primitive than gross object terms, such as "cat" and "mat," or gross relation terms, such as "on." No automatic mechanism, as far as I know (PDP networks excluded – they lie beyond the present scope of concerns), has been proposed to explain how this can be achieved.

2. The Structure of Memory

Pylyshyn's argument about the structure of memory has a number of strong points. It is true that there are no "broken" or partial images that appear in consciousness in the manner of torn photographs. It is true that memory information is retrieved in more or less complete conceptual units very rapidly and with no consciousness of searching through a huge number of randomly filed images. This latter point can be amplified. If memory were only a collection of images, there would be no way to tell what they were images of. All this points to the necessity of some form of conceptual organization to memory.

Yet, Pylyshyn's argument does not offer much that is really new in the history of theories of memory. It has been recognized from the earliest times that memory requires some consciousness of the time and context of prior events in personal history, and therefore some conceptual

organization. Pylyshyn's complaint that raw visual data cannot be stored because the storage capacity of the brain would not allow it, is simply an assumption. As Kosslyn points out in rebuttal to this argument, we simply do not know what the storage capacity of the brain is (see Kosslyn, 1980, p. 20). There is no reason to set an arbitrary limit on the scope or extent of memory. Similar considerations apply to Pylyshyn's objection that there is no point to storing an image once the conceptual information about it is stored. There may be no logical or computational reason, but there are plenty of reasons, derived from evolutionary adaptations, for animals to store information that is currently useless but may have enormous survival value in some future context. Again, we simply do not know precisely what memory actually consists of or why everything in memory is stored the way it is.

Pylyshyn's arguments about memory, then, are not so much about how memory is as about how it must be if the principles of computationalism are true. If all information must be propositional in nature there will be no place in memory for non-propositional and non-computable elements such as images. If images are understood to be raw appearances only, having no conceptual content, then they cannot be translated into the computable, "propositional" form necessary for computationally-inspired cognitive

psychology. Kosslyn, and others in cognitive science against whom the argument is directed, often speak as if images were raw appearances, yet they also claim to accept the strictures of computationalism. Therefore, Pylyshyn's arguments about the implications of computationalism should be given careful consideration when his theory is pitted against the other side in the imagery debate.

Some of Pylyshyn's comments actually support the view advanced in chapter 3 that memory has no specific format. Pylyshyn first states that the amodal information could in principle be stated in a description; later he softens this somewhat, allowing for the possibility of "conceptual images." He agrees that memory information is to be thought of as something that is neither words nor images. While I do not agree that it is the format of brain representations (if there can be said to be such) that we need to worry about, this at least corresponds roughly with the idea that the cognitive capacity (i.e., conscious capacity) of memory is a readiness for multi-modal interaction.

In sum, then, Pylyshyn's view of the structure of memory just tells us how it must be if his theory is true. As for it being impossible for there to be images, qua visually inspectable items in memory, this follows as a matter of course from the strictures of his theory, the nature of computational representations, and what he

presumes to be the content of original perceptive input. The challenge to the computational imagist is to show how to circumvent this difficulty.

3. *Problems for the Procedural Model Theory*

According to Pylyshyn, when we count the windows in the mental image of our house, we are relating several concepts, such as number, windows, and my house, and applying a set of procedures (Pylyshyn, 1973, p. 18). Pylyshyn suggests there is some procedure, let us call it count, that simultaneously applies to and relates the above concepts, resulting in the output of a specific number. In discussing this example, Pylyshyn implies that since the above concepts and procedure would require considerable computing, they might all be moved to a workspace, resulting in the phenomenal image of a house when performing the count procedure.

Is Pylyshyn's account of window counting credible? Pylyshyn holds that the number of windows is not explicit knowledge:

It would be unreasonable to hold that "number of windows in my house" is a static term in my store of explicit knowledge. Indeed it could not be the case in general since there is no limit to the number of propositions of the type "number of Xs in N" which a person potentially possesses. (Pylyshyn, 1973, p. 18)

According to Pylyshyn's theory any knowledge is either implicit or explicit. The number of windows is knowledge, therefore, that is implicit and that is made explicit by the count procedure. How does this occur? Presumably, I automatically store information about the relations of some primitive constructs that compose what the visual input is. In the case of a house, I store information about rooms or exterior sides in terms of selected primitives, including windows. Now, since the total number of windows is by hypothesis unknown to me, it must be presumed that there are what correspond to cognitive slots for the concept "instances of windows in room (side) X." We can imagine that within a set of visual data corresponding to a particular scene, each instance of "windows" is, as it were, chalked up on a mental score card. The windows are not actually counted during storage, but each instance is recorded. The resultant stored knowledge can be symbolized as indicated below.

			*			
Windows	*	*				
	*	*			*	*
	*	*	*		*	*
Location	1	2	3	4	5	6

For each location, marks serve to record the instances without indicating totals. A procedure, count, will count the marks at each location, yielding a number that can then be used to keep a running subtotal.

If this is an accurate construal of how to understand a descriptivist explanation of the window-counting example, it has the advantage of being rather simple in execution. It also betrays some cleverness in selecting and designing data structures to fit the task. And this, I suggest, is something of a problem. There is too much cleverness or fitness for purpose here. Having no knowledge of any possible future uses (except possibly to answer questions on psychological tests), why is my cognitive system so clever as to provide this interior score card for my counting exercises?

Let us try to consider how such memory problems are consciously solved. Our memory experiences seem to be triggered not by any consciousness of the concept of windows or of windows as numerical ciphers, but by recall of many experiences about interactions with various windows (such as numerous cleanings, openings, etc.) that allow us to form visual mental images. As we recall these various experiences, we are enabled, within the context of a larger constellation of memories, to keep track of windows specifically. These memories generally owe strength to a

set of experiences with particular objects at various times. If we do not interact with a particular window in a large house, we are likely to forget it entirely.

According to Pylyshyn, our memory experiences do not figure into the matter. The count procedure does all the work. What degree of disparity is to be allowed between our subjective experiences and any presumed computational explanation? Pylyshyn concludes his 1973 article with the remark that we will make no progress until we "remove the image metaphor" and replace it by the "fine detail information processing model whose relation to the experience of imagery is...really quite a secondary matter" (Pylyshyn, 1973, p. 22).

Some (Block, 1983a, 1983b; Tye 1991) accept the logical possibility that our experiences could be of one form while the processing that accounts for it could be of another. Block points out that as a general principle, it is not correct to assume that like causes produce like effects. We cannot reason that because our visual experiences are "picture like" or seem to involve images that there must be literally picture-like representations that produce them. It is indeed a logical possibility, and it may be one philosophers can accept as grounds for entertaining a descriptivist view. As a logical possibility, we give the computational theory-builder a free hand to create the

formal representational constraints in any way necessary for a successful model. The thrust of the imagist complaint, I believe, comes from psychologists who want more than what logic allows for in the relation between our experiences and the underlying representations. They ask, in effect, "what constraints, relative to the nature of our experiences, should the theory-builder allow in describing the form of the internal representations?" Suppose that instead of supplying no information on cognitive processes, our subjective experiences supply clues (at least) as to the internal functions of our brains (Kosslyn, Shepard, and others believe this is true, see discussion of Kosslyn's views on epiphenomenalism, below). How does this fit with the hypothesis of epiphenomenalism? Consider the window counting example. I experience quasi-visual images of windows when I count them. I do not experience counting the settings of neurons in my brain. But my cognitive system is going through a procedure that actually counts real states of some sort of individually marked particulars in my brain. Why do I not experience numbers or ciphers in my visual consciousness instead of windows? This would also be consistent with the purported internal processing. Some rationale for the kind and extent of the experiences generated in the process of recollection seems to be needed within the descriptivist account.

Aside from the nature of our own conscious experiences in memory tasks, there is another element in Pylyshyn's argument that needs further explanation. We mentioned the need to explain the foresight necessary to catalog windows as items to be enumerated. Pylyshyn tells us there are an infinite number of things I might record that would ultimately fit the form "the number of X's in N." While my cognitive system was chalking off instances of windows, it might just as well have been checking instances of bricks, shingles, and lighting fixtures. Why should any one thing be selected as a primitive unit for recording instances?

It seems clear, as I suggested in chapter 3, there must be some account of human interest that structures the priority of the information to be stored as a percept. Once we appeal to human interest, we again need to explain how this is to be accounted for in computational terms. Pylyshyn and many others have recognized this problem and identified it as "the robot frame problem." This is the problem of how to know when to apply general or background knowledge when interpreting input or solving problems. An ordinary (contemporary) "seeing" robot cannot always distinguish between object and background or between objects it should test by compressing with, say, 500 pounds of force and those it shouldn't (hands) without enormous computational resources. As for accounting for interest,

the computationalist is forced to supply either an innate set of "interest codes" or a long series of other instructions with only a dubious connection to the ordinary (biological/intentional) meaning of "interest" at best.

V. Pictorialism: Kosslyn's Theory

Overall, Kosslyn's position is relatively clear. He means to salvage the common-sense notion that images are a part of our mental life, retaining a place for images in a science of the mind that does not reduce images to mere epiphenomena. At the same time, Kosslyn means to defend a specific scientific idea, directly opposed to Pylyshyn's, namely, that there can be specific functional structures that have pictorial properties. In this section I clarify Kosslyn's claims about epiphenomenalism, and then show that his attempt to salvage common sense runs aground because of his commitment to computationalism. Neither his theory of depictive data structures nor his theory of inspection shows there are any true, image-based representations in his system.

A. Kosslyn's Anti-Epiphenomenalism

There are two tracks in Kosslyn's discussions about epiphenomenalism. As these are not always kept separate in his own discussions, we need to discern what they are and

how Kosslyn understands their relation in making his claims about epiphenomenalism.

The first track invokes a folk-psychologic concern. Kosslyn asks, "Are the spatial, picture-like images people report experiencing a functional part of mental life?" (Kosslyn, 1980, p. 29, my emphasis). This, of course, is part of the question posed in our own inquiry, as we stated in chapter 1. I believe what Kosslyn wants to say about this sort of epiphenomenalism is relatively clear. Like the traditionalists in psychology, Kosslyn wants to defend the idea that our conscious mental images are causal factors -- that our basic intuitions about mental images are usually sound.

The second track involves a scientific concern. He holds there should be unconscious representations in the brain that function distinctively as images. These unconscious representations are variously referred to as the "functional images," "quasi-pictorial image representations," the underlying "data structures," or the "images per se." Kosslyn opposes Pylyshyn's idea that our experiences and the underlying representations do not match, insisting that our experiences, rather than being deceptive, are mirrors of the form and function of the underlying representations. He wants to maintain there is a parallelism in form and function between the phenomenal and

functional images. This position is clear from a remark Kosslyn makes in summary of his position:

It is important to note that the foregoing claims [about the general properties of images] not only posit properties of the representation per se [i.e., the functional representations in the brain], but also that we have the interpretive processes to "see" these properties. (Kosslyn, 1980, p. 34)

The functional representations, as he puts it, "give rise" to the experiences we have and our experiences "index" the depictive properties of the underlying data structures (Kosslyn, 1980, p. 30).

While espousing that there should be parallelism between functional and phenomenal states, Kosslyn is also conspicuously careful about the following claim, in which he recognizes the logical possibility that parallelism may be false:

... As a working hypothesis I began with the notion that the characteristics of an image evident in the experience of imagery did in fact index characteristics of the underlying data-structure, but this need not be so. (Kosslyn, 1980, p. 30, note)

Obviously then, Kosslyn's other reasons for thinking that the epiphenomenalism of experiences is false give way, in

the final analysis, to the scientific requirement that he remain neutral on the issue until more evidence is at hand.

What, then, are Kosslyn's actual claims? I believe they amount to the following. First, he claims that it is theoretically possible for there to be data structures and a procedural model that incorporates images, therefore giving him stronger reasons to suppose his parallelism hypothesis is true. Second, he claims that it turns out to be true, based on experimental evidence, that there are image-like data structures.

In summary, there is a level at which Kosslyn's view represents an attempt to follow common sense and restore mental images to psychology, particularly cognitive psychology. This level takes second place, however, to the pursuit of a scientific ideal, according to which cognitive phenomena are to be explained in terms of computations on data of a specific type, having imagistic properties.

B. The Theory of Depictive Functional Images

1. *Basics of the Theory*

Kosslyn claims that the functional mental images exist in a "spatial" medium. By this he means that mental images are significantly restrained by the computations that can be performed on them. He claims that images can be scanned or rotated only at certain rates determined by the operational

parameters of the structures and processes operating in the brain at the time. The "space" in which images are said to exist forms a mental architecture that will place permanent, significant constraints on the way shapes are represented and manipulated by the mind.

Kosslyn states that the computational space for images is like a coordinate space:

Images occur in a spatial medium that is functionally equivalent to a (perhaps Euclidian) coordinate space
(Kosslyn, 1980, p. 33)

If the space is Euclidian, this means that the locations of parts of the object imaged are accessed such that the original (perceived) distances between parts of the object are functionally maintained during recall or imaginary reconstruction. Again, this does not mean that the parts of the representation in the brain are literally in the same relative position and same distances apart, only that they are handled by the mind as if they were.

Kosslyn claims this conception of an inner space for mental representations is consistent with the computational notion of a functional space:

A perfect example of this is a simple two-dimensional array stored in a computer's memory: There is no physical matrix in the memory banks, but because of the way in which cells are retrieved, one can sensibly

speak of the intercell relations in terms of adjacency, distance, and other geometric properties. (Kosslyn, 1980, p. 33)

Since Kosslyn uses this example in support of his claim that functional images depict, it is appropriate to analyze it in more detail.

Let the following list represent the contents of a set of memory cells. Each cell, numbered 1 through 12 contains two values. In computer terminology, this is a two-dimensional array. (Also see Tye, 1991, chapter 3, pp. 33-60, for a similar treatment of arrays in Kosslyn's theory. I am indebted to Tye's exegesis for my understanding of this aspect of Kosslyn's theory. Tye, however, accepts the viability of this aspect of Kosslyn's theory, while I understand the treatment of arrays to demonstrate the essential conceptual flaw in the computational aspect of Kosslyn's theory.)

1. 2,2	7. 4,2
2. 2,3	8. 5,5
3. 2,4	9. 5,2
4. 2,5	10. 5,3
5. 3,2	11. 5,4
6. 3,5	12. 5,5

By themselves, the values in each cell have no meaning. A system of interpretation is necessary to convert the array values into some meaningful information. For illustration, we shall suppose the values are interpreted as row and column numbers on a grid. We shall suppose the grid is finite, consisting of six rows and six columns. Assume the cells indicate the locations in the grid that are to be filled with a visible point or marker. Hence, the information in cell number one indicates that grid location row 2, column 2, is to be filled. This scheme allows the numbers to be used to indicate the outline of a shape within the grid. The resulting grid, when filled in by an "X" at each row and column indicated, appears as follows.

	1	2	3	4	5	6
1						
2		X	X	X	X	
3		X			X	
4		X			X	
5		X	X	X	X	
6						

It is obvious that the conversion scheme used has transformed the list into a depiction of a geometrical figure.

The functional intercell relationships to which Kosslyn refers can now be understood in terms of this example. We may say that the contents of cell number one is functionally above cell five because the application of the prescribed procedure results in a depiction wherein the information in cell one produced a mark that is above the mark produced by the information in cell five. Hence, original data, combined with a translation scheme, yields a functional space in which spatial relations apply.

