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Grasping at Straws: Motor Intentionality and the Cognitive Science of Skilled Behavior

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A drowning man will catch at a straw, the Proverb well says.
Richardson, *Clarissa*

Hubert Dreyfus has had a lot to say over the years about the inadequacies of traditional cognitive science. He is also, of course, one of the foremost commentators on the work of the founders of modern phenomenology—Martin Heidegger and Maurice Merleau-Ponty—not to mention a gifted phenomenologist himself. Anyone who knows Bert or his work will know that for him these two apparently disparate projects—one unabashedly empirical, the other paradigmatically philosophical—form two sides of the same coin. He calls this coin, in a pleasingly difficult phrase, "applied philosophy." Applied philosophy as Dreyfus practices it comes, characteristically, from the simple fount of common sense. It is predicated on the observation that if phenomenology tells us about the phenomena of human experience, its results ought to be relevant to the human sciences. This simple formula has led Dreyfus to explore areas of human science as diverse as nursing, management science, and artificial intelligence. But the very first problem he addressed—in his Ph.D. dissertation at Harvard—was the problem of perception. Although I do not intend to discuss the problem of perception per se in this chapter, I do want to think about a problem that is tightly connected with it—namely, the problem of determining the phenomenological features of certain skillful bodily actions. I will argue

that the phenomenology of these actions, as it is developed by Merleau-Ponty in *Phenomenology of Perception*, is inconsistent with the standard cognitive science models of them. Furthermore, certain neural network models of action, I will argue, are much better at accounting for these phenomenological data. In approaching the problem of bodily action this way, I intend this essay to be both a methodological and a substantive tribute to Dreyfus's work: it not only sits squarely within the methodological rubric of applied philosophy, it also returns to substantive problems that are related to perception, the problem that launched Dreyfus's philosophical career. Because this is a problem with which, in his equally valuable role as teacher, mentor, and advisor, he has helped me to launch my own, I hope that any contribution this chapter makes will be seen as a further tribute to him.

I What Is Phenomenology and Why Should a Cognitive Scientist Care?

Phenomenology is essentially descriptive. Its goal is completely and accurately to describe the phenomena of human experience without the interference of metaphysical presuppositions inherited from psychological, scientific, historical, sociological, or other theoretical frameworks. Description is so central to the method of phenomenology that, as Heidegger says, the phrase "'descriptive phenomenology' . . . is at bottom tautological".[1] And yet, description is not as easy as it seems. This is because, metaphysical presuppositions being the tenacious creatures that they are, the phenomena of human experience tend to hide themselves: "Just because the phenomena are proximally and for the most part *not* given," Heidegger explains, "there is need for phenomenology."[2] To say that phenomenology is descriptive, then, is not in any way to minimize its difficulty or worth.

Some evidence for the value of a phenomenological approach to philosophy can be found in the fact that even traditional analytic philosophers, the sworn enemies of all things continental, sometimes endorse a descriptive—which is to say, broadly speaking, a phenomenological—methodology. The remarks of the later Wittgenstein, for instance, and the ordinary language philosophy of J. L. Austin are often mentioned in this regard. Both of these approaches have an important descriptive element to them, but a particularly interesting and little noticed ally of phenomenology can be found in the descriptive method that Strawson employs in his famous book *Individuals*.[3] The phenomenological preference for descriptive accuracy over systematic theoretical cogency is there reiterated by Strawson in his preference for what he calls "descriptive" over "revisionary" metaphysics: "Descriptive metaphysics is content to describe the actual structure of our thought about the world, revisionary metaphysics is concerned to produce a better structure."[4]

I mention Strawson here both because his sympathy for the descriptive approach may lend credence to the phenomenological approach, and also because the differences between these approaches can help better to characterize phenomenology. The major distinction between Strawson and the phenomenologists is that Strawson, as he says in the quote above, is concerned primarily with "*thought* about the world," while the phenomenologists believe that many of our most basic ways of relating intentionally to the world are precisely not in the form of having thoughts about it. Rather, perceiving and acting upon the objects in the world are more basic modes of intentionality, according to the phenomenologists, and these perceptions and actions have an intentional content that is, as Merleau-Ponty says, "pre-predicative."