2. Critique of Functional Depiction

So much for what I take to be the essentials of how Kosslyn means to make depiction compatible with computation. We must now ask, in what sense does the property of depiction belong to the representational data type he calls the image? It is important to recall that according to Kosslyn's theory and his own analogy to the computer array, the image properties need to inhere in the list and what it is used for in the system, not to any actual display, drawing, or even any inner mental "depiction" at all. Has Kosslyn succeeded? Not at all. Clearly, our example demonstrates that the list and what it results in requires a further interpretation. It is not obvious that the outcome of the procedure is an "O" shape. We had to bend the truth of the matter when we stated above that the resultant

depiction was "obviously" a geometric shape. The so-called outcome is what it is only to a trained, conscious, and presumably human interpreter. The outcome can only be obtained by supposing a true publicly-visible visual particular. Therefore, the entire sequence falls prey to the homunculus objection.

From the computational standpoint, the series of transformations from list to a series of marks on a physical surface accomplishes nothing. Just as the drawing machine produced images that were irrelevant to the computations made from Euclid's postulates (see discussion of Pylyshyn, above), so the resultant "depiction" here is entirely outside of the computational flow. The sense that the result is an image is brought to us by the insertion of a supposed mechanism by which numerical values were transformed into physical actions that produced visible marks, followed by the imposition of how human consciousness would accept what is physically present in the visual field.

And what if the image were produced in the visual cortex itself? This changes nothing. From a physiological standpoint, he simply establishes the possibility of setting up certain "points" in the visual cortex.⁵ These "points"

⁵ Kosslyn's explanation of inner "seeing", stripped of computationalism, amounts to the view I advanced in chapter 3. It just states that there are probably neural correlates for this in the restimulated visual system.

are causally inert until the subject interprets them. This is precisely Pylyshyn's objection. The interpreter cannot be the whole conscious mind; that would suggest that the entire visual system is activated and the subject actually sees the image. The homunculus problem recurs. The "interpretation" of the activated points, to the extent there can be said to be any, must come from non-visual content already inhering in the computational state that generated the "O," namely, the content "this figure is an 'O'." (Tye comes to the same conclusion that this is a necessity of computational schemes. He defines images as a "symbol-filled array" to which a "sentential interpretation" is affixed (1991, p.90))

Again, Kosslyn's argument is that an uninterpreted symbol array itself counts as a depiction because of the way it is used to generate a phenomenal appearance to a conscious subject. It is clear, however, that a list of numbers cannot be said to depict anything in and of itself. The application of a computational procedure to it does not change its nature. Therefore, depictive properties of assumed list-like data (or other data formats) presumed to exist as the basis for image generation can only be said to be depictive in a metaphorical sense. The list data is metaphorically depictive because it ends up being used to generate an image.

I conclude that although data structures in the cognitive system (assuming they exist) might be said to be depictive in virtue of their results in consciousness, their own properties are not inherently depictive or spatial in any sense that serves as an explanation for phenomenal appearances. To say these abstract functional qualities of a system are "deictive" represents a word choice that is appropriate only by analogy to ordinary vision. Therefore, Kosslyn does not show that there are computational entities that are, or should be, recognized as having the properties of images.

C. Kosslyn's Computational Model for Inspection

1. *Basics of the Inspection Model*

What shape are Snoopy's ears? Does a Volkswagen Bug have a vent window? Questions like these are likely to elicit imagery experiences in which a mental image is, ostensibly, inspected by the mind's eye. From 1977 through 1994, Kosslyn developed many computer models of the process of inspection. Each one is intended to demonstrate how these imagery experiences can be completely explained in terms of the flow of information and the interpretation of data within a computer. Kosslyn sought to avoid the homunculus objection by showing that the mind's eye in the computational process "is equated with a set of procedures

that operate to categorize spatial patterns; it is an interface between propositional representations and depictive representations" (Kosslyn, 1980, p. 160). This strategy, I show, also fails to generate any computational use of images.

Kosslyn's strategy is to introduce information processing modules into his computer emulation that are intended to perform functions analogous to human cognitive processes. Some of these modules are based on conscious processes we are directly familiar with. If we imagine a penny on the sidewalk seen from ten feet away, we can "zoom in" on this image until the penny image becomes large enough to "see" the details on the face of the penny. We can also have experiences in which a mental image is rotated, or our point of view seems to shift across the surface of the image. Kosslyn gave the names ZOOM, ROTATE, and SCAN to the modules in the program that he believes emulate these human capabilities.

These modules operate on information data files designed to emulate information in short term memory (STM). The information in STM data files is derived from data files representing information in long-term memory (LTM). All the information is controlled and accessed through computational modules designed to meet the demands of computation and to

be as consistent as possible with human experiences and capabilities.

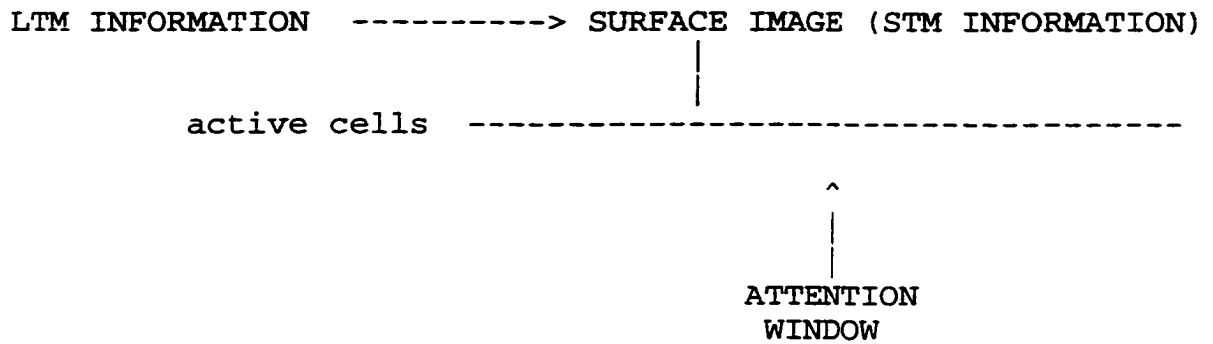
The process of inspecting an image begins by recalling the information necessary to generate an image from the LTM files. These data files consist of both positional information and propositional information. Each sort of object that can be imagined has both sorts of information stored in LTM. The positional or "literal" information includes lists of locations of points that are to be "filled" in the row/column structure of the STM matrix. The positional information, then, generates a display or "surface image" in which appearance and geometric properties become explicit.

The propositional information consists of a set of lists of information about the object. The information embodied in these lists is extensive. We shall not give a detailed account of each type of list, but these include lists containing information on the parts associated with each object, the locations of various parts relative to other parts, the sizes of objects and parts, the categories to which the object belongs, and so on.

When we are asked a question about the presence of a part on an object Kosslyn describes how the model handles this using a long series of complicated steps. The name of the object is located in LTM, a skeletal image is generated

in the surface matrix (STM) from the positional information, the part is searched for in the lists of parts for that object, the part is located in the skeletal images using mathematical rules, and so on. At this point, the part in question is located on the surface image, but is not yet "seen" by the mind's eye. The reason for this is that all the parts of the image are not capable of being seen or resolved in the same degree at the same time. This is meant to correspond to the introspective fact that we inwardly scan across a mental image, bringing in one part then another under the scrutiny of the mind's eye. Kosslyn parallels this phenomenon by including what corresponds to an attention window in his simulation. The part in the image is not seen until a procedural module called SCAN is activated. This module translates the surface image across the spatial matrix until the part in question is in the center of the matrix. This corresponds to our being attentive to the part in the image generated for the mind's eye.

In following the process so far we have only succeeded in locating a set of points at the attention window. But the activated cells being "attended to" are still simply points in a representational space. How is a part recognized? How can the region of activated cells in a portion of memory be known to represent a particular thing?



The answer lies in the use of information in LTM that provides the description of the part sought. The FIND process module initiates "a set of procedures that test for various spatial configurations in the surface matrix" (Kosslyn and Schwartz, 1977, p. 276). These tests on the surface image are derived from the description originally retrieved from LTM.

2. Critique of the Inspection Model

You have been given the job displaying information via a matrix of electric lights at Times Square. You are shown how to program a computer that will turn the circuit to each light bulb on or off at the correct moment in order to form letters or other shapes on the display. You are meticulously careful in compiling lists of electric circuits and the times at which each is to open or close. You check your program against another previously-stored program that reads your program, checking for errors. You even have a

simulation program that shows you, on your private CRT, what the result will look like when your program is placed in action. After all these steps have been taken, have you accomplished your mission?

One might be tempted to answer the above question with a resounding "Yes!". A moment's reflection will show that this can not possibly be the correct answer. What was the mission? The mission was to display information via the electric lights on an actual, physical, publicly visible installation - not to write a program about hypothetical circuit-closings and simulated lights turning on. For all you know, every single light bulb in the physical display may be burned out, or fifty percent of the relays closing the electrical circuits may not be functioning. Your program is irrelevant to the actual events happening on the matrix of lights at Times Square. The only way to be sure your mission is accomplished, is to visually inspect the light output of the matrix itself.

This, I believe, is a telling analogy to Kosslyn's inspection model. His description of inspecting images involves processes that are completely unnecessary for an unadorned information retrieval process. When the question is asked "does an X (object) contain a Y (part)" the information is already in LTM. The parts that definitively belong to an object are given in lists in propositional

form. No additional process described in the model improves on the ability to answer the question of whether or not the part is believed to be a part of the object. The use of descriptions to interpret the patterns in STM of categorization is unnecessary because the description of the part and the description of various categories ("round," "pointed," etc.) both exist in LTM. In theory, they could be compared directly without the translation into spatial information. The process represents a needless circumlocution of computational steps; the information sought is available at the beginning of the process.

The spatial "image" itself, or the pattern of activation in STM, never actually enters into the flow of information. Just as the actual appearance of the light bulbs on the Times Square matrix remains out of the picture until actually viewed, the actual pattern of the cells activated in STM by Kosslyn's FIND procedure are irrelevant to the computation. The description of the pattern is analyzed, not the pattern itself. The actual states of the matrix cells in STM are never part of the process. Just as in the Times Square analogy, we might presume that the cells have been activated according to a positional information pattern. But in order to test the actual states, we need to perceive the cells of the matrix being filled.

In Kosslyn's model, the information used to "activate" the cells is just a form of template matching with information already in LTM. This is precisely Pylyshyn's objection to introducing "imagery" steps in the computational procedures. In as much as they are not actually perceived, but only conceptually interpreted in terms of categories available for computation or matched against other data already existing, they are no different than any other process. If they are different in the way appropriate to their being classified as images, then, just as Pylyshyn has argued, they require not a figurative, but a literal mind's eye.

Kosslyn attempts to show too much from the model. A cognitive model need not explain experiences or establish a link between forms of processing and experiences, but Kosslyn has implied that his model does. Kosslyn strongly implies (and sometimes directly states, see 1980, p. 160) that the model is actually instantiated in the human mind. His explanation of how images are inspected in the model shows us how he understands the actual inspection of mental images in the mind. Equating the mind's eye process with a set of procedures only disguises the fact that Kosslyn's model is like a shell game, simply shifting the same information and the same procedures from place to place without ever generating new information. The model does not

demonstrate that imagery experiences are, or could be, part of the information flow in the machine (and since we are supposed to be the machine, he needs to show this). In his remarks about the phenomenal images we experience, he never indicates that they amount to more than superficial and ineffective effects of the "truly functional" underlying processes he is interested in uncovering. As a result, Kosslyn's entire theory of the human mind becomes consistent with epiphenomenalism.

VI. Summary and Conclusions

A. Inner Space: Merging the Theories

Kosslyn has suggested that mental images exist in a space. In one sense, this is surely a reasonable way to put it. I suggested in the previous chapter that we have forms of spatial awareness that mediate tasks, and that some of the actual neurophysiological mechanisms involved may be the same ones used during vision. Whatever automatic mechanisms are used for computing⁶ distance, relative size, and the interrelation of parts in vision may be activated in

⁶ In the biological, not the computational theory sense of "compute." The impulses of two nerves may stimulate a third, producing a single output, but this does not mean the two nerve pulses were added. The only theory I have about the nature of inner neural connections is that they almost certainly cannot embody anything like contemporary computational architectures, with registers, stacks, fully addressable memory, communication buses, clocks, and so on. If they did, it would be nothing short of miraculous.

imagery. Some of these mechanisms may enable the holistic spatial rotation of image representations and other mental manipulations. Whatever these innate mechanisms are, these may be said to be features of or limits to, the representational medium through which they appear; i.e., when understood as characteristics literally due to some physiological, rather than conceptual limit. We cannot, for example, visually represent to ourselves four-dimensional geometric objects, even though we can conceive of them. Pylyshyn's theory is also compatible with the notion, since he accepts that physiology determines such limits and that there can always be an epiphenomenal activation of the visual centers during imagery tasks. Images as existing in a space in this sense, surely, is a substantial part of what Kosslyn tries to appeal to.

On the other hand, as we have seen, we cannot derive the notion of experienced space from computational models, and we cannot say that brain representations exist in a space or that they depict or have colors. They (the brain representations) are not what we are aware of and their physical properties are utterly unlike anything we experience. It is the mental images we are aware of that represent and exist in mental space.

B. Epiphenomenalism

It is readily seen that whatever the nature of the structures and processes invoked to explain imagery in systems like Kosslyn's or Pylyshyn's, the phenomenal image is left intact. Neither side denies the existence of or any of the significant features of the phenomenal image. From the perspective developed in chapter 3, neither theory has produced much in the way of illuminating the nature of our experiences. It might be that computational models could emulate and because of this predict some features of human cognitive processing, but this appears to have very limited potential for explaining how we solve problems, think, or imagine. And, needless to say, creating a computer emulation of cognitive processes is an entirely different project than claiming that computational structures and procedures are actually instantiated in the brain -- and it is the latter claim that results in the problems of epiphenomenalism we encountered in this chapter.

We should not be so quick to dismiss these theories, however. Epiphenomenalism is a logical possibility and we know that common sense is not always right. Despite the theoretical difficulties, there may be something that emerges from these theories and from the study of empirical data on mental imagery. We explore this possibility in the next chapter.

CHAPTER 5

EXPERIMENTAL EVIDENCE

I. Introduction

The contemporary debate was initiated primarily by concerns about how to interpret experiments. Both sides agreed that internal representations (structures or data) and cognitive processes operating on them were needed to explain the experimental data, but they disagreed about which structures and processes were involved. Most of all, they disagreed about the specific interpretation of several crucial experiments that were thought to reveal imagery characteristics as inextricable from the structure/process pair constituting the cognitive operation. That is, they disagreed over the answer to the question we posed at the beginning of chapter 4:

Are there any root phenomena in the functional architecture of the brain that are intrinsically pictorial or imagistic in character?

As Kosslyn thought it was a theoretical possibility that imagery data structures could exist in the brain, the only remaining problem, from his point of view, was to find

unequivocal experimental evidence in support of it. This would complete his parallelism hypothesis of a match in form between inner brain representations and the form of our experience.