I will say more about pre-predicative content later in the paper (Merleau-Ponty's idea of "motor intentionality" will play a central role there), but for the moment I will just mention that even this idea, or something like it, has shown up recently in the analytic world. Gareth Evans, a student of Strawson's, departs from his teacher when he advocates a "non-conceptual content" for perception, a kind of content that is strikingly similar to the pre-predicative content that Merleau-Ponty describes.[5] Without addressing here the relation between their work, I will simply remark that the advantage of phenomenology continues to be found in the depth of its commitment to descriptive accuracy without the interference of metaphysical presuppositions: even Evans is led to misdescribe the content of perceptual experience because of presuppositions he has about the content of the demonstrative thoughts it makes possible.[6]

What, then, is the descriptively complete and accurate account of perception and action that phenomenology endorses? One central aspect of it is certainly this: that any complete and accurate description of normal perceptual or behavioral phenomena leads to the denial of a private, inner subject who experiences a transcendant, outer world. In place of this roughly Cartesian picture, the phenomenologist holds that perceptual and behavioral phenomena take place in the context of what the psychologist J. J. Gibson calls the "organism-environment system"; in phenomenological terms they are attributed not to the Cartesian subject, but to "open heads upon the world" (Merleau-Ponty) or simply to "Dasein" (Heidegger). Very crudely what this means is that if I am having a perceptual experience of an apple, I cannot completely and accurately describe this experience without at least some reference to the very apple I am having an experience of. Because the apple and the experience of the apple are intertwined in this way, we would be misdescribing the perceptual phenomenon (equally, the content of the perceptual experience) if we said it was attributable to a completely independent, inner self.[7]

I do not intend to argue for this claim here, only to point out that it is at the center of any good phenomenological account of perception and action. And having said this, I want to point out further that, despite a prima facie difficulty, this denial of the Cartesian subject is in no way at odds with the possibility of a scientific, neurophysiological account of perceptual or behavioral phenomena. The prima facie difficulty is generated by the observation that, while the brain scientist explains perception and action in terms of the "inner" workings of the brain, the phenomenology of perception and action denies the existence of an "inner" self. But of course this apparent problem is based on a simple confusion between two different uses of the term "inner." There is an important difference between the inner, Cartesian, subject of experience, on the one hand, and the inner, physiological mechanism of experience, on the other. Even if the accurate description of perceptual and behavioral phenomena demands the denial of an inner, Cartesian, subject, it nevertheless remains the case that the intentional phenomena being described are realized in the physical substrate of the human body,

with particular emphasis on the human brain. We must not confuse the phenomenological fact that the right description of our intentional relation to the world denies that we are private, inner subjects, with the scientific fact that this intentional relation is physically realized within the human organism.

Phenomenology and brain science, then, are not at odds with one another. This is a point that Merleau-Ponty is not always so clear about, but that Dreyfus has emphasized repeatedly in his work with the neurophysiologist Walter Freeman.[8] But if this is so, then what exactly is the right relation between phenomenology and brain science? I propose that the right relation between phenomenology and brain science is that of data to model: brain science is ultimately concerned with explaining the way the physical processes of the brain conspire to produce the phenomena of human experience; insofar as phenomenology devotes itself to the accurate description of these phenomena, it provides the most complete and accurate presentation of the data that ultimately must be accounted for by models of brain function. Thus, the phenomenological account of a given aspect of human behavior is meant to provide a description of those characteristics of the behavior which any physical explanation of it must be able to reproduce.