Pylyshyn's concern with empirical evidence was somewhat different, since he posited no necessary relation between cognitive processes and the form of our experiences. His concern was to find phenomena that were cognitively impenetrable, that is, phenomena that did not admit of being altered by the subject through the application of knowledge about other things. The infiltration of tacit knowledge, say, about the rules of objects moving through space in the real world, would show that the subject is not treating an internal representation as a given, unalterable unit in processing, but as a unit that could be creatively altered to fit the demands of the moment.

Cognitive science, in Pylyshyn's view, is concerned to distinguish cognitive phenomena, or phenomena that are governed by the application of knowledge (the use rules and representations), from those that are non-cognitive, root phenomena, or what Pylyshyn refers to as the "functional architecture" of the mind. Pylyshyn most frequently refers to the functional architecture as those fixed capacities or fixed mechanisms that are "instantiated in the biological medium" (Pylyshyn, 1980, p. 126) or "can only be explained

biologically" (Pylyshyn, 1980, p. 127). These fixed capacities cannot be the result of true learning, or deriving knowledge about the environment (Pylyshyn, 1984, pp. 266-269). In terms of a computational model, the operations performed by the functional architecture correspond to the "wired-in functions" of a computer (Pylyshyn, 1979a, p. 21). Hence, if any empirically-observed psychological phenomenon is purported to be a root phenomenon due to a fixed capacity, it must be one that is stable, invariant, and not the result of applying tacit knowledge.

In light of the above considerations, Pylyshyn says that the imagery debate should be understood as one concerned with

...whether certain aspects of cognition, generally (though not exclusively) associated with imagery ought to be viewed as governed by tacit knowledge -- that is, whether they should be explained in terms of processes which operate upon symbolic encodings of rules and other representations (such as beliefs and goals) or whether they should be viewed as properties of certain representational media or of certain mechanisms that are not alterable in nomologically arbitrary ways by tacit knowledge. (Pylyshyn in Block, 1981a, p. 153)

In short, the empirical search is for a non-computational, unalterable unit in cognitive processing. Since images, qua visible presentations, are non-computational, this search amounts to one guided by the following supposition:

If an experiment can show the existence of any irreducibly visual stimulus-like properties in mental imagery, this suffices to show that imagery can be a root process in cognitive psychology.

This way of stating what is at stake has proven satisfactory to both parties. If any such process is indicated, Kosslyn's view is supported. If no such process is found, Pylyshyn's view that there can be root processes, but that imagery processes are not presently found to be among them is supported.

The search for a true imagery process is sometimes identified as the search for an "analog" process, and this is also an acceptable description, if properly understood. From the computational standpoint, this means the search for a process that could not be accounted for by means of more primitive computational processes. Every computer has wired-in features that are impervious to alteration by programs; these features may be called "analog" simply because of this. Alternately, "analog" may be used to characterize the nature of a particular kind of input/output function. Imagists have often used the term "analog" to

designate processes that exhibit the "smoothness" or "continuity" in functionality that is thought (in their theory) to correspond to operations due to imagistic processes rather than due to discrete (descriptive) processes. Although "smoothness" is not a necessary attribute of any given primitive operation per se, there is nothing wrong with assuming that some primitive operations are also "analog" in this extended sense as well. Imagists, however, have to show that any reputed "analog" operation is not only primitive, but also that it truly retains some irreducible properties of a visual stimulus.

There are other ways of describing what is at stake in the empirical side of the debate, but I take the above to be the most philosophically important one.

II. What Kind of Phenomena are to be Explained?

Consider the question:

(1) Do German shepards have triangular-shaped ears?

Some people might answer straight off "yes," because they know that having triangular-shaped ears is just a plain fact about German shepards. But many people answer such a question only after a moment of reflection. They report that this information is something that is checked by means of inspecting a visual mental image. Apparently, some people have information stored in a form that allows

immediate verbal responses, while others derive the same information from the interior inspection of an image. Their belief is apparently in the more ambiguous form of an image, from which a verbal description may be derived.

Now consider the following examples.

- (2) Which is larger, an ant or an iceberg?
- (3) Which is larger, a mouse or a hamster?
- (4) How many windows are on the front of your house?
- (5) What letter of the alphabet does the capital letter "n" look like when it is rotated 90 degrees counter-clockwise?
- (6) Imagine a cube. Now "paint" one side blue. Paint two sides that are adjacent to the blue side, but opposite each other, red. Now cut the cube into nine smaller cubes (as in a Rubik cube). How many of the smaller cubes have exactly one red side and one blue side?
- (7) Imagine that your house has a doorway facing the street. You are inside the house, ten feet from the open doorway. The threshold of the doorway is level with the street outside, which runs perpendicular to your line of sight out through the door. At this moment, a huge black car tire, ten miles in diameter, begins rolling slowly down

the street from left to right. As the tire passes your house, what do you see through the doorway?

All of these examples are drawn from the contemporary literature on mental images. On the average, people will find that as they proceed through the questions imagery becomes progressively more involved in solving the problem. Question 2 usually induces no imagery. Question 5 nearly always induces an image, and most people are successful at using the image to arrive at an answer. In question 6, it seems that forming a mental image is absolutely necessary. Many people, while recognizing this necessity, are still unable to mentally maintain and manipulate an image that will provide a solution. Finally, question 7 presents a task in which imagery seems to be required, but the solution is elusive even with an image.

Contemporary empirical cognitive psychology seeks to generate structure/process models that will correspond to the measurable behavioral responses people make when faced with such cognitive tasks. It is not, except peripherally, concerned with describing, investigating, or recording the subjects' introspective accounts of the phenomenal states that occur during such experiments. Subject reports are not considered actual data under the rules of this form of

experimentation; they are considered supplementary confirming evidence.¹

III. Influential Studies

In this section, I review two of the most-often cited forms of experiments in the literature. I show how the apparent case for imagism can be undermined by descriptivist concerns.

A. Mental Rotation

1. *Shepard and Metzler*

Shepard and Metzler's 1971 experiment is the most famous example of an attempt to isolate and quantify a specific cognitive ability involving mental imagery. This experiment and the hundreds of subsequent studies on mental rotation are central elements in the empirical foundations of today's cognitive psychology.

In the experiment, subjects were shown line drawings of two simple three-dimensional shapes. Subjects were instructed to find if the figures were congruent or non-

¹ To my knowledge, there have been no disconfirming subject reports that have been taken seriously as disconfirming evidence for an experiment. In effect, the contemporary procedure, particularly on the imagist side, is to accept subject reports when they are favorable to their position and ignore them when they are not. I am grateful to Professor John Greenwood, for bringing this insight to my attention.

congruent (the "same" or "different"). In half the cases the shapes were identical except for a rotation in space. The shapes were rotated with respect to each other either in depth or in the picture plane. In the remaining half, the shapes were mirror images and could not be brought into coincidence through any possible rotation. Example shapes are shown in Figure 5-1.

Eight male subjects were shown 1600 pairs of shapes. Each subject was tested in several test sessions of about one hour, for a total time of 8-10 hours. The reaction times for each subject to perform the task (in the case of matching pairs only) were averaged.

It was discovered that the average time it took subjects to identify which shapes were identical was directly proportional to their angular displacement from each other. The difference in times for figures rotated in the picture plane instead of in depth was negligible. The results are shown in Figure 5-2. Initially, Shepard and Metzler were careful not to make expansive claims and simply stated "the result places severe constraints on possible explanations of how subjects go about determining identity of shape of differently oriented objects" (Shepard and Metzler, 1971, reprinted in Beakley and Ludlow, p. 216). Subsequently, Shepard and his associates claimed that such experiments demonstrate "the analog nature of mental

rotation" (Cooper, 1976, reprinted in Shepard, 1982, p. 170). The linear function strongly suggested causal mechanisms that operated with machine-like regularity and predictability, causing the mental rotation to be accomplished by a repetitive process through which the mental representation (i.e., a single, unified image) was "rotated" in minute increments (see Cooper, 1976, reprinted in Shepard and Cooper, 1982, p. 160). Kosslyn, Shepard and many others embraced this result as an indication of the reality of irreducibly imagistic processes.

2. Learning and Mental Rotation

If there is significant improvement through practice demonstrating acquired knowledge about how to perform a task such as "mental rotation", then the task is cognitively penetrable (see Pylyshyn, 1979a, especially pages 21 and 26). If this specific type of improvement with practice, or what I shall in this instance refer to as "learning," is involved to a significant extent in the Shepard and Metzler task, then the experiment is not a true indication of an isolated, holistic, analog process, and it does not count as evidence against Pylyshyn's side of the debate. Although I later criticize the over use of chronometric studies (similar to Shepard and Metzler's) as theory-building tools, it can be shown that even by the standards of evidence of

these experiments, there is not a good case for the existence of a fixed, or "hard-wired," mental rotation mechanism that applies to a wide variety of stimuli.²

Yuille (1983) was among the first to introduce the issue of learning and, by expanding the parameters of the original Shepard and Metzler experiment, to show serious flaws in their interpretation. An important historical footnote should be made here. By the time Yuille made his criticisms, the cognitive psychology movement, particularly the imagist side, had gained such momentum that Yuille's work was ignored. Kosslyn, in fact, did not even mention Yuille until 1994 when he (Kosslyn) officially gave up chronometric studies.

First, Yuille reasoned that if rotation were a fixed process operating on holistic entities at a fixed rate, the figures should be rotated at the same rate even if rotated in memory only, without the presence of a stimulus figure. Yuille trained subjects to perform a memory version of the Shepard and Metzler task. Subjects were shown a figure and its mirror image and were given time to memorize the figures. Subjects were then presented with a series of drawings and asked to identify if the drawings were the same

² Shepard and Metzler did acknowledge a possible learning effect of about 20% in increased speed after repetition, but thought this was not significant to the experiment.

or different than the memorized figures. Yuille found that in the memory version of the task the overall speed of rotation was nearly five times faster than the visual version in which figures were present. Yuille concluded that mental rotation, if it was in fact a holistic process proceeding at a uniform rate, had to allow at least two versions: one involving present perceptions only, and one in which the rotation occurs in memory.

Second, Yuille also performed experiments to show how subjects' knowledge of the task altered the results. During his memory experiments, Yuille had discovered that if subjects were not given the mirror image of the figure to memorize, their response times in the memory task were doubled. Evidently, subjects were deriving information from the study of the mirror image that significantly influenced their performance on the task. Since knowledge of figures not seen altered the process, this was not consistent with the idea that a holistic representation of the figure, derived entirely from the current stimulus object, was the element responsible for cognitive processing. This led Yuille to doubt that "mental rotation" of a single representation occurred at all.

To further test the hypothesis that ancillary information could influence performance, Yuille informed subjects of a way of perceptually dissecting the Shepard and

Metzler figures so that they could perform the task by inspecting only the bottom half of the figures. The informed subjects performed the standard Shepard and Metzler task approximately twice as fast.

Finally, Yuille conducted additional experiments with complex figures and found that the complexity of the figures also significantly influenced rotation times. He designed figures with more cubes and more articulated segments. When the figures became too complex, some subjects could not perform the task at all. Those that could perform the task with complex figures invariably found ways of simplifying the task by visually examining only part of the figure. Yuille concluded that in this case "imagery in a simple, holistic sense, does not mediate the so-called mental rotation task" (Yuille, 1983, p. 278).

Yuille argued that Shepard and Metzler's results were obtained because of a fortuitous selection of the figures used. The shapes used were neither too simple nor too complex. Since he did not find evidence of holistic rotation in his own experiments, Yuille speculated that the Shepard and Metzler task itself was not performed in a holistic fashion: "it is our assumption that a piecemeal comparison process mediates this task" (Yuille, 1983, p. 278). He suggested that the increased time for increased angular disparity is accounted for by the number and

distance of eye movements required for feature comparison between two figures (Yuille, 1983, p. 278).

Since Shepard and Metzler averaged the data of all subjects over many hours, their finding also does not address the degree to which early learning stages differ from the average. Their supposition is that averaging results over many hours of testing yields an accurate picture of the mechanism to be isolated.

In order to examine this supposition, I devised an alternative experimental procedure using the Shepard and Metzler figures. With a great deal of assistance,³ I conducted a series of tests on small groups of 10 or more students (26 students tested in all). We used only 30 sets of picture pairs instead of 800 sets. Each subject was tested only 3 times each for each set of angular displacements between the picture pairs (instead of 80 times, as in Shepard and Metzler's experiment). The procedure was intended to capture more information about the initial phases of the subjects' mental rotation.

We discovered that there is no indication of a fixed rotation speed in the early stages of performing the Shepard

³ I am deeply indebted to Radu Luchianov, former student of the American University in Bulgaria, who was unfailing in his support for this project. He wrote (and tirelessly revised) the entire computer program and assisted me greatly in collecting, formatting and analyzing the data.

and Metzler task. As shown in Figure 5-3, subjects generally improve their times after their first attempt to rotate an image at any given degree of angular separation. We also kept records of how a single individual performed on a slightly longer series of trials. Figure 5-4 shows how a single individual dramatically improved his times after two successive trials of 140 Shepard and Metzler figures each. The first trial indicates the subject took considerably longer with rotations greater than 120 degrees. As indicated in the graph, in the second trial this deficiency was overcome, yielding a nearly linear average response time similar to Shepard and Metzler's published results.

These data indicate that subjects can, with practice, substantially improve their times in performing the Shepard and Metzler task, particularly with the more difficult (more angularly divergent) figure pairs. These data alone are not sufficient to demonstrate "learning" in any more than the limited, behavioristic sense that the subject performed a given task faster. Such data alone (as I argue in Section III of this chapter) can be misleading and do not capture the kind of evidence necessary for understanding the conscious component of mental imagery problems and related phenomena. Fortunately, from the point of view I wish to advance, I also collected subject reports for our version of the Shepard and Metzler task. Subjects reported both

conscious cognitive strategies of decomposing and analyzing the figures as well as just "superimposing" (presumably by means of a phenomenal image) the figures. The combined data, including both statistical and subject report data, do, in my view, constitute substantial evidence that subjects adopt learning strategies during the task. The importance of subject reports is a point we shall return to later in this chapter. At present, it will be instructive to consider still another so-called "mental mechanism" phenomenon that was thought to be identified and measured by cognitive science: mental-scanning.

B. Mental Scanning

1. *Kosslyn*

Kosslyn's most famous experiment in mental scanning involves a map memorization task. Subjects were asked to memorize a map of an island with seven different objects on it (Figure 5-4). None of the distances between any two objects on the map are identical. Subjects studied the map until they could reproduce the locations of all seven items to a specified degree of accuracy. Accuracy of recall was tested by having the subjects locate the positions of the objects on a blank piece of paper.

The practiced subjects were then asked to visualize one of the objects on the map. The subjects were then given the

name of another (target) object. This target object was either the name of an object on the map or the name of some other common object, but not one on the map. Subjects were to mentally scan the map in search of the target object. The inclusion of target objects not on the map was to ensure that subjects would actually scan their mental image of the map and not circumvent the instructions by simply memorizing the names of all the objects on the map. Kosslyn describes the instructions to the subjects and the process of making measurements as follows.

Upon hearing this name, he or she was to "look for" the item on the imaged map. If the item was on the map, he or she was to scan to it; scanning was to be accomplished by imaging a small black speck moving in a straight line as fast as possible to the object. ...As soon as the dot hit the second object, the subject was to press one button; if the subject "looked" and was unable to "see" the second object, he or she was to press another button. The subjects were asked to respond as quickly as possible while still following the instructions and keeping errors to a minimum.

(Jolicoeur and Kosslyn, 1985, p. 322, summarizing the original 1978 experiment)

Kosslyn found that the average times to mentally scan the distance between objects on the map was directly

proportional to the distance between objects. The distance/time relationship results in a straight-line function, shown in Figure 5-5.

Kosslyn concluded that the experiment verified his parallelism hypothesis:

This demonstration supports the claim that images are quasi-pictorial entities that can be processed and are not merely epiphenomenal. One of the characteristic properties of such a representation is that the interval distances between portions are depicted, and these data suggest that functional representations underlying the experience of visual mental images do have this property. (Kosslyn, 1980, p. 44)

Kosslyn's scanning experiment was accepted by a large segment of the cognitive science community at the time. As in the Shepard and Metzler experiment, the apparent straight-line function came to be understood as evidence of an underlying analog processes.

2. Pylyshyn's Objections to Scanning Experiments

Pylyshyn argued that mental scanning can be shown to exhibit cognitive penetrability. If subjects are not specifically instructed to mentally scan to the target object, they respond to questions about whether or not other objects are on the map after a fixed delay that is

completely independent of distance. Kosslyn himself reported this phenomenon (Kosslyn, 1980, p. 47). Other experimenters (for example, Lea, 1975, as reported in Kosslyn, 1980, p. 40) also found similar phenomena when subjects were not instructed to use imagery.

Pylyshyn also pointed out that cognitive penetrability is evident in the way Kosslyn describes his original experiment. The subjects are instructed to scan toward the target object. How can subjects carry out the instructions unless they already know in which direction to "scan" toward the target object? The direction in which to scan is knowledge that must be retrieved nearly instantaneously, before the "scanning" process could start. Therefore, the subject already anticipates something about the terminus of his "search." Pylyshyn proved this himself with his own experiments in which he asked subjects to memorize a map and then name compass directions between various objects. No time/distance relations were evident in their responses (Pylyshyn in Block 1981a, pp. 193-199).

Pylyshyn concluded that mental scanning is not a process in which subjects actually find the objects in an image. Rather, subjects engage in a process that is conceptually distinct from any reputed searching for an object. What subjects do does not represent a constraint by the medium of representation, but what subjects believe or

infer "about some likely intermediate stages of an event being imagined or about the relative times at which the event would occur" (Pylyshyn in Block, 1981a, p. 186). The supposition that a medium is involved in or imposes constraints on the responses of subjects is simply an ad hoc hypothesis invented to explain the data.

3. *Finke*

If the scanning results and the Shepard and Metzler results were questionable as solid evidence for the imagist side, then the imagists needed empirical evidence that was more difficult to refute. Finke attempted to supply this evidence in his 1982 experiment. He attempted to block Pylyshyn's form of objection by devising an experiment that could not be shown to be subject to task demands or to be cognitively penetrable. Currently, Finke's experiment is often cited as proof that scanning phenomena truly are analog processes. It is claimed that because it is difficult to show how any task demands could influence the experiment, it is exceptionally strong evidence that the time/distance relation maintained in imagery task performances is the result of the intrinsic constraints of the "mental medium." These constraints would show that the medium maintains an "analog," or smooth and continuous representation, during certain imagery tasks, a

representation not subject to the intrusion of discrete, or non-analog, computations. If Finke's experiment and the claims he makes about it are indeed right, then one of the principal claims of computational imagism gains significant empirical support. (See Kosslyn, 1994, pp. 9-10 and Tye, 1991, p.67 for expressions of this viewpoint⁴).

Finke used a pattern of four circular black dots on a white background as a stimulus display. Subjects were told to memorize this pattern and were allowed to study the display for five seconds. The four dots were then removed and the display remained white for one second. This interval was to allow any induced after-images to fade before the memory test was started. A small arrow then appeared on the display, which either pointed directly at the position of one of the dots or completely missed pointing to any dot by an angle of 40 degrees or more. The arrow appeared at an unexpected location, at various distances from the dots. Subjects were instructed to respond as quickly and as accurately as they could with a button press to indicate whether the arrow pointed to a dot location or not. Subjects were told in advance that the

⁴ Tye writes: "Pylyshyn has recently conceded that the appeal to task demands will not explain the results of all the scanning experiments" (Tye, 1991, p. 67). Tye is right to say Pylyshyn has some obscure comments in print about the experiment, but he has not "conceded" the issue by any means.

experiment involved visual memory and that the task would be easy since the arrow would point directly at one of the dots or miss it entirely. No mention was made of using mental imagery.

Finke found that the average times to make the decision in those cases where the arrow pointed directly to a dot, was linearly proportional to the distance from the arrow to the dot. Finke concluded that although other interpretations were possible, this fact, coupled with some subjects' reports that they formed mental images, made it most likely that "this kind of task is typically performed by scanning along a straight line in a mental image" (Finke, 1982, p.144).

Finke claimed the experiment measured the scanning phenomenon in a way that made the use of prior, or tacit, knowledge impossible. Although subjects might have encoded the various distances between the dots, this information could not be used to solve the problem since it involved the appearance of a new element, the arrow, at an unexpected location. The problem required establishing the relation of the arrow to the previous visual information. The relation of concern to the subject is "pointing to" or "not pointing to." This does not involve the notion of distance. Since the subjects were not told that the experiment involved mental imagery, scanning, decision time, or distances it is

unlikely that they would consciously or unconsciously try to establish a correspondence between the distance from the arrow to a dot and the time needed to traverse the distance (i.e., form a conceptual relation corresponding to $T = D/S$). For these reasons, Finke claimed that the issue of task demands, or the application of tacit knowledge, could be eliminated from this experiment.

The results appear to be consistent with the pictorialist view that images are not epiphenomenal but are functional in problem solving. As Finke says,

In general, these interpretations are consistent with the view that attributes to mental imagery the special function of facilitating incidental recall and inferential reasoning, that is, the extraction of information not explicitly encoded at the time of initial learning. (Finke, 1982, p. 146)

The results also appear to be consistent with Kosslyn's theory that the spatial characteristics of image processing are inherent in the medium rather than derivative of beliefs or goals.

Finke's experiment is indeed difficult to discount, but there is a descriptivist response to it. First of all, there are some omitted details to the experiment that have not been consistently reported. In preliminary trials, Finke discovered that if an arrow appeared at a point

previously occupied by a dot, the response times were independent of distances. This led him to conclude that the relative interpoint positions were remembered and there was no need to utilize a mental image in this version of the task. Finke also discovered that the reaction time/distance ratio decreased slightly as subjects became practiced in the experiment. Furthermore, only six of the twelve subjects actually reported scanning a mental image along the axis of the arrow, while five reported using an image "in some way," and one reported not using images at all. This is why Finke hedged his conclusion by saying the task "typically" involves imagery (see quotation above). Kosslyn, in his references to this experiment as a final blow to the issue of task demands (see 1985 and 1994 texts) does not refer to any of these important details about the experiment. Finke does not report these details in his 1984 Scientific American article, nor does Kosslyn in his 1994 book.

Far more important than these omitted details is Pylyshyn's response. Pylyshyn responded that the entire experiment was essentially irrelevant to imagery since it involves use of specific visual features in a present stimulus (Pylyshyn, 1984, p. 247). He writes:

When you are actually looking at a screen you can use location cues such as the borders of the screen or specks on the surface to indicate where to move

attention (or even your eyes) -- in which case this becomes a visual task and not an imagery one. (Zenon Pylyshyn, personal communication).

This analysis supports the definition of imagery phenomena given in chapter 3 and how to understand its experimental implications (the fourth objective of the study of imagery types). Imagery experiments need to be arranged so that stimulus conditions are not confused with imagery phenomena proper (which, by the definition we made in chapter 3, involve effects attained in the absence of a corresponding stimulus).

C. Conclusion

From our discussion so far, we conclude that although the operations of the brain indeed must have some constraints, the scanning operation and the rotation phenomena do not appear to be among them. The spatial relations that appear to hold in these cases are in fact optional in the crucial, empirically verifiable sense that they can vary or disappear under alternate experimental conditions. Hence, the scanning and rotation phenomena do not appear to be sufficiently constrained to be incorporated into cognitive psychology as root phenomena (i.e., as phenomena intrinsically constrained by non-cognitive properties of a mental medium that cause the representation

to be operated on only as if it were a singular, undecomposed visual stimulus).

IV. Problems for Empirical Cognitive Psychology

A. Individual Variation

As long as averages are adduced as evidence of what individuals are actually doing in a given task, the experimenters run the risk of making interpretive hypotheses that apply only to ideal responses. Instead of applying to everyone, a hypothesis derived from an ideal response may apply to no one. As Darryl Bruce pointed out in an essay critical of contemporary laboratory approaches to memory, the over use of averages implies a type of Platonism about psychological entities. This approach is an inversion of the perspective he recommends. Rather than supposing that mean values are real, Bruce suggests "it is variation in the group that is real and the mean value or type that is the abstraction" (Bruce, 1985, p. 82). The danger is that the features of an idealized average will become the object of psychological investigations. This may obscure what is happening on an individual or finer-grained level of analysis. We saw how the Shepard and Metzler results did not necessarily indicate all that subjects were doing, and how the interpretation of the experiment changed once it was subjected to a finer-grained analysis.

The problem of how to incorporate individual variations within psychology, particularly when one is searching for root phenomena, is absolutely fundamental for experimental psychology. Hull, one of the most important theorists of behaviorism, explained variations in response to an identical stimulus by supposing that they are caused by random oscillations of neurons about a central level of activity. He concluded that although this precluded an exact predictive science of individual behavior, repeated measurements would be sufficient to "reveal a close approximation of the laws which are operating" (Hull, 1943, p. 317).

A less restrictive way to account for individual variations in task performance is to allow that subjects employ different strategies for the same task. My experiments with mental rotation suggested this possibility from an objective standpoint, but the easiest way to clear the matter up is simply to allow subject reports into the "data" of the experiment. If we assume that subjective reports are fairly accurate, we get a whole new and easily-explained set of data consistent with the view that "percepts" do not come in pre-formed computational (or non-computational) units, but in ways varying according to subject dispositions and interests. It may be that subjects who report piecemeal solutions actually employ them, while

others who report holistic solutions may actually employ them. Perhaps what counts as a unit of processing, either on the conscious or the unconscious level, for one person does not count as a unit of processing for another person. This would account for individual differences in times, and, since the various strategies will be distributed over different subjects as well as the same subjects in different iterations of the task, the overall result will be an "average" performance corresponding to some mathematical function (in some cases, conveniently, a linear relationship).

B. Underdetermination and Lack of Predictive Power

Kosslyn and Pylyshyn have accused each other of having an unscientific theory that lacks predictive power. Let us briefly review the bases for such accusations, and then suggest a possible resolution. (In order to frame the accusations, we need to assume, for the moment, that the above considerations about individual variation are moot, and that an interpretation of Platonized data is needed.)

Kosslyn argues that Pylyshyn's theory cannot explain or predict the rotation data. If Pylyshyn's theory is right, there are no constraints due to an internal spatial medium. But if that is the case, why has one "rotation" rate been measured rather than another? Pylyshyn's response is that

there is a rotation parameter in cognition that is set by the "cognitive analysis of the stimulus and the subjects' beliefs and goals" (Pylyshyn in Block, 1981a, p. 178). Kosslyn counters by saying that the explanation that the parameters of the experiment somehow "set" the rotation rate is simply an ad hoc hypothesis. There is no reason to suppose that this is a knowledge-driven response rather than one reflecting the properties of the internal representational medium. In his 1994 book, Kosslyn took the stand that the entire descriptivist side had the character of being an ad hoc system; he called it "a moving target" (Kosslyn, 1994, p. 8). Whatever data was found, he pointed out, could be adapted to the propositionalist side simply by proposing new "knowledge bases" or "parameters" sufficient to cover the data.

On the other hand, Pylyshyn has pointed out the kinds of problems faced by Kosslyn's stance on his map scanning experiments. Kosslyn admitted that subjects could find or "see" the target objects independently of distance, but he insisted that this was evidence for his position. When subjects choose to follow the instructions, the scanning time/distance relation emerges. When they do not, the phenomenon does not appear. Kosslyn concluded that this is evidence that imagery, when used, has certain spatial characteristics. One can only regard such a defense as a

last ditch effort to maintain credibility where there is none. A task demonstrating a root imagery phenomenon cannot optionally involve imagery processing; this violates the principle that an experiment must involve irreducibly visible stimulus-like properties in order to be proof of imagery processing, as set forth in the introduction to this chapter. As Pylyshyn has argued, in order to be sure that any phenomenal imagery state associated with a task is not just an epiphenomenal result of a descriptive process, it must at least be shown that the task cannot be done in any other way than through generating a phenomenal image. Once this has been established, one can then debate whether or not the characteristics of the task demand that new information has been extracted by means of the phenomenal image.⁵

One reason, I suggest, that neither side has been able to get the upper hand on this issue is that computational models are simply too flexible. So flexible that, given the original terms of the debate (i.e., assuming some form of

⁵ Note, in defense of philosophic imagism, or the view expressed in chapter 3, that Pylyshyn's objections do not apply to it. In philosophic imagism, the use or non-use of mental imagery in any situation is entirely optional. For the philosophic imagist, the ultimate issue is not whether or not certain observable behavior results in a certain situation, but whether the subject has, or uses, a conscious mental image. The use or non-use of mental imagery is explained by referring to free choice or natural dispositions in adopting strategies to perform a mental task.

computationalism to be true), it may be unsolvable in principle. This idea was taken up by Anderson in 1978. Both sides, he pointed out, agree the problem is to identify the form of the mental representations and the processes that operate on them. The representations and processes always work together, forming the complete system that is to be investigated. Anderson argued that given any behaviorally-measured data, it is possible to devise a model operating either with images or propositions as the root form of representations. Either form of representation would serve equally well, since appropriate processes can be proposed to accommodate them. If, for example, the root representations are considered as holistic images, then a process, say, of rotation, can be hypothesized to operate on them. If, on the other hand, the representations are thought to be descriptions of positions and angular quantities, then another suitable type of process can be hypothesized to operate on them.

Anderson concludes that since the behavioral data can always be interpreted as conforming to some combination of representations and processes, it will never be possible to isolate the specific nature of one-half of the operating pair (either the processes alone or the representations alone). Anderson suggests, therefore, that the debate is essentially insoluble because the two theories are

computationally equivalent. Cognitive psychology will be left in the position of proposing various models that emulate rather than capture the nature of mental phenomena. He compares the situation to that in physics, in which the same phenomenon may be described in terms of either waves or particles.

Anderson's critique, I believe, is basically correct given the assumptions it makes. He accepts Kosslyn's idea that images could be computational entities, but he correctly diagnoses the problem of working with hypothetical models that are constrained only by the process input, the process output, and a time lag in between. This is just a black-box problem. Given only the input and output, any series of events can be hypothesized to mediate them, limited only by the creativity of the model maker.