In this chapter, I intend to address a very special case of the interplay between phenomenology and brain or cognitive science. I will be concerned only with the kind of skillful motor behaviors that take place naturally in the context of environmental cues—behaviors such as grasping a doorknob in walking though a door, grasping a coffee mug to drink from it, or, as in Richardson's extreme case, grasping after a thin reed to prevent oneself from drowning. What all of these actions have in common is that they are not, in any strict sense, deliberate or reflective; rather, they are actions that are, as Gibson would say, "afforded" by the environment. Skillfully grasping an object, in the most natural and everyday cases, occurs in this unpremeditated mode. It is my contention that the phenomenology of these skillful grasping behaviors invalidates the standard assumptions made by the traditional cognitive science models of them.

Furthermore, although the classical models of skillful action fail to reproduce its phenomenology, I believe that certain neural

network models can be interpreted as accurately reproducing at least some of the most important phenomenological characteristics of skillful grasping behavior. In particular, I will discuss briefly a model of limb movement to a target that has been developed by the neurologists Donald Borrett and Hon Kwan. By explaining this motor behavior in terms of network relaxation, their models can be interpreted as reproducing the central phenomenological characteristics of the understanding of place that is inherent in the skillful grasping of objects. Because these characteristics are realized in a model that is, at least in some general sense, neurophysiologically plausible, I believe that their account of skillful motor action goes some way toward meeting the dual constraints of neurophysiological plausibility and phenomenological accuracy that ought to guide all projects devoted to discovering the physical bases of human experience.

II Motor Intentional Behavior

The central feature of skillful motor behaviors, according to Merleau-Ponty, is that they are not accurately described in either an empiricist or an intellectualist vocabulary, but rather, "we have to create the concepts necessary to convey"[9] them. Neither the empiricist, who believes that skillful motor behavior is analyzable in terms of completely non-intentional elements like the reflex arc, nor the intellectualist (or modern day cognitivist), who believes that skillful motor behavior is analyzable in terms of completely rational cognitive processes, can account for all the essential phenomenological characteristics of this kind of behavior. The empiricist account fails because its purely mechanical vocabulary does not allow it to distinguish between mere reflex movements and directed, skillful motor actions. On the other hand, the cognitivist account fails because its purely cognitive vocabulary does not allow it to distinguish between unreflective motor actions like grasping an object, and deliberate, cognitive actions like pointing at one. I will develop the anticognitivist point later in the chapter, but for now I will simply note that because of the inability of either empiricism or cognitivism to explain them, Merleau-Ponty understands skillful motor actions like grasping an object to define a category of behavioral phenomenon that is

between the mechanical and the cognitive. He calls this kind of phenomenon "motor intentionality":

> We are brought to the recognition of something between movement as a third person process and thought as a representation of movement—something which is an anticipation of, or arrival at, the objective and is ensured by the body itself as a motor power, a "motor project" (*Bewegungsentwurf*), a "motor intentionality."[10]

The argument against the empiricist account of motor intentional behavior is simple and obvious. It is based on the observation that there is a clear phenomenological distinction between a reflex movement, such as the leg exhibits when struck just below the kneecap, and a directed, skillful action like grasping an object. The difference is that the grasping action has a certain kind of intentionality to it—it is directed toward the object to be grasped—while the reflex action does not. One way to convince yourself of this is to notice that the success or failure of the grasping act, unlike that of the reflex act, depends in part on whether or not the intended *object* was grasped. If I perform the very same physical movement but do not end up holding the intended object, then the grasping act has failed. The success or failure of the reflex act, on the other hand, depends entirely on the occurrence of the relevant muscular contractions. Because the empiricist is devoted to explaining all behavior in terms of the non-intentional reflex arc, she is incapable of accounting for the intentional component of motor intentional behaviors like grasping an object.

The argument against the cognitivist account of motor intentional behavior is more complicated. Roughly speaking, the idea is that the cognitivist cannot account for the motor component of motor intentional behavior. In the next section, I will show that Merleau-Ponty develops this criticism by focusing on the cognitivist assumption that all the features of motor intentional behavior "are fully developed and determinate",[11] while a complete and accurate phenomenological description requires rather that we "recognize the indeterminate as a positive phenomenon."[12] Motor intentional behavior is "pre-predicative," according to Merleau-Ponty, precisely because it identifies the object it is directed toward in an indeterminate, provisional

manner. I will conclude the next section by arguing that neural network models, under an interpretation provided by Borrett and Kwan, have the capacity to mimic the kinds of indeterminacy that Merleau-Ponty sees as central to motor intentional behavior.