The supposition that there are any serious constraints on the mediating model derives, I suggest, from a predilection to accept as a supposition precisely what is to be proved. The idea that computational images or descriptions, in whatever preferred combination, actually mediate input and output derives not from computational restraints, but from the actual phenomenology of conscious imagery experiences. These, as we know, involve both active and passive aspects, i.e., both consciously-directed activities and some measure of automatic awareness of

spatial environments. The model maker just attempts to solidify these global aspects of conscious mental life that actually mediate perceptual problem-solving and imagery tasks into a computational model. Since the model maker can not capture the nuances of conscious problem-solving, the model fails.

Some of the misunderstandings about the value of cognitive model-making derive from the tension between two issues that underlie Kosslyn's approach: on the one hand, he seeks to show that the phenomenal image is involved in causing the subject's response; on the other, he seeks to show that there is a special medium that constrains the time of the response. Is there a perspective from which we can gain information about the nature of imagery experiences, including whether or not phenomenal images were present and used by the subject? Of course. One has only to perform mental rotations or the Finke experiment on one's self and then ask others to do it and report their findings. To be more rigorous, one might use more demanding tests, such as those designed by Stromeyer and Psotka or Chambers and Reisberg (section V of this chapter) from which the presence of a phenomenal image seems even less logically intractable. But any claims or implications of this sort made by Kosslyn are independent of the (in his view) more important claims he makes about what interpretation the hard evidence alone

demands. On this issue, I side with Pylyshyn. The evidence examined so far is simply insufficient to make the claims. Further, Pylyshyn's claims to the contrary notwithstanding, I think Anderson's critique of the standards of evidence and the models used to explain the evidence stands. Suppose we had a model of human imagery processing that was fully accurate and predictive of the behavior of subjects in experimental conditions. Are we then constrained to attribute to the subjects the same functional states as are used in the model? We would be tempted to, naturally. We would not, I would argue, be constrained to, unless there were other evidence, such as neurophysiological evidence or subject reports conforming to the model. Kosslyn's subsequent claims that we do have such confirming evidence (and I do not dispute its value, since it is part of the descriptive model of traditional/common-sense psychology I support) should not be confused with specific claims he makes about interpretations forced on us by specific experiments.

Restricting ourselves to the input/output/time-lag model that Anderson criticizes, could there be any sort of task measurable in an experimental situation that would demand that "imagery processing," rather than "descriptive processing," be included as the hypothesized mediating component in cognition? Can we exclude this as a

possibility at this stage of the game in empirical investigations? Perhaps not. Perhaps in the future some sort of test will be formulated that can demonstrate one sort of interpretation of the evidence in favor of the other. Both Pylyshyn and Kosslyn strongly disagree with Anderson that the issue is undecidable in principle. Indeed, if Pylyshyn is right, and the experimental arm of cognitive science succeeds, there will be a discovery of a root mechanism in the functional architecture (loosely termed an "analog" or perhaps even an "imagistic" process).⁶ Pylyshyn's point about the present state of the empirical data, and the one re-emphasized here, is that we have very little in the way of unequivocal data (about mental imagery, as opposed to vision, or other areas investigated in cognitive science). There must be, according to Pylyshyn, cognitively impenetrable elements in the functional architecture, but so far there is no evidence that the scanning and rotation phenomena, as empirically defined and measured, are among them.

⁶According to Pylyshyn, some of the root phenomena needed for cognitive psychology may have already been discovered. Among them are some aspects of visual interpretations of unfamiliar scenes (cf. Pylyshyn, 1984, p. 269).

C. The Will and Conscious Judgment

If the aim of psychology is to reduce the phenomenal image to some other explanatory mechanism, the phenomenal image has no role in science. This view, which we have seen is supported by both Pylyshyn's and Kosslyn's theory, has a strange consequence for the Shepard and Metzler experiment. What if I experienced no images, no thoughts, and no subjective experiences during the experiment? Under these circumstances, would I be able to arrive at anything that could rightfully be called a judgment?

Let us consider this for a moment, for many of our intuitions about consciousness, thought, and the prospects for computational solutions in the philosophy of mind depend on them. Idiot savants have been reported to be able to multiply large figures in their heads. The answer may be correct, but is it right to say that the subject thought of the answer? Did the subject think it through? According to the reports of such subjects, the answer is "no." The answer just "appears" in consciousness. According, then, to the traditional philosophic definition of knowledge an idiot savant has no knowledge of what he is doing, since knowledge is true belief plus the ability to give a reasoned account. When we are considering models of human processes, we need to bear our intuitions about such examples in mind.

Let us return to the image rotation example. If I reported that my first awareness was the stimulus (the figures placed before me) and the next awareness I had was my finger pressing the "SAME" button, would anyone be likely to interpret the experiment as showing how we perform mental processes? I think not. Yet, within the prescriptions of contemporary techniques, the total absence of these intervening mental states is completely compatible with the purpose of collecting data from subjects in order to form straight-line graphs indicating the nature of the mental processes they use. This is a strange consequence because it implies that the ordinary meaning of "using a mental process" can completely disappear in a scientific context.

Consider the psychological phenomenon of the perception of color constancy. Two identical sheets of paper, one in bright light and the other in shade, can be easily and effortlessly judged to be the same color. The neurological processes and the principles of light reflection involved in this phenomenon are undoubtedly complex, yet our subjective experience involves virtually no effort. Problems in rotation, on the other hand, require both effort and consciously-directed attention. I suggest that an unprejudiced, common-sense view of the matter is that the forms of explanation required in the two cases diverge. Once the physical explanation of color constancy is given,

we need an additional explanation of the presentational consciousness of color; that is, we need to explain how something can appear to us in a certain way without conscious effort. Rotation problems require an additional explanation of how problems requiring effort and self-direction can be solved. The continuity of an interconnected series of presentations in consciousness resulting in a judgment needs to be explained. Behaviorist-inspired psychology attempts to collapse the difference in modes of explanation by collapsing the difference in the subjective experience in those processes requiring effort and those processes that occur automatically.

D. Conclusion

The various attempts we examined to find a root imagery phenomenon did not, upon examination, yield a consistent picture even within the strictures of computational models. We gave ample reasons to question the fruitfulness of such models.

We are now ready, hopefully, to entertain another possibility about the "kinds" of information encoded in the brain and available to us. Perhaps the search to verify the existence of "pure" analog or discrete coding information is not a problem of experimental design. It may be that the lack of separation of the two supposedly distinct "kinds" is

a feature of the information itself, and that this is the reason experimental evidence tends to be equivocal. This might be revealed in other, less restrictive, experiments.

V. An Alternate Experimental Model: Chambers and Reisberg

Chambers's and Reisberg's approach is distinctive in that it integrates elements from both Pylyshyn's and Kosslyn's theories. In support of a descriptivist perspective, Chambers and Reisberg claim to show that unprompted "discovery" of new interpretations from a single image does not occur. Yet, in support of a pictorialist perspective, they also claim that "learning" or surprise may be present in mental imaging. The latter claim is to be understood advisedly, since Chambers and Reisberg give a special sense to the term "learning." It is not to be confused with the meanings we have given the term earlier in this chapter. Chambers and Reisberg claim that "learning" takes a restricted form, one that is consistent with the conceptual constraints built into the image and therefore one that does not represent learning from a neutral stimulus.

A. Experiments

Between 1985 and 1991 Chambers and Reisberg reported on a total of eight experiments using various ambiguous figures

that could be reinterpreted by reversing front and back, rotating the figure, or reversing figure and ground. A total of some 200 subjects were tested in these experiments. In many cases, subjects were given practice sessions in which they were taught to reverse standard ambiguous figures such as the Necker cube or the face/vase figure. In a typical experiment, subjects were allowed to inspect a stimulus, such as the duck/rabbit figure, for five seconds. This was generally long enough for a subject to arrive at one interpretation of an ambiguous figure but not the other. Subjects were then given instructions (in the manner of many of Kosslyn's experiments) to inspect and/or rotate their mental images to find a new interpretation.

The results of these experiments were dramatically uniform: in all cases except two, no subject was able to arrive at a new interpretation of their mental image through untutored inspection. (See Reisberg and Chambers, 1991, p. 345 for this summary result. Chambers and Reisberg attribute the two anomalous cases to lucky guesses on the part of the subjects. These anomalous cases amount to only one percent of their data.) In particular, none of the 35 subjects exposed to the duck/rabbit stimulus in the original 1985 experiments were able to reconstrue their mental images as representing another animal. Even when subjects were specifically encouraged to find an alternate interpretation

of their image as they had previously practiced with stimuli, they were unable to do so.

B. Qualifications of Results

These results need considerable qualification. Although no spontaneous reconstruals were recorded, Chambers and Reisberg did find that if subjects were given the appropriate hints or instructions, they were able to give alternate interpretations to the stimulus figure using memory information only. The way in which these alternate interpretations became "available" (for want of a better term) to subjects is of central importance if Chambers and Reisberg are to maintain their claim that no reconstrual of images is possible. Despite the fact that their results are strong arguments that mental images do not retain all the properties of a neutral stimulus, the fact that new interpretations are possible under some conditions argues that some stimulus-like properties are retained.

An overview of the types of instructions used and how this changed the results of Chambers's and Reisberg's experiments will indicate the kind of dilemma they faced in trying to state a consistent and comprehensive conclusion. Various forms of suggestive instructions were tried, with no readily predictable effects. The instruction to rotate the image, for example, did not allow subjects to find an

alternate interpretation, but the instruction to give the figure "a new top" (i.e., think of the side of the image as the top of the figure) often allowed subjects to find an alternate interpretation. Similar results were found using the duck/rabbit figure. Suggestions inspired by the idea that mental images can be scanned, such as "look at the left side of your image," or "this figure resembles a familiar form" did not allow subjects to find an alternate interpretation. But in latter experiments, Chambers and Reisberg (1992) reported that rather specific instructions, such as "some people interpret this figure as a duck" or "imagine the front of the figure as the back of another" did allow a significant percentage of subjects (about half) to find an alternate interpretation of the duck/rabbit figure. Perhaps even more surprising, Chambers and Reisberg found that the new interpretation apparently restored visual information that had been lacking. If subjects originally encoded the figure as a duck, for example, they were able, after the new interpretation, to recognize visual details on the "rabbit" side of the original stimulus figure with greater accuracy.

Kosslyn also addressed the Chambers and Reisberg results and their interpretation. In defense of a stronger imagist view, he opposed their implication that images were fixed by descriptive constraints that limited, or rendered

impossible, spontaneous reconstrual. Kosslyn pointed out that other data exists on the abilities of ordinary subjects to reconstrue images. The following exercise (slightly modified here) was used by Finke, et. al. (1989, as reported in Kosslyn, 1994, pp. 336-337) to demonstrate interpretive reconstrual:

1. Imagine an uppercase letter "d."
2. Rotate the letter 90 degrees counter-clockwise.
3. Place the letter of the alphabet following "i" on the bottom of the image.
4. What does the figure resemble?

Most subjects have no difficulty describing the figure thus constructed in the imagination; "an umbrella" is a typical response. In this case, a figure is rotated and shapes are assembled for the purpose of constructing an image. It seems clear (phenomenologically, at any rate) that the resulting image is then reconstrued as representing something other than the sum of its parts.

Chambers and Reisberg attempted to bring the data together and address such apparent counter examples by distinguishing between learning and discovery within single images. The Finke/Kosslyn "umbrella" example is a case of learning because the subjects make a single image from separate images and learn how that new image could be described. Within that new single image, however, there is

no authentic discovery, in the sense implied by visual inspection of raw data. The new image also brings with it certain unconscious parameters that restrict how the subject will reconstrue the image. As evidence of this, Chambers and Reisberg point out that there is no uniform explanation or pattern that predicts how, when, or if subjects will be able to reconstrue images -- as there would be if Kosslyn's pure stimulus view were correct. It might be, for example, that the umbrella case allowed "learning" because everything in the figure is upright. This hypothesis fails to carry over as an explanatory pattern to the duck/rabbit figure, where everything is also upright and no spontaneous reconstrual occurs. In addition, some figures do not appear to exhibit any preferential orientation that determines initial encodings: the shapes of automobiles or scissors, for example, are instantly recognized regardless of orientation. Chambers and Reisberg concluded that more research might reveal a pattern, but Kosslyn's pure stimulus view seems to be blocked.

C. Conclusion

In Chambers and Reisberg we have finally encountered an approach that attempts to accept conceptual, experimental and phenomenological evidence on more or less equal footings. The Chambers and Reisberg experiments do not fit

neatly into either the pictorialist or the descriptivist camps of experimental psychology. Images are not like neutral stimuli, we are told, but then in certain circumstances, they seem very much like them. There should be a theory explaining why some image reconstructions are possible and others are not, but we presently lack such a theory. Chambers and Reisberg strongly disagree with Kosslyn's claim that images are pictorial in the pure stimulus sense:

Images are not quasi-pictorial in the sense of needing some interpretation. Instead, an image's referent is specified by the imaginer. Thus although an image might in some fashion resemble more than one content...this does not result in ambiguity because it is not by resemblance that the images refer. (Chambers and Reisberg, 1985, p. 325; also in Clark, 1988, p. 56)

On the other hand, Chambers and Reisberg, appeal to the pictorialist notion that images, i.e., phenomenal images, depict. The phenomenal image has a certain (phenomenal) size, orientation, color, and may incorporate elements that allow us to "learn" from it. How do we derive information from the phenomenal image such that we may be said to "learn" from it? Here is Chambers's and Reisberg's (1992) proposal:

We propose that, in imagery as in perception, the specific meaning of an image guides how attention is deployed across the image. Thus, which aspects of an image will be clear and which will be vague will also depend on the specific meaning of the image. In this way, the meaning of an image does not merely accompany the depicted geometry; instead the meaning literally shapes the depiction. (Chambers and Reisberg, 1992, p. 151)

Note that this way of stating the role of the phenomenal image incorporates two conflicting views that have shaped the contemporary imagery debate. One aspect of this explanation supports a pictorialist interpretation. The subject directs inward attention in order to "see" parts of the image that are "clear." This is, of course, the vision metaphor of imagery that Pylyshyn is so much opposed to. The mind's eye is presumed to be able to pick up clear or vague information depending on the quality of the image. It is implied that to some extent the image in this role is passive -- for it is the attention of the agent that accounts for picking up information from the image. The explanation also incorporates nuances that would support descriptivist theory. The meaning of the image is said to "shape" the depiction. How are we to understand the term "meaning?" Could the meaning be reduced to a propositional

or amodal form? Although Chambers and Reisberg attempt to use terms such as "mean" or "understand" in a restricted technical sense (applying to geometric specifications or other empirically discoverable restraints to these terms) no pattern of the meanings (in the technical sense) appears to be at hand. Moreover, Chambers and Reisberg also state that the meaning of an image, in the sense of intentional meaning, is something designated by the subject and is irrelevant to the depictive appearances.

In other words, computational considerations and the abstract functional image, reputed to be the underlying explanatory mechanisms, fade from the picture. In the final analysis, we are left with an intentional psycho-physical view, where the phenomenal image is deemed to be an amalgam of conceptual and quasi-perceptual stimulus properties that differentiate it from vision, and where the phenomenal image is deemed to be the mediating cause in the entire imagery process. Just as in traditional psychology, there is still empirical work to be done, because not everything is given immediately and infallibly through introspection. What is not revealed by introspection, and has to be experimentally confirmed, are the specific ways in which our mental images are preinterpreted. These may well derive from neurophysiological limits of the ways in which we can represent non-present spatial environments to ourselves.

VI. Concluding Remarks

These remarks summarize some of the points made in this and the preceding chapter. Here, I bring together some of the common themes from these chapters, and incorporate them into some reflections on the limitations of computational schemes in general. Although only two computational theories were investigated in detail, I believe that some of the results obtained in my investigation are much more general, and are likely to apply to other schemes, particularly those that (1) employ the same sorts of understanding of what constitutes a computational process and (2) use similar standards for what constitutes data in an experiment. This is not to say that the demands of scientific rigor ought to be abandoned, but only that (as we saw in the Chambers and Reisberg approach) some accommodation to philosophic ontology and phenomenology of mental images be made. In addition to these concerns, I raise, once more, the background issue (from the beginning of chapter 4) of studying imagery by means of a theory that abstracts imagery from consciousness and carries with it a strong commitment to epiphenomenalism.

A. Theory and Experiment

Our investigation (in chapter 4) indicated that the most consistent position for a computational theory is to hold that images, in any ordinary sense of the word, cannot be incorporated as computational elements into the system. In as much as the causal flow of information in a computer must be attributed to the properties of the computational elements in it, there will be no causally-effective imagery processes. As a result, any imagery experiences that are thought to be caused by such processes will be epiphenomenal.

The experimental approach to finding imagery processes within a computational framework (examined in chapter 5) fared little better. One form of experimental evidence we examined is inconclusive at best, and possibly inconclusive in principle, given the structure/process pair model and the limitation that subject reports are not actual data. Releasing the latter stricture, as in Chambers's and Reisberg's experiments, yields a better result, and is consistent with many aspects of traditional philosophic psychology.

Overall, however, both the theory and the experimental approach are aimed at a very limited class of the kinds of imagery phenomena discussed in chapter 3. Many of the

experiments (not just the ones we reviewed, but those in the entire literature) pursued in contemporary empirical psychology investigate phenomena that mix perceptual problem solving and short-term memory phenomena. They do very little to establish what images are or how they are involved in spontaneous imagination or thought. The experiments are response-driven, and tend to turn images into "objects" in the very senses we sought to avoid in chapter 3. The image becomes an object (no quote marks needed) of study through behavior, an object of inspection through computational processes, an unconscious physical brain representation, and so on, rather than an "object" (quote marks needed) appropriated in and through an intentional act of the subject. As far as I know, no contemporary, computational theory or experiment has given an account of how one can spontaneously create images of a trip to the moon and back.

The two contemporary theories we examined appear to have little predictive value.⁷ For example, the rates at which mental rotation or mental scanning occur have not been found to be highly predicable. If more research were done on individual variation and subject reports were allowed as data, the results would, I suggest, probably be better. For

⁷Kosslyn would dispute this. He finds his theory highly successful and with good predictive value (see his 1994 book in particular for this claim). Pylyshyn, on the other hand, readily admits lack of predictive capability when the phenomena in question are cognitively penetrable.

example, percept variability (in terms of the amount and kind of information picked up in each eye movement) and specific background knowledge (e.g., knowledge of isomers in chemistry) could be correlated with performance on image rotation tests.

B. Epiphenomenalism

Epiphenomenalism is like Cartesianism: it is a view people often cling to with a kind of religious fervor, and, like Cartesianism, it is probably impossible to disprove. One can only point to the consequences of it and hope that believers will be moved to question their faith. I mentioned at the beginning of chapter 4, that epiphenomenalism means there is no causality in the mental to physical direction, and that as a consequence it is technically incorrect to say that I move my finger -- what really happens is that my finger is moved, not by me, but by purely physical causes that have nothing to do with the mental causal powers I normally attribute to myself. The same follows for images. The mental images sports stars use to train themselves would not be causally effective, my imagining that I see red would not be the actual cause of my retina changing its physical characteristics, and my inner seeing of the car keys on the mantel would not be instrumental in my memory. Images would not be made, used,

or invoked by me, but would be the results of other, purely physical, causes. We could then debate about whether these other causes should themselves be called images, descriptions, or some combination of them, but this would not change the fact that my imagery experiences would be left out of the causal loop.

Although only two theories were examined, I believe the epiphenomenal status of imagery in computational systems is really quite general: computationalism results in epiphenomenalism for images because images are non-computable items. Some theorists are happy with this state of affairs for images (Pylyshyn, also see Jackendoff, 1989) because they see all our behavioral capabilities compatible with computationalism. Others, like Kosslyn and Tye, have attempted to rescue our intuition that our imagery experiences are causally related to behavior, and have also tried to simultaneously maintain a computational view of the mind. The result is forced analogies between computational states and conscious states or the false argument that whatever is designated to be functioning as an image in a computer is itself an image. Experimental evidence in this vein is little better, since it ultimately relies on intuitions derived from our experiences rather than the requirements of computationalism. Epiphenomenalism is not eradicated in these attempts, just covered over.

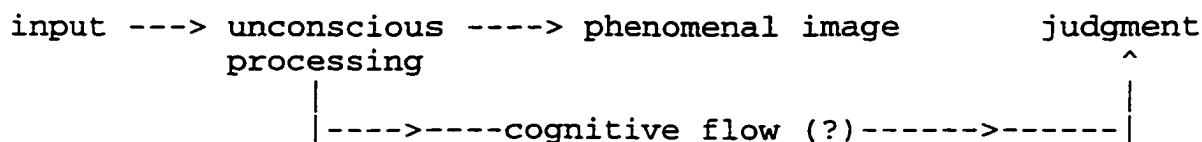
These criticisms of epiphenomenalism do not apply to a somewhat looser form of epiphenomenalism that might be appealed to as falling under the general rubric of cognitive psychology (as opposed to the computational physicalism we have been considering here). This form of epiphenomenalism is one that can be argued for, and is quite compatible, given a correct understanding, with philosophical imagism. The argument is in two steps. The first is to employ notions of "cognition" and "judgment" in the unconscious.⁸ Imagine a cognitive system that accepts inputs from perception or the imagination, processes this data, and then yields a result in the form of a new cognitive state. Let us call this new state a knowledge state or a judgment state. Suppose also that this process happens unconsciously without the intrusion of conscious rationality. It seems reasonable to assert that there are cognitive steps involved in the process even if we are not conscious of them.

This form of identifying what is a cognitive step makes no reference to possible reduction, and it does not specify whether the causes of the intervening steps or the steps themselves are physical, mental, or if they conform to demands of computationalism. Unconscious cognition, in this

⁸A dubious proposition unless the scare quotes are present (see my discussion of will and conscious judgment above), but necessary to accept for expositional purposes here.

sense of the term, occurs all the time and on many levels. I previously pointed out the case of color constancy, but one can add multitudinous examples at will: adding numbers without being aware of every step, judging that an object will fall before it falls, recognizing a picture of a familiar face immediately, and so on. (I argued in chapter 3 that such examples do not involve "images," however. The notion of an unconscious image, as Pylyshyn has repeatedly argued, has little to recommend it.)

The next step is to add consciousness and a phenomenal image to the system, as indicated below.



In this system, the unconscious processing produces a phenomenal mental image, but (it can be asserted) the actual cognitive flow remains just as it was before the image was introduced: the cognitive flow is around, rather than through the image. Therefore, the conscious mental image is an epiphenomenal result of cognitive processing. As Pylyshyn has argued many times, support for this model follows from elementary theoretical and empirical considerations. Recall Pylyshyn's argument on the use of images in memorization tasks (from chapter 4): If I use the

image of a dog riding a bicycle to remember that the fourth item on the list I wish to memorize is a bicycle, it cannot be the image of the bicycle that brings about the recall. The image might as easily have designated "riding" or "amusement" as "bicycle." Therefore, he concludes, it is not the image that is responsible for generating the judgment that the fourth item on the memorized list was "bicycle." Since the phenomenal image falls out of the flow of the actual cognitive processing it is epiphenomenal. This phenomenon of memory is well studied and even Kosslyn agrees that in these cases phenomenal imagery is sometimes epiphenomenal.

There is one sense in which there is nothing wrong with this argument. This is, in fact, based on one of the fundamental descriptivist complaints against imagism listed in chapter 2: the no content objection. I accepted this argument as valid, but only if images are considered to be raw appearances with no intentional content. The problem is that mental images generally resist, on both phenomenological and empirical grounds, the reduction to raw visual data. Therefore, this simple account of the relations among cognition, judgment, and the phenomenal image always needs to be filled in.

Philosophical imagism points toward the fact that how and with what we reach our judgments, when imagery is

present in consciousness, is an ambiguous and difficult matter to start with. Imagery experiences, as I have argued, nearly always involve being concerned with both the visual and the intentional content. We inwardly "see" a dog on a bicycle, but we remember that the fourth item on the list was "bicycle." The descriptivist-inspired argument that because these forms of content can be distinguished, they must be separate in mental causation (i.e., as we experience it, rather than as it is defined by some external standard of what cognitive steps are), seems to me to be a dubious one.

Memory is much more complicated than such an example makes out. On the one hand, it often seems that the phenomenal image is entirely necessary. What if the subject does not recall the fourth item on the list because he simply cannot conjure up any image? In that case, the absence of the phenomenal image blocks the recall of the desired item. We can also take into consideration a counterfactual claim: if the presence of the image would have resulted in the recall, then having the conscious phenomenal image was necessary in the causal chain and therefore not epiphenomenal.⁹ On the other hand, memory

⁹A similar argument applies to interpreting Finke's subject report data. The ability to perform an imagery-related task may be blocked by the absence of an appropriate phenomenal image. Finke also found a subject who could not form a phenomenal image was unable to perform the task. See

does not always work this way. The phenomenal image is sometimes superfluous. A subject may remember the item in question despite being unable to form an image.

Now, none of these considerations results in conclusive proof about the causal status of phenomenal image in any given instance. The point for philosophical imagism is not to secure (univocally) the status of the visual component of imagery, but to point to what having an image is like in the first place. There will always be cases in memory that seem clearly to indicate (practical) necessity, those that do not, and those that are ambiguous. Similar points about the active and passive, conceptual and visual aspects of any sort of image may be made, as in chapter 3.

Phenomenologically, we can always point to some example of an image (e.g., one I might have while thinking or speaking about any given topic that seems utterly extraneous to the topic) that is epiphenomenal with respect to some other process (conscious or unconscious) that may be occurring. What matters is that there are some instances where we have every reason to believe that there are cases where an image can be an efficient cause (causing shock, surprise, or emotion) or an instrumental cause (in imagination or thought).

Finke, 1982, p. 144.

The difference between philosophical imagism and the accounts examined here is that once "cognition" is reconstrued so that it loses its neutrality and becomes determined by computational constraints and the notion of physical causality, the phenomenal image becomes epiphenomenal in every case.

C. Computer User Dualism

At the beginning of chapter 4 (end of "Epiphenomenalism" section), I mentioned the incipient dualism of computationalism. In an attempt to rescue our intuitions, computational imagists often revert to what I call computer-user dualism. In attempting to bridge the gap between saying

I inspect an inner image

and

There is an inner computational array that is the functional image (constituted by physical brain states) in the human system,

imagist theorists sometimes revert to phraseology in which the subject is said to directly inspect arrays or other computational structures. For example, Tye's

"...I need only look initially at [brain!] representations of the shapes of general classes..."
(Tye, 1991, pp. 82-83).

The phrase is unintelligible from the common sense point of view. Humans never report directly inspecting brain states. The theory-laden meaning of the phrase, that what "I" am doing when I search for a memory image is really to sort through inner computational representations, is just dualism in disguise. In a consistent computational system there can be no self-conscious agents standing outside a computational system. Conscious, agent-controlled activity is an illusion produced (miraculously) by the system itself. It can not be "I" -- in the ordinary sense of the word -- who sorts through computational arrays; it can only be that some blind series of physical events are occurring in which "I" -- again, in the ordinary sense of self-conscious awareness -- never appear. How then, does the physical process restore the lost subjectivity? In such phrases as this, the answer is "by implication and through the equivocal use of the subject term," that is, by saying that although the process is totally blind, "I" nevertheless perform the process. Because both senses of "I," the ordinary subjective sense, and the mechanical system sense are used, the intelligibility of such phrases rests on the hidden presupposition that human subjects, with their full conscious faculties of reason and visual discrimination are, in fact, users of an entirely separate mechanical system, devoid of semantic content, that yields up to them various

requested forms of information. The conscious "I" appears to search for memory information just by willing it, this activates a computer mechanism that does the unconscious search through "information" that is devoid of semantic content, and then the result is returned to consciousness. In short, the system is no different than Descartes's scheme in which information was displayed to the conscious agent on an inner screen.

At the end of chapter 3, I suggested that if the brain were an information processing machine, there should be no reason that its principles of operation would not be discoverable. If it were an information processing machine, we could get past the suggestive metaphor of saying that we have or process information and find the actual mechanisms, the actual information, and the actual processes that do this. I think now, after our review of two sample information processing systems, it should be clear that getting past the metaphor is difficult if not impossible. There are some reasons for this that the metaphysician of consciousness might have put forward at the beginning, and perhaps obviated the entire discussion. Computational and mechanical systems are systems that move irrevocably forward due to events of the past; they have no way to globally synthesize the present in conscious awareness of the past and the possibilities of the future, and no principle of

self-directed activity arising in a spontaneous (mental) act that has no prior history in "physical" (17th Century sense) terms. In mechanical systems, there are no relative beings or potential beings; everything is actual. There are no representations in computers because there is nothing in a computer to whom anything could be represented. These limitations remove the basis for the metaphysical possibility of self-conscious awareness. As a result, there are no conscious seeing activities and no images in such systems. To the extent any such systems might be instantiated in the brain, they will terminate in their explanatory history of computational events at a stage in which neurophysiological facts take over and then pronouncement is made: "and then we see" or "and then we have an image" - which is just to say that the mind/body problem has not been solved, we are exactly where we started and we will be left with the appeal to the forms of explanation we already visited, i.e., ones that combine an analysis of intentional awareness with neurophysiological facts.

It seems to me, then, that computationalism is likely to end (consistently) in epiphenomenalism or (inconsistently) in computer-user dualism. So, if computationalism implies epiphenomenalism, and epiphenomenalism is not true, computationalism cannot be a

true theory of the mind. As far as images are concerned, these systems turn the image into an object in the wrong senses we sought to avoid. It is either an epiphenomenal (conscious) object or a physical (unconscious) brain state only. The idea that mental images can be constituted in and through acts of the subject is lost.