III The Phenomenology and Cognitive Science of Motor Intentional Behavior

One good way to determine the phenomenological characteristics of a behavior is to consider the behavioral pathologies that can occur. Toward this end, Merleau-Ponty considers a patient, Schneider by name, who is

> unable to perform "abstract" movements with his eyes shut; movements, that is, which are not relevant to any actual situation, such as moving arms and legs to order, or bending and straightening a finger.[13]

On the other hand,

> Even when his eyes are closed, the patient performs with extraordinary speed and precision the movements needed in living his life, provided that he is in the habit of performing them: he takes his handkerchief from his pocket and blows his nose, takes a match out of a box and lights a lamp.[14]

Among the abstract movements he is incapable of performing, Schneider is unable to describe the position of his body or head, and he is unable to point to a part of his body when asked to do so. On the other hand, among the "concrete" movements he is capable of performing, Schneider, like a normal subject, will quickly move his hand to the point on his body where a mosquito is stinging him. Thus, Merleau-Ponty argues, following Goldstein,[15] that in Schneider there is a

> dissociation of the act of pointing from reactions of taking or grasping . . . It must therefore be concluded [given that Scheider is capable of the one but not the other] that "grasping" . . . is different from "pointing."[16]

Merleau-Ponty goes on to describe the phenomenological characteristics in terms of which grasping and pointing are distinct. It is these characteristics, which we will discuss in a moment, that must be accurately reproduced in any model of motor behavior. Before we develop the phenomenological distinction between pointing and grasping, though, let us look at the typical cognitivist account of grasping actions.

Traditional cognitivist theories of movement are incapable of distinguishing between pointing and grasping, since they explain the latter in terms of the former. Although Merleau-Ponty had already levelled this criticism against cognitivism in 1945,[17] as recently as 1992 it was considered a radical point to make:

> We often do not differentiate between grasping and pointing when we generalize about how vision is used when generating limb movements. It is possible, that how individuals use vision may vary as a function of whether they are generating pointing or grasping movements, and that some principles of how vision is used during reaching and pointing is [sic] not generalizable to grasping.[18]

Why should cognitivist theories so adamantly refuse to distinguish between pointing and grasping behavior?

The answer has largely to do with the kinds of problems that motivate the relevant psychological research. Much of the psychological research on limb movement is organized around the well-studied phenomenon of speed-accuracy tradeoff.[19] The relation between the speed and the accuracy of a limb movement was first discussed by Woodworth in his now classic article "The Accuracy of Voluntary Movement"[20]; the general idea is that the faster you make a movement, the less likely it is that the movement will accurately reach its target, and conversely, the larger the target, the faster you can make the movement accurately. The general relation between speed and accuracy is described by Fitts's Law.[21] The theoretical question, according to the psychologists, is how to explain the generation of motor behavior in such a way as to account for the fact that there is a constant relation between speed and accuracy.[22]

All the theoretical explanations of this phenomenon share the basic assumption, due to Woodworth himself, that rapid movements involve two successive phases, which he called "initial adjustment" and "current control." The first of these is a gross movement of the relevant body part in the general direction of the target location; the second of these "corrects any errors made along the way, using sensory feedback to reach the target accurately."[23] The characteristic

explanation of these two phases is given by Woodworth using an example of what might be called a "calculative" movement:

> If the reader desires a demonstration of the existence of the "later adjustments" which constitute the most evident part of the "current control," let him watch the movements made in bringing the point of his pencil to rest on a certain dot. He will notice that after the bulk of the movement has brought the pencil point near its goal, little extra movements are added serving to bring the point to its mark with any required degree of accuracy. . . . If now the reader will decrease the time allowed for the whole movement, he will find it more difficult, and finally impossible to make the little additions.[24]