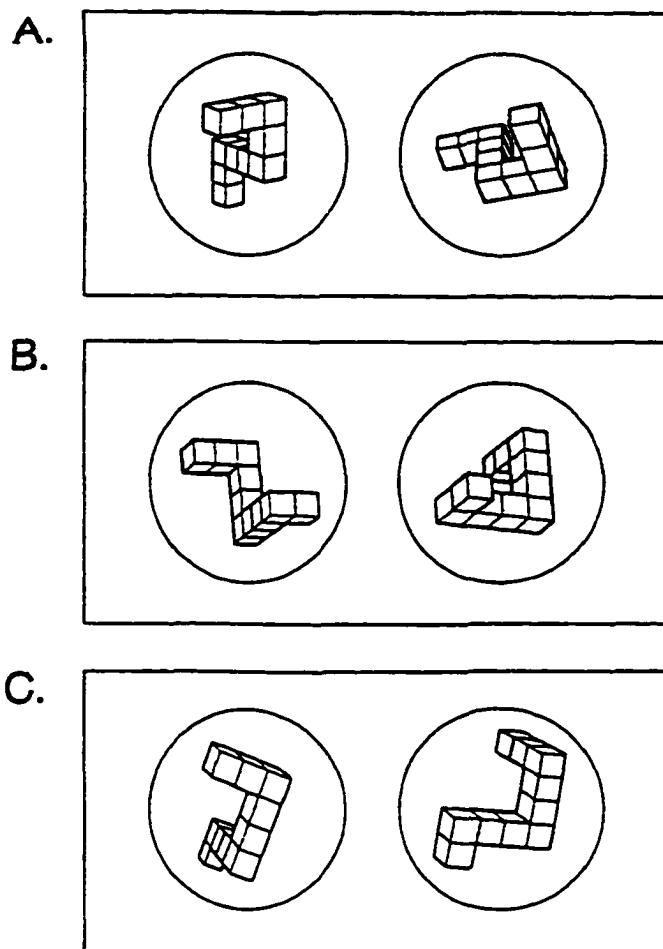


Figure 5-1. Shepard and Metzler Figures

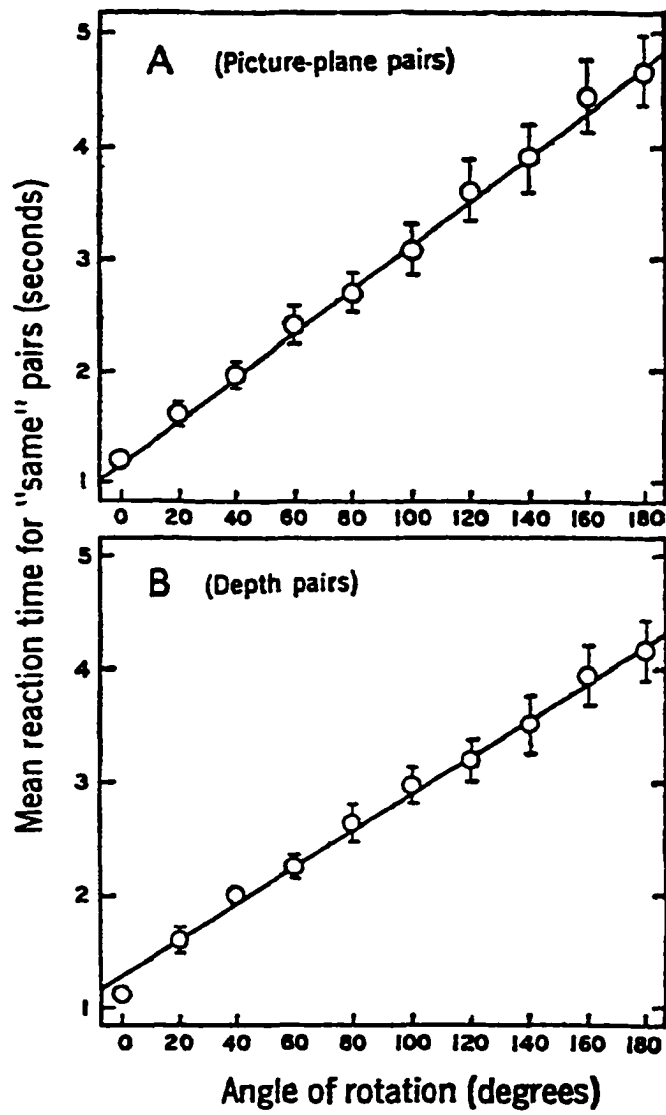


Figure 5-2. Shepard and Metzler's Results

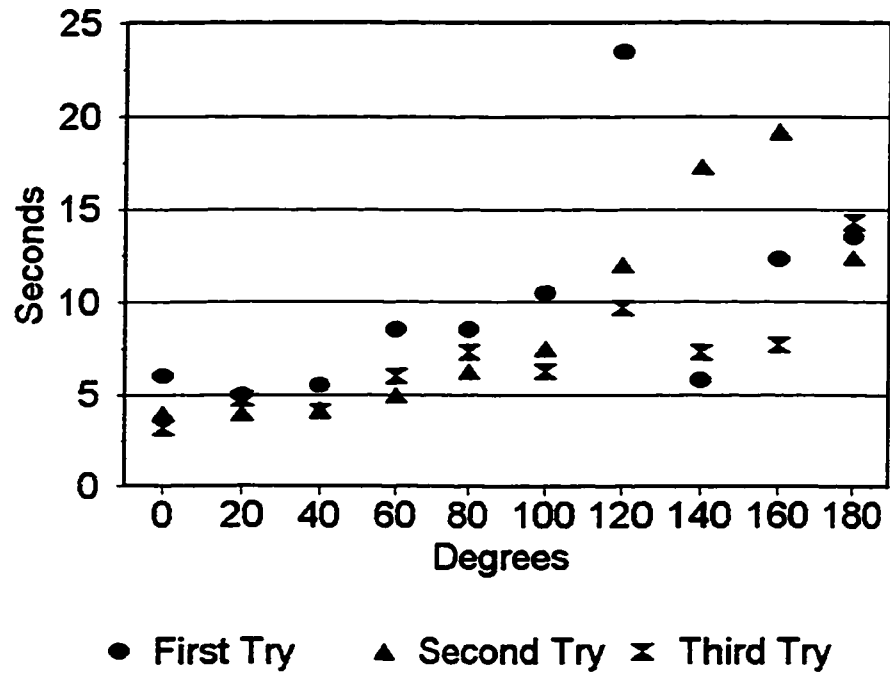


Figure 5-3. Average Improvement in Response Time for First Three Attempts at Shepard and Metzler Task. (Note that all attempts except those at 140 through 180 degrees show first try is the slowest. Number of students tested = 10.)

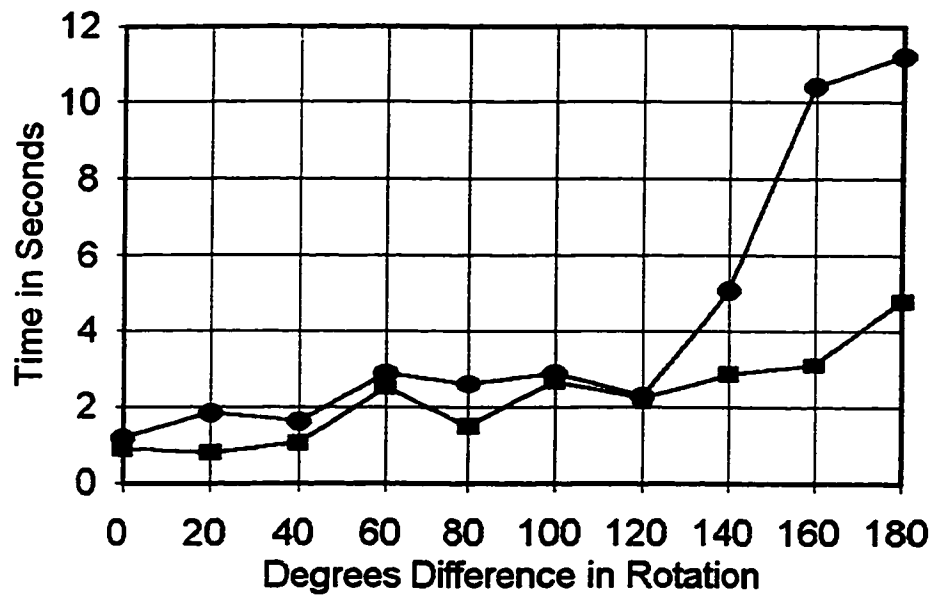


Figure 5-4. Successive Tests of 140 Pairs of Shepard and Metzler Figures by a Single Subject. (Upper curve is first test, lower curve is second test.)



Figure 5-5. Kosslyn's Map

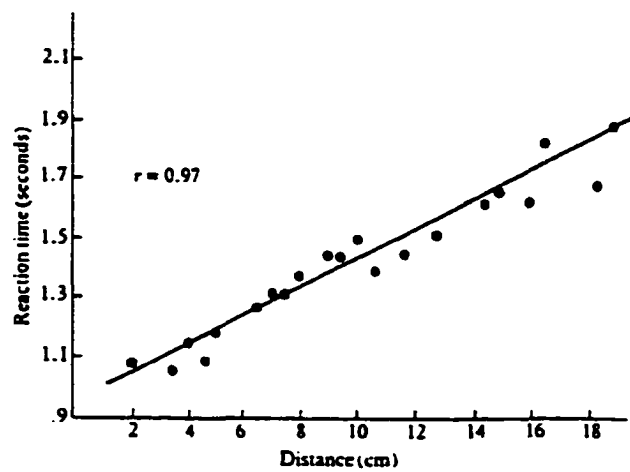


Figure 5-6. Map Scanning Results

BIBLIOGRAPHY

- Addis, Laird (1989). Natural Signs: A Theory of Intentionality. Philadelphia: Temple University Press.
- Anderson, John R. (1978). "Arguments Concerning Representations for Mental Imagery." *Psychological Review*, Vol. 85, No. 4, pp. 249-277.
- Aquinas, Saint Thomas (1948). Introduction to Saint Thomas Aquinas. Edited by Anton C. Pegis. New York: Random House.
- Aristotle (1941). The Basic Works of Aristotle. Translated by J. A. Smith. Edited by Richard McKeon. New York: Random House.
- Beakley, Brian and Ludlow, Peter, eds. (1992). The Philosophy of Mind. Cambridge: MIT Press, Bradford Books.
- Bechtel, William (1988). Philosophy of Mind: An Overview for Cognitive Science. Hillsdale: Lawrence Erlbaum Associates, Publishers.
- Berkeley, George (1710/1965). The Principles of Human Knowledge. In Berkeley's Philosophical Writings, edited by D. M. Armstrong. New York: Collier Books.
- Blanshard, Brand (1940). The Nature of Thought, 2 vols. New York: The Macmillan Company.
- Block, Ned, ed. (1981a). Imagery. Cambridge: MIT Press.
- Block, Ned, ed. (1981b). Readings in Philosophy of Psychology, Vol. 2. Cambridge: Harvard University Press.
- Block, Ned (1983a). "Mental Pictures and Cognitive Science." *The Philosophical Review*, Vol. 92, No. 4, pp. 499-541.
- Block, Ned (1983b). "The Photographic Fallacy in the Debate about Mental Imagery." *Nous*, Vol. 17, pp. 651-661.

- Boring, Edwin G. (1950). A History of Experimental Psychology, Second Edition. New York: Appleton-Century-Crofts, Inc.
- Bower, Kenneth J. (1984). "Imagery: From Hume to Cognitive Science." *Canadian Journal of Philosophy*, Vol. 14, No. 2, pp. 217-234.
- Brentano, Franz (1867/1977). The Psychology of Aristotle. Translated and edited by Rolf George. Berkeley: University of California Press.
- Brentano, Franz (1874/1973). Psychology from an Empirical Standpoint. Translated by Linda McAlister. London: Routledge.
- Brentano, Franz (1911/1978). Aristotle and His World View. Translated and edited by Rolf George and Roderick M. Chisholm. Berkeley: University of California Press.
- Bruce, Darryl (1985). "The How and Why of Ecological Memory." *Journal of Experimental Psychology: General*, Vol. 114, No. 1, pp. 78-90.
- Campbell, Keith (1984). Body and Mind, 2nd ed. Notre Dame: University of Notre Dame Press.
- Chambers, Deborah and Reisberg, Daniel (1985). "Can Mental Images Be Ambiguous?" *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 11, No. 3, pp. 317-328.
- Chambers, Deborah and Reisberg, Daniel (1992). "What an Image Depicts Depends on What an Image Means." *Cognitive Psychology*, Vol. 24, pp. 145-174.
- Chappell, V. C. (1981). The Philosophy of Mind. New York: Dover Publications, Inc. Originally published in 1962 by Prentice-Hall.
- Chase, William and Clark, Herbert (1972). "Mental Operations in the Comparison of Sentences and Pictures." In Gregg, 1972, pp. 205-233.
- Chisolm, Roderick M. (1966). Theory of Knowledge. Prentice Hall, Inc., Englewood Cliffs, N.J. Reprinted in Rosenthal, pp. 380-384.
- Churchland, Paul M. (1992). A Neurocomputational Perspective. Cambridge: MIT Press.

- Clark, Andy (1988). "Superman and the Duck/Rabbit: A Reply to Gordon and Bringsjord." Analysis, Vol. 48, pp. 54-56.
- Cooper, Lynn A. (1976). "Demonstration of a Mental Analog of an External Rotation." Perception and Psychophysics, Vol. 19, pp. 296-302. Reprinted in Shepard, 1982, pp. 159-170.
- Cummins, Robert (1983). The Nature of Psychological Explanation. Cambridge: MIT Press, Bradford Books.
- Cummins, Robert (1991). Meaning and Mental Representation. Cambridge: MIT Press.
- Dennett, Daniel C. (1969). "The Nature of Images and the Introspective Trap." In Content and Consciousness. London: Routledge and Kegan Paul. Reprinted in Beakley and Ludlow.
- Dennett, Daniel C. (1978). "Two Approaches to Mental Images." In Brainstorms. Cambridge: MIT Press, Bradford Books. Reprinted in Block, 1981a.
- Dennett, Daniel C. (1991). Consciousness Explained. London: Penguin Books.
- Descartes, Rene (1649/1911). Passions of the Soul. In The Philosophic Works of Descartes, Vol. 1. Translated by Elizabeth H. Haidane and G. R. T. Ross. London: Cambridge University Press.
- Dretske, Fred (1988). Explaining Behavior: Reasons in a World of Causes. Cambridge: MIT Press, Bradford Books.
- Ducasse, Curt J. (1951). Nature, Mind, and Death. LaSalle, Illinois: The Open Court Publishing Company.
- Fechner, Gustav (1860/1966). Elements of Psychophysics. Translated by Helmut E. Adler. New York: Holt, Rinehart and Winston.
- Finke, Ronald A. (1980). "Levels of Equivalence in Imagery and Perception." Psychological Review, Vol. 87, No. 2, pp. 113-132.
- Finke, Ronald A. (1982). "Spontaneous Imagery Scanning in Mental Extrapolation." Journal of Experimental Psychology: Learning, Memory, and Cognition, Vol. 8, No. 2, pp. 142-147.