Woodworth admits, though it is not widely remarked in the literature, that the "groping" characteristic of the current control phase is more evident in beginners and unskilled practitioners of a given task (he considers singing a note, playing a note on the violin, and performing a musical passage on the piano), but speculates that even for the virtuoso "the later adjustment is probably there, but it is made with perfect smoothness, and has by long and efficient practice attained the sureness and speed of a reflex."[25] This assumption, apparently made (in the absence of any scientific evidence) for the simple sake of theoretical cogency, has been maintained for nearly a century. The major debate in the psychological literature is not over whether there are two distinct phases of rapid movement, but over whether movement speed affects movement accuracy primarily by affecting the current-control or the initial adjustment phase.[26]

A typical and influential entry in this debate was offered by Crossman and Goodeve in the late 1960s, though it is still important today.[27] The linear feedback correction model of rapid movement that they developed is typical in that it uses sensory feedback during the current control phase to account for how the limb reaches its target accurately. On this model the actual position of the limb is continuously compared with the target position to produce an error measure which is reduced by means of a linear feedback mechanism. The faster the speed of the limb movement, the less accurate will be the comparison between limb and target position. The appeal of this model is taken to be the fact that it predicts the relation between movement speed and movement accuracy to be exactly that

described by Fitts's Law. The disadvantage, from the phenomenological point of view, is that because it takes for granted the general assumption that all limb movement is comprised of two distinct phases, the second of which is calculative in nature, it does not have the resources to distinguish between pointing and grasping behaviors.

What are the phenomenological characteristics of this distinction? According to Merleau-Ponty, the central characteristic is that pointing and grasping are based on two different kinds of understanding of place:

> If I know where my nose is when it is a question of holding it, how can I not know where it is when it is a matter of pointing to it? It is probably because knowledge of where something is can be understood in a number of ways.[28]

Furthermore, the way in which we understand where something is when we are grasping it *is capable of being experienced* independently from the way in which we understand where something is when we are pointing at it. Thus, far from its being the case that grasping behavior can be explained on the model of pointing behavior (by assuming that the understanding of an object's place with respect to the limb is uniformly expressible in terms of an objectively determined distance function) it seems instead that the understanding of place underlying the concrete, situational behavior of grasping is of a distinct and independently experiencable kind altogether. As Merleau-Ponty says, "Bodily space may be given to me in an intention to take hold without being given in an intention to know".[29] Presumably the case of Schneider provides evidence that this claim is empirically true.

Further psychological evidence to this effect has recently been provided by the physiological psychologists Melvyn Goodale and David Milner, in the case of the subject whom they call DF.[30] Like Goldstein's Schneider, DF is capable of very sophisticated differential behavior when directing visuomotor actions toward an object; nevertheless, because of a profound disorder in perception she is incapable of identifying the very object qualities to which she is, apparently, responding. In fact, there is a double dissociation here, since patients with the disorder called optic ataxia appear to be able

to pick out objects by their qualities without being able to handle them. Goodale and Milner argue, on the basis of this evidence, that

> the visual processing underlying "conscious" perceptual judgements must operate separately from that underlying the "automatic" visuomotor guidance of skilled actions of the hand and limb.[31]

In a series of articles over the last ten years, Goodale and Milner have hypothesized that the ventral and dorsal pathways for visual information, which have traditionally been interpreted as providing "what" and "where" information about an object, should instead be interpreted as providing "what" and "how" information.[32] The "what" information of the ventral pathway tells us about the object qualities traditionally associated with perception, while the "how" information of the dorsal pathway tells us how to respond to the object in a motor intentional manner. If the visual information from these two pathways is encoded differently, as Goodale and Milner suggest, then this would explain at the neural level Merleau-Ponty's phenomenological claim that we understand the place of an object differently when we are grasping it than when we are pointing at it.[33]

What are the phenomenological characteristics of these different kinds of understanding of place? In the case of pointing to an object, as in Woodworth's calculative pencil-pointing example, the place of the object is given "as a determination of the objective world."[34] That is to say, I understand the place of the dot on the paper as objective, determinate, and outside of myself. Since a representation of the place of an object by means of its three-dimensional coordinates in Cartesian space would reproduce these features, the idea of a current control phase in pointing behavior is at least phenomenologically viable, since the idea of comparing an external, visually identified, determinate, objective location in three-dimensional Cartesian space to an internal, kinaesthetically (or perceptually) identified, determinate, objective location in three-dimensional Cartesian space makes sense. Indeed, it is phenomenologically evident that something like this kind of comparison and calculation does take place in the pencil-pointing example.

On the other hand, in the case of grasping an object, the place of the object is not understood as outside of me in a distinct objective

world: "There is no question of locating it in relation to axes of coordinates in objective space."[35] Rather,

> there is a knowledge of place which is reducible to a sort of co-existence with that place, and which is not simply nothing, even though it cannot be conveyed in the form of a description or even pointed out without a word being spoken.[36]

The phenomenologist must attempt to give an accurate description of the features of this kind of understanding of place.

When I want to drink some coffee from my coffee mug in the morning, I simply grab the mug in a single, smooth, undifferentiated movement. As Merleau-Ponty says, "From the outset the grasping movement is magically at its completion."[37] This is different from pointing to the mug or even touching it without the intention to grab it. For instance, if in the act of grabbing for my coffee mug I am stopped and told to touch it with my forefinger instead, the movement takes on a radically different character: "[A grasping movement] can begin only by anticipating its end, since to disallow taking hold is sufficient to inhibit the action."[38]

The major difference between grasping and merely touching is that it is very difficult to touch the mug with my forefinger unless I have relatively extensive visual feedback, at least toward the end of the movement; as with the pencil-pointing example, I seem to be relatively sure of the general direction of the mug (initial adjustment), but actually to touch it I have to look (current control). On the other hand, if I want to grab the mug in order to drink from it, this act requires little visual feedback at all. In fact, my understanding of the place of the coffee mug when I intend to grasp it depends so little on visual feedback that if the mug is nearby in a place I have recently put it, I can even grab it with my eyes closed. Merely to touch it with my forefinger under these circumstances is much more difficult. Thus it seems that the central phenomenological characteristics of the understanding of place that underlies grasping behavior are that the place of the object is understood equally well and in the same manner at the beginning of the grasping motion as it is at the end, and that this understanding is dependent upon the intention *to grasp* the object, not just to point at it or locate it in space. For the kind

of understanding of place that underlies grasping behavior, then, the current control phase of movement is inappropriate, since there is little or no sensory feedback in terms of which an external, visually identified, determinate, objective location can be compared to an internal, kinaesthetically (or perceptually) identified, determinate, objective location.

But how does a grasping action identify its object, if not by simply locating it objectively in space? To find the answer to this question, we can look to recent empirical work by Goodale, Jakobson, and Keillor.[39] These authors have shown that there are measurable qualitative differences between natural grasping movements directed at an actual object and "pantomimed" movements directed toward a remembered object. When an actual object is present to be grasped, there are certain characteristic actions that subjects are seen to perform in the act of reaching for the object. For instance, among other things subjects typically scale their hand opening for object size and form their grip to correspond to the shape of the object. In pantomimed actions, on the other hand, when there is no object present, although the subjects continue to scale their hand opening, their grip formation differs significantly from that seen in normal target-directed actions.

This empirical result is interesting because it gives us some sense of the ways in which, in normal situations, the grasping act identifies the object it is directed toward. In normal circumstances the act of grasping a coffee mug is from the start scaled and formed in such a way as to take into account a multiplicity of aspects of the mug including, among other things, its size, shape, orientation, weight, fragility, and contents. This scaling and forming of the hand in the act of grasping is a way of identifying the object, since we scale and form our hands in different ways depending upon the object we are trying to grasp. And it is a much more sophisticated way of identifying the object than merely picking out its location in space, since it is dependent on many more aspects of the object in question. But most importantly, it is a way of identifying the object that makes sense of the phenomenological claim that "[f]rom the outset the grasping movement is magically at its completion."[40] This is because the scaling and forming of the hand is a measurable component of the

grasping action that begins with the very initiation of movement toward the object to be grasped.