- Finke, Ronald A. (1984). "Mental Imagery and the Visual." *Scientific American*, Vol. 236, No. 12, pp. 88-95.
- Finke, Ronald A. (1989). Principles of Mental Imagery. Cambridge: MIT Press.
- Friedman, Alinda and Harding, Cory Alexander (1990). "Seeing Versus Imagining Movement in Depth." *Canadian Journal of Psychology*, Vol. 44, No. 3, pp. 371-383.
- Gregg, Lee W., ed. (1972). Cognition in Learning and Memory. New York: John Wiley & Sons, Inc.
- Hampson, Peter J., Marks, David E., and Richardson, J. T. E., eds. (1990). Imagery: Current Developments. London: Routledge.
- Hart, W. D. (1988). The Engines of the Soul. New York: Cambridge University Press.
- Hobbes, Thomas (1651/1968). Leviathan. London: Penguin Books.
- Holt, Robert R. (1964). "Imagery: The return of the Ostracized." *American Psychologist*, Vol. 19, No. 3, pp. 254-264.
- Hull, Clark (1943). Principles of Behavior. New York: Appleton-Century-Crofts.
- Hume, David (1739-1740/1978). A Treatise of Human Nature. London: Oxford University Press.
- Jackendoff, Ray (1989). Consciousness and the Computational Mind. Cambridge: MIT Press.
- Jackson, Frank (1976). "The Existence of Mental Objects," *American Philosophical Quarterly*, Vol. XIII, No. 1, pp. 33-40. In Rosenthal, 1991, pp. 385-391
- James, William (1890). "Imagination." In The Principles of Psychology, Vol. 2. New York: Henry Holt. Reprinted in Beakley and Ludlow.
- James, William (1892/1961). Psychology: The Briefer Course. New York: Harper and Row.
- Johnson-Laird, Philip N. (1988). The Computer and the Mind. Cambridge: Harvard University Press.

- Jolicoeur, Pierre and Kosslyn, Stephen M. (1985). "Is Time to Scan Visual Images Due to Demand Characteristics?" *Memory and Cognition*, Vol. 13, No. 4, pp. 320-332.
- Jubien, Michael (1993). Ontology, Modality, and the Falacy of Reference. Cambridge: Cambridge University Press.
- Kail, Robert and Park, Young-Shin (1990). "Impact of Practice on Speed of Mental Rotation." *Journal of Experimental Child Psychology*, Vol. 49, pp. 227-244.
- Kaufmann, Geir (1980). Imagery, Language and Cognition. Oslo: Universitets forlaget.
- Kosslyn, Steven (1980). Image and Mind. Cambridge: Harvard University Press.
- Kosslyn, Stephen (1981). "The Medium and the Message in Mental Imagery: A Theory." In Block, 1981a, pp. 207-244.
- Kosslyn, Stephen (1983). Ghosts in the Mind's Machine: Creating and Using Images in the Brain. New York: Norton.
- Kosslyn, Stephen (1990). "Scanning Visual Mental Images: The First Phase of the Debate." In An Invitation to Cognitive Science. Cambridge: MIT Press. Reprinted in Beakley and Ludlow.
- Kosslyn, Stephen (1994). Image and Brain. Cambridge: MIT Press.
- Kosslyn, Stephen and Pomerantz, James (1977). "Imagery, Propositions, and the Form of Internal Representations." *Cognitive Psychology*, Vol. 9, pp. 52-76.
- Kosslyn, Stephen and Pomerantz, James (1981). "Imagery, Propositions, and the Form of Internal Representations." In Block, 1981b, pp. 150-169. Based on Kosslyn and Pomerantz, 1977.
- Kosslyn, Stephen and Shwartz, S. P. (1977). "A Simulation of Visual Imagery." *Cognitive Science*, Vol. 1, pp. 265-295.
- Kulpe, Oswald (1912). "The Modern Psychology of Thinking." In Thinking: From Association to Gestalt. New York: Wiley, 1964. Reprinted in Beakley and Ludlow.

- Kunzendorf, Robert G. (1990). Mental Imagery. New York: Plenum.
- Kunzendorf, Robert G. and Sheikh, Anees A. (1990) The Psychophysiology of Mental Imagery. Amityville, NY: Baywood Publishing Company.
- Landesman, Charles (1965). "The New Dualism in the Philosophy of Mind." *Review of Metaphysics*, Vol. 19, pp. 329-345.
- Landesman, Charles (1972). Discourse and its Presuppositions. New Haven: Yale University Press.
- Landesman, Charles (1989). Color and Consciousness: An Essay in Metaphysics. Philadelphia: Temple University Press.
- Landesman, Charles (1993). The Eye and the Mind: Reflections on Perception and the Problem of Knowledge. Boston: Dordrecht.
- Locke, John (1690/1924). An Essay Concerning Human Understanding. Abridged and edited by A. S. Pringle-Pattison. Oxford: Clarendon Press.
- Maloney, J. Christopher (1984). "Mental Images and Cognitive Theory." *American Philosophical Quarterly*, Vol. 21, pp. 237-248.
- Manser, A. N. (1967). "Images." In The Encyclopedia of Philosophy. New York: Macmillan Publishing Co., Vol. 4, pp. 133-136.
- Modrak, Deborah (1987). Aristotle: The Power of Perception. Chicago: University of Chicago Press.
- Moore, G. E. (1903). "The Refutation of Idealism." *Mind*, Vol. 12, pp. 433-453.
- Morris, Peter E. (1983). Imagery and Consciousness. London: Academic Press.
- Moyer, Robert S. and Bayer, Richard H. (1976). "Mental Comparison and the Symbolic Distance Effect." *Cognitive Psychology*, Vol. 8, pp. 228-246.
- Paivio, Alan (1975). "Perceptual Comparisons Through the Mind's Eye." *Memory and Cognition*, Vol. 3, No. 6, pp. 635-647.

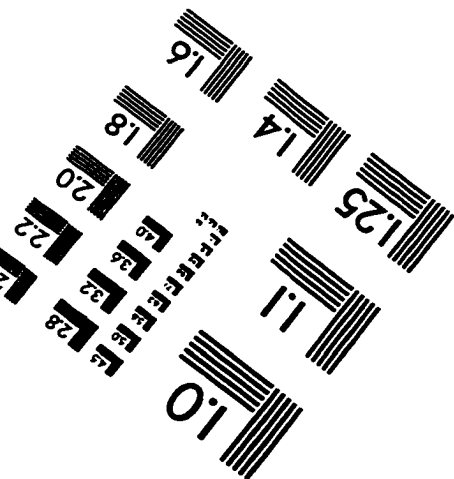
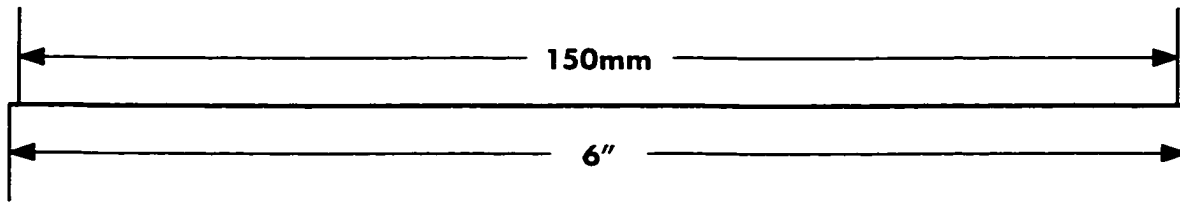
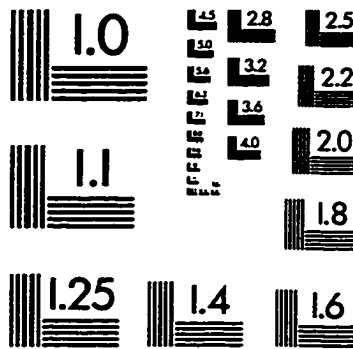
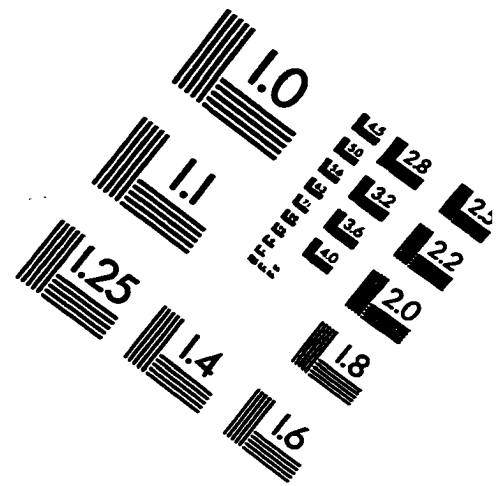
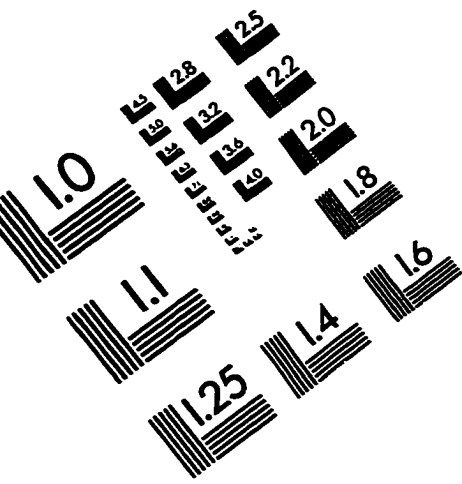
- Paivio, Alan (1971). Imagery and Verbal Processes. New York: Holt, Reinehart and Winston.
- Penfield, Wilder (1955). "The Permanent Record of the Stream of Consciousness." Proceedings of the 14th International Congress of Psychology, pp. 47-69.
- Perky, Cheves West (1910). "An Experimental Study of Imagination," American Journal of Psychology, Vol. 21, pp. 422-452.
- Price, H. H. (1953). Thinking and Experience. London: Hutchinson University Library.
- Priest, Stephen (1991). Theories of the Mind. Boston: Houghton Mifflin Company.
- Putnam, Hilary (1975). Mind, Language and Reality, New York: Cambridge University Press.
- Pylyshyn, Zenon (1973). "What the Mind's Eye Tells the Brain: A Critique of Mental Imagery," Psychological Bulletin, Vol. 80, No. 1, pp. 1-24.
- Pylyshyn, Zenon (1978). "Imagery and Artificial Intelligence." In Minnesota Studies in the Philosophy of Science, Vol. 9, pp. 19-55. Minneapolis, University of Minnesota Press. Reprinted in Block, 1981b, pp. 170-194.
- Pylyshyn, Zenon (1979a). "The Rate of 'Mental Rotation' of Images: A Test of a Holistic Analogue Hypothesis," Memory and Cognition, Vol. 7, pp. 19-28.
- Pylyshyn, Zenon (1979b). "Validating Computational Models: A Critique of Anderson's Indeterminacy of Representation Claim," Psychological Review, Vol. 86, No. 4, pp. 383-394.
- Pylyshyn, Zenon (1980). "Computation and Cognition: Issues in the Foundations of Cognitive Science," Behavioral and Brain Sciences, Vol. 3, pp. 111-169.
- Pylyshyn, Zenon (1981). "The Imagery Debate: Analog Media versus Tacit Knowledge." In Block, 1981a, pp. 151-206.
- Pylyshyn, Zenon (1984). Computation and Cognition. Cambridge, MIT Press.

- Quine, Willard Van Orman (1953). From a Logical Point of View. New York: Harper and Row.
- Quine, Willard Van Orman (1966). The Ways of Paradox and Other Essays. New York: Random House
- Reisberg, Daniel and Chambers, Deborah (1991). "Neither Pictures Nor Propositions: What Can We Learn From a Mental Image?" *Canadian Journal of Psychology*, Vol. 45, No. 3, pp. 336-352.
- Rey, Georges (1981). "What are Mental Images?" In Block, 1981b.
- Richardson, Alan. (1969). Mental Imagery. New York: Springer Publishing Company, Inc.
- Richardson, John T. E. (1980). Mental Imagery and Human Memory. New York: St. Martin's Press.
- Rollins, Mark (1989). Mental Imagery. New Haven: Yale University Press.
- Rosenthal, David M., ed. (1987). Materialism and the Mind/Body Problem. Indianapolis, Hackett Publishing Company, Inc.
- Rosenthal, David M., ed. (1991). The Nature of Mind. New York: Oxford University Press.
- Russow, Lilly-Marlene (1985). "Dennett, Mental Images, and Images in Context." *Philosophy and Phenomenological Research*, Vol. 45, No. 4, pp. 581-593.
- Ryle, Gilbert (1949). The Concept of Mind. London: Hutchinson's University Library.
- Santayana, George (1923). Scepticism and Animal Faith. New York: Dover Books.
- Sajama, Seppo and Kamppinen, Matti (1987). A Historical Introduction to Phenomenology. London: Croom Helm.
- Seager, William (1991). Metaphysics of Consciousness. London: Routledge.
- Searle, John (1980a). "Minds, Brains, and Programs," *Behavioral and Brain Sciences*, Vol. 3, pp. 417-424.

- Searle, John (1980b). "Intrinsic Intentionality: Reply to Criticisms of Minds, Brains, and Programs," Behavioral and Brain Sciences, Vol. 3, pp. 450-456.
- Searle, John (1983). Intentionality: An Essay in the Philosophy of Mind. Cambridge: Cambridge University Press.
- Searle, John (1990). "Consciousness, Explanatory Inversion, and Cognitive Science," Behavioral and Brain Sciences, Vol. 13, pp. 585-642.
- Searle, John (1992). The Rediscovery of the Mind. Cambridge: MIT Press.
- Shepard, Roger and Metzler, Jacqueline (1971). "Mental Rotation of Three-Dimensional Objects." Science, Vol. 171, pp. 701-703. Reprinted in Beakley and Ludlow.
- Shepard, Roger N. (1982). Mental Images and Their Transformations. Cambridge: MIT Press.
- Shipley, Thorne. (1961). Classics in Psychology. New York: Philosophical Library.
- Smart, J. J. C. (1981). "Sensations and Brain Processes," in Chappell, V. C., 1981, pp. 160-172.
- Stich, Stephan (1983). From Folk Psychology to Cognitive Science. Cambridge: MIT Press, Bradford Books.
- Thilly, Frank (1957). A History of Philosophy, 3rd ed. Revised by Ledger Wood. New York: Holt, Rinehart and Winston.
- Tye, Michael (1984). "The Debate About Mental Imagery." Journal of Philosophy, Vol. 81, pp. 678-690.
- Tye, Michael (1988). "The Picture Theory of Mental Images." Philosophical Review, Vol. 97, pp. 497-520.
- Tye, Michael (1991). The Imagery Debate. Cambridge: MIT Press.
- Von Eckardt, Barbara (1988). "Mental Images and their Explanations." Philosophical Studies, Vol. 53, pp. 441-460.

- Watson, John B. (1913). "Psychology as the Behaviorist Views it." *Psychological Review*, Vol 20, pp. 158-177. In Shipley (1961), pp. 798-821.
- White, Alan R. (1990). The Language of Imagination. Oxford: Basil Blackwell.
- Wittgenstein, Ludwig (1967). Zettel, Edited by G. E. M. Anscombe, and G. H. Wright, translated by G. E. M. Anscombe. Berkeley: University of California Press.
- Wright, Edmond (1983). "Inspecting Images." *Philosophy*, Vol. 58, pp. 57-72.
- Wundt, Wilhelm (1892/1912). Lectures on Human and Animal Psychology, 5th ed. Translated from German 2nd edition of 1892 by J. E. Creighton and E. B. Titchener. London: George Allen & Co. Ltd.
- Yolton, John W. (1984). Perceptual Acquaintance from Descartes to Reid. Minneapolis: University of Minnesota Press.
- Yuille, John C. (1983). "The Crisis in Theories of Mental Imagery." In Imagery, Memory and Cognition: Essays in Honor of Allan Paivio. London, Lawrence Erlbaum Associates.
- Zeki, Semir (1992). "The Visual Image in Mind and Brain." *Scientific American*, Vol. 267, September, pp. 68-76.

IMAGE EVALUATION TEST TARGET (QA-3)



APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989

© 1993, Applied Image, Inc., All Rights Reserved