I have suggested that the scaling and forming of the hand in grasping is a sophisticated way of being directed toward an object that is not merely a way of locating the object objectively in space. The understanding of the "place" of an object that is inherent in the grasping actions directed toward it is properly spelled out not in terms of the objective location of the object, but rather in terms of the scaling and forming of the hand and the movements of the arm that are required to perform the grasping act successfully. This motor intentional understanding of the object is precisely not the kind of cognitive identification of it in terms of its objective location that is inherent in the current control phase of the cognitivist models of skillful grasping actions.

Having identified some phenomenological aspects of the understanding of an object inherent in the motor intentional act of grasping, I want to go on briefly to suggest that a neural network model of action can reproduce some of the most important features of this way of identifying an object. On the conceptualization of movement generation suggested by Borrett and Kwan,[41] a movement is conceived as the behavioral correlate of the evolution or relaxation of a recurrent neural network toward a fixed point attractor. Thus, the initial conditions of the network represent the initial position of the limb, the relaxation of the network toward the attractor state represents the movement of the limb, and the final state of the network at the fixed point attractor represents the position of the limb at its desired endpoint. The most important aspect of this proposal is that, after the network has been trained, whenever it is given a set of appropriate initial conditions its output will evolve in a manner representative of movement to the endpoint with no moment-to-moment supervisory mechanisms required to oversee its evolution.

On this interpretation of the neural net model of limb movement, the movement of the limb from initial position to endpoint occurs without the sensory feedback loop for the current control phase of the movement that is required by models like that proposed by Crossman and Goodeve; in fact, the whole idea of a two-phase process has

been scrapped. In particular, there is no locating in relation to axes of co-ordinates in objective space since there is no representation of the objective location of the object in the model, and there is no error correction by means of feedback since there are no supervisory mechanisms by means of which such correction could occur.[42] Instead, the understanding of place reproduced by this model is one in which, as with grasping movements, the initial generation of the movement contains its completion in it. The initial conditions of the model, like the initial intention to grasp, is sufficient to ensure, in normal circumstances, that the limb will reach the appropriate endpoint in the appropriate way. In this sense we can say that the neural net model of limb movement reproduces the central phenomenological features of grasping behavior since, as with grasping, the model is from the outset "magically at its completion."

IV Conclusion

Merleau-Ponty argues that the phenomenological analysis of action indicates the need for a category of behavior that is between the purely reflexive and the properly cognitive. He calls this category motor intentional behavior, and he takes the grasping of an object to be a canonical example of this type of behavior. When we grasp an object we are directing ourselves toward it, and therefore the action is intentional. But grasping actions do not identify the object they are directed toward in terms of any of the objective, determinate features it has. In particular, they do not identify it in terms of its objective location, the way a pointing action might. Rather, grasping actions identify their object in terms of the bodily movements required to grasp it successfully—movements such as the shaping and forming of the hands. These actions are provisional and indeterminate in the sense that they change and develop throughout the course of the movement, only completely conforming to the object at the moment the grasping action is complete. It is this indeterminacy that leads Merleau-Ponty to say that the grasping action identifies its object "pre-predicatively": it does not give the kind of information about the object that could be made into a descriptive sentence about it.

If this phenomenological account of motor intentional behavior is accurate, then it is an important resource for those attempting to develop scientific models of actions like grasping an object. As Dreyfus's applied philosophy suggests, the conclusions of phenomenology provide the data for scientific explanations of human phenomena. In the instance we have discussed, the phenomenology of motor intentional behavior highlights a simple fact: that scientific models of action should not attempt to assimilate the explanation of grasping to that of its more cognitive cousin, pointing. It seems that grasping at straws is not only a canonical type of motor intentional behavior, it is also the desperate act of a cognitivist program going under for the last time.[43]